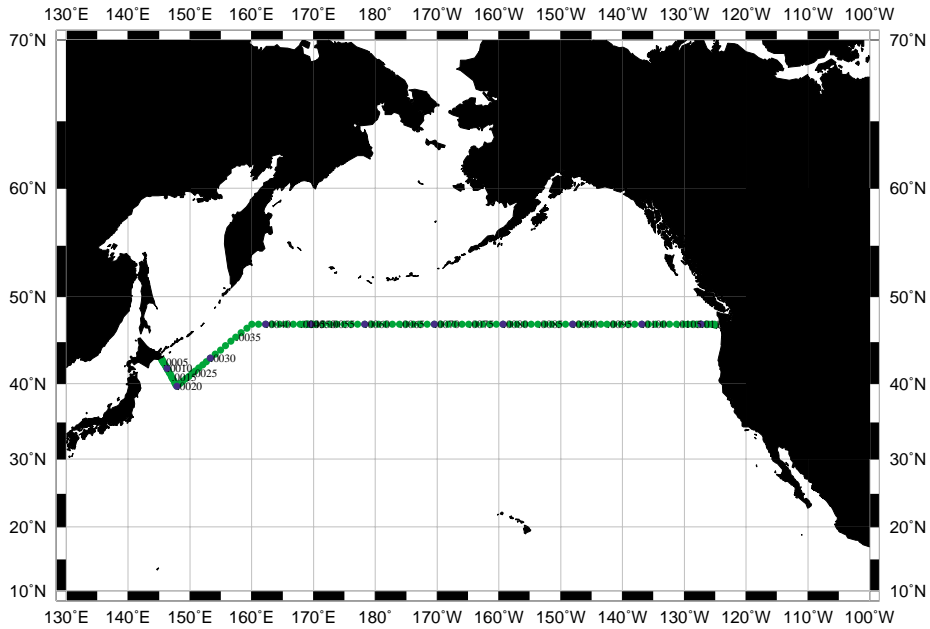


**A. Cruise Narrative: WOCE Section P01**



**A.1. Highlights**

**WHP Cruise Summary Information**

WOCE section designation	<b>P01</b>
Expedition designation (EXPCODE)	<b>31TTTPS47</b>
Chief Scientist(s) and their affiliation	<b>Lynne Talley/SIO*</b>
Dates	1985.08.04 - 1985.09.07
Ship	R/V Thomas G. Thompson
Ports of call	Hakodate, Japan to Seattle, Washington, USA

**A.2. Cruise Summary Information**

Number of stations	115 CTD/rosette stations
Geographic boundaries of the stations	47° 00.00' N 145° 27.30' E      124° 59.30' W 39° 41.30' N
Floats and drifters deployed	none
Moorings deployed or recovered	none

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Contributing Authors: L. Talley, M. Martin, P. Salameh, the Oceanographic Data Facility, John Lupton

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\* Scripps Institution of Oceanography  
 University of California San Diego  
 9500 Gilman Drive  
 La Jolla CA 92093-0230

Phone: 619-534-6610  
 Fax: 619-534-9820  
 e-mail: ltalley@ucsd.edu

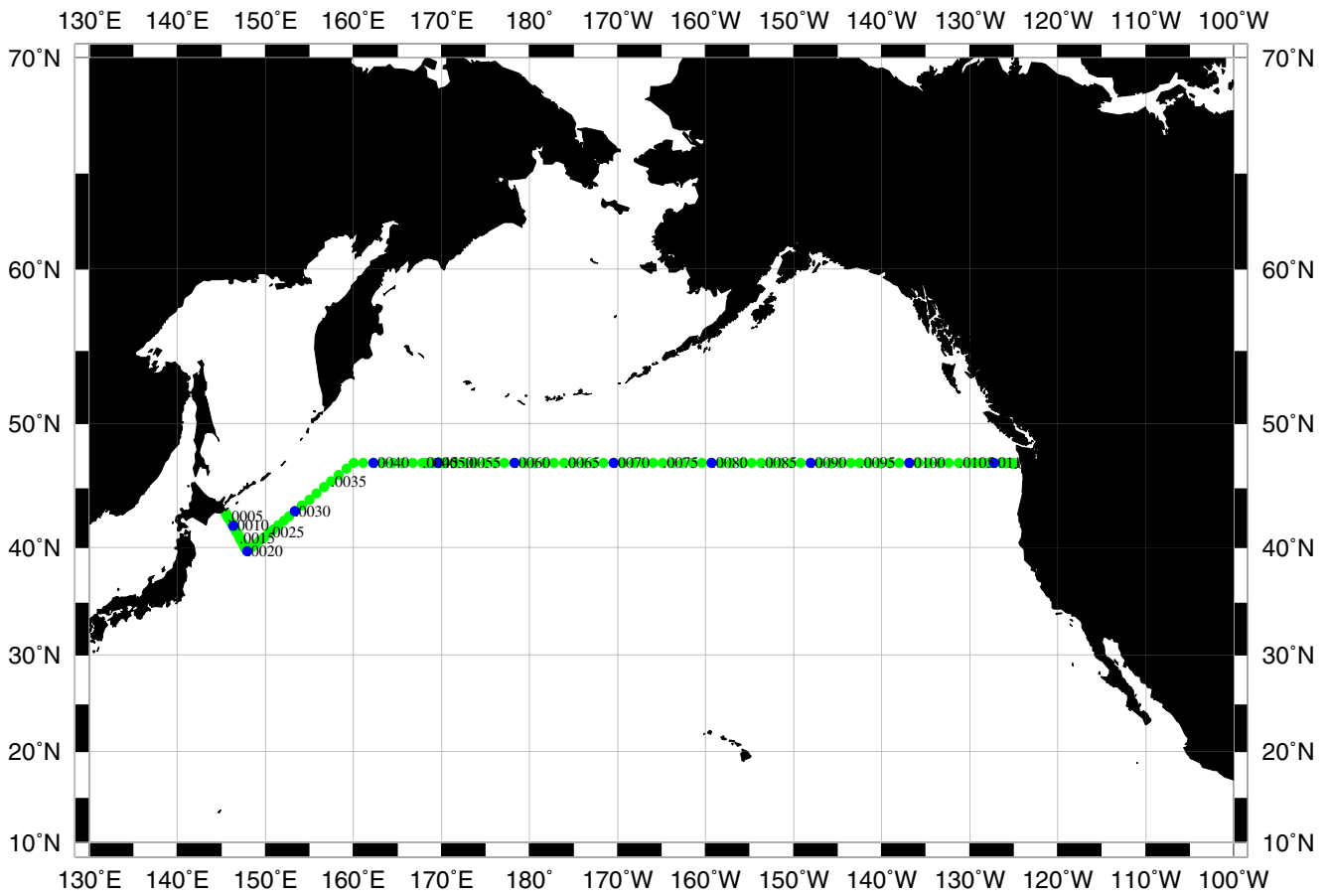
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## WHP Cruise and Data Information

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

<b>Cruise Summary Information</b>	<b>Hydrographic Measurements</b>
Description of scientific program	CTD - general
	CTD - pressure
Geographic boundaries of the survey	CTD - temperature
Cruise track (figure)	CTD - conductivity/salinity
Description of stations	CTD - dissolved oxygen
Description of parameters sampled	
	Salinity
	Oxygen
	Nutrients
	CFCs
Principal Investigators for all measurements	Helium
Cruise Participants	Tritium
Problems and goals not achieved	CO2 system parameters
Other incidents of note	
<b>Underway Data Information</b>	<b>Acknowledgments</b>
Navigation	<b>References</b>
Bathymetry	
Acoustic Doppler Current Profiler (ADCP)	<b>DQE Reports</b>
Thermosalinograph and related measurements	
XBT and/or XCTD	CFCs
Meteorological observations	
Atmospheric chemistry data	
	<b>Data Processing Notes</b>

# Station locations for p01



Produced from .sum file by WHPO-SIO

### A.3. List of Principal Investigators

**TABLE 1:** List of Principal Investigators and Measurements

Measurement	Principal Investigator	Institution
Salinity, oxygen, nutrients, CTD/O2	Lynne Talley	SIO
Chlorofluorocarbons	Ray Weiss	SIO
Helium	John Lupton	NOAA/PMEL
Tritium	Gote Ostlund	U. Miami
Alkalinity/TCO2	Richard Feely/Paul Quay	NOAA/PMEL
Manganese	Gary Massoth	NOAA/PMEL
Chlorophyll/productivity	Elizabeth Venrick	SIO
Chlorophyll	Bob Bidigare	TAMU
Plutonium	Hugh Livingston	WHOI
Rare elements	Donald Piepgras	Harvard
Transmissometer	Wilf Gardner	TAMU
Meteorology	Kern Kenyon	SIO
ADCP	Terrence Joyce	WHOI
Towed salt-bridge GEK	Tom Sanford	UW/APL
Bathymetry	Lynne Talley	SIO
Thermosalinograph	Lynne Talley	SIO

**Table 2:** List of Institutions

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NOAA/PMEL: NOAA  
Pacific Marine Environmental Laboratory  
7600 Sand Point Way NE  
Seattle, WA  
98115-0700

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SIO: Scripps Institution of Oceanography  
University of California of San Diego  
9500 Gilman Drive  
La Jolla, CA  
92093

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U. Miami: University of Miami  
Rosenstiel School of Marine and Atmospheric Sciences  
Miami, FL  
33149

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TAMU: Texas A&M University  
Department of Oceanography  
College Station, TX  
77843

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WHOI: Woods Hole Oceanographic Institute  
Woods Hole, Ma  
02543

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Harvard: Harvard University  
Department of Geological Sciences  
Hoffman Laboratory, 20 Oxford St.  
Cambridge, MA  
02138

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UW: University of Washington  
School of Oceanography  
Seattle, WA  
98195

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#### **A.4. Scientific Programme and Methods**

The following paragraphs are condensed from Scripps Technical Report SIO-88-9, by L. Talley, M. Martin, P. Salameh and the Oceanographic Data Facility, entitled:

Transpacific Section in the Subpolar Gyre (TPS47) Physical, Chemical, and CTD Data Report 4 August 1985 - 7 September 1985 RV Thomas Thompson TT 190

A nearly zonal CTD/hydrographic section across the subpolar North Pacific was occupied from August 4, 1985 to September 7, 1985 on cruise TT 190 of the RIV Thomas Thompson. The cruise track was primarily along 47°N except at the western boundary. The section consisted of 115 high quality, full water-column CTD/hydrographic stations. Additional components of the physical oceanographic program were: continuous acoustic doppler current profiling (T. Joyce, WHOI), towed salt-bridge GEK (P. Spain and T. Sanford, Univ Wash ), and XBTs (P. Spain and T. Joyce).

Each station consisted of a CTD lowering with a rosette carrying 36 10-liter Niskin bottles. Water samples were collected on the upcast. Salinity, oxygen, and nutrient analyses were performed at sea by the Oceanographic Data Facility at SIO. Initial CTD processing was accomplished at sea by ODE. In addition to this standard suite of measurements, water samples from the same casts were made available for analyses by other investigators. Chlorofluorocarbons (freons) F-11 and F-12 were analyzed at sea by R. Weiss' group from SIO with the assistance of K Kelly-Hansen (NOAA/PMEL); their results are included in this data report and are also available in a separate data report. Samples for tritium and alkalinity analyses were collected for processing by the tritium laboratory of the University of Miami (G. Ostlund and R. Fine) and by R. Feely at NOAA/PMEL, respectively. A separate, complete tritium data report is available (Ostlund, 1987) Chlorophyll-a and phaeopigment measurements were made by E. Venrick's group at SIO. High-performance liquid chromatography pigment measurements were made by R. Bidigare's group at Texas A&M University; results are available in a separate data report (Bidigare, et al., 1987). Samples were collected for helium-3, carbon-14 (AMS), manganese, plutonium, and rare earth elements for analyses by other investigators. In addition to the basic CTD/hydrographic stations included in this report, approximately one shallow bottle cast was made per day for primary productivity measurements by E Venrick's group at SIO.

**A.5. Major Problems and Goals Not Achieved: none**

**A.6. Other Incidents of Note: none**

**A.7. List of Cruise Participants**

Ship's Captain: C. W. Clampitt - R/V THOMAS THOMPSON

<b>Personnel participating in collection of data at sea:</b>	
Talley, Lynne	Chief Scientist, Assistant Professor, SIO
Joyce, Terrence	Co-Chief Scientist, Associate Scientist, WHOI
Beaupre, Marie	Staff Research Associate, SIO
Costello, James	Staff Research Associate, SIO
Cummings, Sherrie	Staff Research Associate, SIO
Delahoyde, Frank	Principal Programmer, SIO
Dunworth, Jane	Research Assistant, WHOI
Field, Timothy	Marine Technician, SIO
Hamann, Ilse	Graduate Student, Univ of Washington
Kelly-Hansen, Kim	Oceanographer, NOAA/PMEL
Martin, Margie	Staff Research Associate, SIO
Mattson, Carl	Electronics Technician,
SIO Pierce, Stephen	Graduate Student, WHO/MIT
Schnitzer, Michelle	Research Associate, Texas A & M Univ.
Spain, Peter	Graduate Student, Univ. of Washington
Sweet, Paul	Staff Research Associate, SIO
Vanwoy, Rick	Staff Research Associate, SIO
Warner, Mark	Graduate Student, SIO
Wells, James	Marine Technician, SIO

<b>Additional personnel participating in analysis of CTD/hydrographic data:</b>	
Bos, David	Staff Research Associate, SIO
Johnson, Mary	Staff Research Associate, SIO
Muus, David	Staff Research Associate, SIO
Patrick, Ronald	Staff Research Associate, SIO

## **B. Underway measurements**

### **B.1. Navigation and bathymetry**

Navigation was pre-GPS, and included Loran-C near coastlines.

Bathymetry was logged manually from the shipboard PDR every five minutes while underway.

### **B.2. Acoustic Doppler Current Profiler**

The underway ADCP was operated continuously throughout the cruise.

### **B.3. Towed salt-bridge GEK**

A GEK was towed behind the ship between stations.

### **B.4. Expendable bathythermograph observations:**

none.

### **B.5. Meteorology**

Weather was logged on the bridge.

## **C. DISCRETE DATA - METHODS**

### **C.1. Temperature and Salinity**

Pressure and temperature for the discrete hydrographic tabulations was taken from the calibrated CTD data; calibrations are discussed in the following section. Reversing thermometers were mounted on 4 to 5 Niskin bottles on each cast to be used to resolve shifts in the CTD temperature calibration. As there was at most a 0.001 deg. C shift in temperature calibration from the beginning to the end of the cruise and as the reversing thermometers had not been calibrated in some time, the reversing thermometer information was not required. Depths were calculated from CTD pressures (Saunders, 1981).

Salinity samples were analyzed at sea using one of two Guildline Autosal inductive salinometers. All salinities were calculated from conductivity using the 1978 practical salinity scale (UNESCO, 1981) and are tabulated to three decimal places. Wormley standard seawater batch P96 was used for calibration at the beginning and of each station's analyses; hydrographic and CTD salinities are reported herein relative to P96 and have not been adjusted further. Mantyla (1987) reported differences between various other batches of standard seawater and P96. Deep salinities from TPS47 relative to P96 have been compared with deep salinities on a prior cruise in 1984 at 152 W on which standard seawater batch P92 was used. The average difference in deep salinities between the cruises using stations from the intersecting region was about 0.003 ppt with

P92 salinities lower than P96; this is in agreement with Mantyla's finding. Precision of the bottle salinities is +/- 0.002 ppt.

Bottle salinities were compared with CTD salinities to identify leaking bottles or salinometer malfunctions. Calibrated CTD salinities replace bottle salinities in the event of problems and are indicated by the letter "D" in this data report. CTD values were used on 27 stations, almost exclusively at one level only. Exceptions are stations 25 and 83 where three CTD values were required due to faulty sample drawing, and at stations 104, 105, 106, 110, and 111, where 3 to 5 samples drawn for detailed vertical profiling of helium-3 and manganese were not analyzed for salinity, oxygen, or nutrients. The spread in deep bottle salinities is approximately +/-0.001 ppt.

## **C.2. Oxygen and Nutrients**

Dissolved oxygen content was determined by the Winkler method as modified by Carpenter (1965), using the equipment and procedures outlined by Anderson (1971). Oxygen measurements are given in ml STP per liter of water at 1 atmosphere and at the potential temperature of the sample. A small number of oxygen outliers was discarded. The precision of the oxygen measurements within a single cast is 0.01 ml/l and the accuracy is 1%.

Silicate, phosphate, nitrate, and nitrite were analyzed using a Technicon autoanalyzer. The procedures are similar to those described in Atlas et al. (1971). Nutrient measurements are reported here in micromoles/liter at 1 atmosphere and 25 deg. C, which is assumed to be the laboratory temperature. A failure of the nitrate channel power supply at station 91 resulted in loss of measurements below 800 m. The precision of nutrient measurements (within a single cast) is better than 0.5% and the station-to-station, cruise-to-cruise accuracy is 2% to 3%.

## **C.3. Chlorofluorocarbons**

Concentrations of the dissolved atmospheric chlorofluorocarbons F-11 (trichlorofluoromethane) and F-12 (dichlorodifluoromethane) were measured by shipboard electron-capture gas chromatography, according to the methods described by Bullister and Weiss (1988). The results have been corrected for sampling and analysis blanks, the statistical variations of which are responsible for occasional negative values near the detection limit. It is important to emphasize that the data have been edited to remove serious "flyers" and contaminated samples, and to correct gross numerical errors. However, the data have not yet been subjected to the level of scrutiny associated with careful interpretive work. Readers are therefore requested to contact R. Weiss' group at SIO for any revisions in the data which may post-date this report, and to draw to their attention any suspected inconsistencies. The results are reported on the SIO 1986 calibration scale. The precision (+/- one s.d.) of the measurements is about 1% or about 0.005 pmol/kg, whichever is greater, for both chlorofluorocarbons, except during the first 29 stations, where the low-level F-12 measurements had a larger error of about 0.01 pmol/kg caused by large



sampling contamination blanks. The estimated accuracy of the calibrations is about 1.3% for F-11 and 0.5% for F-12.

#### **C.4. Tritium**

Tritium was measured by electrolytic enrichment and low level gas counting, according to Ostlund and Dorsey (1977) The listed TU81N values are the tritium ratios (T/H x E-18) in the "new NBS scale" based on the NBS standard #4926 as on 1961/09/03, with the new half-life of 12.43 years, i e., a decay rate of 5.576% per year. All values are age corrected back to the reference date of 1981/01/01. All TU81N data are directly comparable without further age correction. Negative TU values are reported as such for the benefit of allowing the user unbiased statistical treatment of sets of the data. For other applications, 0 TU should be used. The errors are 3.5% or 0.05, whichever is larger.

#### **C.5. Alkalinity**

Water samples for alkalinity measurements were transferred from the 10-L Niskin bottles into 1-L glass-stoppered bottles containing 1.0 mL of a saturated solution of Hg<sub>2</sub>Cl<sub>2</sub> to decrease bacterial oxidation of organic matter. The samples were stored in a dark, cold storage room at 4 deg. C. The samples were analyzed by the potentiometric method using a Brinkman E636 titroprocessor linked to a Hewlett-Packard 85 computer. The data from the titroprocessor were automatically fed into the computer and processed using the nonlinear, least squares fitting program of Dickson (1981) with the modifications suggested by Johansson and Wedborg (1982). Alkalinity contributions from boric, silicic, and phosphoric acid were computed from equations similar to those presented by Takahashi, et al. (1982) in the GEOSECS Pacific Expedition report. Total borate concentration was computed using the relation given by Culkin (1965). The dissociation constants of carbonic acid and boric acid are from the work by Almgren, et. al. (1977). Potassium chloride was used to adjust the ionic strength of the sodium carbonate standards to 0.7. At each station a blank was determined by titrating aliquots of a KCl solution containing no sodium carbonate. The average blank was 4 µeq/L The results have been corrected for sampling and analysis blanks. The data have been edited to remove "flyers" resulting from bottle contamination. The precision of the measurements is about 0.1 % (+/- one S. D).

#### **C.6. Helium-3 (WOCE P01 and P03)**

(John Lupton)

Samples for helium analysis were drawn directly from the rosette bottles and sealed into copper tubing by cold-welding the copper using a special hydraulic press (see Young and Lupton, 1983). This method hermetically seals each sample into an all-metal container, thereby allowing long term storage of the sample without loss of integrity. In order to avoid contamination with atmospheric helium, special care was taken to eliminate any air bubbles from each sample before it was sealed into the copper tubing. Samples were then returned to the laboratory and processed on a shorebased high-vacuum system

which extracts the dissolved gases from the water. The extracted gases are sealed into glass ampoules.

The extracted gas samples were then analyzed on a special 21-cm radius, dual collector mass spectrometer designed for the analysis of helium and rare gas isotopes. This instrument is fitted with a low temperature charcoal trap (38\370K) which separates He from Ne so that the helium isotope ratio can be determined in the absence of neon. This eliminates a troublesome interference which occurs when He and Ne are analyzed together. The instrument response was determined by analyzing aliquots of marine air of known size. For each sample, the  $^3\text{He}/^4\text{He}$  ratio as well as the absolute concentration of  $^4\text{He}$  was determined. Because air is used as a standard, the helium isotope ratio is reported as  $\delta^3\text{He}$ , which is the percentage variation of  $^3\text{He}/^4\text{He}$  from the  $^3\text{He}/^4\text{He}$  ratio in air. The precision for the  $^3\text{He}/^4\text{He}$  ratio and  $^4\text{He}$  concentration averages 0.2% and 0.5% (1 sigma), respectively.

For the WOCE P1 and P3 sections, essentially every sample which was collected at sea was analyzed for helium isotopes in the laboratory. Because the primary focus of this work was mapping the distribution of the deep helium signal introduced by hydrothermal venting, the sampling was restricted mainly to depths between 1000 m and the bottom. For the WOCE P3 section, the sampling was rather sparse and helium samples were collected at 15 stations spaced fairly evenly across the Pacific. For WOCE P1, helium sampling was carried out at 31 separate stations, with a higher sampling density at the eastern end of the section in the vicinity of the hydrothermal sources on the Juan de Fuca Ridge.

## Reference

Young, C. and J.E. Lupton, An ultratight fluid sampling system using cold-welded copper tubing, EOS Transactions AGU 64, 735, 1983.

### C.7 Total CO<sub>2</sub>

(text not available; see Data Processing Notes: [1/6/00](#) and [7/17/00](#))

### C.8. CTD DATA

#### C.8.1. Processing Summary

116 CTD casts were completed using a 36-bottle rosette sampling system. ODF CTD #1 (a modified NBIS Mark 3) was employed exclusively for all CTD casts. The CTD data were initially processed into a filtered, 1-second average time-series during-data acquisition. The pressure and PRT temperature channels were corrected using laboratory calibrations. The conductivity channel was calibrated to salinity check samples acquired on each cast. The CTD time-series data were then pressure-sequenced into two decibar pressure intervals.

## **C.8.2. CTD Laboratory Calibrations**

### **C.8.2.1. Pressure Transducer Calibration**

The CTD pressure transducer was calibrated in a temperature- controlled bath to the ODF Ashcroft to (pre-cruise) and Ruska (post-cruise) deadweight-tester pressure standards. Thermal response-time, thermal hysteresis and mechanical hysteresis were measured. The mechanical hysteresis loading curves were measured at 0/1 deg. C and 24/22 deg. C (pre-/post-cruise) and at maximum loadings of 1530 and 8830 PSI. The transducer thermal response-time was derived from the pressure response to a thermal step-change from 23 to 0 C.

### **C.8.2.2. PRT Temperature Calibration**

The CTD PRT temperature transducer was calibrated in a temperature-controlled bath to a Leeds and Northrup standard PRT (pre-cruise) and to a Rosemont standard PRT (post-cruise). Seven calibration temperatures, spaced across the range of 0 to 27 C, were measured both pre and post-cruise.

## **C.8.3. CTD DATA PROCESSING**

### **C.8.3.1. CTD Data Acquisition**

Seven channels (pressure, temperature, conductivity, dissolved oxygen, elapsed time, altimeter and voltage) were acquired at a data rate of 31.25 FPS. The FSK CTD signal was demodulated by an ODF-designed deck unit and output to an IEEE-488 bus interface. An IBM CS-9000 served as the real-time data acquisition processor.

Data acquisition consisted of storing all raw binary data on hard disk (and later on nine-track magnetic tape) and generating a corrected and filtered one-second average time-series. Data calculated from this time series were reported and plotted during the cast. A ten-second average of the time-series data was calculated for each water sample collected during the data acquisition.

Generating the one-second time-series involved applying single-frame absolute value and gradient filters, then performing a two-pass standard-deviation test to all channels, rejecting points exceeding 4 standard deviations from the mean on the first pass, then repeating the rejection using 2 standard deviations as the criterion. The pre-cruise laboratory calibration data were applied to pressure and temperature. Pressure and conductivity were lagged to match the thermal response of the PRT temperature transducer. The conductivity channel was corrected for thermal and pressure effects.

### **C.8.3.2. CTD Dissolved Oxygen Data**

The dissolved oxygen channel was not processed beyond averaging the raw oxygen current. Raw CTD oxygen data were continuously examined for signal quality. There is

moderate noise in much of the oxygen data, with occasional large spikes. Stations 6 through 8 had severe spiking problems, and stations 91 through 93 had spiking/drift problems which remained to a smaller extent until the end of the cruise. Small-scale oxygen noise was evident in the data beginning at station 78, and re-appeared intermittently until the end of the cruise. The oxygen transducer was replaced several times during the cruise because of cracked sensor holders.

### **C.8.3.3. Pressure, Temperature, and Conductivity Corrections**

A maximum of 36 salinity check samples and 4 to 5 thermometric pressure and temperature measurements were collected on each cast. A ten-second average of the CTD time-series was calculated for each water sample. Differences between bottle and CTD data were then used to verify the pre- and post-cruise pressure and temperature calibrations and to derive CTD conductivity calibrations

#### **C.8.3.3.1. CTD Pressure Corrections**

The pre- and post-cruise pressure calibrations were compared. The post-cruise calibration was applied to the CTD data because newer, more accurate pressure standard equipment and techniques were used to collect the data, and because its calibration date was three months closer to the time of the cruise. The shipboard processing pressures differ from the revised pressures by up to 3 dbar due to the new calibration data as well as improvements to the pressure correction model. No significant drift was apparent in comparisons between CTD and thermometric pressures.

#### **C.8.3.3.2. CTD Temperature Corrections**

A comparison of the pre- and post-cruise laboratory PRT temperature transducer calibration curves indicated a difference of 1 millidegree at 1 C up to 3 millidegrees at 25 C. The pre-cruise data is very scattered at each calibration temperature due to bath instability and the cumbersome manual method used to collect the information. The post-cruise calibration was able to take advantage of a new, very stable temperature bath and a new resistance-measuring system which can collect data more rapidly and accurately. Since there was no apparent drift or shift in the CTD and thermometric temperature differences over the time scale of the cruise, and because of less scatter in the data and its close proximity to the cruise, the post-cruise calibration was applied to the temperature data.

#### **C.8.3.3.3. CTD Conductivity Corrections**

Check sample conductivities were calculated from the sample salinities and from corrected CTD pressures and temperatures. The differences between sample and CTD conductivities were fit to CTD conductivity using a linear least-squares fit. Values greater than two standard deviations from the fit were rejected. The resulting conductivity correction slopes for each east were fit to station number, giving a continuous smoothed

conductivity slope correction as a function of station number. Conductivity correction slopes were then derived from this smoothed fit.

Conductivity differences were calculated for each cast after applying the conductivity slope correction. These differences were fit to station number at various pressure ranges. Conductivity correction offsets were then generated individually for each east, weighted more toward deep and/or mixed-layer differences. Some offsets were manually fine-tuned to compensate for discontinuous shifts in the conductivity transducer response and for bottle salinity problems, as well as to insure a consistent deep T-S relationship from station to station. Less than 10% of the casts were manually adjusted from 0.001 to 0.0025 psu. Conductivity offset corrections for shallow casts were checked against adjacent deep casts for consistency.

#### **C.8.3.4. Additional Processing**

A filter was used on 12 percent of the stations to remove conductivity spikes larger than 0.1 above 1000 dbar and 0.01 below 1000 dbar. Less than 0.1% of the time-series data in those stations were affected. Temperature and pressure did not require filtering. The down cast portion of each time-series was then pressure-sequenced into two decibar pressure intervals. A ship-roll filter was applied to disallow pressure reversals.

#### **C.8.4. General Comments/Problems**

There were 119 CTD rosette casts. Three were aborted and were neither processed nor included on the tape. One pressure-sequenced CTD data set exists for each CTD station, with an extra shallow cast included for station 98. All data was simultaneously recorded on audio cassette tape. Due to deck-unit malfunction, station 97 was redigitized from the audio tape following the cruise, with no degradation of quality.

Up-cast thermocline data were typically noisier than the corresponding downcast data, possibly due to the positioning of the CTD near the bottom of the large rosette package. Nine up-casts were used as final data instead of down-casts because of conductivity offsets or other instrument-related problems on the down-casts. The up-casts are: 1-1, 8-1, 9-1, 16-1, 18-1, 28-2, 31-1, 77-2, and 84-1.

Because ship-roll effects cause more severe thermocline density inversions on the up-casts, some down-casts were included despite deep ca. 0.002 psu salinity offsets, apparently caused by an intermittent CTD malfunction. The following casts are affected: 19-1, 25-1, 26-1, 42-1, 62-1, 76-1, 78-1, 81-1, 82-1, 83-1, and 87-1. Salinity offsets at stations 25, 26, 36, 42, 47, and 76 were removed individually.

On several casts, the CTD was held at one pressure or cycled up and down in mid-cast ("yoyo"). The effect after pressure-sequencing is a discontinuity in the pressure-series data. Yoyos larger than 10 dbar occurred on stations 8, 18, 32 and 58.

Intermittent single-level gaps in the data are due to the removal of ship-roll effects and filtering. Two groups of stations had a significantly larger percentage of single-level data gaps than the rest of the stations (up to two percent versus less than 0.2 percent gaps) The weather log for stations 28 through 36 and stations 104 until near the end of the cruise indicates that the majority of these casts occurred in 20+ knot winds and/or 8 to 12 foot waves, both much larger than recorded for the other casts. Multi-level data gaps where data were not recorded occurred at stations 8, 12 and 97.

The deep T-S relationship was examined for calibration problems and consistency Instrument problems have been corrected where possible and otherwise documented.

Remaining density inversions in high-gradient regions cannot be accounted for by a mismatch of pressure, temperature, and conductivity sensor response. Detailed examination of the raw data shows significant mixing occurring as a consequence of ship roll. The ship-roll filter, applied to most casts to disallow pressure reversals, resulted in a reduction in the amount and/or size of density inversions in the upper 500 dbar of the water column.

#### **D. ACKNOWLEDGEMENTS**

The acquisition and publication of this data set was funded by the National Science Foundation, Ocean Sciences Division, under Grants OCE84-16211, OCE8740379 (hydrographic and CTD work), OCE 83 16602 (chlorofluorocarbons), and OCE85-10842 (tritium), and by a grant from the Pacific Marine Environmental Laboratory of NOAA (alkalinity)

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## DATA QUALITY EVALUATION

### **Final CFC Data Quality Evaluation (DQE) Comments on tps47 (P01).**

(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 (R. Weiss, [rfw@gaslab.ucsd.edu](mailto:rfw@gaslab.ucsd.edu)) or David Wisegarver ([wise@pmel.noaa.gov](mailto:wise@pmel.noaa.gov)).

Additional information on WOCE CFC synthesis may be available at: <http://www.pmel.noaa.gov/cfc>.

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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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## Appendix A

The salinity comments in the table below refer to the original version of the bottle data file from this pre-WOCE cruise. Some bottle salinities were deleted because they were bad, and replaced with a CTD salinity value. In the original data file, the data provider (SIO ODF) differentiated between the two, CTD vs bottle, with a D code where the CTD value was reported. The WOCE program does not support this annotation feature for salinity. In the copy of the data provided to the WOCE Hydrographic Program Office CTD salinities have already been substituted for bad bottle salinities. This table provides information about the substitutions that were made.

STA	SAMP #	DEPTH	REMARKS
007	129	3094	Salinity was not analyzed; therefore CTD salinity reported
025	109	237	Drawing error, no bottle salinity from this level.
025	111	356	Drawing error, no bottle salinity from this level.
025	113	506	Drawing error, no bottle salinity from this level.
029	125	2001	Drawing error, no bottle salinity from this level.
039	124	1795	Deleted high Salinity.
040	110	283	Salinity appears to have come from 109 level.
043	213	446	Deleted Salinity, drawing error.
050	133	1779	Deleted low Salinity.
057	107	156	Deleted Salinity, drawing error.
059	120	1206	Deleted low Salinity.
062	115	606	Deleted high Salinity.
065	110	287	Deleted Salinity, does not agree with CTD trace.
065	120	1203	Deleted Salinity, does not agree with CTD trace.
065	122	1603	Deleted Salinity, does not agree with CTD trace.
066	119	1001	Deleted Salinity, drawing error.
067	110	287	Deleted Salinity, drawing error.
071	133	4692	Deleted high Salinity.
078	107	128	Deleted Salinity, drawing error.
083	129	3182	Deleted Salinity, drawing error.
083	131	3776	Sampler bottle lost; therefore, no water samples.
083	132	4072	Sampler bottle lost; therefore, no water samples.
084	121	1253	Deleted Salinity, drawing error.
090	106	128	Deleted Salinity, sampling error.
090	133	4094	Salinity bottle broken during analysis.
097	134	3672	Deleted salinity, inconsistent with CTD.
097	135	3971	Deleted salinity, inconsistent with CTD.
101	113	336	Deleted Salinity, sampling error.
104	127	1835	Salinity not drawn per sampling schedule.
104	129	2048	Salinity not drawn per sampling schedule.
104	137	2243	Salinity not drawn per sampling schedule.
104	138	2332	Salinity bottle broken during analysis.

<b>STA</b>	<b>SAMP #</b>	<b>DEPTH</b>	<b>REMARKS</b>
104	133	2515	Salinity not drawn per sampling schedule.
105	128	1893	Salinity not drawn per sampling schedule.
105	130	2091	Salinity not drawn per sampling schedule.
105	138	2287	Salinity not drawn per sampling schedule.
105	133	2388	Salinity not drawn per sampling schedule.
105	135	2588	Salinity not drawn per sampling schedule.
106	129	1874	Salinity not drawn per sampling schedule.
106	137	2073	Salinity not drawn per sampling schedule.
106	133	2273	Salinity not drawn per sampling schedule.
108	130	2085	Deleted low Salinity.
110	129	1900	Salinity not drawn per sampling schedule.
110	137	2098	Salinity not drawn per sampling schedule.
110	133	2297	Salinity not drawn per sampling schedule.
110	135	2497	Salinity not drawn per sampling schedule.
111	130	1998	Deleted low Salinity.
111	129	1899	Salinity not drawn per sampling schedule.
111	137	2096	Salinity not drawn per sampling schedule.
111	133	2289	Salinity not drawn per sampling schedule.
112	124	704	Deleted Salinity, sampling error.
114	108	34	Deleted high Salinity.

### DATA PROCESSING NOTES

Date	Contact	Data Type	Data Status Summary
8/15/97	Uribe	DOC	Submitted, See Note:
<p>2000.12.11 KJU File contained here is a CRUISE SUMMARY and NOT sumfile. Documentation is online.</p> <p>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.</p>			
7/7/98	Lupton	HELIUM	Submitted for DQE
1/12/99	Talley	CFCs	Submitted
<p>I am ftping a file with the CFC data from Ray Weiss, courtesy of Peter Salameh, for the two old cruises TPS47 (P01) and TPS24 (P03). I will have Danie merge them and then the final files should be placed in the WHPO public site. I will also contact John Lupton about helium data and the Miami lab about tritium data for the same cruises.</p>			
1/25/99	Talley	TRITUM	Submitted
2/8/99	Feely	ALKALI/CO2	Data Requested by Talley
2/16/99	Bartolacci	CFCs/He/Tr	available by request
<p>The bottle data for P01 has been updated. CFCs, He and Trit are now available by request. CFCs He/Tr are non-public, but merged into the non-public bottle le. All tables have been updated. The public le has columns for CFCs, He/Tr, but they have been masked out pending word from their respective PIs.</p>			
2/17/99	Diggs	BTL	Data Update
<p>I have re-done the bottle data file so that the ODF bottle numbers are included and the pressures now match the station, cast and sample numbers. For those of you who are unfamiliar with this situation, WHPO-WHOI made an error when they translated the NODC-SD2 formatted file into WOCE format and had the deepest bottle as the lowest bottle number. According to the original ODF data, it was the other way around. All flags have been retained and the table entries and website files have been updated accordingly.</p>			
2/23/99	Talley	DOC	Data Update
3/30/99	Bartolacci	He/Tr/CFCs	Website Updated: data OnLine, encrypted
<p>now has an encrypted version of the bottle data file that contains cfc-11/12, helium, and tritium (these parameters were not in the public bottle file before) in addition to the public version of the bottle file. Also, it has been confirmed that no C14 measurements were made.</p>			
9/22/99	Swift	CFCs	Data are Public
<p>CFCs for the two 1995 cruises (P1 &amp; P3?) are public.</p>			

9/22/99	Talley	CFC/TRITUM	Data are Public
	<p>I've been corresponding with Ray Weiss and sent email to John Lupton about releasing the TPS47 CFC and helium data. The tritium data are public. Charlene at RSMAS told me that a year ago or so. I'm attaching Ray's correspondence.</p> <p>"The CFC data are public. Since the data set that you've merged in the WHPO file was obtained from Peter Salameh just recently, I think it must be the latest version. I'm trying to call John Lupton today. Still working on figuring out how to reach Dick Feely about his alkalinity data."</p>		
9/27/99	Talley	He/Tr	Data are Public
	<p>new data file needs to be merged &amp; put online. Here is the word from John Lupton on helium data for P1:</p> <p>"It is all public. The tritium are also public. Therefore the complete data set should be public.</p> <p>Caveat though - John here sends a revised helium data set. I suggest that this be merged and the few problems sorted out that he mentions, and THEN the complete data set be moved into public."</p>		
11/5/99	Diggs	CFCs/he/tr	Website Updated: CFCs public, He/Tr encrypted
	<p>P01 (31TTTPS47) CFCs are now public, but I'm leaving the He/Tr non-public pending merging of the new values from Lupton, which we have received and are in the "queue" to be merged. I know that Lupton has released them, but I'd rather be on the safe side until we are able to have the most up-to-date values online. All tables and files have been updated.</p>		
1/6/00	Feely	ALKALI/CO2	No Data Submitted: Problems with data:
	<p>I really don't recommend using that alkalinity data set in the Atlas. The data were obtained before properly calibrated alkalinity reference materials were available to the carbon community and I don't trust some of the results. All hydrographic and carbon data are listed, including DIC and Talk.</p> <p>My understanding from you is that the DIC data should either be flagged as '3' (questionable measurement), '4' (bad measurement), or eliminated altogether. The plot of Talk has many bullseyes, so perhaps it should be flagged as well?? At this point, the Epic data has no flags associated with it. Mar</p>		
1/6/00	Bartolacci	DOC	Website Updated: latest version from L. Talley
6/30/00	Bartolacci	HELIUM	Data Merged: HE data merged into BTL file,
	<p>2000.06.30 DMB</p> <p>Merging Lupton's helium and delta he3 into existing (encrypted) p01 woce file.</p> <p>NOTES:</p> <ul style="list-style-type: none"> <li>• data sent by Leigh Evans was comma separated values. Used quick perl script to convert data into uniform 8byte fields. Also converted missing data to -9.0 missing data values.</li> <li>• used David Newton's mrgsea program to merge helium, delhe3 and</li> </ul>		

associated flags.

- ran wocecvt with following warnings:

```
fndsum: found stn=10 . can't find cast= 2
main:   cast 2 not found. will try cast 1
main:   will use .SUM info from cast 1.
fndsum: found stn=10 . can't find cast= 2
main:   cast 2 not found. will try cast 1
main:   will use .SUM info from cast 1.
fndsum: found stn=98 . can't find cast= 1
main:   cast 1 not found. will try cast 1
fndsum: found stn=98 . can't find cast= 1
main:   cast 1 not found either.
main:   stn= 98 cast= 1 skipping.
```

Station 10, cast 2 is in sumfile, but not bottle file. No helium data was sent for this station/cast.

Station 98, cast 1 and 2 are in bottle file but only cast 2 is in sumfile. No data was sent for either cast.

- Added date/name stamp. Renamed file p1hy\_complete\_mrg.txt and copied to parent directory and re-encrypted.

6/30/00

Bartolacci | HELIUM | Data Merged into BTL file, encrypted

I have remerged most recent helium and delta helium3 values into existing bottle file. Notes are in README file in the "original" subdirectory. Re-encrypted bottle file version (complete file) and masked out helium values in second version (public file) and replaced both files on current website. Updated front table to reflect this change.

7/3/00

Talley | HELIUM | Data Update: BTL file updated and reformatted

Hi John - you sent the helium file for tps47 last September. We just got the values merged in. You had several questions about bottles, which I just sorted out today with Kristin Sanborn.

- 1) 31 and 32 replaced by 37 and 38 - correct
- 2) Sta. 89 bottle 22: this was tripped with bottle 23. All values for 23 have long since been deleted. So what we should do is take your helium values for bottle 22, duplicate the line in the sea file for bottle 23, call it 22 (remove all bottle analyses - just keep CTD values) and put your helium values in there.
- 3) Sta. 89 bottle 35 - tripped with bottle 24. Same procedure as bottle 22
- 4) Sta. 109 bottle 26 - notes are that the sampler leaked, so values were deleted.
- 5) Sta. 111 bottle 26 - notes are that the sampler leaked, so values were deleted.

So could you please send the two sets of values for station 89 that we can now insert in the file? I'm not sure we should reconstitute the sta. 109 and 111 lines. Once we get your values inserted we can go ahead and make the whole file public. -- Lynne

7/17/00	Key	CO2	No Data Submitted: precision/accuracy problems
	On TPS cruises which were sampled for TCO2, there were problems with precision and accuracy. These data have never been reported to either me or CDIAC. Feely's group did what sampling there was for the various carbon parameters. I believe that he does have alk values for at least one of the three TPS lines. Note that carbon data from the Japanese zonal line(s) is available from Feely (at least he has the data) and permissions.		
7/21/00	Lupton	HELIUM	Data are Public
	helium 4 concentrations subject to revision		
	To: Lynne Talley <lynne@gyre.ucsd.edu> Subject: tps47 heliums		
	the answer is yes, they can be made public. only proviso is that the helium 4 concentrations are subject to revision when we (Schlosser, Jenkins, Top, Lupton and Roether) complete our intercalibration and data synthesis exercise. cheers, -- JL		
7/26/00	Diggs	He/Tr	Website Updated: files unencrypted
	Bottle: (tritium, helium, delhe3, triter, qual1)		
	As per Lynne Talley, I have unencrypted the helium/tritium and delhe3 parameters in the p01 data file. All data are now public. All table references have been edited to reflect this change.		
10/12/00	Kappa	DOC	Doc Update: pdf, txt versions created
10/13/00	Huynh	DOC	Website Updated: pdf, txt versions online
6/22/01	Uribe	CTD/BTL	Website Updated: CSV File Added
	CTD and Bottle files in exchange format have been put online.		
7/11/01	Talley	NITRIT	Correct nitrit value: station 34, bottle 9
	I just placed the corrected p01hy.txt and p01_hy1.csv files in my ftp area at whpo.ucsd.edu (in FTP/TALLEY). I added a line in the .csv header indicating what I did, since it looks like you might prefer to regenerate the csv file from the hy.txt file given all the dates and times in the original header. The single corrected value is NITRIT at station 34, bottle 9, which was corrected from 0.86 to 0.01 per email from Kristin Sanborn today (7/11/01) indicating that there was a typo in the original data entry.		
7/11/01	Talley	NO2+NO3	Update Needed: all values changed to -9
	I got an email from Arnold Mantyla who said that somehow all of the 0.0 nitrites and nitrates in the p01hy.txt file have been changed to -9. this definitely needs to be corrected. Can we have Sarilee or David take care of it if your time is short? meanwhile I'll check to see if anything else was inadvertently changed to -9 in the same file. Lynne		
8/21/01	Bartolacci	CFCs	Submitted, need to be merged into BTL file
	I have placed the new file containing updated CFC values into the P01 subdirectory called original/20010702_CFC_WISEGARVER_P01. These data are in need of merging into the current bottle file as of this date.		

8/23/01	Bartolacci	CFCs	Data Merged into BTL file
<p>New BTL file contains CFC data merged by D. Muus</p> <p>I have replaced current online bottle files with new files containing merged updated CFC values. Data was sent by Wisegarver and merged by D. Muus. All table entries reflect this replacement. previous files moved to original subdirectory. A copy of merging notes will be sent to J. Kappa under separate email.</p> <p>Notes on P01 CFC merging Aug 22, 2001. D. Muus</p> <ol style="list-style-type: none"> <li>1. New CFC-11 and CFC-12 from:  /usr/export/htmlpublic/data/onetime/pacific/p01/original/20010702_CFC_WISEGARVER_P01/20010702.143520_WISEGARVER_P01_tps47_CFC_DQE.dat merged into web SEA file as of Aug 21, 2001 (20000630WHPOSIODMB)SEA file had no QUALT2 word and new CFCs have quality 2 codes so added QUALT2 identical to QUALT1 prior to merging. Changed DELHE3 missing data value from -9.00 to -999.00.</li> <li>2. SUMMARY file from web Aug 21, 2001 (no version code) has no Station 10 Cast 2 and no Station 98 Cast 1. SEA file contains data from these casts. Sta 10/2 is a 3 bottle wire cast and Sta 98/1 is the deepest 12 bottles of the first Rosette cast. Sta 98/2 is the shallowest 24 bottles of the Rosette cast. NAV has the 3 entries for each station BO, EN &amp; BE instead of BE, BO &amp; EN.   Time and position for each entry are identical.  NAV has both "INT" and "UNK" entries.  Added 10/2 and 98/1 to SUMMARY file and corrected 98/2 entries.  Changed all NAV "INT"s to "UNK".  Changed BO to BE  EN BO  BE EN</li> <li>3. Exchange file checked using Java Ocean Atlas.</li> </ol>			
8/28/01	Kappa	Doc	Updated PDF and TXT Doc files
Added Data Processing Notes, linked appropriate text blocks to table of contents in PDF file.			