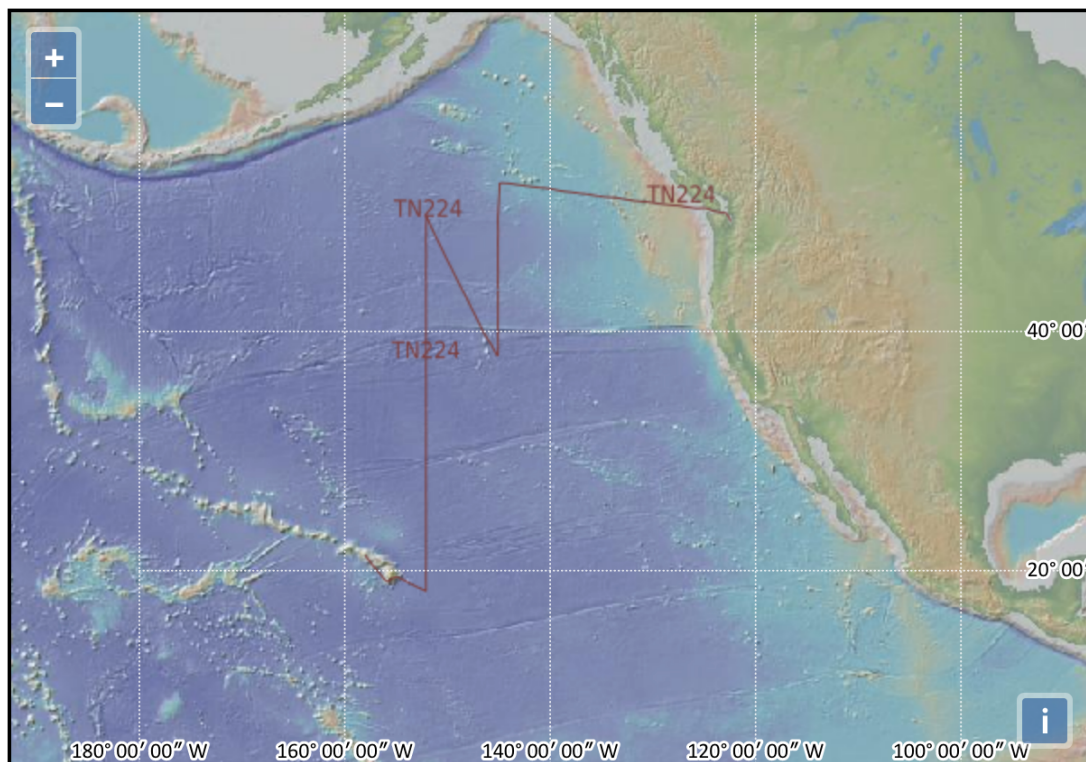


CRUISE REPORT: P16N

(Updated SEP 2021)



(Rolling Deck to Repository website)

Highlights

Cruise Summary Information

Section Designation	P16N (TN224)		
Expedition designation (ExpoCodes)	325020080826		
Chief Scientists	Steven Emerson / UW		
Dates	2008-08-26 to 2008-09-17		
Ship	RV THOMAS G. THOMPSON		
Ports of call	Seattle, Washington - Honolulu, Hawaii		
Geographic Boundaries	50.1		
	-157.9		-122.3
		18.0	
Stations	38		
Floats and drifters deployed	0		
Moorings deployed or recovered	0		

Contact Information:

Steven Emerson

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Final report assembly by Jerry Kappa, SIO/UCSD

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Nutrient Data

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DIC

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Chlorofluorocarbon (CFC) And Sulfur Hexafluoride (Sf6) Measurement

CCHDO Data History

Dataset_ID:	TN224
Investigator(s) Name:	Emerson, Steve
Organization:	UW
Address:	University of Washington, 419 OSB, Box 355351, Seattle, WA 98195-7940
Phone:	(206) 543-0428; (206) 685-0983
Web Site:	http://faculty.washington.edu/emerson/
Dataset Info:	Dataset ID: TTN224
Submission Dates:	Initial Submission: 20110401
Revised Submission:	
Cruise Info:	

* Experiment:

1. Experiment Name: TN224

Cruise:

* Cruise ID: 325020080826

* Section: TN224

* Geographical Coverage:

1. Geographical Region: Pacific Ocean

Bounds:

North	West	South	East
50.1	-157.9	18.0	-122.3

Temporal Coverage: Start Date: 20080826 End Date: 20080917

Vessel: Vessel Name: R/V Thomas Thompson

Vessel ID: 3250

Country: USA

Vessel Owner: School of Oceanography, University of Washington

Variable Name	Description of Variable
Temperature	deg. C
Salinity	
Oxygen	umol/kg
Nitrate	umol/kg
Nitrite	umol/kg
Silicate	umol/kg
Phosphate	umol/kg
CFC11, CFC12	pmol/kg
DIC	umol/kg
TALK	umol/kg

A Test Cast is listed as station 999 in data file.

Method Descriptions:

CTD DATA:

T2 and Cond2 calibrated after cruise; T drift +0.0004 deg/yr since last cal (June 07); Cond2 drifted -.0001 PSU/mo since June 07. Temperature in data file is from T2 and has no correction applied.

Salinity calibration with salinometer indicates S00 (Cond 1) is best salinity data. Salinity in data file is from Cond 1 with no correction for drift.

CTD Oxygen sensor data are *not* calibrated against bottle oxygen data. When O2 sensor as when plotted vs bottle Oxygen there is a slope of 0.963 indicating a calibration problem with the sensor. Calibration should be done by the user before using the CTD O2.

Dana Greeley converted the ctd Oxygen data from ml/l to umol/kg with the following:

Sbeox (ml/l)*44.66/1+(density)/1000; where density was calculated from the ctd in-situ temp.

Nutrient Data:

Nutrients were determined using an autoanalyzer by Aaron Morello from the University of Washington routine chemical laboratory. There were problems with the nutrient data during the entire cruise, but data quality improved as the cruise progressed. Calibrations caused accuracy difficulties and there was a cadmium column problem on the nitrate channel at the beginning. Quality flags for this data were determined by plotting NO3 vs PO4 and comparing these trends with CLIVAR P16 (2006) data also from along 152 W in the North Pacific. We assumed that the rest of the nutrient species (silicate and nitrite) have the same data quality. The most difficulties were encountered during Leg 2 (Stn 3-8). Based on comparison with CLIVAR P16 we believe data from Stn. 7 is Good (2) and the rest are Questionable (3). In Leg 3 (Stn 9-15) Stn 9 and 13 are believed to be Good (2) and the rest Questionable (3). During Leg 4 (Stn 16-39) Stn 18, 22 and 27-35 look Good (2) based on this criteria; the rest are given Questionable (3) flags.

Dana Greeley converted the nutrient data from umol/l to umol/kg with the following formula and assuming a constant lab temp aboard the Thompson of 25°C: $y \text{ (umol/kg)} = x \text{ (umol/l)} / 1.0 + (\text{density}/1000)$

Bottle Oxygen:

UW dissolved oxygen analyses were performed using a Dosimat 765 titrator and visual endpoints. Standards were dispensed using a Dosimat 665 titrator calibrated to deliver five (5) ml.

UW used a whole-bottle modified-Winkler titration following the technique of Carpenter [1965] with modifications by Codispoti. [1988]. Two KIO3 standards were run every eight hours. A Wako 0.025N KIO3 standard (#166-17521, 99.98% purity, Wako Pure Chemicals Ltd, 1600 Bellwood Road, Richmond, VA 23237, Phone +1 804 271 7677, Fax +1 804 271 7791, labchem@wakousa.com) was used as the primary standard. An Aldrich 0.025N KIO3 standard (#7758-05-6, 99.7% ± 0.3% purity, Sigma-Aldrich Company, St. Louis, MO, USA, Phone: 314-771-5765, Fax: 314-771-5757, cssorders@sial.com) was used

as a secondary standard. Reagent/distilled water blanks were determined every day or more often if a change in reagents required it to account for presence of oxidizing or reducing agents. 1876 oxygen measurements were made with duplicate samples at each of 938 distinct depths over 40 casts at 39 stations.

Samples were collected for dissolved oxygen analyses soon after the rosette was brought on board. Using a Tygon drawing tube, nominal 125ml volume-calibrated iodine flasks were rinsed 3 times with minimal agitation, then filled and allowed to overflow for at least 3 flask volumes. The sample drawing temperatures were measured with a thermistor embedded in the drawing tube. These temperatures were used to calculate $\mu\text{mol/kg}$ concentrations, and as a diagnostic check of bottle integrity. Reagents were added to fix the oxygen before stoppering. The flasks were shaken twice (18-20 inversions) to assure thorough dispersion of the precipitate, once immediately after drawing, and then again after about 20 minutes. The samples were analyzed within 1-4 hours of collection, and the data incorporated into the cruise database. Oxygen flask volumes were determined gravimetrically with degassed deionized water at UW.

Each Niskin bottle was sampled in duplicate and the data are reported as the mean of the duplicates. The average difference of more than 900 duplicate pairs was $0.36 \mu\text{mol kg}^{-1}$. For samples with O_2 concentration greater than $200 \mu\text{mol kg}^{-1}$ the average standard deviation of the pairs was $\pm 0.1 \%$ of their mean value.

DIC:

The DIC analytical equipment was set up in a seagoing container modified for use as a shipboard laboratory. The analysis was done by coulometry with two analytical systems (PMEL-1 and PMEL-2) used simultaneously on the cruise. Each system consisted of a coulometer (UIC, Inc.) coupled with a SOMMA (Single Operator Multiparameter Metabolic Analyzer) inlet system developed by Ken Johnson (Johnson et al., 1985, 1987, 1993; Johnson, 1992) of Brookhaven National Laboratory (BNL). In the coulometric analysis of DIC, all carbonate species are converted to CO_2 (gas) by addition of excess hydrogen to the seawater sample. The evolved CO_2 gas is carried into the titration cell of the coulometer, where it reacts quantitatively with a proprietary reagent based on ethanolamine to generate hydrogen ions. These are subsequently titrated with coulometrically generated OH^- . CO_2 is thus measured by integrating the total charge required to achieve this.

The coulometers were each calibrated by injecting aliquots of pure CO_2 (99.995%) by means of an 8-port valve outfitted with two sample loops (Wilke et al., 1993). The instruments were calibrated at the beginning of each station with two sets of the gas loop injections.

Secondary standards were run throughout the cruise (at least one per station) on each analytical system. These standards are Certified Reference Materials (CRMs), consisting of poisoned, filtered, and UV irradiated seawater supplied by Dr. A. Dickson of Scripps Institution of Oceanography (SIO). Their accuracy is determined shoreside manometrically. DIC data reported to the database have been corrected to the batch 89 CRM value.

Samples were drawn from Niskin-type bottles into cleaned, precombusted 540-mL Pyrex bottles using silicon tubing. Bottles were rinsed once and filled from the bottom, overflowing half a volume. Care was

taken not to entrain any bubbles. The tube was pinched off and withdrawn and 0.2 mL of saturated HgCl₂ solution was added as a preservative. Samples were corrected for the addition of poison by a factor of 1.00037. The sample bottles were sealed with glass stoppers lightly covered with Apiezon-L grease, and were stored in a 20°C water bath for a minimum of 20 minutes to bring them to temperature prior to analysis.

Over 200 pure (99.995%) CO₂ gas calibrations were run on both SOMMA systems during this cruise. The precision and accuracy obtained from these calibrations can be described as follows:

1. The precision is estimated from ~80 replicate pairs. The absolute average difference from the mean of these replicates is 0.85 µmol/kg. No significant systematic differences were noted.
2. The accuracy is estimated from the analysis of 46 Certified Reference Materials (batch 89). The CRM value is 2025.7 µmol/kg. Our average value was 2024.7 µmol/kg with a standard deviation of 1.47 µmol/kg.

References:

- Dickson, A.G., Sabine, C.L. and Christian, J.R. (Eds.), (2007): [Guide to Best Practices for Ocean CO₂ Measurements](#). PICES Special Publication 3, 191 pp.
- Johnson, K.M., A.E. King, and J. McN. Sieburth (1985): "Coulometric DIC analyses for marine studies: An introduction." *Mar. Chem.*, 16, 61-82.
- Johnson, K.M., P.J. Williams, L. Brandstrom, and J. McN. Sieburth (1987): "Coulometric total carbon analysis for marine studies: Automation and calibration." *Mar. Chem.*, 21, 117-133.
- Johnson, K.M. (1992): Operator's manual: "Single operator multiparameter metabolic analyzer (SOMMA) for total carbon dioxide (CT) with coulometric detection." Brookhaven National Laboratory, Brookhaven, N.Y., 70 pp.
- Johnson, K.M., K.D. Wills, D.B. Butler, W.K. Johnson, and C.S. Wong (1993): "Coulometric total carbon dioxide analysis for marine studies: Maximizing the performance of an automated continuous gas extraction system and coulometric detector." *Mar. Chem.*, 44, 167-189.
- Lewis, E. and D. W. R. Wallace (1998) Program developed for CO₂ system calculations. Oak Ridge, Oak Ridge National Laboratory. <http://cdiac.ornl.gov/oceans/co2rppt.html>
- Wilke, R.J., D.W.R. Wallace, and K.M. Johnson (1993): "Water-based gravimetric method for the determination of gas loop volume." *Anal. Chem.* 65, 2403-2406.

Alkalinity:

Potentiometric titration was used to analyze over 900 samples, including duplicates and certified reference materials (CRM), for total alkalinity during the UW Student 2008 cruise. With the exception of the first non-test station (station 2), the analytical equipment performed well, as well as is generally expected for shipboard analyses. Reference materials were used to verify proper operation of the analytical equipment and comparison of deep samples from this cruise with historical data (<http://www.pmel.noaa.gov/co2/story/P16N>) reveal the same within analytical uncertainty.

Samples were drawn from Niskin-type bottles into cleaned, 270 mL borosilicate glass bottles using silicone tubing. Bottles were rinsed three times and filled from the bottom, overflowing by half of the bottle volume, and taking care not to entrain any bubbles. The sample tube was closed off and withdrawn from the sample bottle, leaving a 5.0 mL headspace. Samples were preserved by poisoning with 0.20 mL of a 50 percent saturated HgCl₂ solution. Sample bottles were sealed with ground glass stoppers lightly coated with Apiezon-L grease and stored at room temperature (21–25 °C) for a maximum of 12 hours prior to analysis.

Analysis of seawater for total alkalinity, AT, was performed using an open cell, potentiometric titration method published by Dickson et al. [2003] and subsequently adopted as one of standard analytical methods for ocean carbon measurements [Dickson et al., 2007]. By this method, a measured amount of acid titrant (0.1 m HCl) is added to the sample to reduce the pH to less than 3.55, CO₂-free air is bubbled through the acidified sample to facilitate removal of the evolved CO₂ gas, followed by titration to a pH of less than 3.0. The titration curve is fit to a derivation of the defining equation for alkalinity in seawater using a non-linear least squares approach in which one of the adjustable parameters in the fit equation is A_T. All titrations were performed at a constant temperature of 25.0 ± 0.2°C in a water-jacketed, 250 mL glass beaker. Samples were introduced into the beaker using a fixed volume (108.130 ± 0.012 mL) glass syringe. Prior to titration, all samples were brought to 25°C by placing them in a temperature-controlled water bath for at least one hour prior to analysis. After each titration, the beaker was emptied, rinsed three times with de-ionized water, and dried.

Titration progress was monitored by measuring the electromotive force, E, of a combination glass-reference pH electrode (Radiometer, PHC 2002-8). Temperature during the titration was monitored using a 100Ω Pt RTD. A National Instruments™ high-precision data acquisition card (NI-4351) was used to record both titration E and T. Removal of CO₂ generated by acidification of the sample was accomplished by bubbling CO₂ free air through the sample at 100 mL min for 5 minutes. Air was dried by flowing through a Drierite column and CO₂ removed by flowing through an Ascarite II column. A Metrohm Dosimat 765 was used to deliver acid to the sample beaker in increments of 0.050 mL. The acid titrant used was 0.1 mol kg⁻¹ HCl prepared in 0.6 mol kg⁻¹ NaCl background to approximate the ionic strength of seawater (0.7 mol kg⁻¹). A single batch of titrant was used over the course of the cruise: PMEL 071607-1. The acid concentration, determined gravimetrically during preparation, is 0.100190 mol kg⁻¹. Instrument control and data acquisition was with custom software developed at NOAA/PMEL using the National Instruments LabView programming environment.

Analytical accuracy was assessed by periodic analysis of CRMs (Batch 84: supplied by Dr. A. Dickson of Scripps Institution of Oceanography; <http://andrew.ucsd.edu/co2qc/index.html>) throughout the cruise. References were analyzed approximately every 24 samples. Standard deviation over the course of the cruise is approximately 2.5 μmol kg⁻¹. In addition, duplicate samples were taken at each station, totaling about 10% of samples analyzed, with an average standard deviation of 2.9 μmol kg⁻¹.

References:

- A. G. Dickson, J. D. Afghan, and G. C. Anderson. Reference materials for oceanic CO₂ analysis: a method for the certification of total alkalinity. *Mar. Chem.*, 80(2-3):185–197, January 2003.
- A. G. Dickson, C. L. Sabine, and J. R. Christian, editors. [Guide to Best Practices for Ocean CO₂ Measurements](#). Number 3 in Special Publication. 2007.

Chlorofluorocarbon (CFC) And Sulfur Hexafluoride (Sf6) Measurements:

Analysts: Fred Menzia (JISAO, University of Washington and Marie Salmi (University of Washington)
This data report prepared by Dave Wisegarver and John Bullister, NOAA-PMEL

A PMEL analytical system was used for CFC-11, CFC-12, and sulfur hexafluoride (SF₆) analyses on the 2008 University of Washington Student Cruise ('2008 Student Cruise'). About 913 seawater samples were analyzed for dissolved CFC-11, CFC-12 and SF₆ ('CFC/SF₆') concentrations. Measurements of the concentrations of these compounds in air were also made along the cruise track.

Water samples on the 2008 Student Cruise were collected in bottles designed at PMEL with a modified end-cap to minimize water contact with the end-cap O-rings after closing. Stainless steel springs covered with a nylon powder coat were substituted for the internal elastic tubing provided with standard Niskin bottles. When taken, water samples collected for dissolved CFC-11, CFC-12, and SF₆ analysis were the first samples drawn from the bottles. Care was taken to coordinate the sampling of CFC/SF₆ with other samples to minimize the time between the initial opening of each bottle and the completion of sample drawing. Samples easily impacted by gas exchange (dissolved oxygen, DIC and pH) were collected within several minutes of the initial opening of each bottle. To minimize contact with air, the CFC/SF₆ samples were drawn directly through the stopcocks of the bottles into 250 ml precision glass syringes equipped with three-way plastic stopcocks. The syringes were immersed in a holding tank of clean surface seawater held at ~10°C until ~20 minutes before being analyzed. At that time, the syringe was placed in a bath of surface seawater heated to ~30°C.

For atmospheric sampling, a ~75 m length of 3/8" OD Dekaron tubing was run from the CFC van located on the fantail to the bow of the ship. A flow of air was drawn through this line into the main laboratory using an Air Cadet pump. The air was compressed in the pump, with the downstream pressure held at ~1.5 atm. using a back pressure regulator. A tee allowed a flow of ~100 ml min⁻¹ of the compressed air to be directed to the gas sample valves of the CFC/SF₆ analytical systems, while the bulk flow of the air (>7 l min⁻¹) was vented through the back-pressure regulator. Air samples were analyzed only when the relative wind direction was within 60 degrees of the bow of the ship to reduce the possibility of shipboard contamination. Analysis of bow air was performed along the cruise track. At each location, at least five air measurements were made to determine the precision of the measurements.

Concentrations of CFC/SF₆ in air samples, seawater, and gas standards were measured by shipboard electron capture gas chromatography (EC-GC) using techniques modified from those described by Bullister and Weiss (1988) and Bullister and Wisegarver (2008) as outlined below. For seawater analyses, water was transferred from a glass syringe to a glass-sparging chamber (volume ~200 ml). The dissolved gases in the seawater sample were extracted by passing a supply of CFC/SF₆ free purge gas through the sparging chamber for a period of 4 minutes at ~150 ml min⁻¹. Water vapor was removed from the purge gas during passage through an 18 cm long, 3/8" diameter glass tube packed with the desiccant magnesium perchlorate. The sample gases were concentrated on a cold-trap consisting of a 1/16" OD stainless steel tube with a 5 cm section packed tightly with Porapak Q (60-80 mesh) and a 15 cm section packed with Carboxen 1000. A Neslab Cryocool CC-100 was used to cool the trap to ~-70°C. After 4 minutes of purging, the trap was isolated, and it was heated electrically to ~160°C. The sample gases held in the trap were then injected onto a precolumn (~60 cm of 1/8" O.D. stainless steel tubing packed with 80-100 mesh Porasil B, held at 80°C) for the initial separation of CFC-12, CFC-11 and SF₆ from later eluting peaks.

After the SF₆ and CFC-12 had passed from the pre-column and into the second precolumn (5 cm of 1/8" O.D. stainless steel tubing packed with MS5A, 90°C) and into the analytical column #1 (240 cm of 1/8" OD stainless steel tubing packed with MS5A and held at 80°C), the outflow from the first precolumn was diverted to the second analytical column (150 cm 1/8" OD stainless steel tubing packed with Carbograph 1AC, 80-100 mesh, held at 90°C). Column #1 and the first pre-column were held in a Shimadzu GC8 gas chromatograph with an electron capture detector (ECD) held at 340°C. Column #2 and the second precolumn were in another Shimadzu GC8 gas chromatograph with ECD held at 250°C.

The analytical system was calibrated frequently using a standard gas of known CFC/SF₆ composition. Gas sample loops of known volume were thoroughly flushed with standard gas and injected into the system. The temperature and pressure was recorded so that the amount of gas injected could be calculated. The procedures used to transfer the standard gas to the trap, precolumn, main chromatographic column, and ECD were similar to those used for analyzing water samples. Four sizes of gas sample loops were used. Multiple injections of these loop volumes could be made to allow the system to be calibrated over a relatively wide range of concentrations. Air samples and system blanks (injections of loops of CFC/SF₆ free gas) were injected and analyzed in a similar manner. The typical analysis time for seawater, air, standard or blank samples was ~11 minutes.

Concentrations of CFC-11 and CFC-12 in air, seawater samples, and gas standards are reported relative to the SIO98 calibration scale (Cunnold et al., 2000). Concentrations of SF₆ in air, seawater samples, and gas standards are reported relative to the SIO2005 calibration scale (Bullister and Tanhua, 2010). Concentrations of CFC/SF₆ in air and standard gas are reported in units of mole fraction CFC/SF₆ in dry gas, and are typically in the parts per trillion (ppt) range. Dissolved CFC concentrations are given in units of picomoles per kilogram seawater (pmol kg⁻¹) and SF₆ concentrations in fmol kg⁻¹. CFC/SF₆ concentrations in air and seawater samples were determined by fitting their chromatographic peak areas to multi-point calibration curves, generated by injecting multiple sample loops of gas from working standards into the analytical instrument. Air samples were calibrated vs. cylinder PMEL33790 and water samples were calibrated vs. cylinder PMEL45186. The response of the detector to the range of moles of CFC/SF₆ passing through the detector drifted somewhat during the cruise. Full-range calibration curves were run at intervals of 4-5 days during the cruise. Single injections of a fixed volume of standard gas at one atmosphere were run much more frequently (at intervals of ~90 minutes) to monitor short-term changes in detector sensitivity.

The purging efficiency was estimated by re-purging a high-concentration water sample and measuring this residual signal. At a flow rate of 150 cc min⁻¹ for 4 minutes, the purging efficiencies were:

CFC-11	~ 97.8%
CFC-12	~99.6%
SF ₆	~100%

Corrections for these purging efficiencies have been applied to the reported CFC/SF₆ concentration data.

There were an unusually large number of problems with the CFC/SF₆ analyses on the 2008 Student Cruise. These problems were not resolved completely during the cruise and had a significant negative impact on the overall quality of CFC/SF₆ data set. One recurring problem was the appearance of late eluting peaks of unknown origin on the chromatograms. Attempts were made to heat the chromatographic columns at various intervals (one to several hours) to try to reduce the impact of these

peaks on the chromatograms. These efforts were only partially successful. Changes in the column injection and backflush times were also made at various times during the cruise to try to eliminate the late eluting chromatographic peaks, again with limited success. After about Station 13, it appears that one (or both) of the water and air sample run files were altered so that the injection times differed between the two kinds of samples. This may have led to a partial loss of CFC-12 extracted from the water samples. This was diagnosed from the substantially lower (by about 12%) near-surface saturation values for CFC-12 (vs. CFC-11) after about station 13. In order to try to correct for this loss of CFC-12 in seawater samples, all dissolved CFC-12 concentrations measured after station 13 have been increased by ~ 14.2% in the data report. The need for this correction is unfortunate and adds significant uncertainty to the CFC-12 values for these samples. As a consequence, the WOCE quality flags for CFC-12 in seawater samples after Station 13 which were initially set as '2' or '6' (good) have been changed to '3' (questionable).

On this expedition, based on the analysis of about 130 pairs of duplicate samples, we estimate precisions (1 standard deviation) of about 1% or $0.005 \text{ pmol kg}^{-1}$ (whichever is greater) for both dissolved CFC-11 and CFC-12 measurements. The estimated precision for SF_6 was ~3% or $0.01 \text{ fmol kg}^{-1}$ (whichever is greater). Overall accuracy of the measurements (a function of the absolute accuracy of the calibration gases, volumetric calibrations of the sample gas loops and purge chamber, errors in fits to the calibration curves and other factors) is difficult to estimate for this data set but may be about 2% or $0.005 \text{ pmol kg}^{-1}$ for CFC-11, 6% or $0.005 \text{ pmol kg}^{-1}$ for CFC-12 and 4% or $0.04 \text{ fmol kg}^{-1}$ for SF_6 .

A number of water samples had anomalously high CFC/ SF_6 concentrations relative to adjacent samples. These samples occurred sporadically during the cruise and were not clearly associated with other features in the water column (e.g., anomalous dissolved oxygen, salinity, or temperature features). This suggests that these samples were probably contaminated with CFCs/ SF_6 during the sampling or analysis processes.

Measured concentrations for these anomalous samples are included in the data file, but are given a quality flag value of either 3 (questionable measurement) or 4 (bad measurement). For CFC-11, ~2% of the water sample concentrations reported were assigned a flag of 3 and ~2% assigned a flag of 4. For CFC-12 ~68% of samples were assigned a flag of 3 (primarily because of the correction factor applied after Station 13) and ~ 2% assigned a flag of 4. For SF_6 , ~3% of water samples were assigned a flag of 3 and ~ 2% assigned a flag of 4. A quality flag of 5 was assigned to samples which were drawn from the rosette but never analyzed due to a variety of reasons (e.g., leaking stopcock, plunger jammed in syringe barrel, etc).

References:

- Bullister, J.L. and R.F. Weiss (1988): Determination of CCl_3F and CCl_2F_2 in seawater and air, Deep-Sea Research, 25, 839-853.
- Bullister, J.L., and T. Tanhua (2010): Sampling and measurement of chlorofluorocarbons and sulfur hexafluoride in seawater. In The GO-SHIP Repeat Hydrography Manual: A Collection of Expert Reports and Guidelines. E.M. Hood, C.L. Sabine, and B.M. Sloyan (eds.), IOCCP Report Number 14, ICPO Publication Series Number 134. Available online at <http://www.go-ship.org/HydroMa>
- Bullister, J.L., and R.F. Weiss, 1988: Determination of CCl_3F and CCl_2F_2 in seawater and air. Deep-Sea Res., v. 25, pp. 839-853.

Bullister, J.L., and D.P. Wisegarver (2008): The shipboard analysis of trace levels of sulfur hexafluoride, chlorofluorocarbon-11 and chlorofluorocarbon-12 in seawater. Deep-Sea Res. I, 55, 1063–1074.

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, 2000: A history of chemically and radiatively important gases in air deduced from ALE/GAGE/AGAGE. J. Geophys. Res., v. 105, pp. 17,751-17,792.

CCHDO Data History

- **File Merge SEE**

[325020080826_ct1.zip \(download\)](#) #3b9c4

Date: 2017-07-06

Current Status: merged

- **File Merge SEE**

[325020080826_nc_ctd.zip \(download\)](#) #d9969

Date: 2017-07-06

Current Status: merged

- **Website Update SEE**

Date: 2017-07-06

Data Type: CTD

Action: Website Update

Note:

P16N 2008 325020080826 processing - CTD/conversion - CTDOXY

2017-07-06

SEE

Changes

325020080826_ct1.zip id 11903

- Converted CTDOXY from ML/L to UMOL/KG

- CTDXMISS: changed parameter name from XMISS to CTDXMISS

- CTDPAR: changed parameter name from PAR to CTDPAR
- CTDPAR: changed CTDPAR units from unknown to ARBITRARY
- CTDFLUOR: changed parameter name from FLUOR to CTDFLUOR

Conversion

file	converted from	software
325020080826_nc_ctd.zip	325020080826_ct1.zip	0.8.2-48-g594e1cb

Updated Files Manifest

file	stamp
325020080826_ct1.zip	20170706CCHSIOSEE
325020080826_nc_ctd.zip	20170706CCHSIOSEE

:Updated parameters: CTDOXY

opened in JOA with problems, seems to be problem with parameter names beginning with "CTDP"; bug report sent to JOA:

325020080826_ct1.zip

opened in JOA with no apparent problems:

325020080826_nc_ctd.zip

opened in ODV with no apparent problems:

325020080826_ct1.zip

- **File Merge CCHDO Staff**

[TTN224CTD.zip \(download\)](#) #9e470

Date: 2015-07-07

Current Status: merged

- **CTD online, exchange and netcdf formats SEE**

Date: 2015-07-07

Data Type: CTD

Action: Website Update

Note:

P16N 2008 325020080826 processing - CTD online -
CTDPRS, CTDTMP, CTDSAL, CTDOXY, XMISS, PAR

2015-07-07

SEE

Submission

filename	submitted by	date	id
TTN224CTD.zip	Robert M. Key	2012-09-14	5355

Changes

TTN224CTD.zip

- converted SBE CTD files into CTD Exchange format.
- Profiles, as submitted, have not been quality controlled, outliers exist.
- Added comments and headers to Exchange files.
- Added comments to the Exchange files.
 - # INSTRUMENT_ID not submitted
 - # DEPTH not submitted
 - # Flags were not submitted for any parameters.
 - # DATE_UNITS = YYYYMMDD
 - # TIME_UNITS = HHMM, UTC
 - # LATITUDE_UNITS = degrees_North
 - # LONGITUDE_UNITS = degrees_East
 - # CCHDO converted SBE .cnv files to Exchange format
 - # This CTD profile has not been quality controlled
 - # name 0 = prDM: Pressure, Digiquartz [db]
 - # name 2 = t090C: Temperature [ITS-90, deg C]
 - # name 11 = flECO-AFL: Fluorescence, Wetlab ECO-AFL/FL

[mg/m^3]

- # name 12 = par: PAR/Irradiance, Biospherical/Licor
- # name 13 = sbeox0ML/L: Oxygen, SBE 43 [ml/l]
- # name 14 = xmiss: Beam Transmission,

Chelsea/Seatech/Wetlab CStar [%]

- # name 22 = sal00: Salinity [PSU]

:Updated parameters: CTDPRS,CTDTMP,CTDSAL,CTDOXY,FLUOR,XMISS,PAR

325020080826_ct1.zip opened in JOA and ODV with no apparent problems.

325020080826_nc_ctd.zip opened in JOA with no apparent problems.

- **File Online CCHDO System**

[325020080826_hy1.csv \(download\)](#) #8f58e

Date: 2015-04-23

Current Status: dataset

Notes

Files migrated to new CCHDO backend, there is not enough information to know where this file should go in the timeline.

- **File Online CCHDO System**

[p16n_325020080826trk.jpg \(download\)](#) #6856f

Date: 2015-04-23

Current Status: merged

Notes

Files migrated to new CCHDO backend, there is not enough information to know where this file should go in the timeline.

- **File Online CCHDO System**

[p16n_325020080826trk.gif \(download\)](#) #5ff35

Date: 2015-04-23

Current Status: merged

Notes

Files migrated to new CCHDO backend, there is not enough information to know where this file should go in the timeline.

- **File Online CCHDO System**

[325020080826_nc_hyd.zip \(download\)](#) #27c6f

Date: 2015-04-23

Current Status: dataset

Notes

Files migrated to new CCHDO backend, there is not enough information to know where this file should go in the timeline.

- **File Online CCHDO System**

[325020080826_ct1.zip \(download\)](#) #8a20a

Date: 2015-04-23

Current Status: dataset

Notes

Files migrated to new CCHDO backend, there is not enough information to know where this file should go in the timeline.

- **File Online CCHDO System**

[325020080826_nc_ctd.zip \(download\)](#) #3715b

Date: 2015-04-23

Current Status: dataset

Notes

Files migrated to new CCHDO backend, there is not enough information to know where this file should go in the timeline.

- **Exchange and netCDF files online Rox Lee**

Date: 2014-03-25

Data Type: BTL

Action: Website Update

Note:

```
=====
325020080826 processing - BTL
=====
```

2014-03-25

R Lee

.. contents:: :depth: 2

Parameters

325020080826.exc.csv

~~~~~

```
- CTDPRS
- CTDTMP
- CTDSAL [1]_
- SALNTY [1]_
- CTDOXY [1]_
- OXYGEN [1]_
- SILCAT [1]_
- NH4 [1]_
- NITRAT [1]_
- NITRIT [1]_
- PHSPHT [1]_
- CFC-11 [1]_
- CFC-12 [1]_
- SF6 [1]_
- TCARBN [1]_
- ALKALI [1]_
- XMISS [3]_
- FLUOR [3]_
```

```
.. [1] parameter has quality flag column
.. [3] not in WOCE bottle file
```

Process  
=====

Changes  
-----

- Changed NH4 STNNBR 999, CASTNO 1, BTLNBR 1-24 from flag 1 to 2

Conversion  
-----

| file                    | converted from       | software                 |
|-------------------------|----------------------|--------------------------|
| 325020080826_nc_hyd.zip | 325020080826_hy1.csv | hydro 0.8.0-110-g7da02f9 |

All converted files opened in JOA with no apparent problems.

Directories  
=====

:working directory:

/data/co2clivar/pacific/p16/p16n\_325020080826/original/2014.03.25\_BTL\_R  
JL

:cruise directory:

/data/co2clivar/pacific/p16/p16n\_325020080826

Updated Files Manifest  
=====

| file                    | stamp             |
|-------------------------|-------------------|
| 325020080826_nc_hyd.zip | 20140325SIOCCHRJL |
| 325020080826_hy1.csv    | 20140325SIOCCHRJL |

- **File Merge Carolina Berys**

[325020080826.exc.csv \(download\)](#) #6c30b

**Date:** 2014-03-24

**Current Status:** merged

**Notes**

BTL



- **Exchange and netCDF files online Rox Lee**

**Date:** 2014-03-24

**Data Type:** BTL

**Action:** Website Update

**Note:**

```
=====
325020080826 processing - BTL
=====
```

2014-02-25

R Lee

.. contents:: :depth: 2

Submission

=====

| filename             | submitted by  | date       | data type | id   |
|----------------------|---------------|------------|-----------|------|
| 325020080826.exc.csv | Robert M. Key | 2011-11-15 | BTL       | None |

Parameters

-----

325020080826.exc.csv

~~~~~

- CTDPRS
- CTDTMP
- CTDSAL [1]_
- SALNTY [1]_
- CTDOXY [1]_
- OXYGEN [1]_
- SILCAT [1]_
- NH4 [1]_
- NITRAT [1]_
- NITRIT [1]_
- PHSPHT [1]_
- CFC-11 [1]_
- CFC-12 [1]_
- SF6 [1]_
- TCARBON [1]_
- ALKALI [1]_
- XMISS [3]_
- FLUOR [3]_

.. [1] parameter has quality flag column

.. [3] not in WOCE bottle file

Process

=====

Changes

- Changed empty data values -9 to -999
- AMMONI changed to NH4
- SILCAT empty data values flag 2 changed to flag 9

325020080826.exc.csv

~~~~~

#### Conversion

-----

| file                    | converted from       | software                 |
|-------------------------|----------------------|--------------------------|
| 325020080826_nc_hyd.zip | 325020080826_hy1.csv | hydro 0.8.0-110-g7da02f9 |

All converted files opened in JOA with no apparent problems.

#### Directories

=====

:working directory:

/data/co2clivar/pacific/p16/p16n\_325020080826/original/2014.03.24\_BTL\_R  
JL

:cruise directory:

/data/co2clivar/pacific/p16/p16n\_325020080826

#### Updated Files Manifest

=====

| file                    | stamp             |
|-------------------------|-------------------|
| 325020080826_nc_hyd.zip | 20140324SI0CCHRJL |
| 325020080826_hy1.csv    | 20140324SI0CCHRJL |

- **File Submission Robert M. Key**

[TTN224CTD.zip \(download\)](#) #9e470

**Date:** 2012-09-14

**Current Status:** merged

#### Notes

CTD data files

- **File Submission Key, Robert M.**

[TTN224CTD.zip \(download\)](#) #9e470

**Date:** 2012-09-14

**Current Status:** merged

**Notes**

Expocode: 325020080826

Ship: Thomas Thompson

Woce Line: P16N

Note: I previously (11/15/11) provided the bottle file and documentation for this cruise. Here is a zip file with the CTD data. These data need a reformat.

- **Available under 'Files as received' CCHDO Staff**

**Date:** 2012-09-14

**Data Type:** CTD

**Action:** Website Update

**Note:**

The following files are now available online under 'Files as received', unprocessed by the CCHDO.

TTN224CTD.zip

- **to be reformatted Bob Key**

**Date:** 2012-09-14

**Data Type:** CTD

**Action:** Submitted

**Note:**

I previously (11/15/11) provided the bottle file and documentation for this cruise. Here is a zip file with the CTD data. These data need a reformat.

- **Available under 'Files as received' Carolina Berys**

**Date:** 2011-11-18

**Data Type:** BTL/CrsRpt

**Action:** Website Updated

**Note:**

Files 325020080826.exc.csv (containing bottle data) and

TT224\_Metafile\_DG&SE\_0611.docx (Cruise Report), submitted by Bob Key on 2011-11-15, available under 'Files as received', unprocessed by CCHDO.

- **File Submission Robert M. Key**

[325020080826.exc.csv \(download\)](#) #6c30b

**Date:** 2011-11-15

**Current Status:** merged

**Notes**

Bottle file - U.W. student cruise

- **File Submission Key, Robert M.**

[325020080826.exc.csv \(download\)](#) #6c30b

**Date:** 2011-11-15

**Current Status:** merged

**Notes**

Expocode: 325020080826

Ship: T.G. Thompson

Woce Line: P16N mostly

Note: One of the U.W. student cruises. Very high quality oxygen.

Marginal nuts

- **File Submission Robert M. Key**

[TT224\\_Metafile\\_DG&SE\\_0611.docx \(download\)](#) #b1ba0

**Date:** 2011-11-15

**Current Status:** unprocessed

**Notes**

Cruise Report - U.W. student cruise

- **File Submission Key, Robert M.**

[TT224 Metafile DG&SE 0611.docx \(download\)](#) #b1ba0

**Date:** 2011-11-15

**Current Status:** unprocessed

**Notes**

Expocode: 325020080826

Ship: T.G. Thompson

Woce Line: P16N mostly

Note: One of the U.W. student cruises. Very high quality oxygen.  
Marginal nuts

- **High qual. oxygens Bob Key**

**Date:** 2011-11-15

**Data Type:** BTL/CrsRpt

**Action:** Submitted

**Note:**

One of the U.W. student cruises. Very high quality oxygen. Marginal  
nuts