WHP Cruise Summary Information

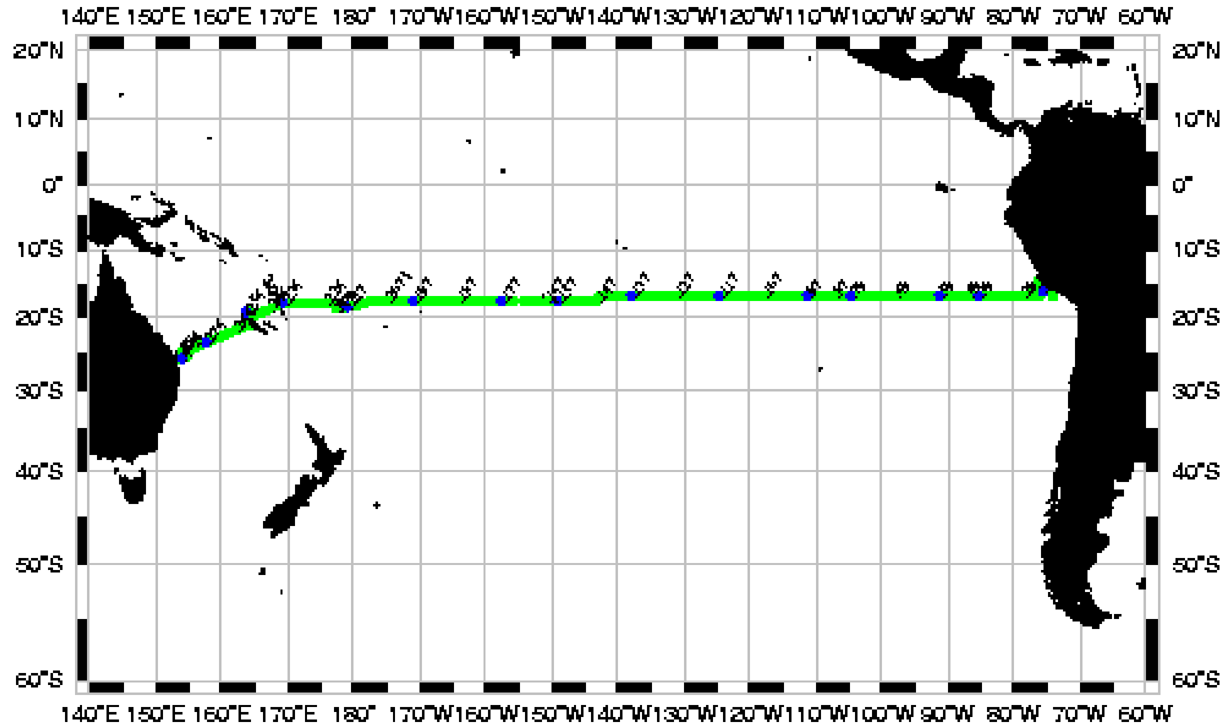
WOCE section designation	P21EW
Expedition designation (EXPOCODE)	318MWESTW_4-5
Chief Scientist(s) and their affiliation	Michael McCartney, WHOI (leg 4) Harry Bryden, JRC (leg 5)
Dates	1994.03.27 – 1994.05.15 (leg 4) 1994.05.19 – 1994.06.25 (leg 5)
Ship	MELVILLE
Ports of call	Iquique, Chile to Papeete, Tahiti (leg 4) Papeete to Brisbane, Australia (leg 5)
Number of stations	161 (leg 4); 133 (leg 5)
Geographic boundaries of the stations: Leg 4	14°30.00"S 149°20.17"W 74°08.00"W 17°30.33"S
Leg 5	17°25.00"S 179°40.17"W 147°49.83"W 25°45.67"S
Floats and drifters deployed	none
Moorings deployed or recovered	none
Contributing Authors	G. Anderson

WHP Cruise and Data Information

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

Cruise Summary Information	Hydrographic Measurements
Description of scientific program	CTD - general
Geographic boundaries of the survey	
Cruise track (figure)	
Description of stations	
	Salinity
Floats and drifters deployed	Oxygen
Moorings deployed or recovered	
Principal Investigators for all measurements	
Problems and goals not achieved	
Other incidents of note	
	References
	DQE Reports
	CTD
	S/O2/nutrients
	Data Status Notes

Station locations for P21



(Produced from .SUM files by WHPO)

A. Cruise narrative

A.1. Highlights

a.	WOCE designation:	P21E and P21W
b.	EXPOCODE	318MWESTW/4 318MWESTW/5
c.	Chief scientist:	Leg 1: Michael McCartney, WHOI Leg 2: Harry Bryden, JRC
d.	Ship:	R/V Melville
e.	Ports of call:	Leg 1: Iquique, Chile to Papeete, Tahiti Leg 2: Papeete to Brisbane, Australia
f.	Cruise dates:	Leg 1: March 27 to May 15, 1994 Leg 2: May 19 to June 25, 1994

A.2. Cruise Summary Information

A.2.a. Geographic boundaries:

	14 30 S	
154 E		74 W
	25 43 S	

The cruise was conducted within 1deg of 17 S from 74 W to 169 E. The section then bore WSW to finish at 25 43 S 154 E.

A.2.b. Stations occupied:

A trackline is shown in Figure 1. The bottle sampling scheme is shown in Figure 2. A total of 294 CTD/rosette stations were occupied. 161 stations were occupied on Leg 4 and 133 on Leg 5.

A.2.c. Floats and drifters deployed:

No information yet available.

A.2.d. Moorings deployed or recovered:

No moorings were deployed or recovered on this cruise.

A.3. List of Principal Investigators

Table 1: List of Principal Investigators

Measurement	Principal Investigator	Institution
Salinity, oxygen	John Toole	WHOI
CTD/O2	John Toole	WHOI
Nutrients	Lou Gordon	OSU
Chlorofluorocarbons	Rana Fine	RSMAS
Helium/tritium	Bill Jenkins	WHOI
ADCP	Mike Kosro	OSU
ALACE floats	Russ Davis	SIO
Drifters	Peter Niiler	SIO
TCO2	Chris Winn	Univ. of Hawaii
	Catherine Goyet	WHOI
pH	Frank Millero	RSMAS
Alkalinity	Catherine Goyet	WHOI
	Frank Millero	RSMAS
Underway pCO2	Catherine Goyet	WHOI
Meteorology	David Wirth	SIO
Air chemistry	?	?
Bathymetry	Stu Smith	SIO

A.4. Scientific Programme and Methods

The object of this cruise was to occupy a series of CTD/O_2 (Conductivity-Temperature-Depth-Oxygen) stations approximately along 17°S from the continental shelf of Peru to the continental shelf of Australia, with an intermediate port stop in Tahiti. This collection of high-quality water-property data will help define the pattern of circulation in the South Pacific. At each station measurements of temperature, salinity, and dissolved-oxygen concentration were made continuously with depth, and the concentrations of dissolved silica, phosphate, nitrate, and nitrite were measured at up to 36 discrete levels. In addition, measurements of freon, tritium concentrations and CO_2 were made at selected levels. The station spacing ranged from 5 to 40 nautical miles, and all lowerings were made to within 10-20 m of the bottom. Continuous echo-sounding was maintained along the cruise track, as well as ADCP current measurements.

A.5. Major Problems and Goals Not Achieved

None noted.

A.6. Other Incidents of Note

As part of the obligations stated as a condition of research in the waters of Peru, Lieutenant Jorge Paz Acosta, Chief of the Department of Environment, Peruvian Navy, participated in the cruise from Iquique, Chile to Tahiti. He was given complete preliminary data files upon his departure from Tahiti. As part of the obligations stated as a condition of research in the waters of the Cook Islands, Mr. Benjamin E. Ponia, Acting Senior Fisheries Research Officer, participated in the cruise from Tahiti to Australia. He replaced Mr. Ian Bertram, who was originally scheduled to participate.

A.7. List of Cruise Participants

B. Underway Measurements

B.1 Navigation and bathymetry

B.2 Acoustic Doppler Current Profiler (ADCP)

B.3 Thermosalinograph and underway dissolved oxygen, etc

B.4 XBT and XCTD

B.5 Meteorological observations

B.6 Atmospheric chemistry

C. Hydrographic Measurements

C.1. General Information and CTD observation log

C.2. Water sample salinity and oxygen data

Water samples were collected from every bottle during this cruise for the determination of salinity and dissolved oxygen. The primary purpose of these measurements is to accurately calibrate the sensors on the CTD.

C.1.a. Salinity

Water was collected in 8 ounce glass bottles. The bottles were rinsed twice, and then filled to the neck. After the sample reach the lab temperature of 21°C, they were analyzed for salinity using a Guildline Autosal Model 8400B salinometer. The salinometer was standardized once a day using IAPSO Standard Seawater Batch P-123. Salinity readings were logged automatically to a computer, merged with the CTD data, and finally used to update the CTD calibrations. Accuracy of salinity measurements were ± 0.001 PSU.

C.1.b. Dissolved oxygen

Measurements were made using a modified Winkler technique similar to that described by Strickland and Parson (1972). Each seawater sample was collected in a 150 ml brown glass Tincture bottle. When reagents are added, iodine is liberated in amounts proportional to the dissolved oxygen in the sample. A carefully measure aliquot was collected from the prepared oxygen sample and was titrated for total iodine content. Titration was automated, using a PC controller and a Metrohm Model 665 Dosimat burette. The titration endpoint was determined amperometrically using a dual plate platinum electrode, with a standard deviation of replicate samples of 0.005. This technique is described more thoroughly by Knapp et al (1990). Calculated oxygen was merged with the CTD data, and used to update the CTD calibrations.

C.3. Water sample nutrient data

C.4. CTD/O_2 data

C.5. Chlorofluorocarbons

C.6. Radiocarbon sampling

C.7. Helium and tritium measurements

C.8. Carbon dioxide

C.9. Transmissometer

C.10. Surface measurements of ^{228}Radium

D. Acknowledgments

E. References

Knapp, G.P., M.C. Stalcup and R.J. Stanley, 1990. Automated Oxygen Titration and Salinity Determination. WHOI Technical Report, WHOI-90-35, 25 pp.

Strickland, J.D.H. and T.R. Parsons, 1972. The Practical Handbook of Seawater Analysis. Bulletin 167, Fisheries Research Board of Canada, 310 pp.

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

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

F. WHPO Summary

Four figures are usually created by the WHPO for the benefit of the reader (NOT SHOWN).

Figure 3 shows station number versus the difference between the individual oxygen water samples and their corresponding CTD value (OXYGEN-CTDOXY).
Figure 4 shows the oxygen difference versus pressure.
Figure 5 shows station number versus the difference between the individual salinity water samples and their corresponding CTD value (SALNTY-CTDSAL).
Figure 6 shows the salinity difference versus pressure.

Several data files are associated with this report. They are the 318westw_4.sum and 318westw_5.sum, 318westw_4.hyd and 318westw_5.hyd, 318westw_4.csl and 318westw_5.csl and *.wct files. The *.sum file contains a summary of the location, time, type of parameters sampled, and other pertinent information regarding each hydrographic station. The *.hyd file contains the bottle data. The *.wct files are the ctd data for each station. The *.wct files are zipped into one file called 318westw_4wct.zip and 318westw_5wct.zip. The *.csl file is a listing of ctd and calculated values at standard levels.

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

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

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

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

Sigma-theta(SIG-TH:KG/M3), Sigma-2 (SIG-2: KG/M3), and Sigma-4(SIG-4: KG/M3): These values are calculated using the practical salinity scale (PSS-78) and the international equation of state for seawater (EOS-80) as described in the Unesco publication 44 at reference pressures of the surface for SIG-TH; 2000 dbars for Sigma-2; and 4000 dbars for Sigma-4.

Gradient Potential Temperature (GRD-PT: C/DB 10-3) is calculated as the least squares slope between two levels, where the standard level is the center of the interval. The interval being the smallest of the two differences between the standard level and the two closest values. The slope is first determined using CTD temperature and then the adiabatic lapse rate is subtracted to obtain the gradient potential temperature. Equations and Fortran routines are described in Unesco publication 44.

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

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

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

Potential Energy (PE: J/M2: 10-5) and Dynamic Height (DYN-HT:M) are calculated by integrating from 0 to the level of interest. Equations and Fortran routines are described in Unesco publication 44.

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

August 23, 1999

Cruise P21E, R/V Melville
March 27, 1994 to May 15, 1994, Iquique, Chile to Papeete, Tahiti
EXPOCODE: 318MWESTW/4
Chief Scientist: Dr. Michael McCartney
DQE of the discrete data listing for
CTD pressure, temperature, salinity, and oxygen, and bottle data for salinity, oxygen, silicate, nitrate, nitrite, and phosphate

The evaluation consisted of preparing plots of the parameters to be investigated. All parameters and sigma-theta (calculated using the CTD derived potential temperature and the bottle salinity) were plotted versus pressure. As necessary, supplementary plots of Θ-salinity and salinity-silicate were prepared for individual stations or groups of stations. In addition, plots of phosphate (x-axis) versus nitrate (y-axis) were prepared for each station. From these data, plots of the NO_3/PO_4 ratio and y-intercept versus station number were prepared (attached).

Positions from the .sum file were plotted and appear to be correct. Cast times and dates were checked for consistency. Inconsistencies were found on two stations. These have been corrected.

The bottle data from this cruise has been compared to that from other cruises where cruise tracks cross (see station position map), but the comparisons will not be presented in this report. P21E was the first leg of a two leg cruise. Since the equipment, techniques, personnel, etc. were similar for both legs, all data comparisons will be detailed in the DQE report for P21W.

Results:
Overall the data look good and generally meet WOCE quality standards, but there are some problems that deserve special mention.

1. Bottle oxygen analyses: precision and analytical procedures used [See the data summary for station 162 in Appendix One at the end of this report]

In the very brief cruise report available for the DQE work the accuracy and precision of the oxygen technique used during this cruise are stated as: ~0.02 and ~0.005 ml/l respectively. At station 162 the mean of the CTD-oxygen data was 178.2 ± 0.24 μmoles/kg. This precision is ~0.005 ml/l, the same value stated in the cruise report. However, the mean of the bottle oxygen data was 180.8 ± 0.76 μmoles/kg; this precision is ~ 0.017 ml/l, about 3 times the precision indicated in the cruise report and ~4 times the recommended precision for discrete oxygen measurements listed in the WOCE manual (page 20). At a concentration of 180.6 μmoles/kg, a precision of 0.76 equals ~0.4%.

All bottle oxygens from this cast were flagged 3 (questionable measurement). This may have been done because the two data sets appear to be offset by ~2.6 μmoles/kg. However, the precision is probably a reasonable estimate of the overall quality of the oxygen data from both legs of this cruise, taking into account Niskin bottle integrity, sampling errors, and all errors associated with the actual analysis. The later would include errors resulting from the procedure used on this cruise where aliquots of sample were titrated rather than the Carpenter (1965) recommended whole bottle titration. In the last ten years there have been improvements in sampling, system components are routinely calibrated, automated burettes are being used, end point detection has improved, and there is now wide spread use of computer assisted titrators. It would be worthwhile to re-evaluate these two techniques of sample titration to determine the extent, if any, of the differences resulting from the added manipulation of acidified samples before titration with thiosulfate over the range of oxygen concentrations likely to be seen in the open ocean.

2. CTD Oxygen data evaluations.

With very few exceptions, the data originator has not flagged the CTD oxygen data. Excluding the surface levels (typically the1st through 3rd bottles) and a few deep values, the CTD-oxygens look very reasonable. Even if the CTD and bottle oxygen differ the shape of the curves are very similar. In the Cruise Report for WOCE Cruise P31 there are several paragraphs devoted to the problems of collecting and processing CTD oxygen data. The following statement appears: “Therefore the usefulness of data in the top 100 decibars should be carefully considered (page 11).” This is very true, not just for P31 but most recent cruises on which CTD oxygen data have been taken and processed. Notwithstanding, an effort has been made to review and annotate the CTD oxygen data on P21E.

The following approach was taken in assigning quality 2 flags: in the upper 100 db of the water column, if the CTD oxygen value disagreed by ~10 or more μmoles/kg from the bottle oxygen, these could be flagged either 3 or 4 depending on the magnitude of the difference. If the CTD oxygen data indicated maxima or minima not seen in the bottle data or suggested by the data on adjacent stations, these would be flagged. For example, if the bottle data showed a true mixed layer in the first three levels of the cast and the CTD oxygen trace showed a pronounced maximum at the second level, this CTD oxygen value would be flagged 3 or 4.

3. CTD Salinity data from CTD 10.

At the end of station 111, the CTD was lost. Through station 111, CTD 10 was used for most casts. Differences in salinity between the CTD and bottles in the upper 500 db were high. As a way of evaluating these large differences, the maximum difference between the CTD and bottle salts was tabulated for two groups of 11 stations, stations 29-39 early in the cruise using CTD 10 and 125-

135 using CTD 9 (see Appendix Two). For stations 29-39, the differences ranged between 0.070 and -0.228 p.s.u. The mean was -0.018 ± 0.106 p.s.u. When the mean was recomputed using the absolute values, the results were 0.081 ± 0.067 p.s.u. Analogous computations for stations 125-135 gave means of -0.012 ± 0.011 and 0.015 ± 0.005 p.s.u. Even in the near surface mixed layer, differences as large as 0.020 p.s.u. were seen with CTD 10, e.g., Station 37.

It would appear from these representative data that the CTD salinity data in the upper 500 db when CTD 10 was used have the potential of large differences that could perhaps be decreased by further data processing, specifically adjusting the sensor lag factors. A large difference could also be explained in part by differences in the two sampling packages; the 36-place rosette is larger and packed with more instrumentation with resulting differences in flow characteristics through the package.

4. Bottle spacing when using the 24 place rosette

Through station 110 a 36-place rosette was used. No water samples were collected at station 111. On station 112, a 24-place rosette was employed with a different CTD. However, with the 24 place rosette, deep water bottles were often tripped ~300 db apart. The WOCE manual (page 12) states, "It is expected that the vertical sample interval will not exceed 200 m for each full-depth station…" With the 24-bottle rosette this coverage was impossible. The interval spacing on stations 110 and 112 follow. The upper water column was sampled about the same with both rosettes.

Station 110		Station 112	
Cast to ~3700 db, 36 bottles		Cast to ~3700 db, 24 bottles	
Sampling range (db)	bottle spacing (db)	Sampling range (db)	bottle spacing (db)
400 – 1600	100	400 – 800	100
1 level of	150	1 level of	250
1750 – 3400	150	1050 – 1800	250
1 level of	200	2100 – 3600	300

Minor difficulties included:

1. occasional levels where bottles leaked and/or closed at depths not desired.
2. a few "bad" bottle salts.
3. a few stations where the phosphate data appear to be offset from the data on adjacent stations from 0.02 to as much as 0.05 μmoles/kg. (See e.g. Stations 24 and 118.)
4. inconsistencies in data flagging, e.g., on Stations 7 (896.7 db) and 31 (898.7db), the Q1 flag for the bottle was 2, but all bottle data were flagged 3 or 4 because the bottle either leaked or tripped in the wrong place. The Q1 bottle flag of 2 would appear to be the wrong choice. And sometimes the PO_4

and NO_3 values for a leaky bottle would be flagged 2, while all other water samples, including silicate, would be flagged 3 or 4. Even when falling on the property/db curve, I believe these nutrient values should be flagged uncertain (see e.g., stations 35 & 36 at ~400 db).

5. bottle problems not being caught promptly. On stations 34-36, the bottle at ~400 db, #SI9328, either leaked or tripped at the wrong depth. Before Station 37 which started ~ 17 hrs after the completion of station 34, this bottle was replaced. I would like to think that problems such as this could be caught and rectified more quickly.
6. When received at the WHPO, the nutrient data were in units of µM/l and the reported nitrate data were uncorrected for nitrite. The conversion of the nutrient data to µM/kg and the correction of the nitrate + nitrite data to nitrate have been made. Personal communications with Lou Gordon, the PI for nutrients on this cruise, indicated that the volume units of µM/l should be converted to mass units of µM/kg using a temperature of 21±2°C. The processing program used to make the conversion used a temperature of 25°C. Over the range of salinity of 33 to 37 p.s.u., the conversion using the density of seawater at 25°C. would give values ~0.11% higher than if the density based on 21° is used. For silicate at a concentration of 140 µM/l, and a salinity of 35 p.s.u., the difference would be ~0.15 µMoles/kg, 136.81 vis 136.65. At the same salinity and for a nitrate concentration of 45 µM/l, the difference would be ~0.05 µM/kg; similarly for phosphate at 3 µM/l, the difference would be 0.003 µM/kg. Although this does represent a bias in the data, the ~0.1% difference is well within the WOCE recommended reproducibility values for these three parameters of ~1 to ~3% in the "better" laboratories. (WOCE manual, page 20).
7. As a result of the subtraction of the nitrite data from the nitrate + nitrite data, the data listing now shows some negative nitrate values. At the extreme, there are values higher than -0.4 µmoles/kg (see e.g., station 44, bottles 36 and 35).
8. At station 113 no nitrite values have been reported. The nitrate values on this station would be expected to be high since there was no nitrite value to subtract from the results of the nitrate + nitrite channel. The nitrite values at adjacent stations have been reviewed. On these stations, the nitrite values are very low, never exceeding 0.10 µmoles/kg. Based on this, it would appear that the nitrate values could be used without the necessity of approximating corrections based on the data from the adjacent stations.
9. Excluding the station position data from a few stations early in the cruise, it would appear that the positions were recorded as degrees, minutes and tens of seconds. The tens of seconds were converted to decimal minutes and rounded to 2 decimal places. This may account for the positions which consistently show decimal minutes of 0.17, 0.33, 0.50, 0.67, and 0.83.
10. There are some stations occupied between 3 and 4 hours which show no changes in position over the duration of the station, see for example Stations 41, 57 and 93. Assuming that positions were recorded to tens of seconds, this means that the ship drifted less than ~1000 feet during this interval. Either the watch was not using the GPS to acquire the positions at the

relevant times or the actual positions represent some smoothing of the data over the interval during which the station was occupied.

11. Depth of surface bottle. Over the first 100 stations, the range in "depth" of the surface bottle was 4.2 to 14.4 db; the median was ~8.5 db. The deepest surface bottle was at 25.5 db, station 127 and for all of P21E, there were seven stations at which the surface bottle was deeper than 20 db. Unless there were problems with weather or the CTD/Rosette package, 20 db seems rather deep for a surface bottle.

Attached are listed changes to be considered by the data originator with some explanations. Most of these changes involve the CTD and bottle data for salinity and oxygen. These "changes-to-be-considered" have not been separately annotated because they reflect the comments made in the text above. A few suggestions have been made regarding other data. These have been explained in this listing.

George C. Anderson
DQ Evaluator

References:

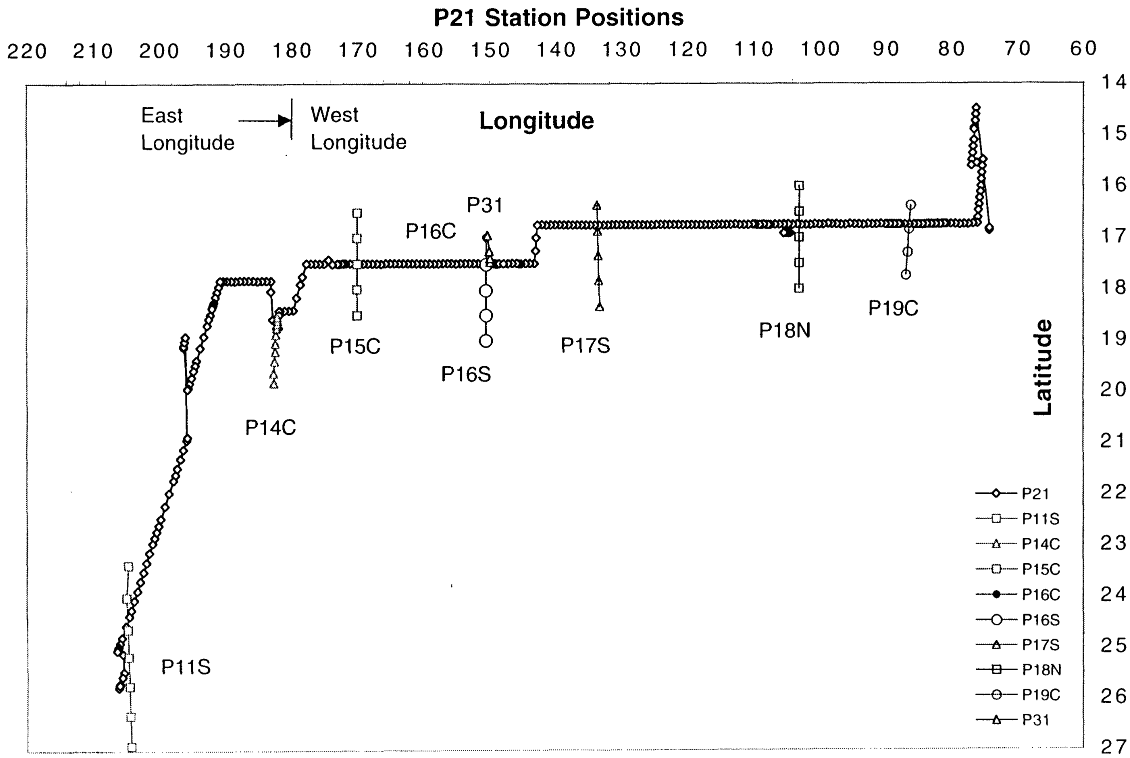
Carpenter, J.H. (1965b), The Chesapeake Bay Institute Technique for the Winkler Oxygen Method**, Limnology and Oceanography, 10**, 141-143.

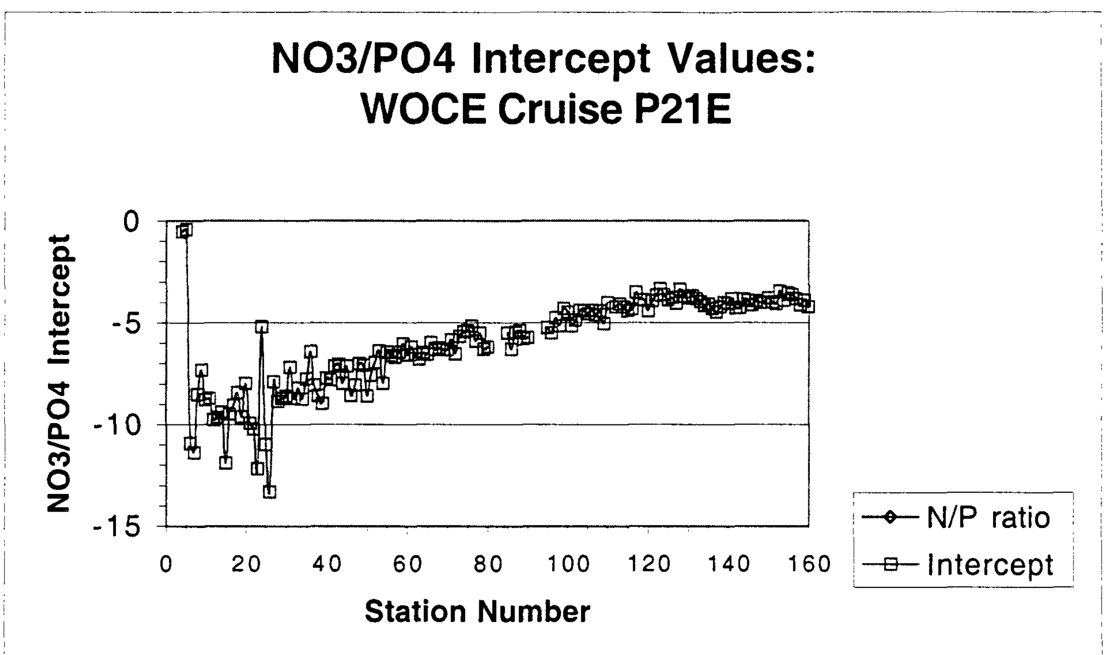
Oceanographic Data Facility (ODF), 18 July 1997, **Final Cruise Report, Cruise P31**.

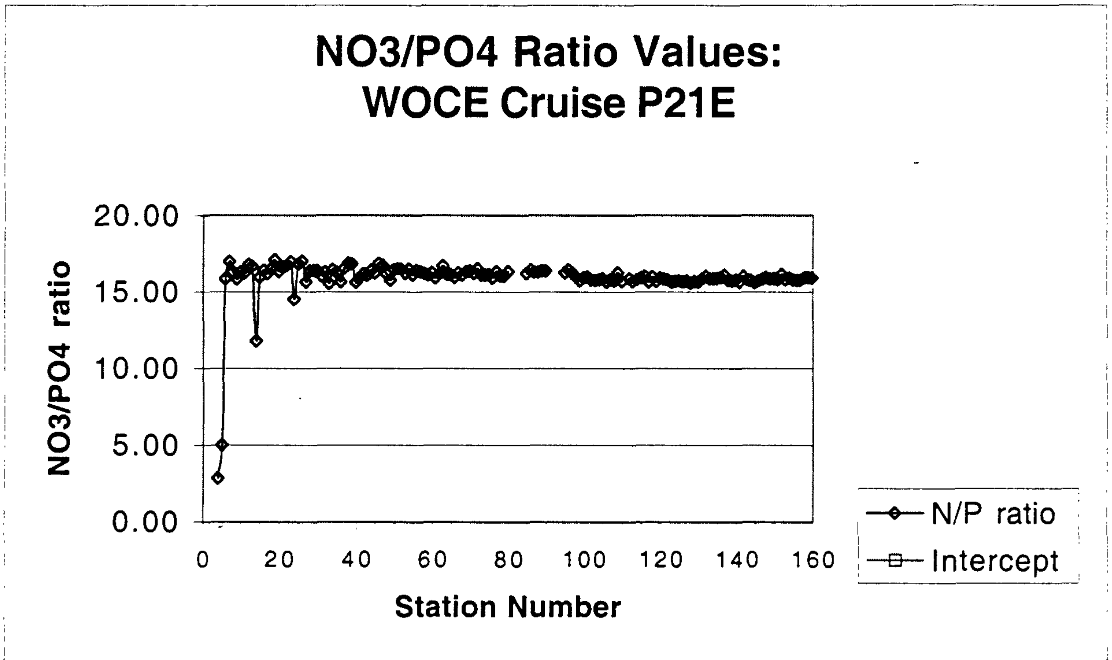
WOCE Operations Manual, May 1994, Vol. 3, Section 3.1, Part 3.1.2, WHP Office Report 90-1, Rev. 2, Woods Hole, Mass, USA.

List of plots:

Plots of the NO3/PO4 ratio, and y-intercept versus station number
Station positions, all of Cruise P21







Appendix One: Data from Station 162 P21W

At the start of leg 2 of this cruise, labeled P21W, at station 162, all 36 bottles on the rosette were tripped at ~ 3900 db. Plots of the data versus pressure indicate no appreciable gradients in any of the properties. The data listing for this station is attached.

The means and standard deviations of all values have been computed and are listed below:

Property	Mean	Standard Deviation	Relative %	WOCE precisions
CTD-Temp	1.4467	±0.0002		0.0005°C
CTD-Salinity	34.6938	±0.0003		0.001 p.s.u.
Bottle-Sal	34.6947	±0.0011		0.001 p.s.u.
CTD-Oxygen	178.2	±0.24	0.14	1.0 %
Bottle-O2	180.8	±0.76	0.42	0.1 %
Silicate	122.50	±0.18	0.14	0.2 %
Nitrate	33.61	±0.12	0.37	0.2 %
Phosphate	2.34	±0.02	0.72	0.4 %

WHI-ID P21W **Station 162: Data with means and standard deviations**

Pressure	Temperature	CTD-sal	CTD-O2	Theta	Bott-sal	Bot-O2	SIL	NO3	NO2	PO4	Sigma-θ	Salinity CTD less bottle	Oxygen Bottle less CTD
3910.9	1.4470	34.6933	177.9	1.1392	34.6963	180.1	122.16	33.58	0.03	2.34	1.027792	-0.0030	2.2
3911.1	1.4468	34.6937	177.9	1.1389	34.6944	180.1	122.29	33.58	0.02	2.33	1.027790	-0.0007	2.2
3911.2	1.4469	34.6936	177.9	1.1390	34.6961	181.0	122.17	33.70	0.02	2.35	1.027792	-0.0025	3.1
3911.3	1.4465	34.6934	177.9	1.1386	34.6950	182.5	122.93	33.55	0.03	2.34	1.027791	-0.0016	4.6
3911.4	1.4465	34.6936	177.9	1.1386	34.6950	182.5	122.49	33.62	0.02	2.35	1.027791	-0.0014	4.6
3911.4	1.4467	34.6937	177.9	1.1388	34.6944	180.1	122.35	33.53	0.02	2.35	1.027790	-0.0007	2.2
3911.5	1.4464	34.6932	177.9	1.1385	34.6954	180.1	122.36	33.63	0.02	2.35	1.027791	-0.0022	2.2
3911.6	1.4464	34.6937	177.9	1.1385	34.6952	181.2	122.37	33.59	0.02	2.34	1.027791	-0.0015	3.3
3911.7	1.4465	34.6942	177.9	1.1386	34.6916	180.4	122.38	33.70	0.02	2.35	1.027788	0.0026	2.5
3911.8	1.4468	34.6942	177.9	1.1389	34.6948	180.8	122.55	33.52	0.02	2.35	1.027791	-0.0006	2.9
3911.8	1.4469	34.6941	177.9	1.1390	34.6961	180.8	123.01	33.47	0.02	2.36	1.027792	-0.0020	2.9
3911.9	1.4465	34.6940	177.9	1.1386	34.6958	180.8	122.71	33.43	0.02	2.35	1.027792	-0.0018	2.9
3911.9	1.4467	34.6934	178.4	1.1388	34.6948	180.8	122.42	33.49	0.02	2.35	1.027791	-0.0014	2.4
3912.0	1.4469	34.6933	178.2	1.1389	34.6946	180.8	122.28	33.64	0.02	2.34	1.027791	-0.0013	2.6
3912.1	1.4470	34.6943	178.4	1.1390	34.6956	179.9	122.60	33.73	0.03	2.36	1.027791	-0.0013	1.5
3912.2	1.4465	34.6940	178.4	1.1385	34.6956	179.9	122.76	33.55	0.02	2.36	1.027791	-0.0016	1.5
3912.3	1.4470	34.6939	178.4	1.1390	34.6936	181.1	122.67	33.53	0.02	2.34	1.027790	0.0003	2.7
3912.4	1.4467	34.6944	178.4	1.1387	34.6936	181.6	122.49	33.75	0.00	2.32	1.027790	0.0008	3.2
3912.5	1.4465	34.6938	178.4	1.1385	34.6934	180.8	122.49	33.75	0.00	2.32	1.027790	0.0004	2.4
3912.5	1.4464	34.6939	178.4	1.1384	34.6971	180.8	122.49	33.75	0.00	2.32	1.027793	-0.0032	2.4
3912.7	1.4470	34.6937	178.4	1.1390	34.6926	181.1	122.49	33.75	0.00	2.32	1.027789	0.0011	2.7
3912.8	1.4470	34.6940	178.4	1.1389	34.6952	181.1	122.49	33.75	0.00	2.32	1.027791	-0.0012	2.7
3912.8	1.4467	34.6943	178.4	1.1387	34.6946	181.1	122.49	33.75	0.00	2.32	1.027791	-0.0003	2.7
3912.9	1.4465	34.6937	178.4	1.1385	34.6940	181.6	122.49	33.75	0.00	2.32	1.027790	-0.0003	3.2
3912.9	1.4469	34.6937	178.4	1.1388	34.6954	180.1	122.49	33.75	0.00	2.32	1.027791	-0.0017	1.7
3913.1	1.4470	34.6941	178.2	1.1389	34.6940	181.0	122.49	33.75	0.00	2.32	1.027790	0.0001	2.8
3913.4	1.4470	34.6940	178.2	1.1389	34.6950	179.4	122.49	33.75	0.00	2.32	1.027791	-0.0010	1.2
3913.6	1.4465	34.6939	178.5	1.1384	34.6944	180.1	122.59	33.51	0.02	2.37	1.027790	-0.0005	1.6
3913.7	1.4470	34.6938	178.2	1.1389	34.6938	182.8	122.60	33.43	0.01	2.36	1.027790	0.0000	4.6
3913.7	1.4466	34.6934	178.2	1.1385	34.6950	180.8	122.46	33.39	0.00	2.35	1.027791	-0.0016	2.6
3913.8	1.4469	34.6934	178.5	1.1387	34.6940	180.8	122.62	33.43	0.02	2.38	1.027790	-0.0006	2.3
3913.8	1.4468	34.6939	178.5	1.1386	34.6952	180.8	122.48	33.50	0.01	2.35	1.027791	-0.0013	2.3

3914.1	1.4465	34.6937	178.5	1.1383	34.6940	179.4	122.49	33.59	0.02	2.34	1.027790	-0.0003	0.9
3914.2	1.4469	34.6934	178.5	1.1387	34.6938	181.0	122.35	33.60	0.02	2.35	1.027790	-0.0004	2.5
3914.2	1.4470	34.6938	178.5	1.1388	34.6960	181.0	122.66	33.37	0.01	2.36	1.027792	-0.0022	2.5
3914.6	1.4469	34.6934	178.2	1.1387	34.6942	180.5	122.49	33.75	0.00	2.32	1.027790	-0.0008	2.3
Average	1.4467	34.6938	178.2	1.1387	34.6947	180.8	122.50	33.61	0.01	2.34	1.027791	-0.0009	2.58
Stdev	0.0002	0.0003	0.24	0.0002	0.0011	0.76	0.176	0.124	0.010	0.017	0.000001	0.0012	0.83
Rel %	0.0152	0.0009	0.14	0.0189	0.0031	0.42	0.143	0.369		0.723	0.000085		

Appendix Two:
Cruise P21E: CTD salinity, bottle salinity comparisons before and after station 111

CTD Fish #10				CTD Fish #9			
Station No.	Pressure	Max diff. CTD less bottle salt	Abs. Value	Station No.	Pressure	Max diff. CTD less bottle salt	Abs. Value
29	97.1	-0.060	0.060	125	202.7	-0.021	0.021
30	149.3	-0.016	0.016	126	300.9	-0.017	0.017
31	149.0	0.065	0.065	127	250.3	-0.017	0.017
32	99.4	-0.022	0.022	128	251.6	-0.017	0.017
33	95.7	0.126	0.126	129	100.8	-0.017	0.017
34	50.5	-0.228	0.228	130	252.4	-0.019	0.019
35	402.4	0.037	0.037	131	151.9	-0.016	0.016
36	98.5	-0.047	0.047	132	400.5	0.005	0.005
37	203.7	0.049	0.049	133	300.9	0.011	0.011
38	50.8	-0.171	0.171	134	300.0	-0.015	0.015
39	200.3	0.070	0.070	135	200.6	-0.006	0.006
	Average	-0.018	0.081		Average	-0.012	0.015
	Std dev.	0.106	0.067		Std dev.	0.011	0.005

Stations before Station 111 with significant CTD/Bottle salt differences in the surface water

Station No.	Pressure Range	CTD less bottle salt	
37	6.1 to 24.7	-0.020	
39	9.3 to 25.6	0.014	
54	10.2 to 25	-0.006	
55	9.2 to 25.3	0.006	a swing of 0.012 p.s.u. on adjacent stations
68	8.7 to 24.1	-0.012	
85	9.2 to 22.9	-0.033	
		-0.012	

Most stations however, showed surface differences in the range of ± 0.003 p.s.u.

DQE Comments Cruise P21E

Stat.	Bottle	Depth	CTD		Bottle	Data				Q	Flags	Comments
	No.	(db)	Salt	O2	Salt	O2	SIL	NO3	NO2	PO4	1	2	
4	SI9301	117.0			X						3	2	
5	9306	8.0		X							2	3	
	9305	28.3		X							2	3	
7	9320	896.5									2	3	Bottle leaked or tripped at the wrong depth, not flagged
8	9313	2202.2		X							2	3	
	9302	4383.9		X							2	3	
	9301	4434.5		X							2	3	
9	9336	13.6		X							2	4	
	9318	1397.7			X						2	3	Bottle salt looks low
10	9336	5.9		X							2	4	
11	9335	25.7			X						3	4	
	9326	602.2				X					3	2	Bottle oxygen falls on property curve
	9320	1200.8	X		X						2,3	3,2	CTD salt suspect, bottle salt okay; perhaps wrong salt flagged "3"
	9304	2807.0				X	X	X	X	X	2's	3's	Oxygen, nutrients look noisy; perhaps a mix-up during sample drawing
	9302	3043.3				X	X	X	X	X	2's	3's	Oxygen, nutrients look noisy
12	9330	248.9			X						3	4	Bottle salt very questionable
	9301	2987.7		X							2	3	
13	9333	50.5	X	X							2's	4's	CTD data very suspect
		50.5				X					3	2	
	9308	2299.1			X						3	4	Bottle salt very questionable
16	9426	51.2		X							3	2	CTD oxygen values falls on property curve
	9417	699.2		X							2	3	
17	9435	26.8			X						2	3	
	9434	52.3		X							3	2	CTD oxygen values falls on property curve
	9407	2942.5					X				2	3	silicate value looks low compared to adjacent stations

Stat.	Bottle No.	Depth (db)	CTD Salt	CTD O2	Bottle Data Salt	Bottle Data O2	Bottle Data SIL	Bottle Data NO3	Bottle Data NO2	Bottle Data PO4	Q Flags 1	Q Flags 2	Comments
	9402	3787.0			X						2	3	
	9401	3852.0		X							2	3	
18	9427	504.1		X							2	3	
	9412	3347.2		X							2	3	
19	9435	23.8		X							4	2	Value falls on property curve
	9433	98.7	X	X							2's	3,4	Values not on property curves
20	9332	149.5		X							2	3	
	9309	3499.2								X	3	2	Value appears consistent with data from adjacent stations
	9308	3745.7								X	3	2	Value appears consistent with data from adjacent stations
	9307	3997.0								X	3	2	Value appears consistent with data from adjacent stations
	9301	5322.4		X							2	3	
21	SI9334	52.9		X							3	2	
	9325	603.4		X							2	3	
	9305	3594.8						X			3	2	Values look okay; fall on NO3/PO4 data plot for this station
	9304	3799.1						X					Values look okay; fall on NO3/PO4 data plot for this station
22	9324	798.0		X							2	3	
	9318	1401.2			X						2	3	
23	9336	6.3		X							2	3	
	9335	23.5	X								2	4	
	9323	896.8									2	3	Bottle either leaked or tripped at the wrong depth.
24	9336	8.0		X							2	3	Deep phosphates 0.02 to 0.04 µmoles/kg low compared to
	9334	48.1		X	X								adjacent stations. Deep salts noisy; Sigma-theta vs db plot
											2's	3's	not smooth
	9327	499.8		X							2	3	
25	9336	7.8		X							2	4	
	9327	500.7			X						4	2	
	9326	602.2		X							2	3	
	9302	4117.8	X								2	3	
26	9334	48.2		X							2	3	

Stat.	Bottle No.	Depth (db)	CTD Salt	CTD O2	Bottle Data Salt	Bottle Data O2	Bottle Data SIL	Bottle Data NO3	Bottle Data NO2	Bottle Data PO4	Q Flags 1	Q Flags 2	Comments
	9332	999.8			X						3	2	
27	9333	26.9	X	X							2's	4's	
	9332	52.9			X						3	2	
	9322	798.8	X								2	3	
28	9334	8.0		X							2	3	
	9331	99.7		X							3	2	
	9322	794.8			X	X					2's	4,3	
	9313	1694.9			X						3	2	
29	36	7.7		X							2	3	
	34	48.8	X		X						3,2	2,4	It appears as though the CTD salt is better than the bottle salt.
	21	1096.0				X					3	2	
30	34	49.6		X							2	3	
	31	199.7			X						3	2	
	30	249.4							X		5	2	Wrong level flagged as having missing nitrite value.
	28	398.3			X						2	3	
	27	500.3			X						3	2	
	25	701.5									2	4	Bottle clearly tripped at the wrong depth; change bottle flag to 4.
	15	1903.6							X		2	5	Value missing
31	23	898.7									2	3	Bottle leaked; suggest bottle flag be changed to 3.
32	12	2295.9			X						4	3	
33	SI9333	95.7			X						2	4	
34	9332	148.1			X						4	3	
	9328	401.4					X				3	4	Value clearly off property curve
	9326	598.2			X						3	2	
35	9328	402.4						X	X	X	2's	3's	Bottle tripped incorrectly; values suspect even though on property curves

Stat.	Bottle No.	Depth (db)	CTD Salt	CTD O2	Bottle Data Salt	Bottle Data O2	Bottle Data SIL	Bottle Data NO3	Bottle Data NO2	Bottle Data PO4	Q Flags 1	Q Flags 2	Comments
	9322	997.9			X						4	3	
	9321	1102.2			X						2	3	
36	9332	149.6	X								2	3	
	9328	400.8						X	X	X	2's	3's	Bottle tripped incorrectly; values suspect even though on property curves
37	9324	703.3									3	2	Unlikely that bottle leaked; all water samples look acceptable
39	9318	9.3		X							2	3	
40	9336	7.5		X							2	3	
	9333	97.6			X						3	2	
	9332	148.8			X						4	2	
	9316	1499.4	X								3	4	
41	9336	7.2		X							2	3	Phosphates to ~2600 db flagged "3". Appear to be ~0.05
	9304	4247.0	X								3	4	µmoles/kg low compared to adjacent stations.
43	9334	51.5		X							2	3	
	9312	2339.0			X						3	4	
44	9336	11.6		X							2	4	
	9328	381.5			X						3	2	
	9320	1211.6			X						2	3	
	9306	3796.3						X			3	2	
	9305	3996.4						X			3	2	
	9304	4244.8						X			3	2	
45	9332	148.0			X	X					3's	2's	
	9318	1305.1			X						3	2	
47	9332	146.7			X						3	2	
	9319	1194.0			X						3	2	
	9309	3199.9				X					2	4	Looks like there was some confusion during the drawing of
	9308	3500.8				X					2	3	the oxygens between ~3200 and 3600 db. Data would

Stat.	Bottle No.	Depth (db)	CTD Salt	CTD O2	Bottle Salt	Bottle O2	SIL	NO3	NO2	PO4	Q Flags 1	Q Flags 2	Comments
													suggest no value at 3199.9 db.
													The value at 3199.9 db should be entered at 3500.8 db.
48	9336	8.1		X							2	4	
	9335	24.0					X	X	X	X	1's	9's	No nutrient data reported; sample not drawn
	9334	49.3		X							2	3	
49	SI9333	99.3		X							2	4	
	9332	150.2		X							3	4	
	9331	201.0		X							2	4	
50	9335	26.3		X							2	3	
52	9336	9.0		X							2	3	
	9305	3954.5			X						2	3	
53	9335	25.3		X							2	3	
	9334	50.1		X							2	3	
	9333	100.4		X							2	4	
	9318	1305.2						X			2	3	
	9316	1550.2			X						3	2	
54	9336	10.2		X							2	3	
	9335	25.0		X							2	3	
	9334	51.7	X								2	4	
	9330	247.5			X						3	2	
	9328	401.7			X						3	2	
55	9334	51.1		X							2	3	
	9332	153.4			X						3	2	
56	9335	25.1		X							2	4	
	9322	1004.7			X						3	2	The CTD - bottle salinity difference is only 0.0009 p.s.u.
57	9336	8.5		X							2	3	
	9332	149.4	X								3	2	
58	9336	8.7		X							2	3	
	9335	25.7		X							2	3	

Stat.	Bottle No.	Depth (db)	CTD Salt	CTD O2	Bottle Data Salt	Bottle Data O2	Bottle Data SIL	Bottle Data NO3	Bottle Data NO2	Bottle Data PO4	Q Flags 1	Q Flags 2	Comments
	9315	1754.6			X						3	4	
	9303	4156.8			X						4	3	
	9301	4474.3		X							2	3	
59	9336	10.9		X							2	3	
	9334	50.4		X							2	3	
60	9334	54.0	X								2	3	
	9333	105.4		X							2	3	
61	9334	50.5	X								2	3	
	9302	4203.4			X						2	3	
62	9336	10.6		X							2	3	
	9326	602.1			X						3	2	
	9312	2395.6			X						4	2	
63	SI9333	105.2		X							2	4	
65	9336	8.8		X							2	4	
	9335	243.5		X							2	3	
	9334	49.3		X							2	3	
	9313	1997.1			X						2	3	
66	9336	7.2		X							2	3	
	9318	1402.5	X								2	3	
67	9336	7.7		X							2	4	
	9335	24.6		X							2	3	
	9325	699.4			X	X	X	X	X	X	2's	3's	Bottle probably leaked; suggest bottle and water samples be flagged 3.
	9308	2808.7									2	4	Bottle tripped at wrong depth; suggest bottle flag be changed to 4.
	9304	3496.9			X						2	3	
68	9336	8.7		X							2	3	
	9335	24.1		X							2	3	
	9334	50.2		X							2	3	

Stat.	Bottle	Depth	CTD		Bottle		Data				Q	Flags	Comments
	No.	(db)	Salt	O2	Salt	O2	SIL	NO3	NO2	PO4	1	2	
	9301	4304.9		X							2	3	
69	9326	600.9		X							2	3	
70	9336	6.2		X							2	3	
	9333	97.5		X							2	3	
	9325	602.4			X						2	3	
71	9336	7.8		X							2	3	
	9333	99.2		X							2	3	
	9332	140.8			X	X					4's	2's	Both values fall on property/db curves.
	9324	796.5						X		X	3's	2's	Both values fall on property/db curves.
	9323	892.7								X	3	2	
	9301	3761.3		X							2	3	
72	9315	1701.6			X						3	2	
	9314	1799.4			X						3	2	
	9308	2695.3			X						3	2	
73	9336	5.6		X							2	3	
	9335	25.0		X							2	3	
	9334	51.0		X							2	4	
74	9336	7.7		X							2	3	
75	9336	9.1		X							2	4	
	9335	24.8		X							2	4	
	9334	49.4		X							2	4	
75	SI9324	799.2						X		X	3's	2's	Values fall on property/db curves.
	9323	899.7								X	3	2	Value falll on property/db curve.
76	9336	10.8		X							2	4	
77	9336	5.4	X	X							2's	3's	
78	9334	48.4		X							2	3	
	9310	2498.5		X							2	3	
79	9335	23.8		X							2	4	
	9334	48.1		X							2	4	

Stat.	Bottle No.	Depth (db)	CTD Salt	CTD O2	Bottle Data Salt	O2	SIL	NO3	NO2	PO4	Q 1	Flags 2	Comments
80	9326	495.9			X						3	2	
	9324	623.7			X						3	2	
86	9334	50.3		X							2	4	
	9331	203.3	X								3	2	
	9318	1402.4			X						2	3	
87	9336	7.5		X							2	4	
	9335	23.5		X							2	3	
	9334	47.7		X							2	4	
	9331	200.3	X		X						3,2	2,3	CTD salt looks good; bottle salt suspect, perhaps wrong salt flagged.
	9318	1402.8			X						2	3	
88	9335	26.1		X							2	3	
	9334	48.9		X							2	4	
	9329	298.0		X							3	2	
89	9336	10.7		X							2	3	
90	9318	8.3		X							2	3	
	9315	100.2			X						4	2	
	9301	1202.1						X			3	2	
	9323	3151.4					X				2	3	
	9319	3679.6						X		X	3's	2's	Values fall on property/db curves.
95	9335	25.1		X							2	3	
	9334	49.6		X							2	3	
	9323	896.7			X						4	2	
	9317	1497.4			X						3	2	
	9301	3643.0		X							2	3	
96	9336	10.5		X							2	3	
	9315	1753.0			X						3	4	
97	9335	22.2		X							2	3
	9329	306.3	X								3	2	

Stat.	Bottle No.	Depth (db)	CTD Salt	CTD O2	Bottle Salt	Bottle O2	Data SIL	Data NO3	Data NO2	Data PO4	Q Flags 1	Q Flags 2	Comments
97	SI9328	348.5	X								3	2	
98	9336	8.1		X							2	3	
	9330	250.6	X								3	2	
	9327	499.1					X	X	X	X	2's	3's	
	9301	3311.0		X							2	3	
99	9336	10.7		X							2	4	
	9335	24.6		X							2	3	
	9334	49.4		X							2	3	
	9315	1699.8			X						4	3	
100	9335	24.1		X							2	3	
	9325	700.8	X								2	3	
101	9336	6.4		X							2	4	
	9333	106.4	X								2	4	
	9323	898.3		X							2	3	
102	9326	602.1			X						3	2	
	9302	3236.0			X						4	3	
103	9330	251.9	X	X							3's	4's	
104	9336	7.9		X							2	3	
	9330	251.5	X								3	2	
	9329	301.5	X								3	2	
	9312	1998.0			X						2	3	
105	9333	102.7		X							2	3	
	9327	501.0			X	X					2's	3's	Looks like bottle salinities and oxygens reversed at these two levels.
	9326	603.3			X	X					2's	3's	
	9301	3355.2			X						3	2	
106	9336	9.4		X							2	4	
	9335	25.5		X							2	3	
	9334	48.0		X							2	3	

Stat.	Bottle No.	Depth (db)	CTD Salt	CTD O2	Bottle Data Salt	Bottle Data O2	Bottle Data SIL	Bottle Data NO3	Bottle Data NO2	Bottle Data PO4	Q Flags 1	Q Flags 2	Comments
	9323	901.2			X						2	3	
107	9336	10.6		X							2	3	
	9335	23.9		X							2	3	
	9327	504.3			X						2	3	
108	9335	23.0		X							2	3	
	9329	307.4		X							3	4	
108	SI9319	1203.4				X					3	2	The shape of the oxygen versus db curve is very similar to
	9318	1298.6				X					3	2	that on adjacent stations. The data however, are slightly
	9317	1398.7				X					3	2	offset from these data, but not so much as to flag these
													oxygens "3".
	9316	1500.7				X					3	2	
	9315	1649.7				X					3	2	
	9314	1796.4				X					3	2	
	9313	1952.1				X					3	2	
109	9336	9.1		X							2	3	
	9333	101.1		X							2	3	
	9332	151.2						X			3	2	These nitrate data compare favorable with the data from the
	9331	202.9						X			3	2	adjacent stations.
	9330	250.2						X			3	2	
	9329	303.0						X			3	2	
110	9336	10.1		X							2	4	
	9335	25.1		X							2	3	
	9334	49.9		X							2	3	
112	9405	24.5		X							2	3	
113	9404	7.2							X		2	5	All nitrite data this station missing; data should be flagged 5.
115	9404	5.9		X							2	3	Surface silicates are slightly negative suggesting a slight baseline problem
116	9404	7.4		X							2	3	

Stat.	Bottle	Depth	CTD		Bottle			Data			Q	Flags	Comments
	No.	(db)	Salt	O2	Salt	O2	SIL	NO3	NO2	PO4	1	2	
117	9405	23.1		X							2	3	
	9407	48.8				X					2	3	
	9423	1104.2			X						2	3	
118	9404	5.8		X							2	3	All phosphates this station are ~0.03 µmoles/kg lower than
	9419	602.6		X							2	3	on adjacent stations. Lower values are not supported by
													the nitrate or oxygen data.
	9429	2297.1						X			2	3	NO3 value of 35.57 much better, perhaps a key entry error
													of 1 unit.
119	9404	8.2		X							2	4	
120	9404	8.1		X							2	3	
	9405	24.1		X							2	3	
	9407	47.5		X							2	3	
	9415	298.6		X							2	3	
121	9404	10.8		X							2	3	At this stat Bottle 9433 showed a CTDO/bottle O2 difference
	9405	25.4		X							2	3	of 1.1 units and was flagged 2; on stat 127 the bottle again
	9433	3346.7				X					2	4	leaked. The CTDO/bottle O2 difference was 0.2 and was
													flagged 4. Flagging not consistent.
122	9404	6.1		X							2	3	
	9405	23.1		X							2	3	
122	SI9435	3490.6	X		X						2,3	4,2	CTD salt is suspect; bottle salt looks okay.
123	9404	7.7		X							2	3	
	9411	198.9		X							2	3	
124	9404	8.8		X							2	4	
	9405	23.9		X							2	4	
	9407	48.9		X							2	3	
125	9404	10.4		X							2	4	
	9405	24.7		X							2	3	
	9407	49.1		X							2	4	

Stat.	Bottle No.	Depth (db)	CTD Salt	CTD O2	Bottle Salt	Bottle O2	SIL	NO3	NO2	PO4	Q Flags 1	Q Flags 2	Comments
130	9421	8.2		X							2	4	Deep PO4's ~0.02 to 0.03 µmoles/kg higher than on adjacent stations.
	9413	2953.0								X	2	3	This phosphate value definitely low by ~0.04 µmoles/kg.
131	9405	26.0		X							2	3	
	9407	48.8		X							2	3	
133	9421	5.4		X							2	4	
134	9404	8.9		X							2	3	
135	9404	7.8		X							2	3	
	9407	48.7		X							2	3	
136	9404	8.1		X							2	3	
	9405	25.0		X							2	3	
137	9415	300.3			X						2	3	
138	9408	98.9			X						2	3	
139	9404	8.7		X							2	3	From ~600 db to the bottom, the CTD salinities appear
	9405	22.4		X							2	4	offset and higher than the bottle salts by 0.0016 p.s.u.
140	9401	2603.5		X							2	3	CTD salinities offset 0.0012 p.s.u. from ~400 db to the bottom.
141	9404	7.9		X							2	3	
142	9404	23.7		X							2	4	
	9405	48.2		X							2	4	
143	9403	1971.0		X							2	3	
144	9404	7.1		X							2	3	
	9421	800.5			X						3	2	Salinity flagging not consistent. At 1204 db with a CTD/
	9428	1204.0	X								2	3	bottle salt difference of 0.0040 psu, salt was flagged 2; at
	9403	1930.0			X						3	2	800.5 and 1930 db with salinity differences of ~0.002, salts were flagged "3".
145	9411	50.4		X							2	3	
	9419	250.3		X							2	4	
146	SI9409	21.9		X							2	4	Excluding 3 values, the CTD is offset 0.0018 psu higher than

Stat.	Bottle No.	Depth (db)	CTD Salt	CTD O2	Bottle Salt	Bottle O2	SIL	NO3	NO2	PO4	Q Flags 1	Q Flags 2	Comments
	9411	46.7		X							2	3	the bottle salts.
	9401	1482.5							X	X	3's	4's	
147	9421	897.0				X					4	3	
148	9404	9.0		X							2	3	
	9405	23.1		X							2	3	
	9407	47.5		X							2	3	
	9415	292.3		X							2	4	
149	9405	24.6		X							2	3	
	9407	51.4		X							2	3	
	9428	1997.5									2	3	All water samples suspect; suggest bottle flag be changed to
	9431	2642.6			X						4	3	"3".
		2642.6				X		X			4's	2's	Although bottle flagged 3, water samples look fine.
	9403	4085.3			X						2	3	
150	9404	8.5		X							2	3	
	9405	25.7		X							2	3	
151	9409	46.7		X							2	3	
152	9405	48.8		X							2	3	
155	9404	24.0		X							2	4	
	9405	49.0		X							2	3	
156	9415	5.9		X							2	4	
	9416	6.4		X							2	4	
	9417	23.0		X							2	3	
157	9404	8.2		X							2	3	
	9407	48.3		X							2	3	
	9420	702.1				X					3	2	Perhaps flagged the wrong property. May have meant to flag salinity since its value was 0.0033 psu different than CTD salinity value.
158	9404	4.2		X							2	3	
	9415	305.6									2	3	Bottle appears to have leaked; suggest bottle flag to be

Stat.	Bottle No.	Depth (db)	CTD Salt	CTD O2	Bottle Salt	Bottle O2	Bottle SIL	Data NO3	NO2	PO4	Q Flags 1	Flags 2	Comments
													changed to 3.
	9429	1853.4				X					2	3	Bottle appears to have leaked; suggest bottle and oxygen be flagged 3.
159	9405	23.4		X							2	4	
	9407	47.0		X							2	3	
	9411	198.0				X							It looks like the bottle at 198.0 db wasn't sampled for
	9413	248.8				X							oxygen while the bottle at 248.8 was sampled twice.
160	9407	50.1		X							2	4	

DATA NOTES

1999.03.17 SA

P21 had NO2+NO3 and NO2. I subtracted the NO2 from the NO2+NO3 to get the NITRAT (NO3) and replaced the NO2+NO3 with the NITRAT value.

Nutrients (SILCAT, NITRAT, NITRIT, and PHSPHT) were in UMOL/L units. I converted to UMOL/KG units.

Station 30, bottle 15, sta. 113 bottles 24-1, and sta. 177 bottles 35 and 34 had -99.00 for NITRIT - I changed the -99.00 to -9.00 to be consistent with the rest of the file and the WOCE manual.

Station 126, bottles 24 and 23 had -99.00 for NITRAT - I changed the -99.00 to -9.00 to be consistent with the rest of the file and the WOCE manual.

1998.12.17 SA

p21_su.txt
Changed EXPOCODE from 318MWESTW/4, /5 to 318MWESTW_4, _5.

Mostly consisted of adding and shifting columns to make the file conform to the agreed upon format.

p21_newhyd.txt
Changed EXPOCODE from 318MWESTW/4, /5 to 318MWESTW_4, _5 WHP-ID from P21 to P21W and P21W to conform with the .sum file.

Does not have stas. 1-3, 81-84, 91-94, 111, 161, 163, 172 199,200, and 284. Although the .sum file does not have any comments to indicate why these are missing, there is a file p21_stalist.doc that sheds some light on this (see attached file).

There are also some stations that are numbered 913, 980, 985, 918, 401-406, 411-417, 421-423, and 431-434 that are in the .sum file but are not in the .hyd or .ctd files. Again, the p21_stalist.doc file gives info about this.

Header says FC02, should it really be PC02???

Helium units are designated as UMOL/KG. Is that correct? Units for helium should be NMOL/KG - maybe a typo??

Units designated for SILCAT, N02+N03, N02, and P04 are UMOL/L. In comparing with the old file, it looks like that is correct. They should be converted to UMOL/KG units.

N02+N03 should have the N02 subtracted and NITRAT reported.

.WCT files
Changed EXPOCODE for p21e0004.wct-p21e0160.wct from 318MWESTW/4 to 318MWESTW_4 and WHP-ID from P21 to P21E, and for p21w0162.wct- p21w0294.wct from 318MWESTW/5 to 318MWESTW_5 and WHP-ID from P21 to P21W to conform with the .sum file.

Sta. p21e0034.wct - Changed CASTNO from 1 to 2 to conform with the .sum and .hyd files.
Sta. p21e0079.wct had the date as 042094, changed to 042194 to conform with the .sum file.
Sta. p21w0212.wct had the date as 060594, changed to 060494 to conform with the .sum file.

There are no .ctd files for stas. 1-3, 81-84, 91-94, 161, 163, and 284 (see attached p21_stalist.doc file).
p21_stalist.doc - I found this file in /usr/export/html-public/data/onetime/pacific/p21/original on whpo.

Sta_ctd.doc
List of which stations were taken with which CTDs. Stations not included in final data set are starred '*'.

STATION	**CTD**	**COMMENTS**
1	10*	
2	9*	Test: repeat same area as 1
3	8*	Test: repeat same area as 1
4-13	10	
913	9*	Test: bottles all deep, not repeating same area
14-39	10	
40-53	9	Part test:40-46 and 51-53 are interwoven btw CTD 10 stations, 47-50 are not. Keep all these stations in the final data.
54-80	10	
81-84	8*	Test: repeat same area as 78 to 80 but 10 min. further S. 980
	10*	Back to same location as 80
985	10*	Pylon failed
85	10	second station at 985
86-90	10	
91-93	1338*	Test: repeat same area as 87 to 90
94	1338*	NOT INCLUDED IN DATA SET- BAD DATA
95-111	10	CTD 10 lost on recovery of 111
112-160	9	
161	8*	For comparison with start of next Leg
Leg 2		
162	9	Same location as 161
163	8*	Same location as 161 and 162.
164-171	9	
172	9	Pylon failed, no bottle data
173-218	9	
918	9	Numbering prob., station in between 218 and 219 so its 918

219-283	9	
284	8*	Repeat station of 283 with different CTD (correct in sum file)
285-294	9	
401-406	9*	First yoyo
411-417	9*	Second yoyo
421-423	9*	Third yoyo
431-434	9*	Fourth yoyo

The extra stations to be removed are: 1-3,913,81-84,980,985,91-94,161,163,284,401-434

1998:

03/11: sum file errors and replaced by LDT/SCD
08/06: sum file errors and replaced (again) by LDT/SCD

1999:
01/06: new files reformatted from S. Anderson online see doc/*notes*
01/06: CFC masked out (SCD). Almost an "oops!"
01/27: CFCs back in file (Bullister, 1999.01.11)

02/10: CFCs updated (merged in CFCs from R. Fine (D. Willey)

28 March 95

MV05.SEA is the at sea product of P21 made from preliminary, at sea data. This data is only to be used as a reference for other incoming P21 data.

CTD information:
CTDRAW is unscaled pressure and will not change between the preliminary and final version. Pressure and Temperature are scaled with pre cruise calibration terms. Conductivity and Oxygen are the best 'at sea' fits.

Water Sample information:
Water Sample Salts and Oxygens are final although quality word may be updated. Nutrients and all others are preliminary results.

Note on merging in water sample information:
Be sure to merge in data by matching sample number and not pressure. Although we did not have misstrip problems, processing may show that a bottle tripped at a different depth than listed. In that case the bottle and water sample information are shifted together to the correct CTD information.

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