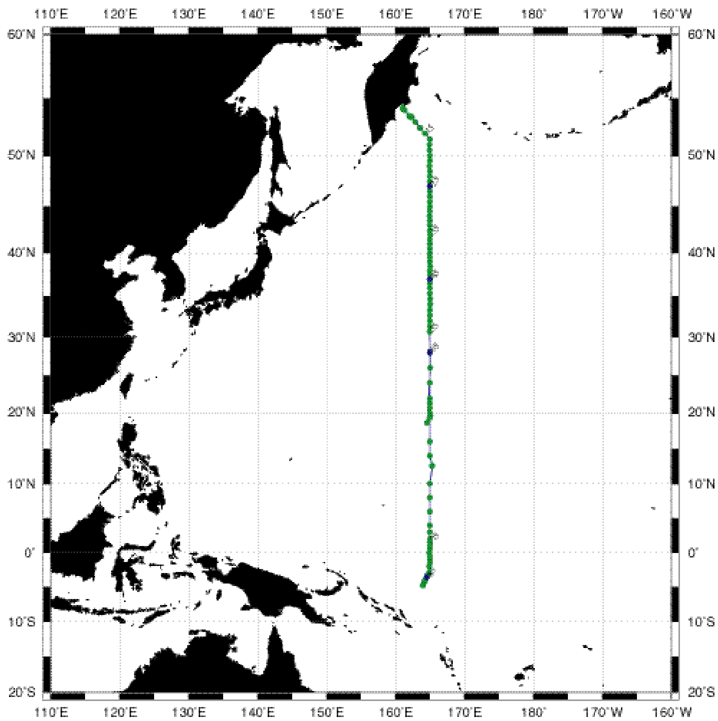
A. Cruise Narrative: P13



A.1. Highlights

WHP Cruise Summary Information

WOCE section designation	**P13**
Expedition designation (EXPOCODE)	**3220CGC92_0, 3220CGC92_1, 3220CGC92_2**
Chief Scientist(s) and their affiliation	**John L. Bullister/**NOAA-PMEL***** Legs 0 & 1 **Bruce Taft**/NOAA-PMEL (retired)** Leg 2
Dates	Leg 0: 1992.AUG.04 - 1992.AUG.14 Leg 1: 1992.AUG.15 - 1992.SEP.15 Leg 2: 1992.SEP.25 - 1992.OCT.21
Ship	R/V John Vickers
Ports of call	Leg 0: Transit from Los Angeles- Dutch Harbor, Alaska Leg 1: Dutch Harbor- Kwajalein Leg 2: Kwajalein- Noumea, New Caledonia
Number of stations	87
Geographic boundaries of the stations	54° 14.71' N 161° 61' E 165° 22.54' E 4° 44.99' S
Floats and drifters deployed	17 RAFOS floats and 1 RAFOS sound source deployed 11 ALACE floats deployed
Moorings deployed or recovered	none

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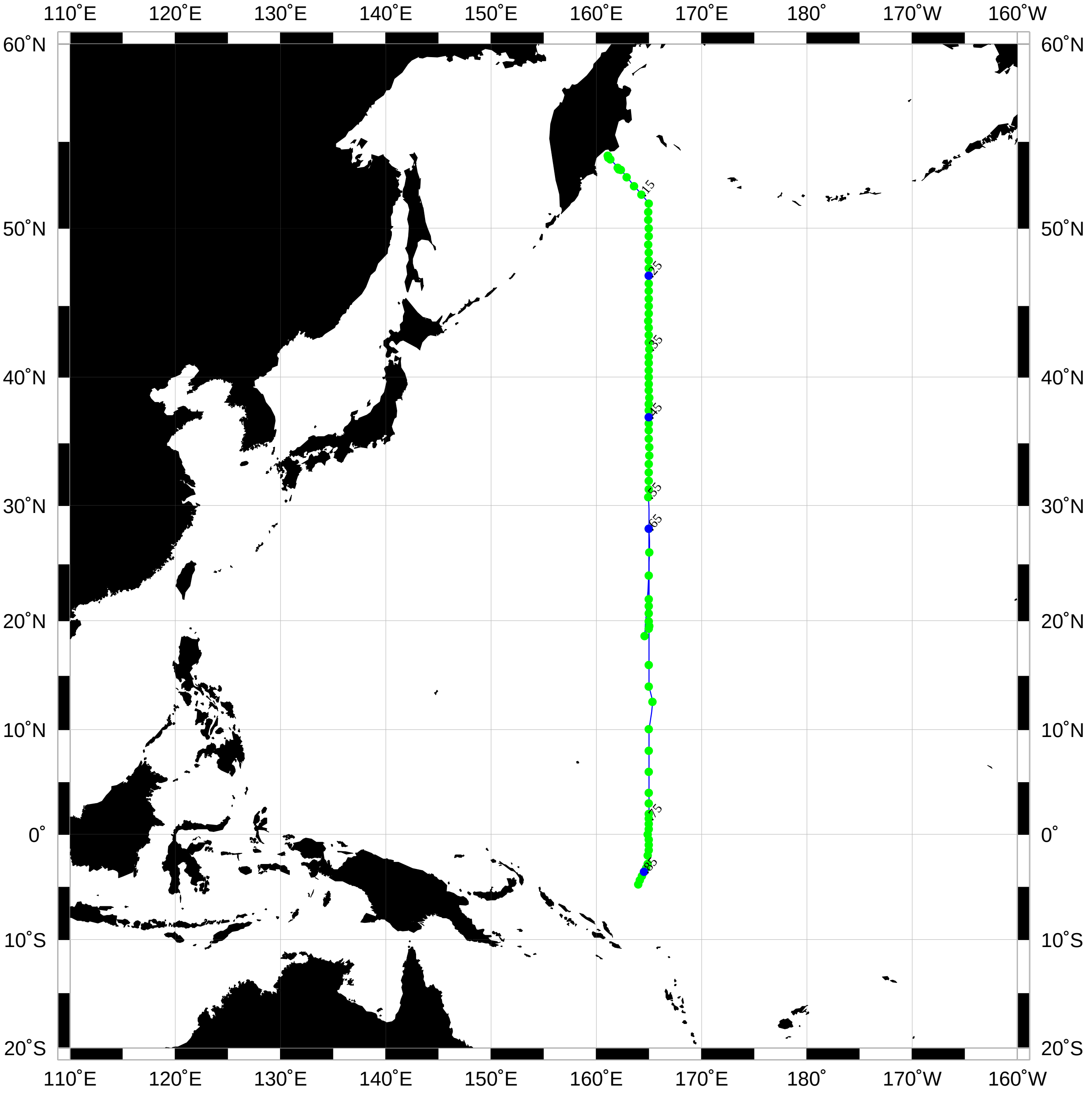
WHP Cruise and Data Information

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

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

Station locations for P13 : BULLISTER



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A.2. Cruise Summary

A.2.1 GEOGRAPHIC BOUNDARIES

A.2.2 STATIONS OCCUPIED

Figure 2 shows the stations occupied. Station number 60 was aborted and is not represented in this figure.

The P13 section began at 54 14.7 N, 161 06.6 E and moved southeastward to 51 30 N 165 E. The section then proceeded southward to 4 44.9 S 164 00.2 E. Nominal station spacing north of 36 N was 30 nautical miles. Because of ship malfunctions and delays, insufficient time was available to complete the section as planned, and station spacing increased south of 30 N (see discussion below).

87 Stations/CTD casts were completed, including 4 on the transit Leg 0, 51 on Leg 1 and 22 on Leg 2. Only small volume (10 liter and 2.4 liter) sample bottles were used.

Approximately number of water samples analyzed:

- 2685 salinity
- 2572 oxygen
- 2608 nutrients
- 1728 chlorofluorocarbons (CFCs)
- 1270 Total CO2
- 1265 Alkalinity

Approximate number of water samples collected for shore-based analysis:

- 761 Helium-3
- 296 Tritium
- 778 AMS radiocarbon (C-14) and C-13

A.2.3 FLOATS AND DRIFTERS DEPLOYED

17 RAFOS floats and 1 RAFOS sound source were deployed.
11 ALACE floats were deployed.
17 ADCP profiles were obtained at stations between 4 N - 4 S using a rosette mounted lowered ADCP instrument.

A.2.4 MOORINGS DEPLOYED OR RECOVERED

A.3 LIST OF PRINCIPAL INVESTIGATORS

Table 1: List of Principal Investigators

Measurement	PI	Inst.	Internet
CTD	B. Taft	PMEL	taft@pmel.noaa.gov
CFCs	J. Bullister	PMEL	bullister@pmel.noaa.gov
Tritium	W. Jenkins	WHOI	wjj@burford.whoi.edu
Helium-3	W. Jenkins	WHOI	wjj@burford.whoi.edu
Helium-3 (deep)	J. Lupton	PMEL	lupton@@pmel.noaa.gov
Oxygen	J. Bullister	PMEL	bullister@pmel.noaa.gov
Total CO2	A. Dickson	SIO	adickson@ucsd.edu
Total CO2	J. Downing	Bat	
Alkalinity	C. Keeling	SIO	cdkeeling@ucsd.edu
nutrients	K. Fanning	USF	KAF@MSL1.Marine.USF.edu
DIC	P. Quay	UW	pdquay@u.washington.edu
C14 (AMS) and C-13	P. Quay	UW	pdquay@u.washington.edu
ADCP	R. Pinkel	SIO	rpinkel@ucsd.edu
ADCP (Lowered)	P. Hacker	UH	hacker@soest.hawaii.edu
RAFOS floats/sound source	S. Riser	UW	riser@ocean.washington.edu
ALACE Floats	R. Davis	SIO	davis@nemo.ucsd.edu
Underway atmospheric and	J. Butler	CMDL	butler@cmdl1.cmdl.noaa.gov
dissolved gas measurements			

PMEL NOAA Pacific Marine Environmental Laboratory
CMDL NOAA Climate Modeling and Diagnostics Laboratory
UW University of Washington
Bat Battelle Laboratory, Sequim
UH University of Hawaii
SIO Scripps Institution of Oceanography
WHOI Woods Hole Oceanographic Institution
USF University of South Florida
AS Academia Sinica - People's Republic of China

A.4 SCIENTIFIC PROGRAMME AND METHODS

LEG 0:

Leg 0 of the CGC92 expedition consisted of a transit from Los Angeles to Dutch Harbor, with 4 stations occupied along the cruise track to test the CTD/rosette system. One of these stations was a re-occupation of Station 'P' (50 N, 145 W). SIO scientists tested an underway ADCP system along the cruise track.

LEG 1:

Leg 1 consisted of 51 stations (Sta. 5-55). The first station on this leg (Station 5) was a test CTD/rosette cast made in the Bering Sea, along the transit from Dutch Harbor to the start of the P13 line near the Kamchatka Peninsula. Sampling of the P13 section began on 21 August 1992 near the 200 meter isobath off Kamchatka. A series of stations were occupied on a southeastward transit down the continental slope and across the Kamchatka Trench. The section turned directly southward at about 51 30 N, 165 E, and continued along the 165 E meridian for the remainder of Leg 1. A RAFOS sound source was deployed at 31 N, 165 E. Nominal station spacing was 30 nautical miles from the start of the section to about 40 N. Due to a series of delays during the first part of Leg 1 (see discussion below) a decision was made at about 36 N to stretch nominal station spacing for the remainder of Leg 1 (36 N - 10 N) to 40 nautical miles. Due to concerns about possible structural deformation to Vickers, and concern over failure of a water-tight door to close properly, work on the P13 CTD/rosette section was halted on 9 September 1992 at about 30 N, and Vickers was ordered to steam directly to Kwajalein. We were unable to occupy any stations along the emergency transit to Kwajalein.

A total of 17 RAFOS floats and 2 ALACE floats were deployed during Leg 1.

LEG 2.

Vickers remained at the dock in Kwajalein for an extended period of time for evaluation of structural integrity by two marine architects and for repair. Vickers left Kwajalein on 26 September 1992 and began steaming back to the break-off point to continue work on the P13 section. Contact was made with TOGA-COARE investigators (the group scheduled to use Vickers following the completion of the P13 section) to negotiate an extension for Leg 2, which would allow us a reasonable chance to complete the P13 section. After direct negotiations with TOGA-COARE investigators over the revised Vickers schedule, we were unable to come up with a mutually satisfactory agreement. The position held by TOGA-COARE at the end of these negotiations (requiring Vickers to be in port in Noumea on 21 October 1992) did not allow us enough time to complete the WOCE P13 section to even minimum WHP specifications. Since an agreement could not be reached between the 2 programs, the final decision was made by the Director of NOAA's Office of Global Programs, who sent instructions to USC that Vickers should arrive in Noumea on 21 October for TOGA-COARE staging. With the remaining allocated time, Vickers occupied CTD/rosette stations at a nominal spacing of about 2 degrees from 28 N to 4 N, and closer spacing from 4 N to 4 30 S. Lowered ADCP measurements were made on stations between 4 N and 4 S. The section was terminated on 17 October 1992 at 4 45 S 164 0 E in order to arrive in Noumea by the 21 October deadline. A total of 32 stations (Sta 56-88) were occupied during Leg 2 (one station Sta. 60 was aborted and not included in the listings).

A total of 9 ALACE floats were deployed during Leg 2.

DISCUSSION:

A NOAA-PMEL designed 36 position, 10-liter rosette frame was used at 84 of the 88 stations on the expedition. A smaller 12-position, 2.4 liter rosette was used as a bad-weather backup system at several stations during the cruise. A General Oceanics (GO) 36 'Intelligent' underwater array (pylon) and deck unit were used with the PMEL 36 position system, along with a Neil Brown MARK III CTD (NBIS serial # 1111). We feel that the new 36 position PMEL rosette package performed well on this expedition. The newly-designed General Oceanics 36 position 'Intelligent' underwater array also performed relatively well. The GO system provides real-time information on the position of the release lever, and allows bottles to be closed in any order desired. Although a bottle (or two) often failed to close properly during casts due to 'sticky' release pins on the GO underwater array, these problems could normally be diagnosed immediately from information sent from the underwater array to the deck unit. This information gave the CTD operator the option of choosing to release another bottle at that depth if desired. Overall, the success rate achieved for closing 10-liter bottles with this new system was about 95%.

A.5 MAJOR PROBLEMS AND GOALS NOT ACHIEVED

We encountered a number of problems which led to delays while at sea, and longer-than-planned port stops. Delays were encountered leaving port in Los Angeles (1.5 days), during an emergency port stop in Port Huaneme, CA (1 day), and extended port stops in Dutch Harbor (2 days) and Kwajalein (8 days). Time was lost due to slowdowns along the cruise track because of ship mechanical problems and weather. Additional time was lost on station due to conducting cable and wire termination problems. There were problems with logging bottom depth using the shipboard PDR system. At several stations (28, 48, 53, 61) no reliable PDR bottom return could be obtained during the casts, and UNC values for these stations are not shown in the P13.sum file. Estimates of UNC bottom depths for these stations, (for use in showing bottom bathymetry, e.g. as shown in Fig. 2) were made by interpolation to adjacent stations, At a number of other stations, the PDR signal was too weak to be reliably detected upon the approach of the rosette near the bottom, causing such casts to be stopped a hundred meters or more away from the sea bottom for safety purposes.

A substantial amount of time was lost (8-10 days) due to the emergency breakoff of the section at 30 N, and the need to return to this point to continue the section on Leg 2. The decision that Vickers would be dropped off in Noumea for the first phase of COARE staging (rather than a port closer to the end point of the abbreviated CTD section, e.g. Honiara) cost additional ship and station time.

Due to this series of delays, the expedition extended about 19 days past the originally scheduled completion date of 3 October 1992 in Noumea, yet a substantial number of planned stations were not occupied.

We feel that the station spacing achieved along the segment north of 30 N and the section near the equator (4 N- 4 S) met WHP guidelines, and that under normal circumstances, the full P13 section would have been completed successfully during this expedition. Preliminary analysis of the data indicate that they meet WHP quality guidelines for precision and accuracy. For several chemical tracers (e.g.. radiocarbon, helium-tritium, CO_2), the total number of samples obtained, and the average horizontal and vertical sample spacing north of 4 S is reasonably close to that originally planned for the expedition (see P13.sea file)

We are disappointed with the overall outcome of the expedition. Due to the coarse station spacing between 30 N and 4 N, and the gap in the section south of 4 S, we feel that the expedition DID NOT successfully fulfill the overall requirements for WHP line P13.

A.6 OTHER INCIDENTS OF NOTE

A.7 CRUISE PARTICIPANTS

Table 2: List of Cruise Participants

NAME	NAT	AFFIL	PROGRAM	Leg0	Leg1	Leg2	INTERNET
John Bullister	US	PMEL	Chief Sci.	x	x		bullister@pmel.noaa.gov
Bruce Taft	US	PMEL	Chief Sci.			x	taft@pmel.noaa.gov
Dave Wisegarver	US	PMEL	CFCs		x	x	wise@pmel.noaa.gov
Fred Menzia	US	PMEL	CFCs	x	x		menzia@pmel.noaa.gov
Dana Greeley	US	PMEL	Salinity		x	x	greeley@pmel.noaa.gov
Kirk Hargreaves	US	PMEL	Oxygen	x	x	x	kirh@pmel.noaa.gov
Kristy McTaggert	US	PMEL	CTD	x	x	x	kem@pmel.noaa.gov
Mike Stapp	US	PMEL	CTD/electron	x			stapp@pmel.noaa.gov
Kevin O'Brien	US	PMEL	CTD			x	kobrien@pmel.noaa.gov
Howard Rutherford	US	USF	nutrients	x	x	x	HOWARD@msl1.marine.usf.edu
Kevin Riskowitz	US	USF	nutrients	x	x	x	
Ron Greene	US	OSU	helium/tritium		x	x	
Andrew Dickson	US	SIO	Total CO2			x	adickson@ucsd.edu
George Anderson	US	SIO	Total CO2		x		
Ron Citterman	US	Batt	Total CO2		x	x	
Peter Guenther	US	SIO	Alkalinity		x		pguenther@ucsd.edu
Guy Emanuele	US	SIO	Alkalinity		x	x	
Lloraine Bell	US	SIO	Alkalinity			x	
Bing-SunLee	Taiwan	UW	CFC	x			blee@pmel.noaa.gov
Brian Salem	US	UW	C-13, C-14		x		
Stagg King	US	UW	C-13, C-14	x			
Beth Plotkin	US	UW	CO	x		x	
Dale Ripley	US	UW	Floats-CTD		x		
Karl Newyear	US	UW	Floats-CTD		x		
Jim Butler	US	CMDL	Trace gases	x		x	butler@cmdl1.cmdl.noaa.gov
Jurgen Lobert	Ger	CMDL	Trace gases	x	x	x	LOBERT@cmdl1.cmdl.erl.gov
Tom Baring	US	CMDL	Trace gases	x	x	x	
Rob Pinkel	US	SIO	ADCP	x			rpinkel@ucsd.edu
Eric Slater	US	SIO	ADCP	x			
Lloyd Green	US	SIO	ADCP	x			
Mike Goldin	US	SIO	ADCP	x			
Chris Neely	US	SIO	ADCP	x			
Amy Hsu	US	UCSD	ADCP	x			
Craig Huhta	US	UH	ADCP			x	
Junshun ZHANG	PRC	AS	CFCs	x	x	x	
Lijun HAN	PRC	AS	chemistry	x	x	x	
Jeff Benson	US	USC	Marine Tech	x	x	x	jbenson@bbsr.edu
George Onodera	US	USC	Marine Tech	x	x	x	
Tony Arnold	US	USC	Electron Tech	x	x	x	
Mike Getscher	US	USC	Owner Rep	x			

Institution Addresses:

NOAA-PMEL	7600 Sand Point Way, NE Seattle, WA 98115
USF	University of South Florida Department of Marine Science 830 First Street South St. Petersburg, FL. 33702
OSU	Oregon State University College of Oceanography Corvallis, OR 97331
SIO	Scripps Institution of Oceanography La Jolla, CA 92093
UW	University of Washington School of Oceanography WB-10 Seattle, WA 98195
NOAA-CMDL	325 Broadway, Boulder, CO 80303
UH	University of Hawaii JIMAR 1000 Pope Rd MSB-312 Honolulu, HA 96822
AS	Academia Sinica Institute of Oceanology 7 Nanhai Road Qingdao, 266071 Shadong Peoples Republic of China

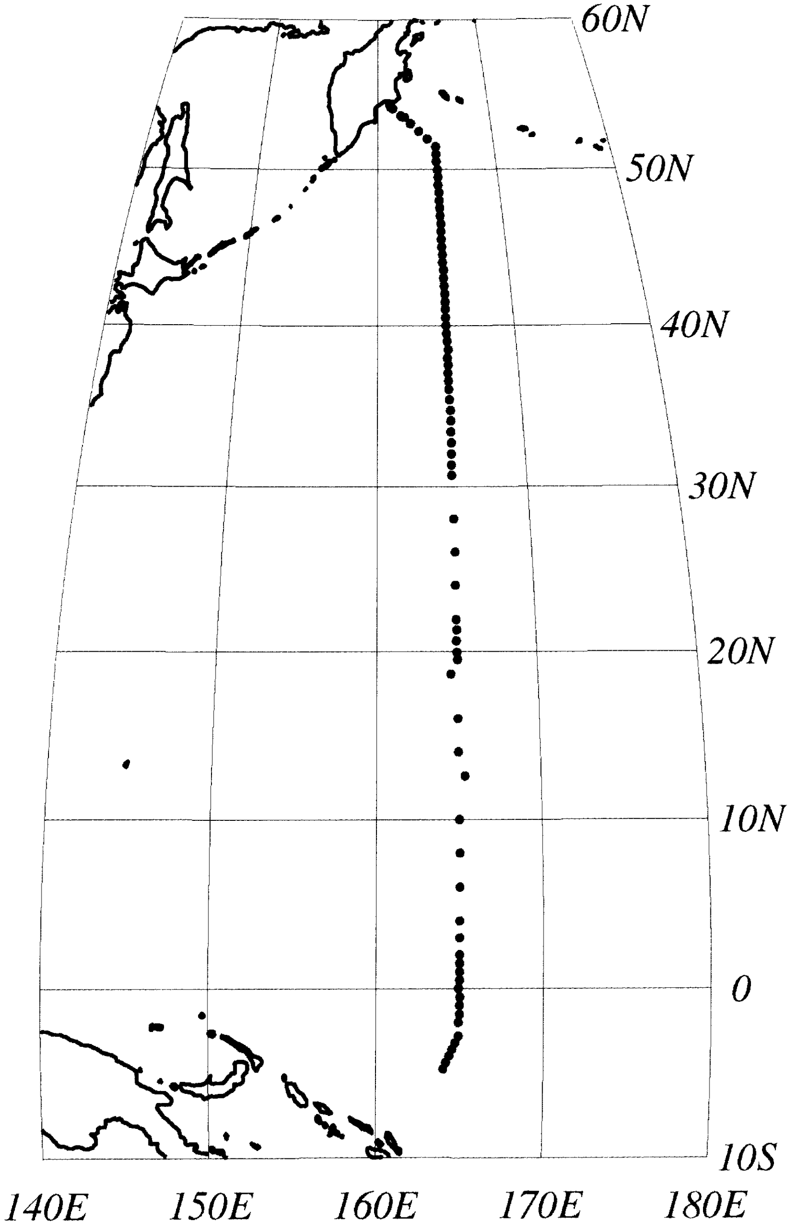

Fig. 1. P13 (CGC92) Station Locations

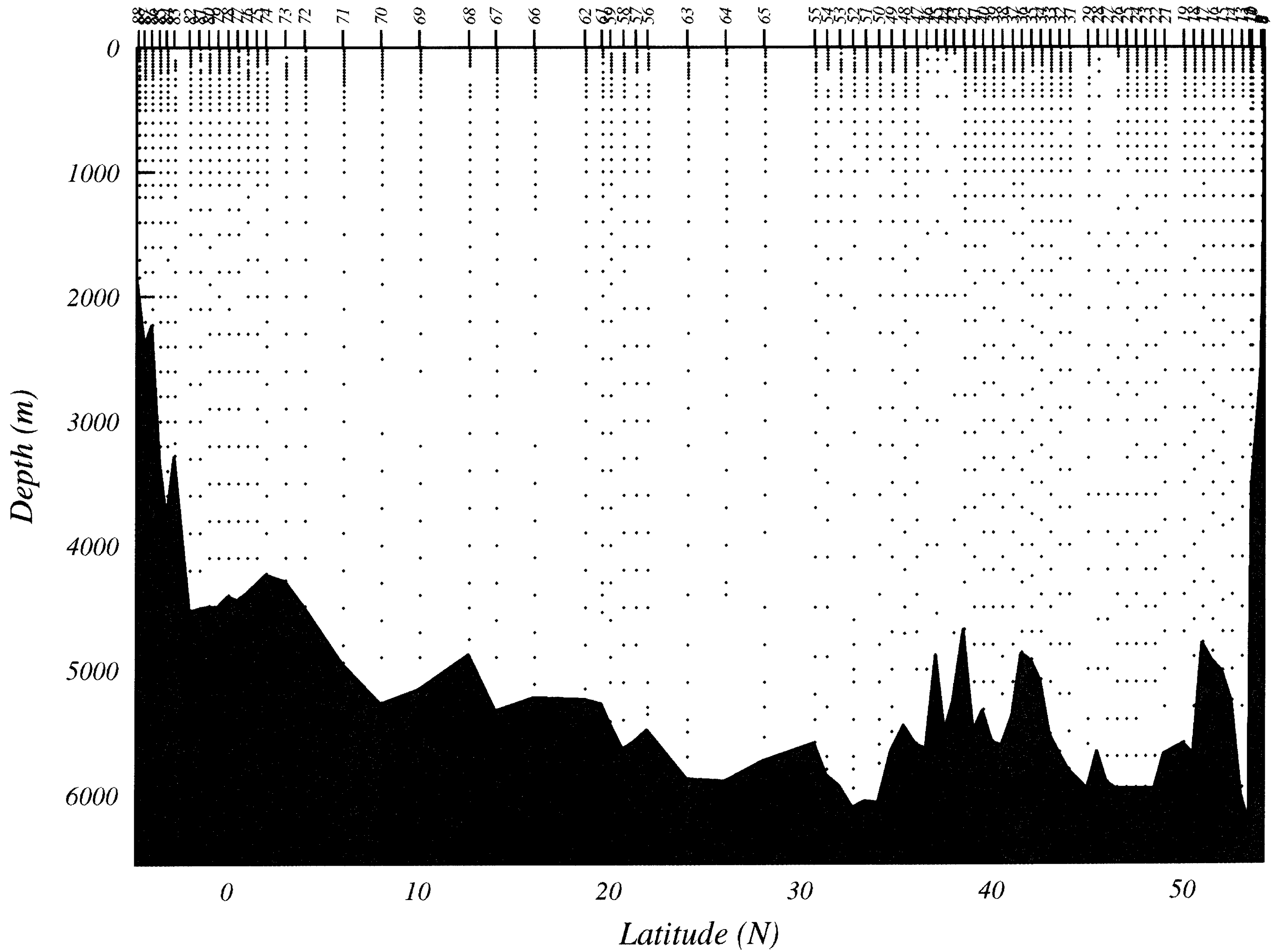

Fig. 2: P13 (CGC92) Expedition
Locations where water samples were collected

B. UNDERWAY MEASUREMENTS

B.1 NAVIGATION AND BATHYMETRY

B.2 ACOUSTIC DOPPLER CURRENT PROFILER (ADCP)

Continuous underway ADCP measurements were made along the cruise track.

B.3 THERMOSALINOGRAPH AND UNDERWAY DISSOLVED OXYGEN, etc

Measurements of surface-layer dissolved gases and atmospheric trace gases (including nitrous oxide and halocarbons) were made along the entire ship-track.

B.4 XBT AND XCTD

B.5 METEOROLOGICAL OBSERVATIONS

B.6 ATMOSPHERIC CHEMISTRY

Air samples were collected at approximately 5 degrees intervals for isotopic analysis of carbon monoxide and methane.

C. HYDROGRAPHIC MEASUREMENTS

C.1. DISSOLVED OXYGEN

(Kirk Hargreaves, PMEL.)

Oxygen samples were drawn immediately after CFCs and Helium. Calibrated 125ml nominal volume iodine determination flasks (Corning 5400-125) were used for sampling. Flasks were partially filled with sea water, capped, shaken, and emptied three time. Then, sea water was allowed to flow freely through the sampling tube and any air bubbles tapped away. The tube was then pinched off, inserted into the flask, and slowly opened to avoid any turbulence. Once completely opened, a wrist watch was used to time the filling rate (typically 7 seconds). Two more flask volumes were allowed to overflow the flask using the watch as a reference.

Reagents were introduced immediately after sampling. The MnCl2 reagent tube was slowly inserted to the bottom of the flask and the reagent introduced. Then the NaOH/NaI reagent tube was inserted halfway into the flask and the reagent introduced. Both reagent dispensers were equipped with Brinkmann Anti-diffusion burette tips (catalog #6.1541.010) to prevent water exchange with the reagents. NOTE: more testing should be done to determine if the burette tips introduced significant mixing of the surface water with the low oxygen water in the flask. The low oxygen data does not indicate any variation which would be expected from such mixing. Reagents were made to WOCE specifications as described by Culberson (1992).

Flasks are capped at this point and vigorously shaken. After station 49, distilled water from a squirt bottle was used to seal the caps (before station 49 it was assumed expansion due to heating would maintain the seal. This was incorrect. After at least 20 minutes, the flask would be re-shaken and, after station 49, resealed. Time until re-shake varied from 20 minutes to 2 hours.

Samples were analyzed no earlier than 20 minutes and no later than 12 hours after being re-shaken. The samples for an entire station would be acidified, re-stopped and re-shaken. Before titration of a sample, its stopper was removed and washed down. Typically, one or two open flasks would be waiting for titration. The previous three steps are not ideal and probably lead to errors in the oxygen values. Data suggests this is on the order to 0.2 µmol/kg.

Titration was done using Carpenter's (1965) whole bottle technique with a modification of the system described by Friederich, et al (1991). A Kloehn 50100 Syringe Drive with a 5 ml burette was used to dispense titrant (nominal 0.05 N) and has a linearity of 0.05%. New software to run the system was written by K. Hargreaves in Turbo C++ with Turbo Vision, but in hindsight it would have been better to use Friederich's software. Standardization was done using approximately 0.01N potassium iodate solutions prepared from pre-weighed potassium iodate crystals. Buoyancy and temperature corrections were applied to get the actual standard strength at the time of standardization. Standard was dispensed with a 1ml Lab Industries Repipet with a calibrated delivery accuracy of 0.03% (under ideal conditions). Several different total volumes (typically 1, 3, 5, 7, 9, 11, 13, and 15 ml) were used to generated a curve. Also, several 1 ml aliquots were used to ensure a good blank. A linear least squares fit was calculated using the algorithm from "Numerical Recipes in C" (Press, 1988). The normalized chi-squared parameters was used to determine goodness of fit.

Each new standard was compared to a reference standard. All except one agreed to within 0.3%. A correction factor was applied to samples run with the standard that did not agree, on the assumption that that standard was improperly weighed. Also, standards were compared to potassium iodate from a different manufacturer. No significant difference was found. From duplicate oxygen samples drawn, the estimated reproducibility is 0.5 µmol/kg. The accuracy of the standardization is estimated to be 0.4%. This is calculated by adding by quadartures the repeatability of the standards (0.3%), the drift in the standardization in half a day (0.25%) and a 0.1% estimate of the accuracy of the standards. The total accuracy is estimated to be 0.4% of value + 0.5 µmol/kg.

Oxygen were converted from µmol/l to µmol/kg by dividing by the density of the water at the time of sampling. Water temperature was measured using a Cole- Parmer G-08497-00 Pt-RTD thermometer together with a Sensing Devices GW2107-01 thin film 100 ohm Pt-RTD (not calibrated, however). Density was calculated using the formula in Culberson (1992).

Also, the amount of oxygen present in the reagents (0.0017 ml O2 = 0.076 µmol O2, Culberson) was subtracted from the total measured amount of oxygen in the flask.

C.2 BOTTLE SALINITY MEASUREMENTS
(D. Greeley, PMEL)

The salinity analysis aboard R/V John Vickers in the fall of 1992 was determined exclusively with a Guildline 8400 Autosal. This instrument was located in a temperature controlled van located on the aft end of the ship. The van was kept at 20.5 degrees Celsius +/- 1 degree Celsius. The bath of the autosal was kept at 21 degrees and proved to be very stable throughout the cruise. Standardization of the autosal was carried out with IAPSO Standard Seawater batch P114. There were ampoules of standard water which was clearly incorrect by comparison to the other vials and thus were not used. The P114 standard water was also compared to 5 ampoules from another batch of IAPSO water, P90. The results from this comparison agreed favorably with the Scripps comparison done in 1986 (Mantyla, Arnold: Standard Seawater Comparisons Updated, Journal of Physical Oceanography, vol. 17, 543-548, 1987).

C.3 NUTRIENTS:
(E. Howard Rutherford, USF)

All analyses were done with an Alpkem RFA/2 320 autoanalyzer. The methods used were modified from those recommended by the Alpkem Corporation. Working nutrient standards used were a mixture of phosphate, silica, nitrate and nitrite in a low nutrient natural seawater matrix. Simultaneous analyses were run on the RFA/2 for all of these nutrients.

SILICA:
The technique utilizes the reaction of dissolved silicate with a molybdate solution to produce a silico-molybdate complex which is then reduced by addition of stannous chloride to form an intensely blue-colored molybdenum compound that is measured spectrophotometrically at its absorbance maximum of 815nm. The primary standard used was prepared from pure silicon dioxide fused and dissolved in basic solution.

PHOSPHATE:
Under acidic conditions orthophosphate reacts with molybdenum (VI) and antimony (III) to form a phosphoantimonyl- molybdenum complex which is subsequently reduced by the addition of ascorbic acid. The mixed valence complex produced by the reduction is measured spectrophotometrically at its absorbance maximum of 880nm. The primary standard was solid KH2PO4 weighed out before the cruise. Nitrite: At pH between 1 and 2 all nitrite undergoes diazotization with sulfanilamide and subsequent coupling with N-1-naphthylethylenediamine. The azo dye formed is measured spectrophotometrically at 540nm. The primary standard was pre- weighed NaNO2.

NITRATE+NITRITE:
Nitrate present in the sample was reduced to nitrite by cadmium metal in an open tubular cadmium reactor. Nitrate + Nitrite was then measured by the nitrite method described above. The primary nitrate standard was pre-weighed KNO3.

PROCEDURE
Samples were analyzed as soon as possible after each cast (usually within 2-4 hours). For each chemistry a set of five standards prepared by additions of known amounts of nutrient to a low nutrient sea water was analyzed at the beginning and end of each analytical run. Analytical runs for the 36 bottle rosette cast take about three hours to complete. At least every hour the slope of each standard curve was re-determined by analyzing the low nutrient sea water and an intermediate standard. The analytical blank used in the RFA/2 sample runs (the blank is assumed to contain no analyte for all four chemistries) was de- ionized water produced onboard the R/V Vickers. The voltage resulting from the difference in refractive index between blank and samples was sufficient to influence computed sample concentrations in the phosphate and nitrite analyses. Magnitudes of these corrections were determined nine times during the cruise. Standards and blanks were all run in triplicate and samples in duplicate.

Calculations Drift of standard curve slopes has been found to be generally linear with time (see the "Nutrients" section of the WOCE Operations Manual, July 1991, section author Lou Gordon). Slope was re- determined at least every hour and drift between determinations was assumed to be linear. Drift of baseline voltage also was assumed linear for periods up to one hour. Each sample peak height was corrected for refractive index difference between blanks and samples and for baseline and standard curve drifts, assuming linear drift between determinations.

C.4. CARBON DATA (see http://cdiac.esd.ornl.gov/oceans/ndp_075/ndp075.html for complete report and appendices)

(AG Dickson, CD Keeling, PR Guenther, and JL Bullister)
2000

This data documentation discusses the procedures and methods used to measure total carbon dioxide (TCO2) and total alkalinity (TALK) at hydrographic stations during the R/V John V. Vickers oceanographic cruise in the Pacific Ocean (Section P13). Conducted as part of the World Ocean Circulation Experiment (WOCE) and the National Oceanic and Atmospheric Administration's Climate and Global Change Program, the cruise began in Los Angeles, California, on August 4, 1992, with a transit line (Leg 0) to Dutch Harbor, Alaska. On August 16, the ship departed Dutch Harbor on Leg 1 of WOCE section P13. On September 15, 1992, the R/V John V. Vickers arrived in Kwajalein, Marshall Islands, for emergency repairs, and after 11 days in port departed for Leg 2 of Section P13 on September 26, 1992. The cruise ended on October 21 in Noumea, New Caledonia. Measurements made along WOCE Section P13 included pressure, temperature, salinity [measured by a conductivity, temperature, and depth sensor (CTD)], bottle salinity, bottle oxygen, phosphate, nitrate, nitrite, silicate, chlorofluorocarbons (CFC-11, CFC-12, CFC-113), TCO2, and TALK.

The TCO2 was measured by coulometry using a Single-Operator Multiparameter Metabolic Analyzer (SOMMA). The overall precision and accuracy of the analyses was ±2 μmol/kg. Samples collected for TALK were measured by potentiometric titration; precision was ±2 μmol/kg. The CO2-related measurements aboard the R/V John V. Vickers were supported by the U.S. Department of Energy.

C.4.1 BACKGROUND INFORMATION

The World Ocean plays a dynamic role in the Earth's climate: It captures heat from the sun, transports it, and releases it thousands of miles away. These oceanic-solar-atmospheric interactions affect winds, rainfall patterns, and temperatures on a global scale. The oceans also play a major role in global carbon-cycle processes. Carbon is unevenly distributed in the oceans because of complex circulation patterns and biogeochemical cycles. The oceans are estimated to hold 38,000 gigatons of carbon, 50 times more than that in the atmosphere and 20 times more than that in plants, animals, and soil. If only 2% of the carbon stored in the oceans were released, the level of atmospheric carbon dioxide (CO2) would double. Every year, the amount of CO2 exchanged across the sea surface is more than 15 times that produced by the burning of fossil fuels, deforestation, and other human activities (Williams 1990).

To better understand the ocean's role in climate and climatic changes, several large experiments have been conducted, and others are under way. The largest oceanographic experiment ever attempted is the World Ocean Circulation Experiment (WOCE). A major component of the World Climate Research Program, WOCE brings together the expertise of scientists and technicians from more than 30 nations. In the United States, WOCE is supported by the federal government under the Global Change Research Program. The multiagency U.S. effort is led by the National Science Foundation and is supported by major contributions from the National Oceanic and Atmospheric Administration (NOAA), the U.S. Department of Energy (DOE), the Office of Naval Research, and the National Aeronautics and Space Administration. Although total carbon dioxide (TCO2) is not an official WOCE measurement, a coordinated effort, supported in the United States by DOE, was made on WOCE cruises to measure the global distributions of TCO2 and other carbon-related parameters [total alkalinity (TALK), partial pressure of CO2 (pCO2), and pH]. The goal of the DOE's CO2 survey includes estimation of the meridional transport of inorganic carbon in a manner analogous to the oceanic heat transport (Bryden and Hall 1980; Brewer et al. 1989; Roemmich and Wunsch 1985), evaluation of the exchange of CO2 between the atmosphere and the ocean, and preparation of a database suitable for carbon-cycle modeling and subsequent assessment of anthropogenic CO2 in the oceans. The final data set is expected to cover ~23,000 stations.

This report presents CO2-related measurements obtained during the Research Vessel (R/V) John V. Vickers NOAA Climate and Global Change (CGC92) expedition along the WOCE meridional Section P13.

C.4.2 TOTAL CARBON DIOXIDE MEASUREMENTS

The samples for TCO2 were taken in 500-mL borosilicate glass bottles in accordance with the procedure specified in Handbook of Methods for the Analysis of the Various Parameters of the Carbon Dioxide System in Sea Water (DOE 1994), an earlier version of which was available at the time in manuscript version to the DOE Science Team. The samples were poisoned with mercuric chloride to minimize biological activity prior to analysis.

Two duplicate samples were taken and analyzed for each profile: one in surface water (near the top of the cast) and one in deep water (near the bottom of the cast). These are used to assist in the assessment of the measurement quality.

C.4.3 ANALYSIS TECHNIQUE

The samples were analyzed using a Single Operator Multiparameter Metabolic Analyzer (SOMMA) developed by K. Johnson (Johnson et al. 1985; 1987). The procedure using this specific instrument is described in detail in the SOMMA operating manual (Johnson 1991 - unpublished manuscript), and a description of the procedure is available in the DOE handbook (DOE 1994).

The principle behind this analysis is as follows: A known amount of seawater is dispensed into a stripping chamber where it is acidified and purged with an inert gas. The presence of solid carbonates, such as CaCO3, thus constitutes an interference in the method. The amount of CO2 in the resulting gas stream is determined by absorbing the CO2 in an absorbent containing ethanolamine and titrating coulometrically the hydroxyethylcarbamic acid that is formed. The pH of the solution is monitored by measuring the transmittance of a thymolphthalein indicator at approximately 610 nm. Hydroxide ions are generated by the coulometer circuitry so as to maintain the transmittance of the solution at a constant value. The relevant chemical reactions occurring in the solution are:

$$CO2 + HO(CH2)2NH2 -- HO(CH2)2NHCOO + H+$$

and

$$H+ + OH- -- H2O.$$

The hydroxide ions used are generated at the cathode by electrolyzing water:

$$H2O + e- -- \Omega H2(g) + OH- ,$$

while silver is dissolved at the anode:

$$Ag(s) -- Ag+ + e- .$$

The overall efficiency of the coulometric procedure is calibrated using known amounts of CO2 gas, either from gas loops or from seawater-based reference materials.

C.4.4 ORDER OF ANALYSES

The samples were analyzed in the order surface-to-deep. This order allowed the cooler deep samples to come to room temperature before they were analyzed. However, this means that it is not possible to ascertain from the analytical measurements alone if there is a systematic variation in the calibration with the life of the coulometric cell (see Sect. 3.2.3 below).

C.4.5 CALIBRATION OF THE ANALYSES

The calibration of the analyses reported here was problematic. The original plan was to use gas loops to calibrate the coulometer system and to check the performance of the analyses using certified reference materials (CRM Batch 13, certified TCO2 value 2015.13 µmol/kg). Unfortunately, a post-cruise examination of the results showed that the calibration factor calculated for gas loops was unexpectedly variable; an examination of the calibration factor that would have been calculated from the analyses of the CRMs also showed similar variability (equivalent to a standard deviation of measurement of 2.4 µmol/kg).

A more detailed examination showed that the variability was restricted to those measurements that had been made in the early stages of a cell's lifetime; measurements on gas loops (Fig. 3 in hard copy) or on CRMs (Fig. 4 in hard copy) made later in the cell's lifetime were much more stable as well as being lower (counts/µmol) than the initial measurements.

The reason for this variability appears to be that the cell was not adequately conditioned prior to being calibrated and used (Ken Johnson, BNL, personal communication). Consequently, measurements made early in the cell lifetime are suspect. These include all of the initial gas loop calibrations as well as the initial measurement of the reference material. The early measurements that were made on water from the upper ocean may also be somewhat degraded (see Sect. 3.2.4 below).

The calibration approach used to calculate the results presented here was as follows:

- The calibration of an individual coulometer was assumed to remain stable from day to day throughout its period of use. This assumption reflects the experience of most investigators (Dickson 1992) and is also borne out by the measurements from this cruise made later in the cell life (see Fig. 3 and Fig. 4). Note that a single coulometer unit was used throughout Leg 1 and for part of Leg 2; it was exchanged during Leg 2 on October 7, 1992, prior to measurement of samples from station 65.
- Thus the measurements on reference materials were divided into two groups: one prior to station 65, the other from station 65 to the end of the cruise, and a mean calibration factor was calculated separately for each group of analyses (based on the measurements made on reference materials later in the cell lifetime).
- This universal (coulometer dependent) calibration factor (i.e., based on the CRMs) was used to calibrate the measurements made on individual sea water samples.

C.4.6 MEASUREMENT DATA QUALITY

Because of the difficulty in assigning a meaningful calibration to the analyses of total dissolved inorganic carbon made on this cruise, it is difficult to assess the data quality of the measurements presented here. Although it is apparent that analyses made later in the coulometric cell's lifetime are less variable, it is less clear when the measuring system settles down. Thus the measurements that are made early in the cell lifetime are also necessarily suspect (this is discussed in more detail below).

One indication of the potential accuracy of the measurement system is the degree of agreement between the calibration factors based on gas loops and those based on CRMs. The average difference is of the order of 0.1% (Leg 1: 0.14%, Leg 2: 0.06%), thus indicating that the gas loops had the potential of providing an accurate calibration if the cell had been adequately conditioned.

The precision of measurement is harder to assess. Duplicate samples were taken at each full station. These were typically a surface sample (in the top 10 m) and a deep sample (usually from one of the two deepest Niskin bottles). The duplicates were analyzed with the surface pair being analyzed at the beginning of a run and the deep pair being split between the beginning and end of a run.

The standard deviation of a single measurement calculated from these duplicates was 1.3 µmol/kg for the surface samples (analyzed together); and 2.0 µmol/kg for the deep samples (analyzed at the start and end of a run).

However, the standard deviation figures are somewhat misleading. The mean difference for the surface samples (first and second) is 0.4 µmol/kg; that for the deep samples is 1.2 µmol/kg. This suggests that even during the measurement of these duplicates the calibration of the cell is changing in the direction shown in Fig. 3 and Fig. 4. Hence, the measurements on the samples done in the first part of a run, those from the upper ocean, may, on occasion, be biased high by the use of a calibration factor more appropriate to the later measurements. An examination of the data on duplicates indicates that the extent of this bias is unlikely to exceed 4 µmol/kg and may on many occasions be less than that (see Section 3.4 for an evidence from the shore-based replicate measurements). The measurements on the later (deep) samples would be expected to have a precision similar to that found for the later CRMs: a standard deviation of 1.1 µmol/kg (i.e., a similar magnitude to that found for those duplicate measurements that were run side-by-side at the beginning of the run).

C.4.7 TOTAL ALKALINITY MEASUREMENTS

The TALK concentrations were determined by potentiometric titration of 1153 Niskin samples, 574 from Leg 1 and 579 from Leg 2. Samples from throughout the water column were measured on 39 stations (nominally 36 depths per station) and from surface Niskins only on 41 additional stations. The TALK was measured on an aliquot of seawater taken from the same 500-mL bottle previously analyzed for TCO2. Calibration of the shipboard measurements of TALK reported in this numeric data package depends upon the standardization of the HCl titrants with titrations of primary standard sodium carbonate solutions at SIO. The titration system and its calibration are described in Guenther et al. (1994a), a reprint of which is provided in Appendix A of this report. Adjustments to the TALK calibration scale are likely to be made in the future.

Data quality was assessed at sea by titration of replicate seawater samples, secondary standard bicarbonate solutions prepared at SIO before expedition, and bottles of CRM batch number 13. Aliquots from the replicate seawater samples and the CRMs were titrated after aliquots had been removed for TCO2 measurements.

The short-term repeatability was estimated by analyzing the agreement of pairs of replicate seawater samples titrated simultaneously, using equation (3) in Standard Operating Procedure (SOP) 23 of the DOE (1994). One or two pairs usually were measured on each day of analysis. On Leg 1, for 33 pairs, the sample standard deviation, si, of a single measurement was estimated to be 1.56 µmol/kg. On Leg 2, for 30 pairs, si was estimated to be 2.13 µmol/kg.

Two batches of bicarbonate reference materials were titrated during the cruise. Usually four measurements were made per day. Analysis of the results using the normal equation for sample standard deviation yields an estimate of the reproducibility of the measurements over the entire cruise. The si was found to be 2.77 µmol/kg for 75 measurements of batch "A" and 2.03 µmol/kg for 90 measurements of batch "B."

Titrations of CRM samples provided an additional estimate of reproducibility and also an estimate of the accuracy through comparison of the at-sea results with the value certified by the laboratory of A. G. Dickson at SIO. The value for CRM batch 13, certified by titrations in 1996 on archived samples, was 2203.79 µmol/kg. During the cruise 84 titrations of CRM batch 13 were made. After 6 measurements were rejected, the si calculated for 78 measurements was 2.29 µmol/kg. The average TALK for the 78 measurements was 2201.26 µmol/kg, nearly within one standard deviation of the certified value. The TALK measurements of seawater reported here have NOT been adjusted by this difference. Figure 5 in the hard copy is a plot of the difference between the shipboard TALK of CRM batch 13 and the certified value versus time during both legs of the cruise.

C.4.8 SHORE-BASED REPLICATE MEASUREMENTS

During the expedition, 322 duplicate samples were collected and returned to SIO for shore-based measurements in the laboratory of C. D. Keeling. A total of 309 TCO2 and 314 TALK measurements were performed on these samples. The 13C/12C isotopic ratio of the carbon comprising the TCO2 was also measured (but not reported in this numeric data package). Comparisons between the shore-based measurements of TCO2 and TALK and those made at sea on water from the same Niskin bottles provide further quality control information on the carbon data set for WOCE Section P13.

Shore-based measurements of TCO2 were made by vacuum extraction/manometry using the procedures established for the DOE/WOCE ocean CO2 program (Guenther et al. 1994b). Results are tabulated in Table B.1 in Appendix B. This table also lists the corresponding SOMMA TCO2 values and the differences between the shipboard and shore-based values. Shipboard data are identified as "SIO" and shore-based as "S.I.O." The repeatability of the shore-based results themselves can be estimated from the agreement of the duplicate samples measured (DOE 1994). The sample standard deviation, si, of an individual shore-based result represents the short-term imprecision of the laboratory analysis, together with imprecision introduced by sampling and storage. The si calculated for the set of 140 pairs of data was 0.95 µmol/kg. Twelve pairs were rejected from this calculation, as shown by the flags in Table B.1. This "replicate imprecision" is approximately average for DOE/WOCE program cruises.

Of the 140 ship - shore differences corresponding to the "good" pairs of shore-based data, two were rejected for being more than 3si from the average (-17.17 and 20.21 µmol/kg). The average difference for the remaining 138 comparisons was 1.37 µmol/kg, with the shore-based being higher, and the si of an individual difference was 3.11 µmol/kg. The average difference was typical for DOE/WOCE cruises during the 1991-1994 period, but the si is rather large. A reason for the increased scatter is the presence of a depth-dependent bias between the ship shore differences. The usual sampling depths for shore-based replicate samples on DOE/WOCE cruises were surface and deep (nominally 3000 m). Differences for WOCE Section P13 are plotted in Figure 6 for this subset of comparisons. "Surface" samples are the shallowest on a station, ranging from 10 to 75 m in depth, and "deep" samples are the deepest, ranging from 1000 to 3200 m. The average surface deep bias for the subset of surface and deep samples in Figure 6 (18 differences between "good" replicate pairs) is 3.5 µmol/kg (si = 2.5 µmol/kg). A surface deep bias has been evident for only a few other cruises and usually is smaller. On this cruise, shore-based replicate samples were also collected in profile from 9 to 12 Niskin bottles from the surface to nominally 3000 m on 10 stations. Ship shore differences for the top several depths of these stations change toward the more negative deep differences. From 400 m down, the differences are relatively constant.

The surface-deep bias results agree fairly well with measurements made at sea. Shipboard measurements for surface comparisons between shore-based and shipboard measurements were made early in the measurement runs, while those for deep comparisons were made late in the runs. Use of the lower calibration factors measured late in the runs resulted in a high bias for measurements made early in the runs (see section 3.2.4). On average, CRM measurements made early in the runs were 2.6 µmol/kg higher than those made late in the runs. Also, deep samples measured early in the runs on Leg 1 on average were 2.3 µmol/kg higher than their duplicates measured late in the runs. However, this pattern was far less apparent for Leg 2.

Shore-based measurements of TALK were made by essentially the same potentiometric titration system as the measurements made at sea. The primary difference was that the aliquots for shore-based titrations more often were dispensed gravimetrically into the titration cell, instead of volumetrically. The aliquots were removed from the sample bottles after those for shore-based TCO2 had been removed. Results are tabulated in Table B.2. This table also lists the corresponding shipboard TALK values and the differences between shore-based and shipboard values. As described for the shore-based TCO2, the replicate imprecision of the shore-based TALK measurements is estimated from the agreement of the duplicate measurements. For samples with analyses from both gravimetric and volumetric systems, analyses separated by more than a week of elapsed time were rejected. For one set of titrations made within a few days on both systems, the gravimetric data were chosen over the volumetric. The si was 1.90 µmol/kg for 154 pairs of measurements, with four pairs rejected as shown by the flags in Table B.2. The apparent imprecisions of the shipboard TALK results (see discussion in section 3.3) and the shore-based results are similar, ~2 µmol/kg.

The average ship - shore difference for TALK is calculated from 147 of the total of 150 comparisons of "good" shore-based duplicates with corresponding shipboard values. Three comparisons with differences of 18.78, 15.63, and 23.01 µmol/kg (greater than 3si) were rejected. The average difference is 3.35 µmol/kg (shipboard higher). The si of an individual difference is 4.11 mol/kg. Both the average ship shore difference and its imprecision are likely to change after the anticipated adjustments to the TALK calibration scale are made, so further analysis and plotting of the data will not be presented at this time.

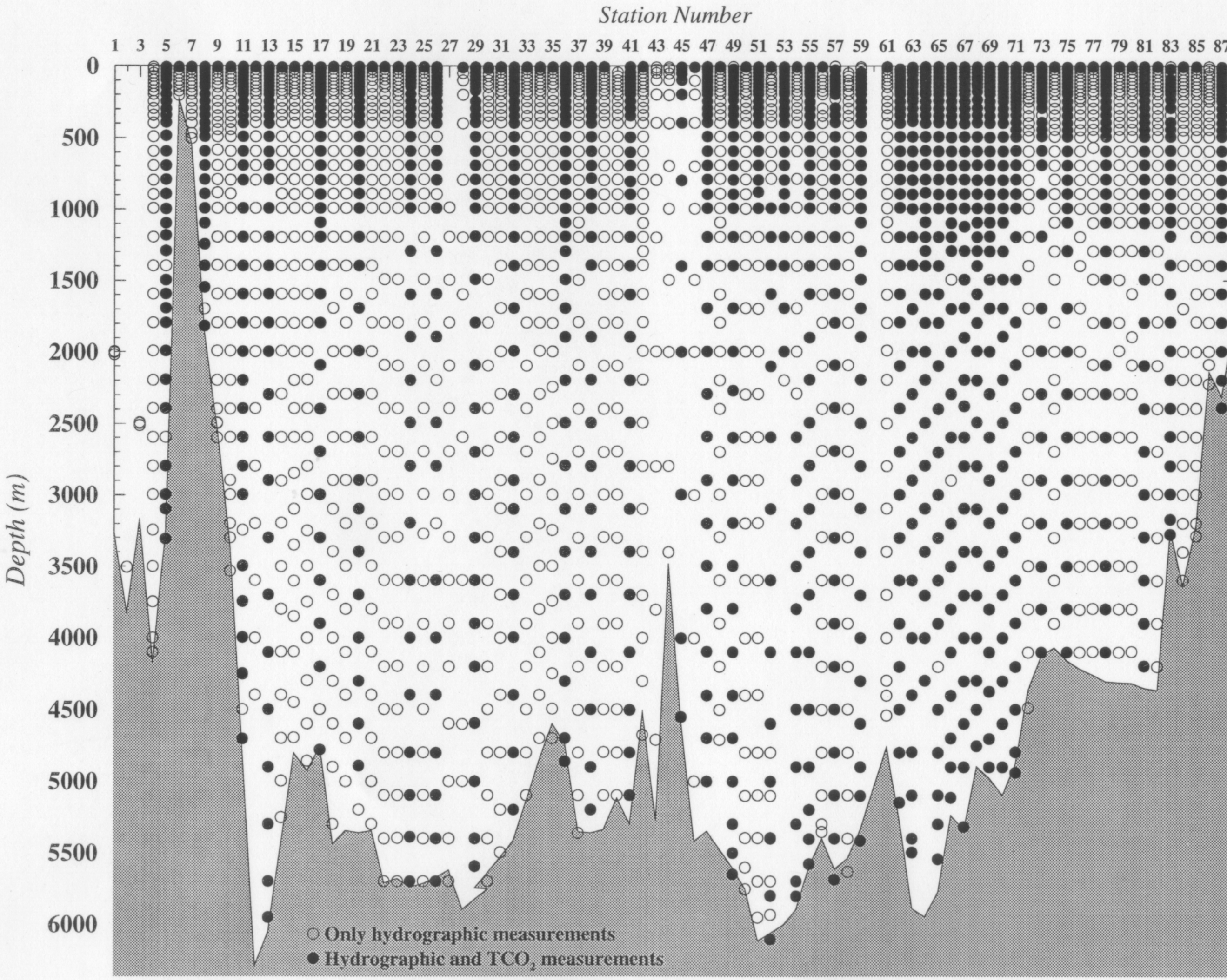

Fig. 2. Sampling depths at all hydrographic stations occupied during the R/V *John V. Vickers* expedition along WOCE Section P13.

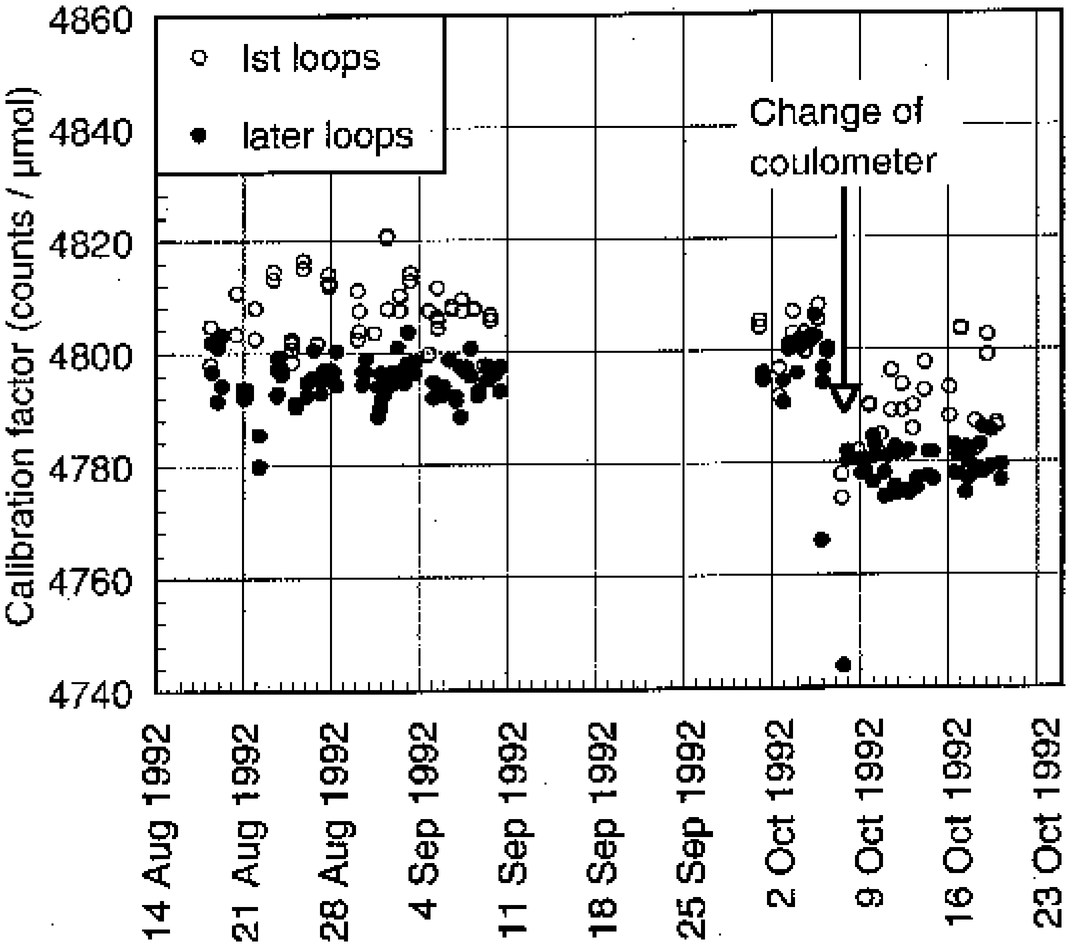

Fig. 3. Calibration factors from gas loops expressed as counts/• mol.

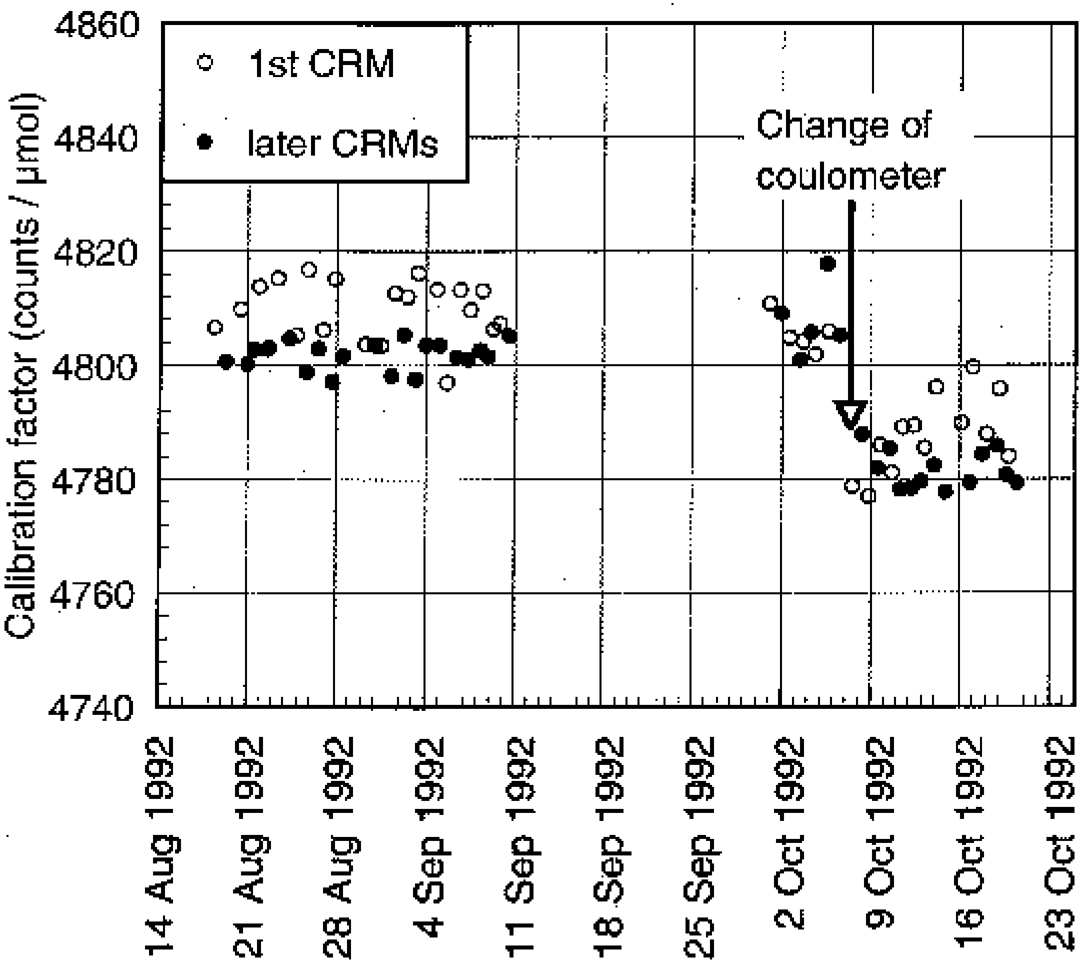

Fig. 4. Calibration factors from CRMs expressed as counts/mol.

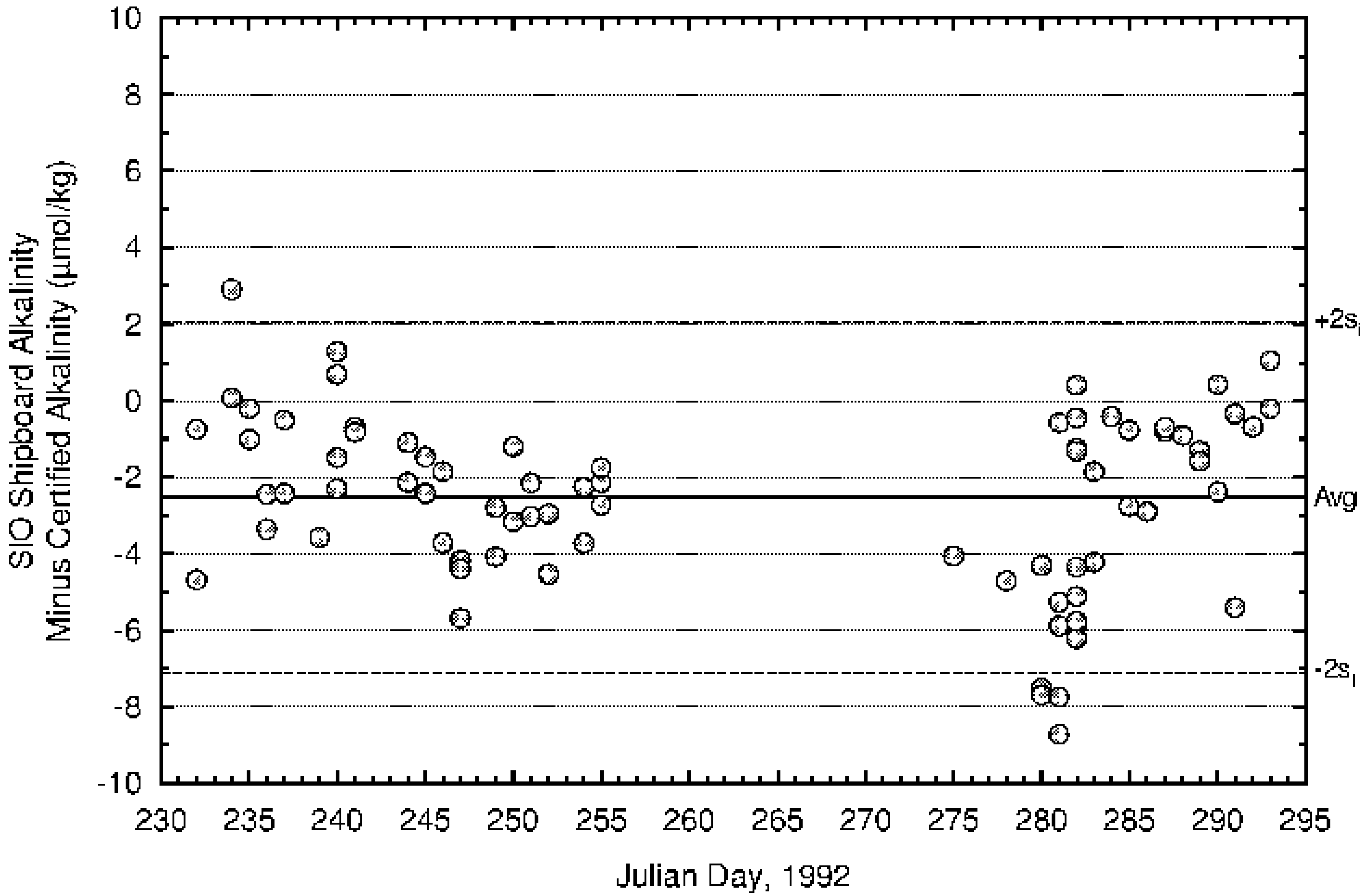

Fig. 5. Difference between SIO shipboard TALK of CRM batch 13 and the certified value vs time during WOCE Section P13.

Solid line denotes the average SIO value and dotted lines denote plus/minus two times the standard deviation of an individual SIO value.

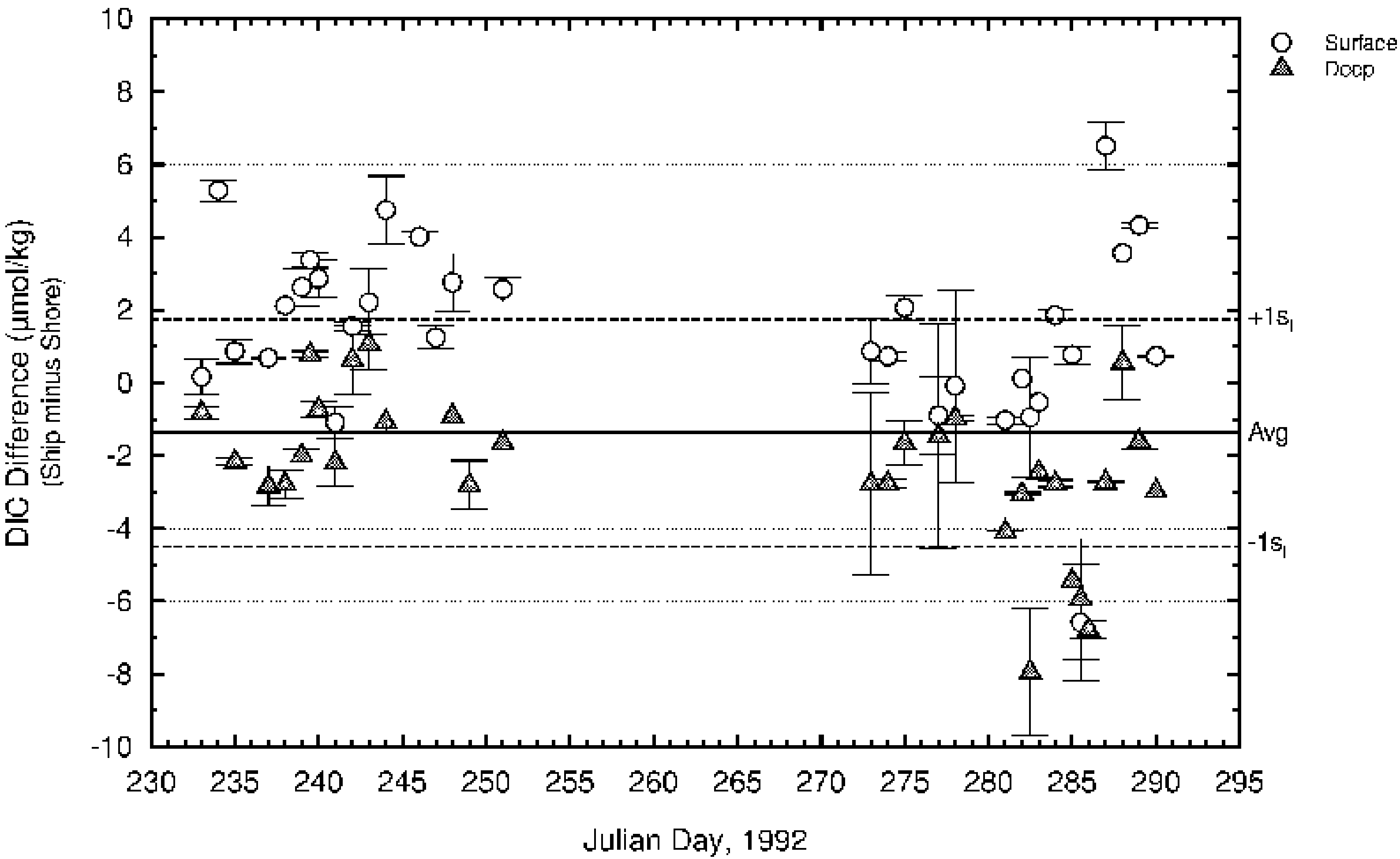

Fig. 6. Difference between shipboard and shore-based TCO_2 measurements vs date for surface and deep samples

Open circles represent near-surface samples; shaded triangles represent deep samples; and vertical bracketed lines represent replicate pair differences.

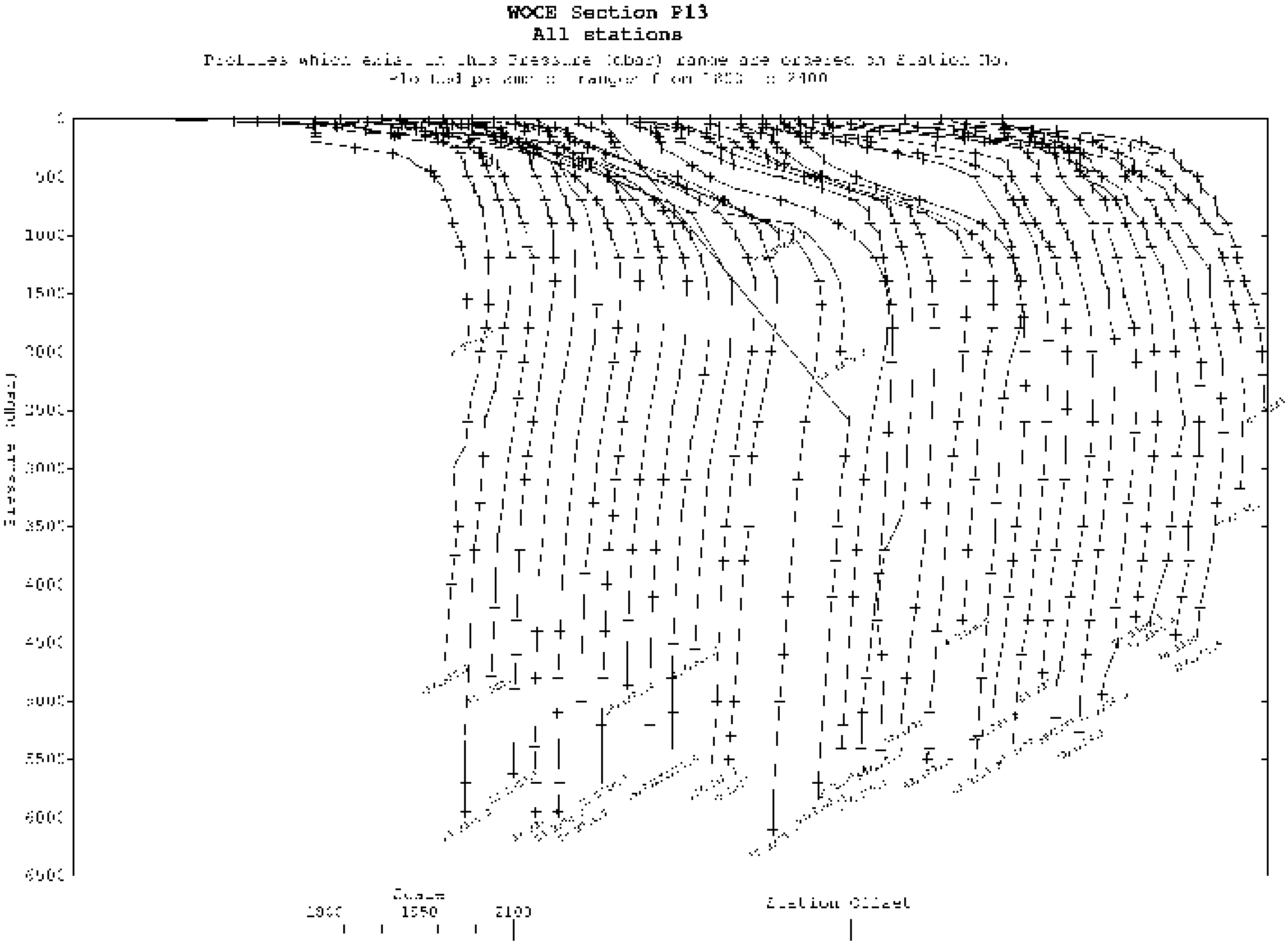

Fig. 7. Nested profiles: Total carbon dioxide (Fmol/kg) vs pressure (dbar) for all stations of WOCE Section P13.

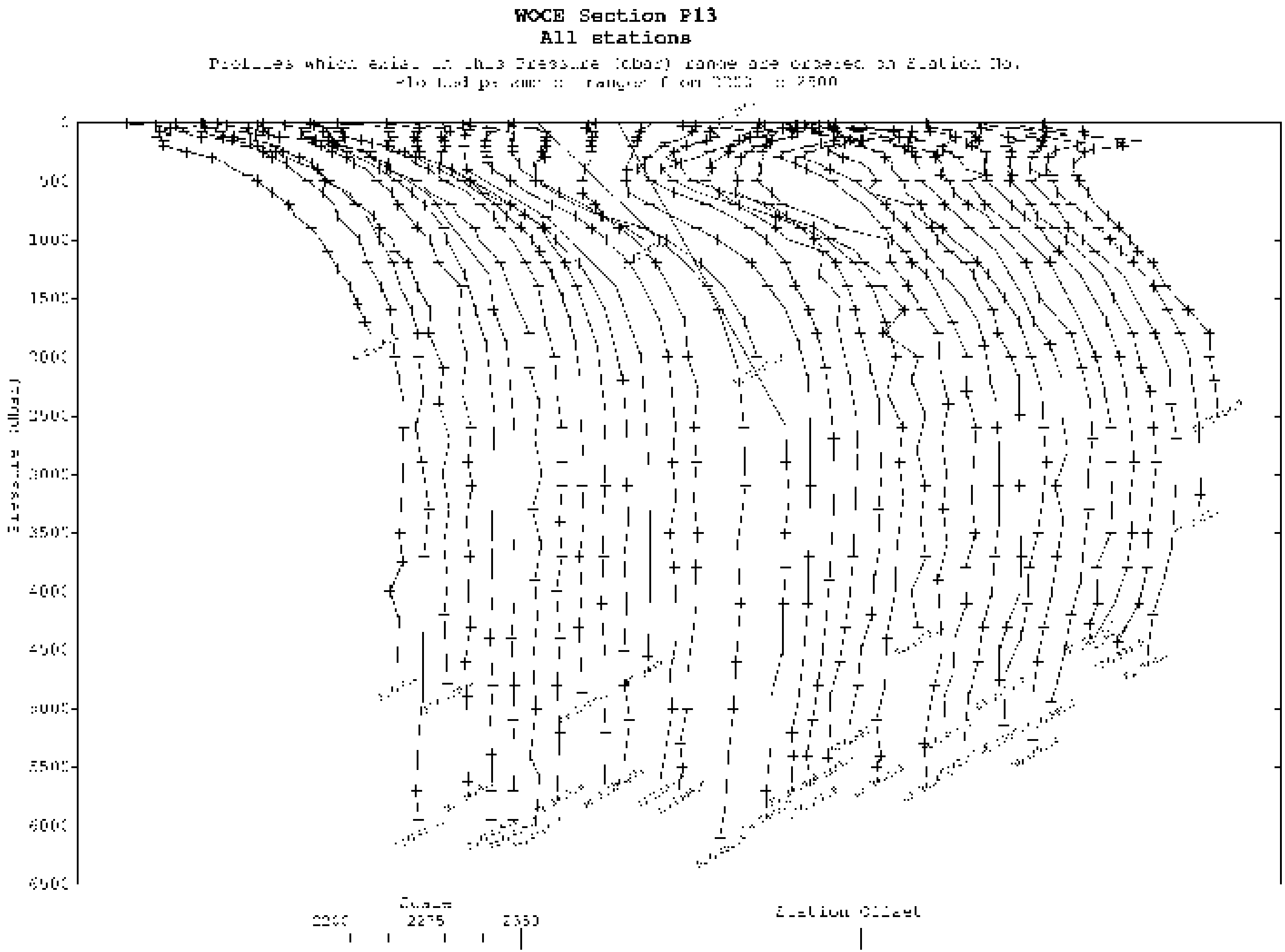

Fig. 8. Nested profiles: Total alkalinity (Fmol/kg) vs pressure (dbar) for all stations of WOCE Section P13.

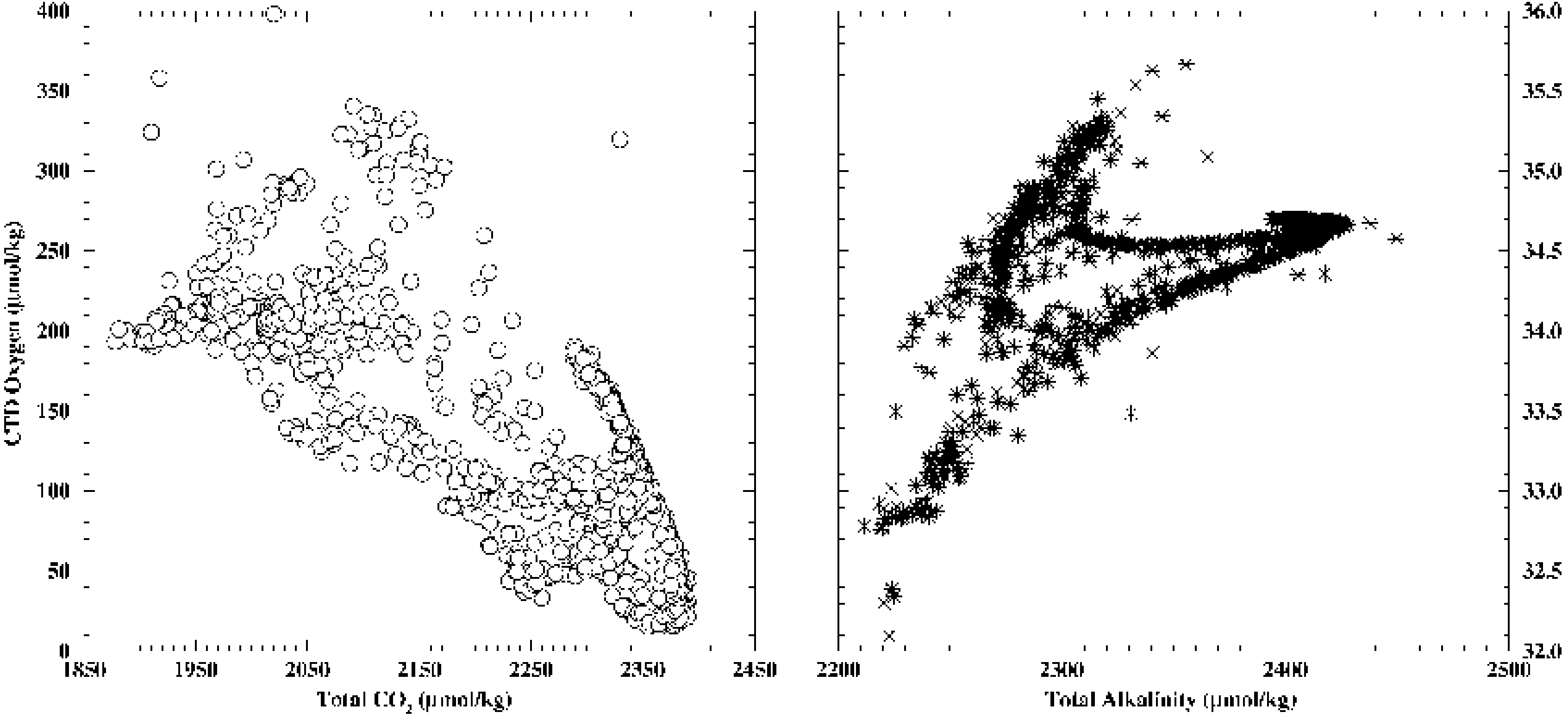

Fig. 9. Property-property plots for all stations occupied during the R/V John V. Vickers cruise along WOCE Section P13.

C.5 CFC MEASUREMENTS

(J. Bullister)

CFCs were usually the first water sample collected from the 10 liter bottles. Care was taken to co-ordinate the sampling of CFCs with other gas samples to minimize the time between the initial opening of each bottle and the completion of sample drawing. In most cases, helium, tritium, dissolved oxygen, total CO2, alkalinity and pH samples were collected within several minutes of the initial opening of each bottle. CFC samples were collected in 100 ml precision glass syringes, and held immersed in a water bath until processing.

The CFC analytical system functioned relatively well during this expedition. The CFC system was installed in a specially designed laboratory van located on deck, and was isolated from possible contamination from high levels of CFCs which are sometimes present in air inside ship laboratories. Concentration of CFCs in air inside this van were usually close to those of clean marine air.

Concentrations of CFC-11 and CFC-12 in air samples, seawater and gas standards on the cruise were measured by shipboard electron capture gas chromatography, according to the methods described by Bullister and Weiss (1988). The concentrations of CFC-11 and CFC-12 in air, seawater samples and gas standards are reported relative to the SIO 1986 calibration scale. CFC concentrations in air and standard gas are reported in units of mole fraction CFC in dry gas, and are typically in parts-per-trillion (ppt) range. Dissolved CFC concentrations are given in unit of picomole CFC per kg seawater (pmol/kg). CFC concentrations in air and seawater samples were determined by fitting their chromatographic peak areas to multi-point calibration curves, generated by injecting known volumes of gas from a CFC working standard (PMEL cylinder 71489) into the analytical instrument. This concentrations of CFC-11 and CFC-12 in this working standard were calibrated versus a primary CFC standard (CC36743) before and after the cruise. No measurable drift in the working standard could be detected during this interval. Full range calibration curves were run at 1 to 2 day intervals. Single injections of a fixed volume of standard gas were run much more frequently (at intervals of 1 to 2 hours) to monitor short term changes in detector sensitivity. The estimated reproducibility of the calibrations is about 1.3% for CFC-11 and 0.5% for CFC-12. We estimate a precision (1 standard deviation) for dissolved CFC measurements of about 1%, or 0.005 pmol/kg, whichever is greater.

Sample loops filled with CFC-free gas, and syringe samples of CFC-free water (degassed in a specially designed glass chamber) were run to check sampling and analytical blanks. CFC-11 and CFC-12 concentrations measured in deep samples along the section were typically in the range of 0 to 0.007 pmol/kg, near the detection limit of the analytical system (~0.004 µmol/kg). Previous studies (Warner, et al 1996) of time-dependent tracers in this region of the Pacific indicate that waters at densities sigma0>27.4 should have CFC concentrations near zero at present. We attribute the low level CFC signal in deep samples to the slow release of CFC from the walls and O-rings of the 10 liter bottles into the seawater sample during storage, and to contamination during the transfer and storage of the seawater samples in glass syringes prior to analysis. Based on the median concentrations observed in deep water samples along the section, the following blank correction were applied to the seawater measurements:

CFC-11 blank	corrections applied
Sta. 1-43	0.010 µmol/kg
Sta. 44-88	0.008 µmol/kg
CFC-12 blank	**corrections applied**
Sta. 1-4	0.000 µmol/kg
Sta. 5-23	0.021 µmol/kg
Sta. 24-27	0.034 µmol/kg
Sta. 28-52	0.018 µmol/kg
Sta. 53-88	0.009 µmol/kg

As a result of this blank correction, some concentrations reported for deep samples are less than zero.

A number of water samples had anomalously high CFC11 and/or CFC11 concentrations relative to adjacent samples. These high values appeared to occur more or less randomly, and were not clearly associated with other features in the water column (e.g.. elevated oxygen concentrations). In most cases, only one of the 2 CFCs measured showed these anomalously high levels. This suggests that the high values were due to analytical variability or isolated low-level contamination events. These samples are included in this report and are flagged as either 3 (questionable) or 4 (bad) measurements. Approximately 181 analyses of CFC-11 and 76 analyses of CFC-12 were given flags of 3 or 4.

C.6. DATA CHECKS AND PROCESSING PERFORMED BY CDIAC

An important part of the numeric data packaging process at the Carbon Dioxide Information Analysis Center (CDIAC) involves the quality assurance (QA) of data before distribution. Data received at CDIAC are rarely in a condition that would permit immediate distribution, regardless of the source. To guarantee data of the highest possible quality, CDIAC conducts extensive QA reviews that involve examining the data for completeness, reasonableness, and accuracy. The QA process is a critical component in the value-added concept of supplying accurate, usable data for researchers.

The following information summarizes the data processing and QA checks performed by CDIAC on the data obtained during the R/V John V. Vickers cruise along WOCE Section P13 in the Pacific Ocean.

1. The final carbon-related data were provided to CDIAC by A. G. Dickson, P. R. Guenther, and C. D. Keeling of Scripps Institution of Oceanography. The final hydrographic and chemical measurements and the station information files were provided by the WOCE Hydrographic Program Office (WHPO) after quality evaluation. A FORTRAN 90 retrieval code was written and used to merge and reformat all data files.

2. To check for obvious outliers, all data were plotted by use of a PLOTNEST.C program written by Stewart C. Sutherland (Lamont-Doherty Earth Observatory). The program plots a series of nested profiles, using the station number as an offset; the first station is defined at the beginning, and subsequent stations are offset by a fixed interval ionable measurement) or "4" (bad measurement) (see File Descriptions in Part 2 of this documentation).

3. To identify "noisy" data and possible systematic, methodological errors, property-property plots for all parameters were generated, carefully examined, and compared with plots from previous expeditions in the Pacific Ocean.

4. All variables were checked for values exceeding physical limits, such as sampling depth values that are greater than the given bottom depths.
5. Dates, times, and coordinates were checked for bogus values (e.g., values of MONTH < 1 or > 12; DAY < 1 or > 31; YEAR < or > 1992; TIME < 0000 or > 2400; LAT < -10.000 or > 60.000; and LONG < 160.000 or > 170.000).

6. Station locations (latitudes and longitudes) and sampling times were examined for consistency with maps and cruise information supplied by A. Dickson and C. Keeling of SIO.

7. The designation for missing values, given as -9.0 in the original files, was changed to -999.9 for the consistency with other oceanographic data sets.

C.7 CTD/02 MEASUREMENTS*

(K.E. McTaggart, G.C. Johnson, and B.A. Taft)

ABSTRACT

Summaries of Neil Brown Instrument Systems CTD/02 measurements and hydrographic data acquired on a Climate and Global Change cruise during the fall of 1992 aboard the RN Vickers are presented. The majority of these data were collected along 165°E from 51.5°N to 5°S. Data collected on a NW-SE dog-leg from the 200-m isobath off the coast of Kamchatka to the beginning of the 165°E line at 51.5°N are also presented. Data acquisition and processing systems are described and calibration procedures are documented. Station location, meteorological conditions, CTD/02 summary data listings, profiles, and potential temperature- salinity diagrams are included for each cast. Section plots of oceanographic variables and hydrographic data listings are also given*.

C.7.1 INTRODUCTION

In support of NOAA's Climate Program, PMEL scientists have been measuring the growing burden of greenhouse gases in the thermocline waters of the Pacific Ocean and the overlying atmosphere since 1980. During this cruise, hydrographic and chemical measurements began with a series of closely spaced stations extending from the Kamchatka Peninsula across the western boundary current regime. The section then crossed the northern end of the Kuril-Kamchatka Trench and extended southward along 165°E from 51.5°N to 5°S crossing such major features as the North Pacific subpolar gyre, Kuroshio Extension, subtropical gyre, and the equatorial current system. Full water column CTD/02 profiles and a suite of anthropogenic and natural tracers including chlorofluorocarbons (CFCs), helium-tritium, radiocarbon, total C02, alkalinity, dissolved oxygen, dissolved nutrients and salinity were collected. These measurements will be used to study the distribution, sources, and formation rates of water masses and their flow patterns and time scales. The CFC and tritium measurements will be of use in studying the rates of upper and intermediate water mass formation and transport processes. C02 measurements will be used to study the flux of C02 from atmosphere to ocean and the importance of this region as a sink for C02.

Four stations were occupied on the transit leg from Los Angeles to Dutch Harbor to test the CTD/rosette system. Another test cast was made in the Bering Sea during the transit from Dutch Harbor to the start of leg 1 of WOCE section P13 near the Kamchatka Peninsula. Fifty stations followed from the 200-m isobath southeastward down the continental slope, across the Kuril-Kamchatka Trench, then southward at 51.5°N along 165°E to 30°N. Nominal station spacing began at 30 miles but was increased to 40 miles south of 36°N after a series of delays. Concerns over the structural integrity of the R/V Vickers resulted in the termination of leg 1 several days prior to the scheduled date, and an emergency steam into Kwajalein. After an extended period of time in port for the evaluation and repair of the ship, the section was resumed with leg 2. With the time remaining, 33 stations were occupied between 30°N and 5°S along 165°E at 2- degree spacing north of 40°N with closer spacing south of 4°N and between 19- 22°N. Figure 1

***Abstracted from "NOAA Data Report ERL PMEL-51", Oct. 1994.**

shows station locations, where leg 1 stations are indicated by a triangle and leg 2 stations are marked by a square. Table 1 provides a summary of cast information.

C.7.2 STANDARDS AND PRE-CRUISE CALIBRATIONS

The Neil Brown Mark IIIb CTD/02 profiler is designed to make precise, high resolution measurements of conductivity, temperature, and pressure in the ocean environment. Electrical conductivity of sea water is obtained using a miniature four electrode ceramic cell and highly precise and stable interface electronics. The EG&G conductivity sensor has a range of 1 to 65 mmho, an accuracy of ±0.005 mmho, resolution of 0.001 mmho, and stability of 0.003 mmho/month. Temperature is determined using a platinum resistance thermometer. The Rosemount platinum thermometer has a range of -32° to 32°C, an accuracy of ±0.005 C (-3° to 32°C), resolution of 0.0005°C, and stability of 0.001°C/month. Pressure is determined using a high performance stainless steel strain gauge pressure transducer. A thermistor within the pressure sensor housing corrects pressure values for the effects of temperature changes on the sensor itself. The Paine pressure sensor has a range of 0 to 6500 db, an accuracy of ±6.5 db, resolution of 0. 1 db, and stability of 0. 1 %/month. A Beckman polarographic dissolved oxygen electrode measures oxygen current and oxygen temperature. Data from the underwater unit is transmitted in real time to a shipboard data terminal through a 3-conductor electro-mechanical cable. The data is in TELETYPE (TTY) format and uses a frequency shift key (FSK) modulated signal superimposed on the DC power supplied to the underwater unit.

Pre-cruise calibrations were done at EG&G Marine Instruments in Cataumet, Massachusets (Millard et al., 1990). Temperature calibrations were determined using a 20-gallon Tronic Model CTB-1000A temperature bath and Model ATB-1250 Automatic Thermometer Bridge. Data were collected using a desk top computer at 0, 15, and 30°C, averaged for 1 minute at each temperature and a line was fit to these values. Conductivity calibrations were performed using four saltwater baths at room temperature, each of different salinities resulting in a conductivity range from 30 to 60 mmho. A correction was made to take into account the difference in thermal coefficient of linear expansion of the alumina CTD cell relative to the quartz conductivity cell on the Model CSA-1250 Conductivity Salinity Adaptor. A line was fit to these values. Pressure calibration of the CTD was performed by connecting a stainless steel pipe from the dead-weight tester to the CTD pressure port or directly to the pressure transducer. Weights were added or removed to generate pressures in ascending and descending increments for three calibration cycles. A third order polynomial was fit to five pressure values ranging from 0 to 6067 db.

The conductivity sensor usually drifts significantly from pre-cruise calibrations with use and is most accurately calibrated using in situ water sample salinities. Immediately prior to tripping the rosette, values of pressure, temperature, conductivity, oxygen current, and oxygen temperature were recorded from the CTD deck unit. These upcast CTD values are usually used for comparison with sample salinity values.

C.7.3 DATA ACQUISITION

PMEL's Neil Brown CTD/02 S/N 1111 (sampling rate 31 Hz) and a General Oceanics 36-bottle rosette were used for the majority of 88 stations. PMEL's Neil Brown CTD/02 S/N 1112 (sampling rate 31 Hz) and a General Oceanics 12-bottle rosette were used at five stations made during bad weather. Casts were made to within a nominal distance of 50 m from the bottom using a Benthos acoustic pinger mounted low and opposite the CTD sensor arm on the frame. The position of the package relative to the bottom was monitored on the ship's Precision Depth Recorder (PDR). A bottom depth was estimated from bathymetric charts and the PDR ran throughout the cast. Ten-liter Niskin bottles were used to collect water samples on the large package; 4-liter Niskins were used on the bad weather package. Samples were drawn for salinity, oxygen, nutrients, CFCs, radiocarbon, helium, tritium, total C02, and alkalinity.

The package entered the water and was lowered at a rate of 30 m/min for the first 50 m. To reduce the chance of contamination in the bottles, the package was not soaked near the surface prior to descent. Speed was increased at 50 in to 45 m/min, and increased again at 200 m to 60 m/min. Ship roll sometimes caused substantial variation about these mean lowering rates. After retrieval of the package, sensors were flushed with fresh water and a plastic cover was placed around the sensor arm and filled with fresh water.

A Neil Brown Mark III deck unit received the FSK signal from the CTD and displayed pressure, temperature, conductivity, oxygen current, and oxygen temperature values. An analog signal was forwarded from the deck unit to an XYY' recorder that monitored the data acquisition in real-time for signal spiking and problems with the electrical termination. An audio signal was backed up to video cassette. Digitized data were forwarded to a 286-AT personal computer equipped with EG&G Oceansoft acquisition software version 2.02 and backed up onto cartridge tape. Data files were transferred to a microVAX 11 where PMEL's standard processing and plotting software were installed. Plots were generated after each cast to check for problems and monitor sensor drift. Backups of the raw and processed data were made on TK50 cartridge tapes and returned to PMEL.

C.7.3.1 Data Acquisition Problems

A considerable amount of time was lost during the cruise owing to unplanned transit time resulting from the premature break of the line at 30°N, steaming to resume the line at 28°N, extended port stops, and delays along the cruise track because of ship's mechanical problems and bad weather. Additional time was lost on station owing to conducting cable and wire termination problems and deficiencies in the ship's Precision Depth Recorder (PDR).

Of the 83 stations along the line, during 22 the PDR bottom trace was indiscernable or the sweeps were not annotated. For stations 6-50, maximum CTD depths plus PDR heights off the bottom were generally greater than the corrected PDR depth values by an average of 14 m (s.d. 37 m). For stations 51-68, maximum CTD depths plus PDR heights off the bottom were all much less than corrected PDR depths by an average of 138 m (s.d. 53 m). For stations 69-88 maximum CTD depths plus PDR heights off the bottom were an average of 4 m greater than the corrected PDR depths (s.d. 23 m). This behavior may be owing to mis-adjustments to the PDR settings.

The newly-designed General Oceanics Model 1016 36-position rosette sampler performed relatively well. The sampler provides real-time information on the position of the release lever and allows bottles to be closed in any order desired. Although a bottle or two sometimes failed to close properly during casts owing to sticky release pins on the underwater pylon, these problems could normally be diagnosed immediately from information sent from the underwater unit to the deck unit. This information gave the CTD operator the option of choosing to release another bottle at that depth if desired.

Station 53 was aborted at 2200 db owing to a deteriorating electrical termination. Due to an operator oversight, CTD data were lost for this cast and the audio backup was unrecoverable. Samples were collected during the upcast, however, and a bottle file exists for this station. At station 60, the package was put on the bottom. No samples were collected during the upcast.

C.7.3.2 Salinity Analyses

Bottle salinity analyses were performed in a climate-controlled van using two Guildline Autosal Model 8400A inductive salinometers and IAPSO Standard Seawater from Wormley batch P 114. The commonly accepted precision of the Autosal is 0.001 psu, with an accuracy of 0.003 psu. The Autosals were standardized before each run and either at the end of each run or after no more than 48 samples. The drift during each run was monitored and individual samples were corrected for the drift during each run by linear interpolation. Bottle salinities were compared with computed CTD salinities to identify leaking bottles, as well as to monitor the conductivity sensor performance and drift. Calibrated CTD salinities replace missing bottle salinities in the hydrographic data listing and are indicated by an asterisk. Bad bottle values have not been flagged in this report.

C.7.4 POST-CRUISE CALIBRATIONS

Several files were combined to produce the CAL calibration file for each CTD/02 package:

111n_ALL.CAL = raw P, raw T, raw C, OXC, OXT

Bottle salinities were received from D. Greeley in file SAL2_88.DAT. It was decided post-cruise to back off any NRCC corrections applied at sea. SAL2_88.DAT was broken into 1111_ALL.SAL and 1112_ALL.SAL. Bottle salinities were added to CTD/02 data using program ADDSAL:

111n-ALL.OUT = raw P, raw T, raw C, OXC, OXT, SO

Bottle oxygens were received from K. Hargreaves in file 02_FINAL.DAT. Program OXYMLL converted the data from µmol/l to ml/l and output file 02_FINAL.MLL. 02_FINAL.MLL was broken into 1111_ALL.MLL and 1112_ALL.MLL. Bottle oxygens were added to .OUT files using program ADDOXY:

111n_ALL.FIN = raw P, raw T, raw C, OXC, OXT, SO, 02

Files FIN were edited so records existed for all 36 (or 12) bottles of each cast whether samples were collected or not. This was done to account for each bottle in the WOCE SEA file. For CTD/02 S/N 1111, 1111_FIN.CAL contained stations 2, 4- 27, 29-42, 47-52, 54-59, 61-88 and therefore ndata = 79 casts*36 bottles = 2844. Since there were no CTD/02 data for station 53 owing to operator error, but its bottle data needed to be accounted for, CAST53.CAL was carried through the conductivity calibration scheme independently. The CTD values listed in CG192BO53.BOT file are from the upcast. For CTD/02 S/N 1112, 1112_FIN.CAL contained casts 3, 28, 43-46 and therefore ndata = 6 casts* 12 bottles = 72.

C.7.4.1 Pressure

Program PBIAS was introduced into the calibration stream to correct for the pressure hysteresis between up and down pressure calibrations following Millard and Yang (199 3). PBIAS reads CALIB.DAT for calibration coefficients and CGC92.HDR for maximum cast pressure and computes a corrected P using the following equation:

$$P = P(up)*(I-W)+P(dn)*W$$
$$W = \exp(-(P(bottom)-P(dn))/Z$$

where P is the derived uptrace pressure, P(up) is the pressure value scaled with the uptrace calibration polynomial, P(dn) is the pressure value scaled with the downtrace calibration polynomial, P(bottom) is the maximum pressure of the station, and Z is 300 db. PBIAS writes:

111n_PCOR.CAL = raw P, cal P, raw T, raw C, OXC, OXT, SO, 02

For CTD/02 S/N 1111, uptrace and downtrace scaling coefficients were the averages of pre(EG&G) and post-cruise (NW Regional Calibration Center, NRCC) pressure calibrations and were applied as follows in program PBIAS:

P = E + D * PRAW + C * PRAW2 + B * PRAW3

where

	E	D	C	B
P(DOWN):	-2.0048	.9968708	0.159752E-5	-0.1804412E-09
P(UP):	-2.6546	.9938283	0.281344E-5	-0.2951405E-09

The differences between pre- and post-cruise pressure calibrations were 4-6 db, mostly a bias. Program MATCH searched downtrace CTD files output from EPCTD92 and matched PBIAS calibrated uptrace pressures with DLAGAVZ calibrated downtrace pressures (no pressure calibration was applied in EPCTD92). Downtrace values replaced uptrace values for pressure (as well as temperature and conductivity) in the CAL and subsequent bottle files.

PBIAS was not used with CTD/02 S/N 1112 data because the up and down pressure calibration coefficients from EG&G in June of 1992 were very similar. Up and down pressure values for CTD/02 S/N 1112 were scaled with pre-cruise (EG&G) coefficients in program CALMSTRW for uptrace data and DLAGAVZ for downtrace data. No additional pressure calibrations were applied in EPCTDW.

	E	D	C	B
P(DOWN) = P(UP):	-0.18188	.9955384	0.194715E-5	-0.2006194E-09

C.7.4.2 Temperature

Final temperature calibrations for CTD/02 S/N 1111 were the averages of pre- (EG&G) and post-cruise (NRCC) coefficients and applied in DLAGAVZ as follows:

T = E+D*TRAW

where E = -0.0022 and D = 0.9999610. The differences between pre- and post- cruise temperature calibrations were 0.3 WC at O°C and 0.7 m°C at 30°C. No additional calibrations were applied in EPCTD92 and it was these downtrace temperature values that replaced uptrace temperature values in the CAL and subsequent bottle files.

Final temperature calibrations for CTD/02 S/N 1112 were pre-cruise (EG&G) coefficients, E = -0.00027 and D = 1.0000130, applied to uptrace data in CALMSTRW and downtrace data in DLAGAVZ. No additional temperature calibrations were applied in EPCTDW.

C.7.4.3 Conductivity

Because standard calibration strategies did not produce good results for CTD/02 S/N 1111, downtrace CTD conductivities were used for the calibration to water sample data. Program MATCH read _PCOR.CAL and EPCTD92 CTD files (raw, lagged, cell corrected conductivity) and matched up/down pressures. It then used downtrace calibrated P, calibrated T, and raw, lagged, cell corrected C to replace uptrace values in a _DOWN.CAL file:

1111_DOWN.CAL = raw P, cal P, cal T, raw C, OXC, OXT, SO, 02

LINCAL92 reads _DOWN.CAL and computes a linear least squares fit between raw CTD conductivity and bottle conductivity. LINCAL92 does not apply P or T calibrations and does not correct CTD conductivity for the cell dependence as this was already done on downtrace data in EPCTD92.

This cruise was divided into 9 groups and only bottles greater than 1500 db were used in the fits for CTD/02 S/N 1111 conductivity:

			LEG	BIAS	SLOPE	STD DEV	NPTS
1111AD_DOWN.CAL	= stations	6-11	1	0.0316455	0.999069	.0029	35
1111BD_DOWN.CAL	= station	12	1	-0.0073853	1.000197	.0028	9
1111CD_DOWN.CAL	= stations	13-18	1	-0.1287451	1.003862	.0021	82
1111DD_DOWN.CAL	= stations	19-36	1	-0.0424973	1.001208	.0016	239
1111ED_DOWN.CAL	= stations	37-42	1	-0.0689275	1.001992	.0020	75
1111FD_DOWN.CAL	= stations	47-55	1	-0.0210941	1.000546	.0018	98
1111GD_DOWN.CAL	= station	56	2	-0.1231067	1.003531	.0009	13
1111HD_DOWN.CAL	= stations	57-74	2	-0.0442417	1.000821	.0021	216
1111ID_DOWN.CAL	= stations	75-88	2	-0.0503203	1.000910	.0015	126

Additional conductivity offsets were applied to 15 casts. This was done by regridding the poorly calibrated cast and an adjacent well calibrated cast according to potential temperature using EPIC (Soreide et al., 1995) utility CTDGRID with the AKIMA (shape-preserving) cubic spline option. The range of potential temperature varied between pairs of casts but was usually the deepest common increment of 0.2°C. The grid size was 0.01°C. The mean difference in salinity between casts was computed using interactive program CTDDIFF. Then for each regridded scan of the poorly calibrated cast, a new conductivity was calculated using the value of salinity plus delta-salinity. The differences between the old and new conductivities were averaged using interactive program COMPUTE and added to the conductivity calibration bias applied:

POOR CAST	GOOD CAST	MEAN DELTA-S	MEAN DELTA-C	NAVG	THETA RANGE
9	10	.0048	.0033	10	1.50-1.70
14	16	-.0035	-.0029	12	1.13-1.28
15	16	-.0037	-.0030	12	1.13-1.28
18	19	.0013	.0011	7	1.10-1.20
24	23	-.0044	-.0036	12	1.10-1.25
54	55	-.0013	-.0011	18	1.05-1.25
57	59	.0014	.0012	17	1.00-1.20
58	59	.0022	.0018	17	1.00-1.20
61	59	-.0019	-.0015	14	1.00-1.20
64	55	-.0020	-.0016	15	1.05-1.25
65	55	-.0028	-.0023	18	1.05-1.25
68	67	-.0037	-.0030	13	1.12-1.28
73	75	-.0019	-.0016	18	1.07-1.27
74	75	-.0018	-.0015	18	1.07-1.27
84	82	-.0232	-.0189	17	1.39-1.59

CALMSTR92 reads _DOWN.CAL and the best fit conductivity coefficients from a command file. CALMSTR92 does not apply P or T calibrations and does not correct CTD conductivity for cell dependence as this was already done on downtrace data in EPCTD92. CALMSTR92 applies the computed conductivity calibrations and writes _DOWN.CLB and _DOWN.SEA (bottle data listing in WOCE format).

1111_DOWN.CLB = cal P, cal T, cal C, sal, SO, oxy, 02 etc.

CALMSTR92 computes CTD oxygen and applies oxygen calibration coefficients read from the .CAL file header (originally from CALIBO.DAT). EPICBOMSTRW reads CLB files and creates EPIC BOT bottle files:

CG092Bnnn.BOT = cal P, cal T, theta, SO, 02, sigma-t, sigma-theta

CTD-bottle conductivity differences used for the final fits are plotted against cast number to show the stability of the calibrated CTD conductivities relative to the bottle conductivities (Fig. 2 upper panel). The entire set of CTD-bottle conductivity differences are plotted against pressure to show the tight fit below 1000 m and the increasing scatter above 1000 in (Fig. 2 lower panel).

C.7.4.4 Oxygen

OXDWN2W reads _PCOR.CAL header for oxygen, pressure, and temperature calibration coefficients. These values must be the same as those applied to downtrace data in DLAGAVZ (i.e., CALIB.DAT). OXDWN2W reads _PCOR.CAL cast by cast and creates pressure, temperature, and bottle oxygen arrays. Pressure calibrations were not applied to CTD/02 S/N 1111 data as this was done by program PBIAS. Calibrations were however applied to temperature. OXDWN2W then reads an ASCII CTD file output from DLAGAVZ and searches it for matching up/down temperatures that must be within a pressure range of ±30 db to be used in the calibration. OXDWN2W replaces uptrace CTD P, T, OXC and OXT values with downtrace CTD P, T, OXC and OXT values. CTD oxygen is then computed using pre-cruise calibration coefficients from CAL header and written to the .CLO file:

1111_DOWN.CLO = cal P, cal T, OXC, OXT, bottle 02, CTD 02

Program WEIGHT was written to duplicate scans in the .CLO file where pressure was greater than 1000 db in an attempt to fit a balanced distribution of shallow and deep samples.

POXFITW reads .CLO and first omits scans where 1) the Weiss oxygen saturation value computed in OXDWN2W exceeds 10.0 ml/l, 2) bottle oxygen exceeds 1.2 times the Weiss oxygen saturation value, or 3) bottle oxygen is less than a minimum of .001 ml/l. POXFITW then determines CTD oxygen calibration coefficients by calculating a non-linear least-squares fit with 6 varying parameters: oxygen current slope, oxygen current bias, pressure correction, temperature correction, internal/external temperature weighting, and oxygen lag. Scans for which the difference in CTD and bottle oxygen is greater than 2.8 times the standard deviation are discarded and the function is minimized again. Iterations continue until no scans are thrown out. POXFITW writes an .REJ file of scans not used in the final fit and .PAR:

1111_DOWN.PAR = BOCI SOC, PCOR, TCOR, WT, OXLAG, STD DEV, NFIT

This cruise was divided into 8 groups and bottles greater than 1000 db were duplicated for CTD/02 S/N 1111 oxygen:

CASTS 5-7,	3 CASTS STD DEV=0.66592E-01			nscans 50	DOX=0.186
BIAS	SLOPE	PCOR	TCOR	WT	OXLAG
-0.008	3.526	0.1689E-03	-0.8151E-01	0.4738E+00	0.1216E+02
CASTS 8-22,	15 CASTS STD DEV=0.46418E-01			nscans 480	dox=O.130
BIAS	SLOPE	PCOR	TCOR	WT	OXLAG
0.010	3.373	0.1516E-03	-0.4973E-01	0.749 1 E+00	0.1263E+02
CASTS 23-27,	5 CASTS STD DEV=0.34275E-01			nscans 133	dox=0.096
BIAS	SLOPE	PCOR	TCOR	WT	OXLAG
0.016	3.439	0.1406E-03	-0.5283E-01	0.8348E+00	0.4187E+01
CASTS 29-36,	8 CASTS STD DEV=0.51974E-01			nscans 228	dox=O.146
BIAS	SLOPE	PCOR	TCOR	WT	OXLAG
0.012	3.269	0.1537E-03	-0.4090E-0I	0.9113E+00	0.2319E+00
CASTS 37-42,	6 CASTS STD DEV=0.57043E-01			nscans 171	dox=O.160
BIAS	SLOPE	PCOR	TCOR	WT	OXLAG
0.010	3.166	0.1595E-03	-0.3693E-01	0.6870E+00	0.8168E+01
CASTS 47-59,	12 CASTS STD DEV=0.97325E-01			nscans 375	dox=0.273
BIAS	SLOPE	PCOR	TCOR	WT	OXLAG
0.015	2.990	0.1643E-03	-0.3174E-01	0.7699E+00	0.3878E+00
CASTS 61-69,	9 CASTS STD DEV=0.48878E-01			nscans 302	dox=0.137
BIAS	SLOPE	PCOR	TCOR	WT	OXLAG
0.008	3.217	0.1594E-03	-0.3405E-01	0.7525E+00	0.2933E+00
CASTS 70-88,	19 CASTS STD DEV=0.46279E-01			nscans 626	dox=O.130
BIAS	SLOPE	PCOR	TCOR	WT	OXLAG
0.022	3.049	0.1650E-03	-0.3157E-01	0.6893E+00	0.5506E+00

CALOX2W reads .CLO and .PAR and applies the oxygen calibration coefficients. CALOX2W writes _PLOT.CLO for use with DOXW.PPC to verify the success of the calibration:

1111_PLOT.CLO = cal P, cal T, OXC, OXT, bottle 02,cal CTD 02

Final oxygen calibration coefficients were included in EPCTD92 command files for downtrace data. Oxygen spikes were individually removed from many traces using EPIC utility CTDINTERP.

CTDOXY was not included in the WOCE SEA file; only bottle oxygen data in µmol/kg. Program ADDTMP added oxygen pickling temperatures to the CAL file. CALMSTRW_02 was modified to 1) read the pickling temperatures as well, 2) if there was no pickling temperature, use potential temperature, 3) compute sigma using function SVAN (CTD salinity, pickling temperature, 0, sigma), 4) convert sigma to density: sigma/1000+1, and 5) convert bottle oxygens in ml/l to µmol/kg according to WOCE Hydrographic Operations and Methods (July 1991) section 3.3 Conversion of Volumetric to Weight Concentrations:

02 (µmol/kg-sw) = 44.660 * 02 (ml/l) / density sw

where the value 44.660 equals (1000/molar volume of oxygen gas at STP). Downtrace CTD oxygens are recorded in ml/l.

C.7.5 POST-CRUISE PROCESSING

VIOODnnn.EDT = raw P, raw T, raw C, sign, OXC, OXT

DPDNZ reads EDT and computes a running fall rate over ±30 scans. DPDNZ writes RECZ for record range and. DPZ:

VIOODnnn.DPZ = raw P, raw T, raw C, sign, OXC, OXT, dpdn

DLAGAVZ reads DPZ and applies calibrations read from CALIB.DAT:

1111 6 380						
-2.0048	.9968708	0.159752E-5	-0.1804412E-09	P	DN	AVG 93
-2.6546	.9938283	0.281344E-5	-0.2951405E-09	P	UP	AVG 93
-0.0022	.9999610	0.000000E-6	0.0000000E-10	T	68	AVG 93
-0.0107	1.0002100	0.000000E-6	0.0000000E-10	C		JUN 92
1112 6 380						
-0.18188	.9955384	0.194715E-5	-0.2006194E-09	P	DN	JUN 92
-0.18188	.9955384	0.194715E-5	-0.2006194E-09	P	UP	JUN 92
-0.00027	1.0000130	0.000000E-6	0.0000000E-10	T	68	JUN 92
-0.00036	1.0000150	0.000000E-6	0.0000000E-10	C		JUN 92
1114 6 380						
20.44148	.9949346	0.120144E-5	-0.828378E-10	P	DN	N0V 90
17.88878	.9924060	0.240110E-5	-0.201636E-09	P	UP	N0V 90
-0.00102	.9998243	0.000000E-6	0.000000E-10	T	68	N0V 90
-0.00309	.9998623	0.000000E-6	0.000000E-10	C		N0V 90

For this cruise, post-cruise pressure and temperature calibration coefficients were the averages of pre- (EG&G) and post-cruise (NRCC) values for CTD/02 S/N 1111.

1111 6 380 EG&G						
-0.0329	.9971750	0.155581E-5	-0.1791408E-09	P	DN	JUN 92
-0.1008	.9943933	0.259377E-5	-0.2747487E-09	P	UP	JUN 92
-0.0006	1.0000170	0.000000E-6	0.0000000E-10	T	68	JUN 92
1111 6 380 NRCC						
-3.9767	.9965666	0.163923E-5	-0.1817416E-09	P	DN	FEB 93
-5.2083	.9932633	0.303312E-5	-0.3155322E-09	P	UP	FEB 93
-0.0039	.9999050	0.000000E-6	0.0000000E-10	T	68	FEB 93

Conductivity coefficients applied in DLAGAVZ were pre-cruise. DLAGAVZ also lags conductivty as follows:

```
     DO 150 I=1,60
     XDATA(I,3)=(l-A)*XDATA(I,3)+A*Y(3)
  150 Y(3)=XDATA(I,3)
```

where XDATA(I,3) is calibrated conductivity and A=0.87. Pre-cruise calibrations are then backed off for raw, lagged conductivity. DLAGAVZ writes an ASCILCTD file:

CGOnnn.CTD = cal P, cal T, OXC, OXT, raw, lagged C

EPCTDW reads the ASCII .CTD and looks to its command file for additional calibrations to apply to P (none), T (none), and C (from LINCALW). EPCTDW corrects conductivity for cell material (alumina) deformation dependence on P and T as follows:

CC = CR *(1-alpha* (DATA(2,L)-15.)+beta *(DATA (I,L)/3.))

where DATA(1,L) is pressure, DATA(2,L) is temperature, alpha = 6.5E-06 and beta = 1.5E-08. EPCTDW also reads default oxygen coefficients from its command file. EPCTDW writes EPIC .CTD:

CG092Cnnn.CTD = cal P, cal T, raw, lagged, corrected C, cal 0

EPCTD92 reads ASCII .CTD and looks to an EPCTD92 command file for additional calibrations to apply to P (none), T (none), C (from LINCAL92), and O (from POXFITW). EPCTD92 corrects conductivity for the cell's dependence on P and T as follows:

CC = CR* (I -alpha* (DATA(2,L)-2.8)+beta* (DATA(l,L)-3000.)

where DATA(1,L) is pressure, DATA(2,L) is temperature, alpha = 6.5E-06 and beta = -1.3E-07. EPCTD92 writes to EPIC .CTD:

CG092Cnnn.CTD = cal P, cal T, cal C, cal 0

EPCTD92 CTD files were searched by conductivity calibration program MATCH for downtrace P, T, and C values at matching uptrace T values within a matching pressure range of ±30 db. Note that station 40 CTD downtrace is missing 0-29 db and station 88 is missing 0-55 db. Therefore 5 bottle stops had no match.

A few casts used a modified version of EPCTD92 where the beta term differed from the majority. For cast 12, EPCTD92_12 used beta = -1.OE-07. For cast 56, EPCTD92_56 used beta = -1.7E-07. And for cast 84, EPCTD92_84 used beta = 1OE-07. Also, casts 2, 4, and 5 used EPCTDW with the old cell correction algorithm and normal beta term.

Salinity and other standard variables were computed and the final EPIC CTD files were added to PMEL's data base and used to produce data report plots and listings. The station depth given in an EPIC header is the corrected PDR bottom depth when available. The nominal sound speed of the pinger was 1463 m/s and had to be corrected to 1500 m/s post-cruise according to Matthews' Tables (Carter, 1980). PDR depths were then corrected for regional variations in sound speed according to Matthews' Tables. The depth scale for fathometer in meters used was 1 fathom = 1.8288 meters.

C.7.6. DATA PRESENTATION

The final calibrated data in EPIC format were used to produce the plots and listings which follow. The majority of the plots were produced using Plot Plus Scientific Graphics System (Denbo, 1992). Tables 2-6 define the abbreviations and units used in the CTD/02 data summary listings. Vertical sections of potential temperature, salinity, and CTD oxygen are contoured with pressure as the vertical axis and latitude as the horizontal axis (Figs. 3-5). Nominal vertical exaggerations are 500:1 below 1000 db (lower panels) and 1250:1 above 1000 db (upper panels). Plots and summary listings of the CTD/02 data follow for each cast. All sample salinity and oxygen values are given including bad values, which are not flagged in this report. Hydrographic bottle data at discrete depths are listed in the final section.

C.7.8. ACKNOWLEDGMENTS

The assistance of the officers and crew of the USC ship John Vickers is gratefully acknowledged. Funds for the CTD/O2 program were provided to PMEL by the Climate and Global Change program under NOAA's Office of Global Programs.

C.7.9. REFERENCES

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C.7.10 FIGURE LEGENDS

Figure 1. CTD station locations made on the R/V Vickers from 7 August to 17 October, 1992.

Figure 2. Calibrated CTD-bottle conductivity (mmho/cm) differences plotted against cast number (upper panel). Calibrated CTD-bottle conductivity (mmho/cm) differences plotted against pressure (lower panel).

Figure 3. Potential temperature (°C) section along 165°E. Contour intervals are 0.2°C from 0-3°C, 0.5°C from 3-5°C, and I'C from 5-35°C in the upper panel. Contour intervals are 0. 1 °C from 0-2°C, 0.2°C from 2-3°C, 0.5°C from 3-5°C in the lower panel.

Figure 4. Salinity (psu) section along 165°E. Contour intervals are 0.1 psu from 34.0-34.5 psu, 0.05 psu from 34.5-34.6 psu, and 0.1 psu from 34.6-37.0 psu in the upper panel. Contour intervals are 0. 1 psu from 34.0-34.5 psu, 0.05 psu from 34.5-34.6 psu, and 0.0 1 psu from 34.6-34.8 psu in the lower panel.

Figure 5. CTD oxygen (ml/l) section along 165°E. Contour intervals are 0.5 ml/l in the upper panel and 0.2 ml/l in the lower panel.

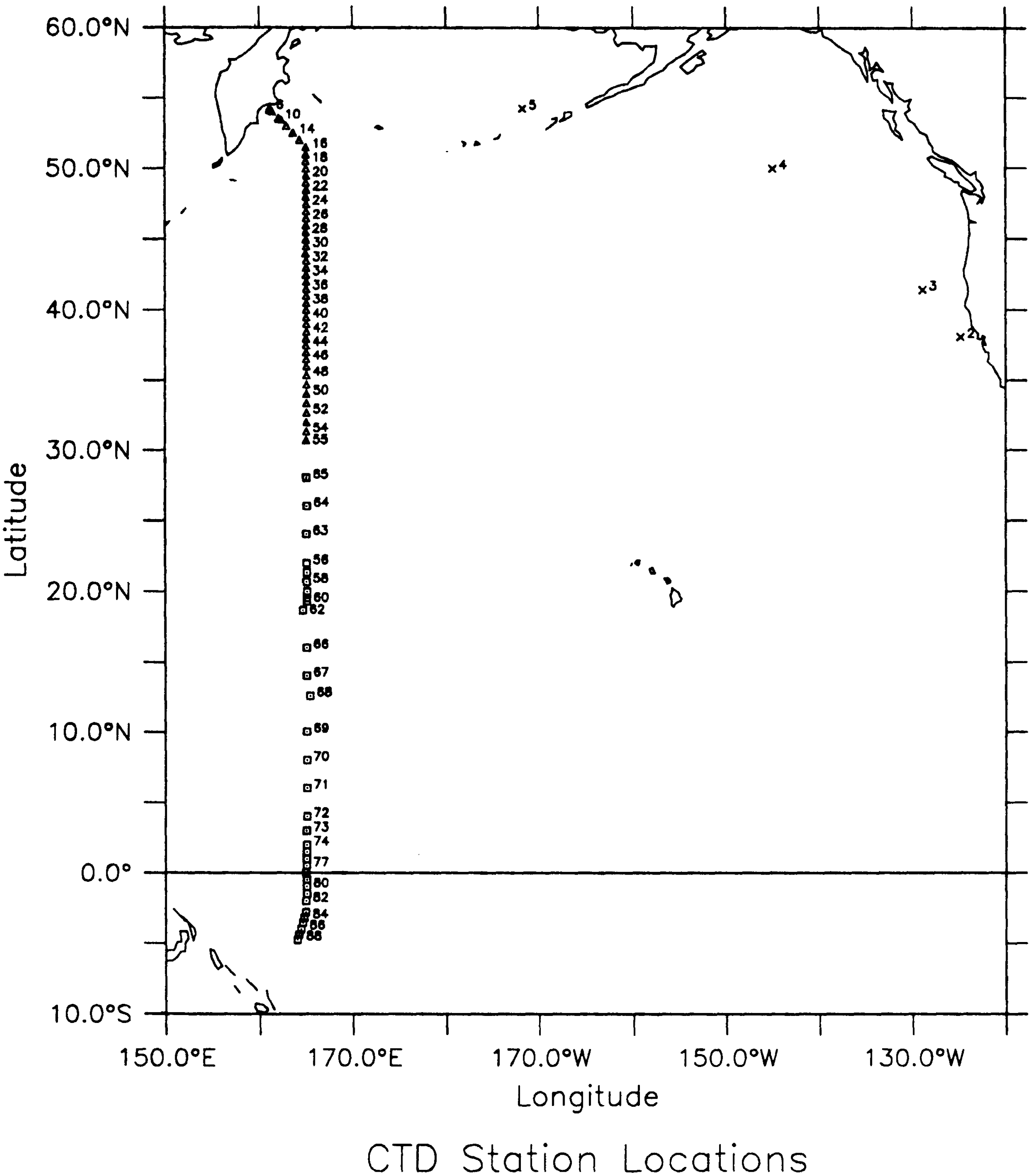

Figure 1. CTD station locations made on the R/V *Vickers* from 7 August to 17 October, 1992.

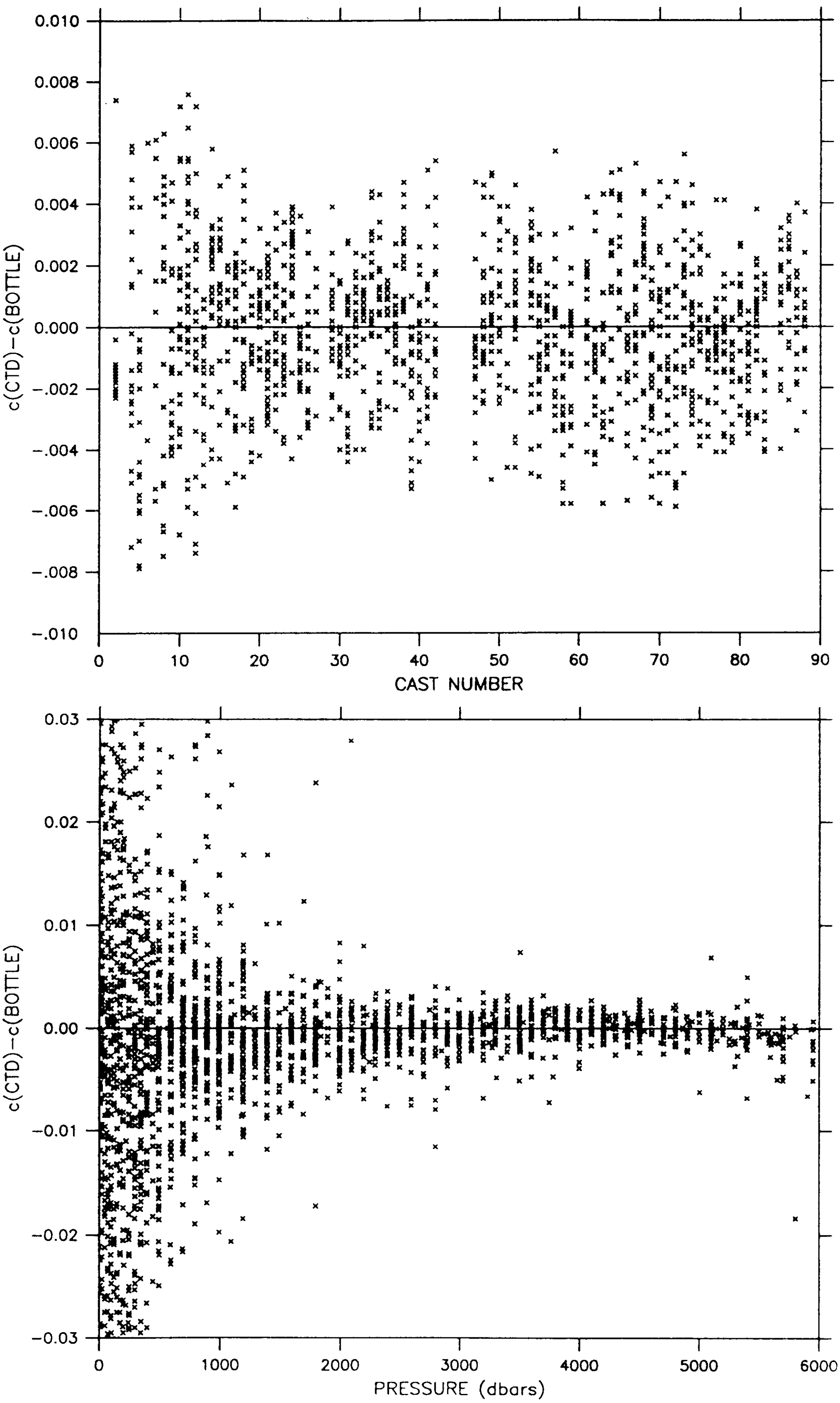

Figure 2. Calibrated CTD-bottle conductivity (mmho/cm) differences plotted against cast number (upper panel). Calibrated CTD-bottle conductivity (mmho/cm) differences plotted against pressure (lower panel).

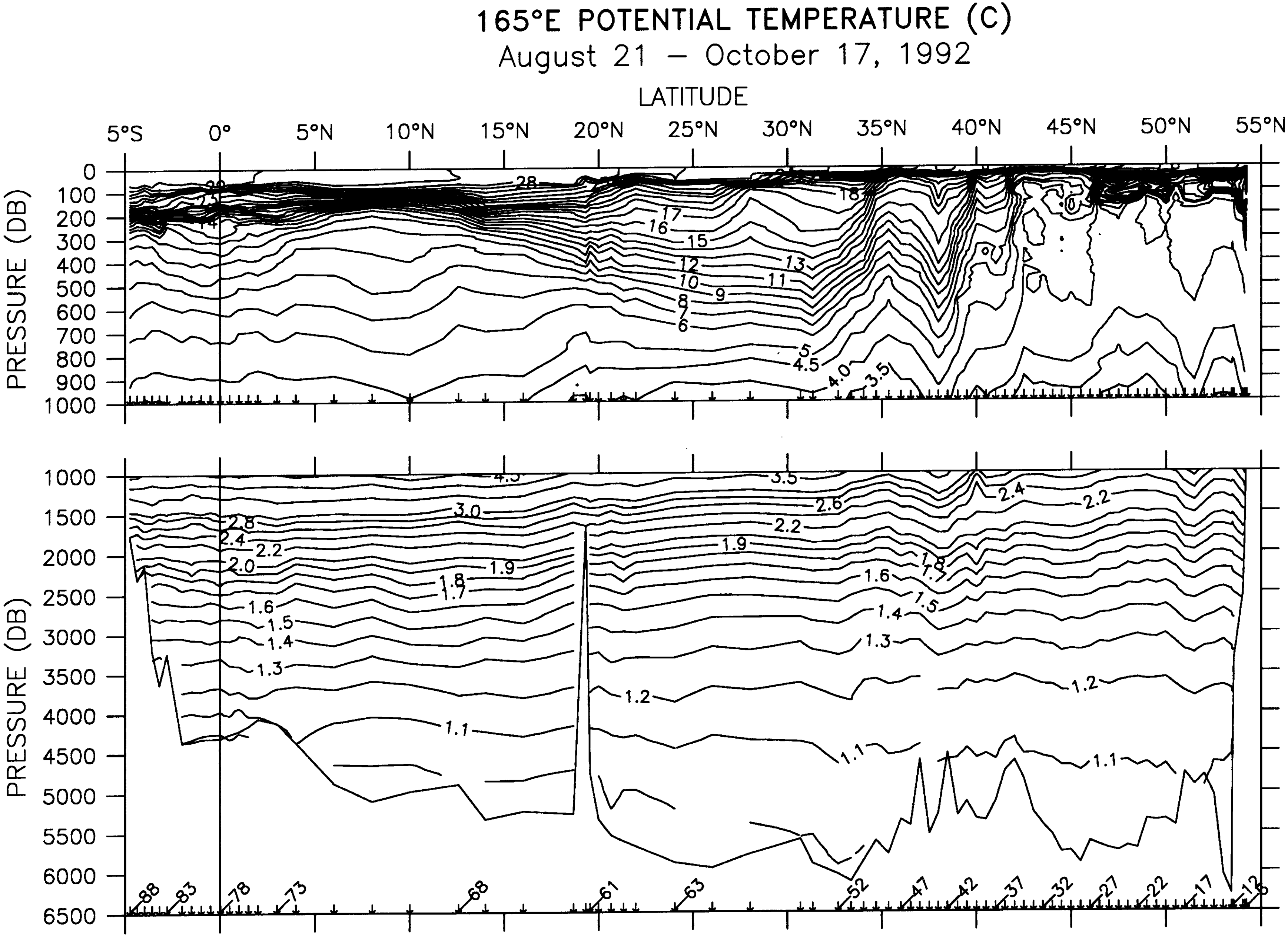

Figure 3. Potential temperature (°C) section along 165°E. Contour intervals are 0.2°C from 0–3°C, 0.5°C from 3–5°C, and 1°C from 5–35°C in the upper panel. Contour intervals are 0.1°C from 0–2°C, 0.2°C from 2–3°C, 0.5°C from 3–5°C in the lower panel.

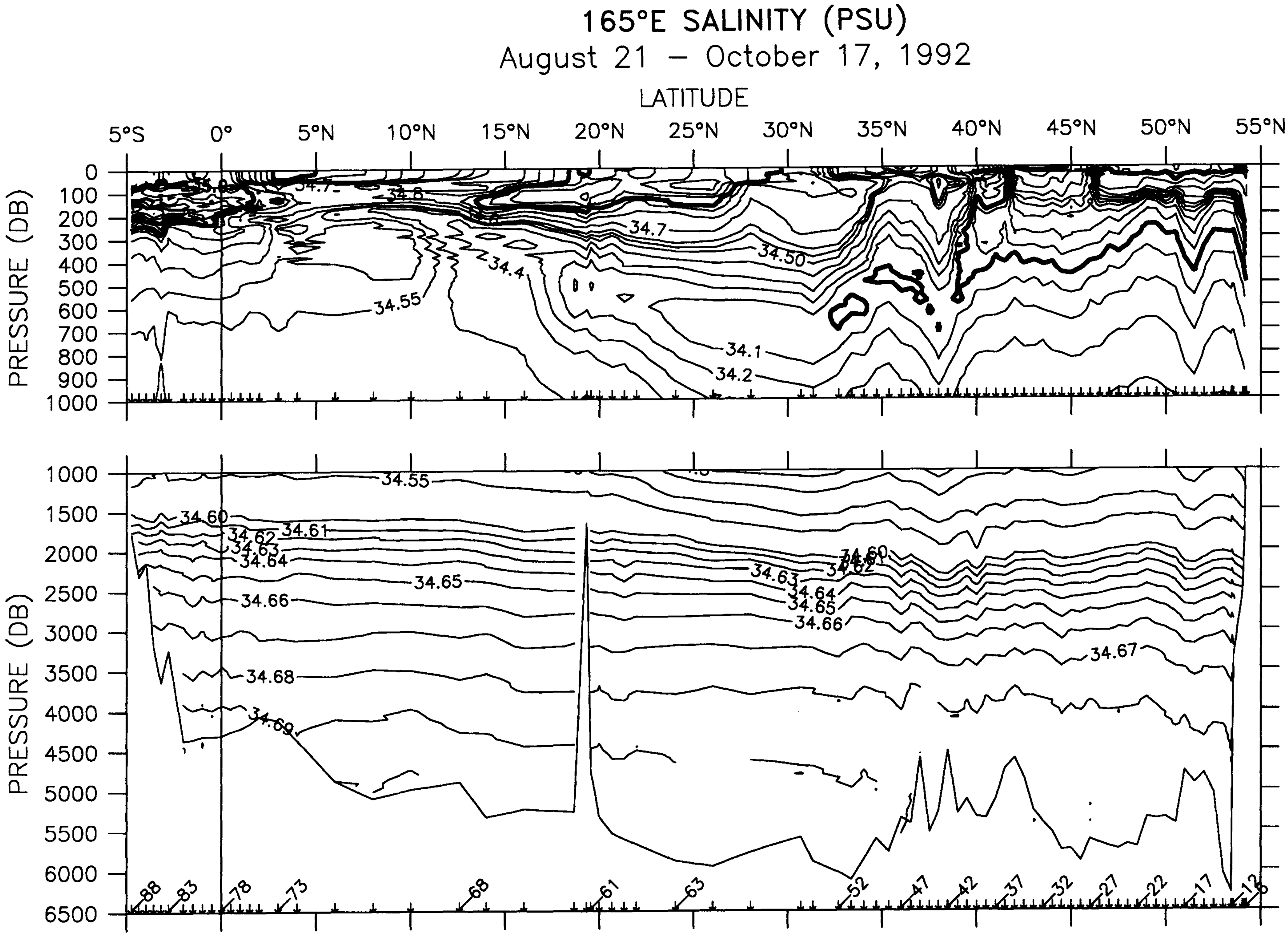

Figure 4. Salinity (psu) section along 165°E. Contour intervals are 0.1 psu from 34.0–34.5 psu, 0.05 psu from 34.5–34.6 psu, and 0.1 psu from 34.6–37.0 psu in the upper panel. Contour intervals are 0.1 psu from 34.0–34.5 psu, 0.05 psu from 34.5–34.6 psu, and 0.01 psu from 34.6–34.8 psu in the lower panel.

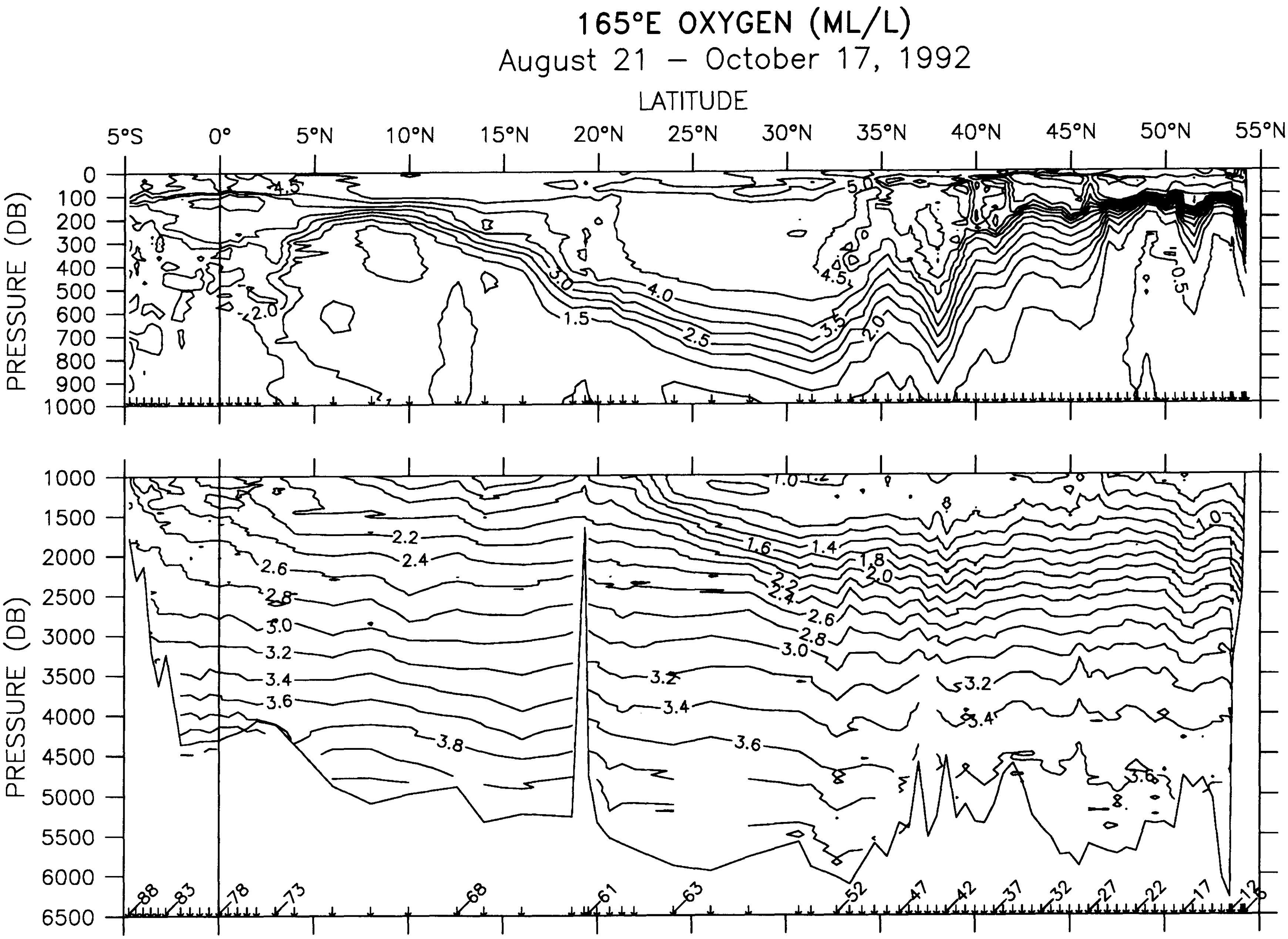

Figure 5. CTD oxygen (ml/l) section along 165°E. Contour intervals are 0.5 ml/l in the upper panel and 0.2 ml/l in the lower panel.

C.7.11 TABLES

Table 1. CTD cast summary.

STN #	CAST #	LATITUDE	LONGITUDE	DATE	TIME	W/D T	W/S (kts)	DEPTH* (m)	SST (C)	CAST (db)
1	1	36 37.8N	123 13.5W	7 AUG 92	442	323	18	3250	16.2	1997
2	2	38 4.7N	124 49.9W	7 AUG 92	2207	295	15	3805	16.9	3503
3	3	41 25.7N	128 52.2W	8 AUG 92	2332	313	10	3154	18.7	2500
4	4	49 59.0N	144 59.0W	11 AUG 92	2218	222	14	4165	13.0	4288
5	5	54 14.7N	171 44.6W	17 AUG 92	2024	142	30	3234	8.2	3309
6	6	54 14.7N	161 6.0E	21 AUG 92	640	322	17		9.5	202
7	7	54 13.1N	161 8.0E	21 AUG 92	827	573			9.2	504
8	8	54 7.7N	161 9.8E	21 AUG 92	1114	296	22		8.7	1817
9	9	54 2.6N	161 22.0E	21 AUG 92	1531	297	14		9.3	2600
10	10	53 33.4N	162 3.7E	21 AUG 92	2250	225	5	3450	10.2	3529
11	11	53 29.0N	162 10.4E	22 AUG 92	443	160	3		10.3	4704
12	12	53 26.5N	162 22.4E	23 AUG 92	39	222	14		10.6	4777
13	13	53 1.2N	162 53.8E	23 AUG 92	931	250	16		10.2	5949
14	14	52 31.3N	163 35.2E	23 AUG 92	1940	236	30	5190	10.0	5252
15	15	52 0.9N	164 17.3E	24 AUG 92	833	231	20	4913	9.9	5004
16	16	51 29.7N	164 59.1E	24 AUG 92	1828	234	19		9.6	4858
17	17	50 59.1N	164 57.7E	25 AUG 92	205	336	16	4845	9.5	4782
18	18	50 30.8N	164 57.2E	25 AUG 92	942	276	16	5597	9.8	5670
19	19	49 59.1N	165 0.1E	25 AUG 92	1738	310	13	5515	9.5	5581
20	20	49 30.1N	165 0.7E	26 AUG 92	102	347	6	5515	9.9	5619
21	21	48 59.6N	164 58.2E	26 AUG 92	853	252	2	5500	10.1	5669
22	22	48 29.9N	165 1.0E	26 AUG 92	1627	280	7	5873	10.4	5949
23	23	47 59.4N	165 0.1E	26 AUG 92	2356	288	9	5850	10.7	5949
24	24	47 30.1N	165 0.2E	27 AUG 92	740	260	15	5905	10.8	5947
25	25	46 59.8N	164 59.2E	27 AUG 92	1520	289	15	5873	11.7	5949
26	26	46 30.0N	165 1.1E	27 AUG 92	2247	295	17	5832	12.4	5947
27	27	46 0.2N	165 0.0E	28 AUG 92	616	300	10	5782	13.4	5902
28	28	45 29.8N	164 58.7E	28 AUG 92	1641	25	4		13.2	5003
29	29	44 59.4N	164 58.8E	30 AUG 92	1744	280	15	5908	12.9	5950
30	30	44 29.7N	165 0.6E	31 AUG 92	124	250	14	5919	14.1	5948
31	31	44 0.2N	164 57.8E	31 AUG 92	847	251	4	5689	14.0	5803
32	32	43 30.2N	165 1.1E	31 AUG 92	1612	200	8	5564	15.0	5658
33	33	43 0.5N	165 0.0E	31 AUG 92	2322	171	12	5409	15.5	5517
34	34	42 29.9N	164 59.4E	1 SEP 92	611	159	13	5008	15.7	5076
35	35	42 0.7N	165 1.9E	1 SEP 92	1300	180	17	4730	16.8	4922
36	36	41 29.8N	165 0.5E	1 SEP 92	2040	172	22		18.8	4861
37	37	41 1.3N	164 59.4E	2 SEP 92	429	170	22	5287	19.0	5361
38	38	40 30.4N	165 0.6E	2 SEP 92	1323	252	13	5512	19.7	5600
39	39	40 0.9N	165 0.2E	2 SEP 92	2107	104	2	5497	19.5	5576
40	40	39 29.7N	165 1.1E	3 SEP 92	459	285	8	5264	21.4	5325
41	41	39 1.2N	165 1.2E	3 SEP 92	1229	189	12	5449	21.7	5488
42	42	38 28.8N	165 2.4E	3 SEP 92	2023	190	19	4658	22.0	4676
43	43	37 59.4N	165 0.4E	4 SEP 92	1119	196	26		22.0	4702
44	44	37 30.9N	165 1.1E	4 SEP 92	1924	190	20		21.3	3401

Table 1. CTD cast summary (continued)

STN #	CAST #	LATITUDE	LONGITUDE	DATE	TIME	W/D T	W/S (kts)	DEPTH* (m)	SST (C)	CAST (db)
45	45	37 0.9N	164 59.9E	5 SEP 92	357	188	17		21.7	4551
46	46	36 31.8N	165 0.4E	5 SEP 92	1307	182	14	5574	22.8	5628
47	47	36 0.8N	165 0.5E	5 SEP 92	2136	232	12	5501	23.2	5594
48	48	35 21.6N	165 0.7E	6 SEP 92	646	148	15		25.3	4710
49	49	34 42.0N	165 3.2E	6 SEP 92	1548	145	20		26.0	5649
50	50	34 2.5N	165 3.2E	7 SEP 92	224	129	15		26.6	5751
51	51	33 22.6N	165 0.9E	7 SEP 92	1454	118	14	6288	26.5	5949
52	52	32 41.9N	165 1.5E	8 SEP 92	153	128	16	6247	26.8	6116
53	53	32 0.0N	165 0.4E	8 SEP 92	1343	109	18		27.2	2196
54	54	31 19.6N	164 59.1E	9 SEP 92	1322	90	17	6053	27.1	5916
55	55	30 41.3N	164 58.5E	10 SEP 92	26	75	22		27.3	5581
56	56	21 58.0N	165 0.6E	30 SEP 92	1259	34	15		27.6	5353
57	57	21 19.2N	165 0.5E	30 SEP 92	2213	20	15	5773	27.6	5690
58	58	20 39.9N	164 59.2E	1 OCT 92	742	313	6	5698	28.5	5633
59	59	19 59.3N	165 0.3E	1 OCT 92	1645	295	15	5491	28.6	5415
60	60	19 18.9N	165 0.4E	2 OCT 92	40					1670
61	61	19 32.2N	165 2.2E	2 OCT 92	1332	210	20		28.7	4548
62	62	18 39.9N	164 35.9E	2 OCT 92	2329	209	15	5403	28.8	5150
63	63	24 2.6N	164 59.1E	4 OCT 92	811	155	20		27.1	5705
64	64	26 1.7N	165 3.9E	5 OCT 92	502	155	18		26.4	4402
65	65	28 2.0N	165 0.0E	5 OCT 92	2159	153	21	5925	26.1	5544
66	66	16 0.5N	164 59.5E	8 OCT 92	1448	82	24	5388	28.6	5112
67	67	14 0.5N	164 59.4E	9 OCT 92	700	160	18	5477	28.9	5317
68	68	12 35.3N	165 22.0E	9 OCT 92	2329	88	27	5024	28.9	4758
69	69	10 0.5N	165 0.1E	10 OCT 92	2001	185	16	5106	29.2	5139
70	70	8 0.2N	165 0.3E	11 OCT 92	1050	180	7	5229	29.6	5262
71	71	6 0.2N	165 1.1E	12 OCT 92	126	45	5	5005	29.9	4939
72	72	4 0.1N	165 0.3E	12 OCT 92	1502	95	10	4480		4486
73	73	3 0.1N	164 59.6E	12 OCT 92	2349	100	14	4228	29.8	4279
74	74	1 59.8N	164 59.4E	13 OCT 92	807	80	10	4173	30.0	4225
75	75	1 30.2N	164 59.2E	13 OCT 92	1451	65	10	4264		4308
76	76	1 0.0N	164 59.2E	13 OCT 92	2102	80	7	4326	30.2	4377
77	77	0 30.3N	164 59.0E	14 OCT 92	330	95	6	4366	30.5	4423
78	78	0 1.4N	164 54.4E	14 OCT 92	1605	300	7	4315	30.1	4431
79	79	0 29.9S	164 59.9E	14 OCT 92	2150	261	10	4424	29.9	4483
80	80	0 59.5S	164 59.6E	15 OCT 92	410	174	12	4430	30.2	4487
81	81	1 29.9S	164 59.2E	15 OCT 92	1054	210	10	4454	30.1	4501
82	82	1 59.8S	164 55.5E	15 OCT 92	1716	200	16	4479	30.5	4519
83	83	2 47.8S	164 54.8E	16 OCT 92	137	132	15	3329	30.1	3277
84	84	3 11.4S	164 43.6E	16 OCT 92	725	161	14	3728	30.2	3782
85	85	3 34.3S	164 32.4E	16 OCT 92	1306	30	17	3292	30.2	3320
86	86	3 58.5S	164 21.5E	16 OCT 92	1752	20	15	2195	30.2	2225
87	87	4 21.6S	164 10.4E	16 OCT 92	2231	46	14	2372	30.1	2392
88	88	4 44.9S	164 0.2E	17 OCT 92	312	152	11	1834	29.9	1836

For stations 51 through 68, bottom depths are suspected to be deep by an average of 138 m owing to PDR problems (see text).

TABLE 2. Weather condition code used to describe each set of CTD measurements.

Code	Weather Condition
0	Clear (no cloud)
I	Partly cloudy
2	Continuous layer(s) of cloud(s)
3	Sandstorm, dust storm, or blowing snow
4	Fog, thick dust or haze
5	Drizzle
6	Rain
7	Snow, or rain and snow mixed
8	Shower(s)
9	Thunderstorms

TABLE 3. Sea state code used to describe each set of CTD measurements.

Code	Height (meters)	Description
0	0	Calm-glassy
1	0-0.1	Calm-rippled
2	0.1-0.5	Smooth-wavelet
3	0.5-1.25	Slight
4	1.25-2.5	Moderate
5	2.5-4	Rough
6	4-6	Veryrough
7	6-9	High
8	9-14	Veryhigh
9	>14	Phenomenal

TABLE 4. Visibility code used to describe each set of CTD measurements.

Code	Visibility
0	<50 meters
1	50-200 meters
2	200-500 meters
3	500-1,000 meters
4	1-2 km
5	2-4 km
6	4-10 km
7	10-20 km
8	20-50 km
9	50 km or more

TABLE 5. Cloud type.

Code	Cloud Types
0	Cirrus
I	Cirrocumulus
2	Cirrostratus
3	Altocumulus
4	Altostratus
5	Nimbostratus
6	Stratocumulus
7	Stratus
8	Cumulus
9	Cumulonimbus
X	Clouds not visible

TABLE 6. Cloud amount.

Code	Cloud Amount
0	0
1	1/10 or less but not zero
2	2/10-3/10
3	4/10
4	5/10
5	6/10
6	7/10-8/10
7	9/10
8	10/10
9	Sky obscured or not determined

D. ACKNOWLEDGMENTS

Funds for shiptime and measurement programs were supplied by NOAA's Climate and Global Change Program (NOAA-C&GC). Funds for the nutrient measurement program was supplied by the US National Science Foundation and NOAA-C&GC.

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Warner, M. W., J.L. Bullister, D.P. Wisegarver, R.H. Gammon and R.F. Weiss, Basin wide Distributions of Chlorofluorocarbons CFC-11 and CFC-12 in the North Pacific: 1985-1989, (submitted to J. Geophysical Research)

F. WHPO SUMMARY

Several data files are associated with this report. They are the
3220CGC92_0.sum, 3220CGC92_1.sum, and 3220CGC92_2.sum,
3220CGC92_0.hyd, 3220CGC92_1.hyd, and 3220CGC92_2.hyd,
3220CGC92_0.csl, 3220CGC92_1.csl, and 3220CGC92_2.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 3220CGC92_0wct.zip, 3220CGC92_1wct.zip, and 3220CGC92_2wct.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) 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 coriolis 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.

G. DATA QUALITY EVALUATION

G.1 AMS 14C DQE

(Robert M. Key and Paul D. Quay)

1997 JUN 01

G.1.1.0 General Information

WOCE cruise P13N was s carried out aboard the R/V John Vickers in the northwestern Pacific Ocean. The WHPO designation for this cruise was 3220CGC92. John Bullister and John Taft, both of NOAA-PMEL were the chief scientists for leg 1 and leg 2, respectively. Leg 1 departed Dutch Harbor, Alaska on August 16, 1992 and ended on September 15, 1992 at Kwajalein. The second leg departed Kwajalein on September 26, 1992 and ended at Noumea, New Caledonia on October 21, 1992. Together the two legs made a meridional section along 165°E from approximately 55°N to 5°S. The reader is referred to cruise documentation provided by the chief scientists as the primary source for cruise information. This report covers details of the small volume radiocarbon samples. The AMS station locations are shown in Figure 1 and summarized in

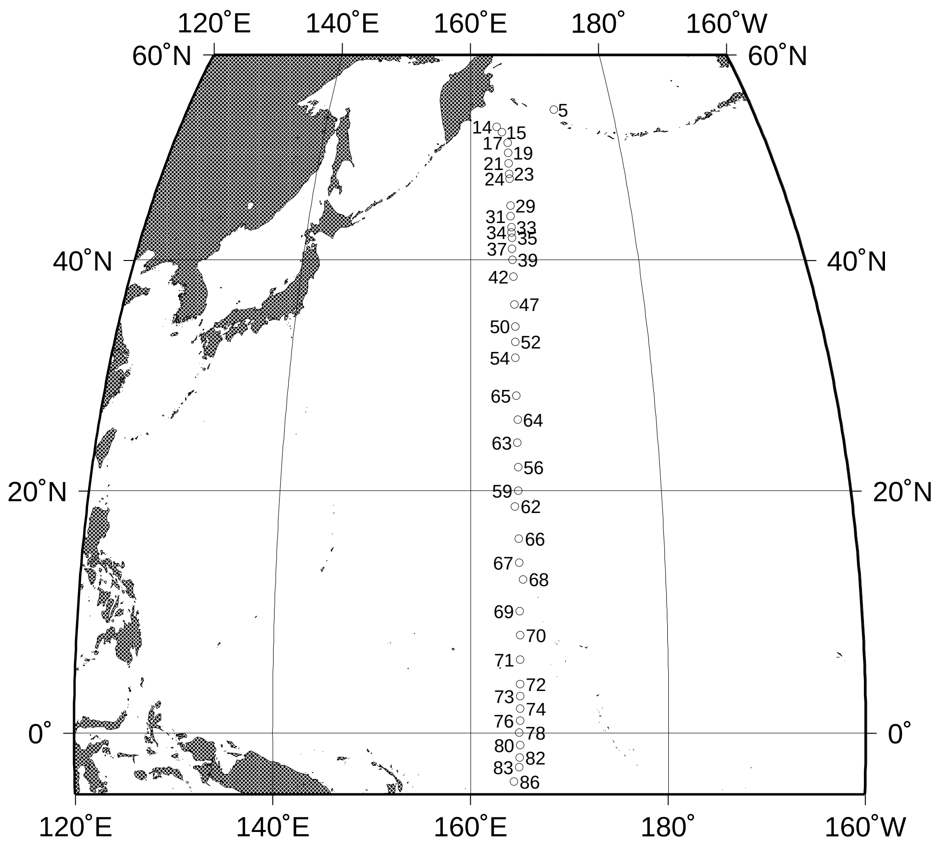

Figure 1: AMS ^{14}C station locations for WOCE P13N.

Table 1. A total of 783 $\Delta^{14}C$ samples were collected including 30 profiles plus additional surface water samples.

Table 1: AMS Station Locations

Station	Date	Latitude	Longitude	Bottom Depth (m)
5	8/17/92	54.245	171.744	3269
14	8/23/92	52.522	163.587	5153
19	8/25/92	49.985	165.002	5472
24	8/27/92	47.501	165.003	5827
29	8/30/92	44.991	164.981	5830
34	9/1/92	42.499	164.990	4987
39	9/2/92	40.015	165.003	5470
47	9/5/92	36.013	165.008	5490
50	9/7/92	34.042	165.053	6070
54	9/9/92	31.326	164.984	5847
56	9/30/92	21.967	165.010	5264
59	10/1/92	19.988	165.005	5325
63	10/4/92	24.042	164.985	5403
64	10/5/92	26.018	165.064	4237
65	10/5/92	28.034	164.999	5732
66	10/8/92	16.009	164.992	5224
67	10/9/92	14.008	164.990	5308
68	10/9/92	12.590	165.367	4879
69	10/10/92	10.008	165.002	5059
70	10/11/92	8.014	165.021	5179
71	10/12/92	6.003	165.018	4864
72	10/12/92	4.001	165.005	4425
73	10/12/92	3.002	164.993	4222
74	10/13/92	1.996	164.99	4170
76	10/13/92	1.000	164.987	4316
78	10/14/92	0.024	164.908	4369
80	10/15/92	-0.991	164.994	4422
82	10/15/92	-1.997	164.925	4457
83	10/16/92	-2.797	164.913	3255
86	10/16/92	-3.975	164.358	2207

G.1.2.0 Personnel

^{14}C sampling for this cruise was carried out by B. Salem and S. King from U. Washington. ^{14}C analyses were performed at the National Ocean Sciences AMS Facility (NOSAMS) at Woods Hole Oceanographic Institution. Salinity (D. Greeley) and oxygen (K. Hargraves) were analyzed by PMEL and nutrients by U. South Florida (E. H. Rutherford). ^{13}C analyses were run in P. Quay's lab (U. Washington). Key collected the data from the originators, merged the files, assigned quality control flags to the ^{14}C and submitted the data files to the WOCE office (5/97). Paul Quay is P.I. for the ^{13}C and ^{14}C data.

G.1.3.0 Results

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

G.1.3.1 Hydrography

Hydrography from this leg has been submitted to the WOCE office by the chief scientist and described in the hydrographic report (WHPO, 1996).

G.1.3.2 ^{14}C

The $\Delta^{14}C$ values reported here were originally distributed in two data reports (NOSAMS, July 31, 1995 & March 3, 1997). Those reports included preliminary results which had not been through the WOCE quality control procedures. This report supersedes those data distributions.

Almost all of the AMS samples from this cruise have been measured. Replicate measurements were made on 14 water samples. These replicate analyses are tabulated in Table 2. The

Table 2: Summary of Replicate Analyses

Sta-Cast-Bottle	$\Delta^{14}C$	Err	E.W.Mean[a]	Uncertainty[b]
24-1-22	-165.9	2.7	-172.3	7.8
	-177.0	2.3		
34-1-21	-152.1	2.8	-148.4	5.8
	-143.9	3.1		
56-1-23	4.8	3.4	0.6	5.4
	-2.8	3.1		
64-1-22	42.5	4.0	45.8	2.7
	45.5	3.0		
	47.9	2.9		
67-1-23	-146.7	3.0	-135.5	14.6
	-126.0	2.7		
71-1-20	-121.0	2.6	-120.2	1.8
	-119.3	2.6		
72-1-21	-115.7	2.7	-112.6	6.3
	-106.8	3.7		
73-1-18	-104.1	2.8	-99.0	6.6
	-94.7	2.5		
74-1-22	-89.5	3.2	-90.5	2.0
	-91.2	2.7		
76-1-21	-75.8	2.4	-74.4	5.6
	-67.9	5.3		
78-1-22	-85.7	3.2	-82.5	4.5
	-79.3	3.2		

Table 2: Summary of Replicate Analyses

Sta-Cast-Bottle	$\Delta^{14}C$	Err	E.W.Mean[a]	Uncertainty[b]
80-1-22	-80.6	3.0	-80.8	2.0
	-81.0	2.8		
82-1-22	-86.5	3.5	-84.1	3.8
	-81.1	3.8		
83-1-22	-84.2	2.4	-91.8	5.2
	-94.4	2.5		
	-92.7	3.1		
	-94.0	3.3		
	-98.0	3.3		

a. Error weighted mean reported with data set

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

table shows the error weighted mean and uncertainty for each set of replicates. Uncertainty is defined here as the larger of the standard deviation and the error weighted standard deviation of the mean. For these replicates, the simple average of the normal standard deviations for the replicates is 4.8‰ (equal weighting for each set regardless of the number of replicates in the set). This precision estimate is approximately correct for the time frame over which these samples were measured (Jun. 1994 - Aug. 1996). Note that the errors given for individual measurements in the final data report (with the exception of the replicates) include only counting errors, and errors due to blanks and backgrounds. The uncertainty obtained for replicate analyses is an estimate of the true error which includes errors due to sample collection, sample degassing, *etc*. For a detailed discussion of this see Key (1996).

G.1.4.0 Quality Control Flag Assignment

Quality flag values were assigned to all $\Delta^{14}C$ measurements using the code defined in Table 0.2 of WHP Office Report WHPO 91-1 Rev. 2 section 4.5.2. (Joyce, *et al.*, 1994). Measurement flags values of 2, 3, 4, 5 and 6 have been assigned. The choice between values 2 (good), 3 (questionable) or 4 (bad) involves some interpretation. There is little overlap between this data set and any existing ^{14}C data, so that type of comparison was difficult. In general the lack of other data for comparison led to a more lenient grading on the ^{14}C data.

When using this data set for scientific application, any ^{14}C datum which is flagged with a “3” should be carefully considered. My subjective opinion is that any datum flagged “4” should be disregarded. When flagging ^{14}C data, the measurement error was taken into consideration. That is, approximately one-third of the ^{14}C measurements are expected to deviate from the true value by more than the measurement precision (~4.7‰). No measured values have been removed from this data set, therefore a flag value of 5 implies that the sample was totally lost somewhere between collection and analysis or that the measurement has not yet been reported. Table 3 summarizes the quality control flags assigned to this data set. For a detailed description of the flagging procedure see Key, *et al*. (1996). The number of samples flagged 5 (128) is exceptionally large for

Table 3: Summary of Assigned Quality Control Flags

Flag	Number
2	619
3	17
4	5
5	128
6	14

this cruise. There are a few samples which have not been completed, but the majority of these samples were lost in processing with the major factor being breakage of the gas ampules during shipment between Seattle and Woods Hole.

G.1.5.0 Data Summary

Figures 2-5 summarize the $\Delta^{14}C$ data collected on this leg. Only $\Delta^{14}C$ measurements with a quality flag value of 2 (“good”) or 6 (“replicate”) are included in each figure. Figure 2 shows the $\Delta^{14}C$ values with 2σ error bars plotted as a function of pressure. The mid depth $\Delta^{14}C$ minimum

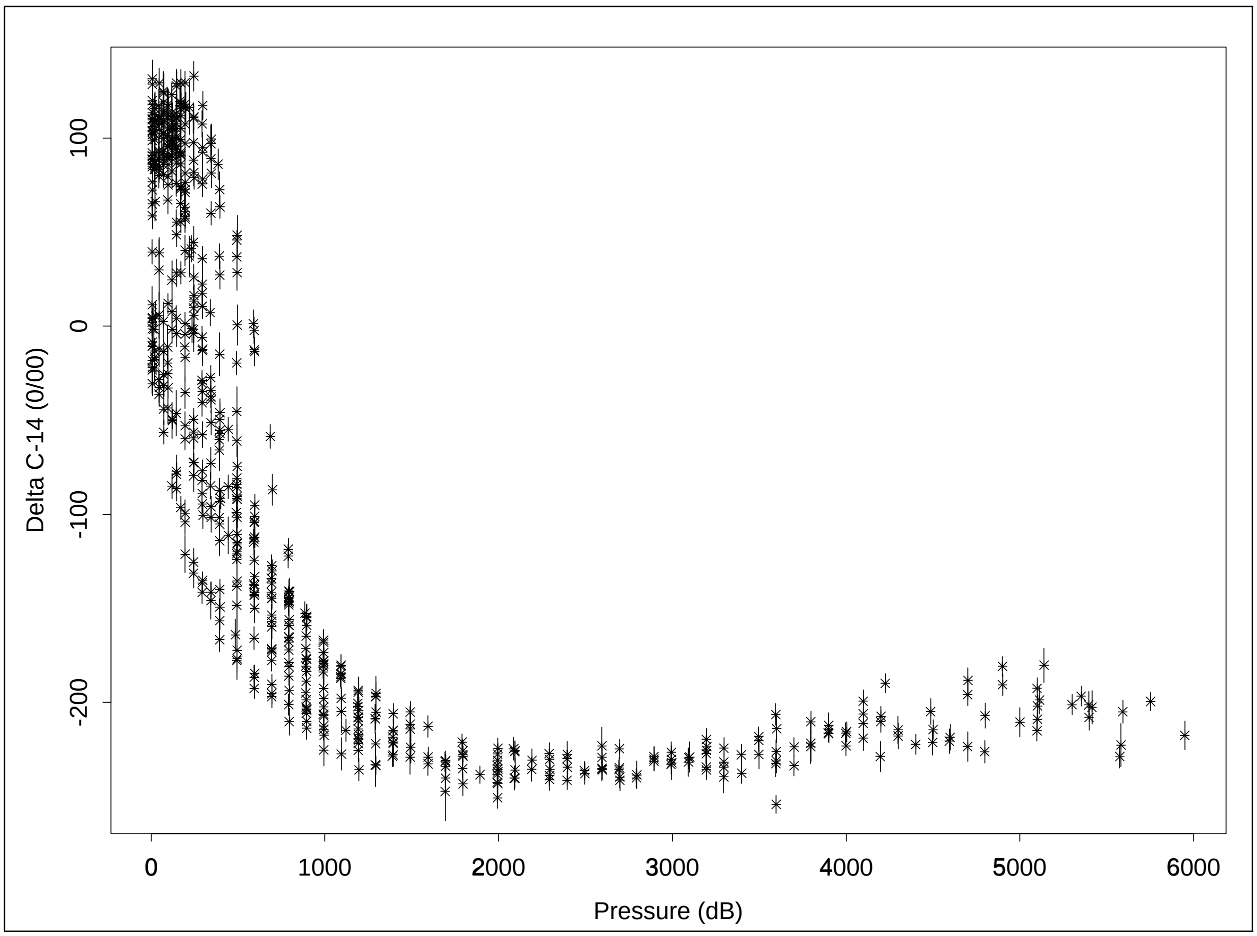

Figure 2: $\Delta^{14}C$ results for P13N stations shown with 2σ error bars.Only those measurements having a quality control flag value of 2 are plotted.

occurs around 2000 to 2200 meters for this section which is somewhat shallower than for other Pacific WOCE data sets reported to date. Figure 3 shows the $\Delta^{14}C$ values plotted against silicate.The straight line shown in the figure is the least squares regression relationship derived by Broecker *et al.* (1995) based on the GEOSECS global data set. According to their analysis, this line ($\Delta^{14}C$ = -70 - Si) represents the relationship between naturally occurring radiocarbon and silicate for most of the ocean. They interpret deviations in $\Delta^{14}C$ above this line to be due to input of bomb-produced radiocarbon, however, they note that the interpretation can be problematic at high latitudes. It is unlikely that the points falling above the line with silicate concentrations greater

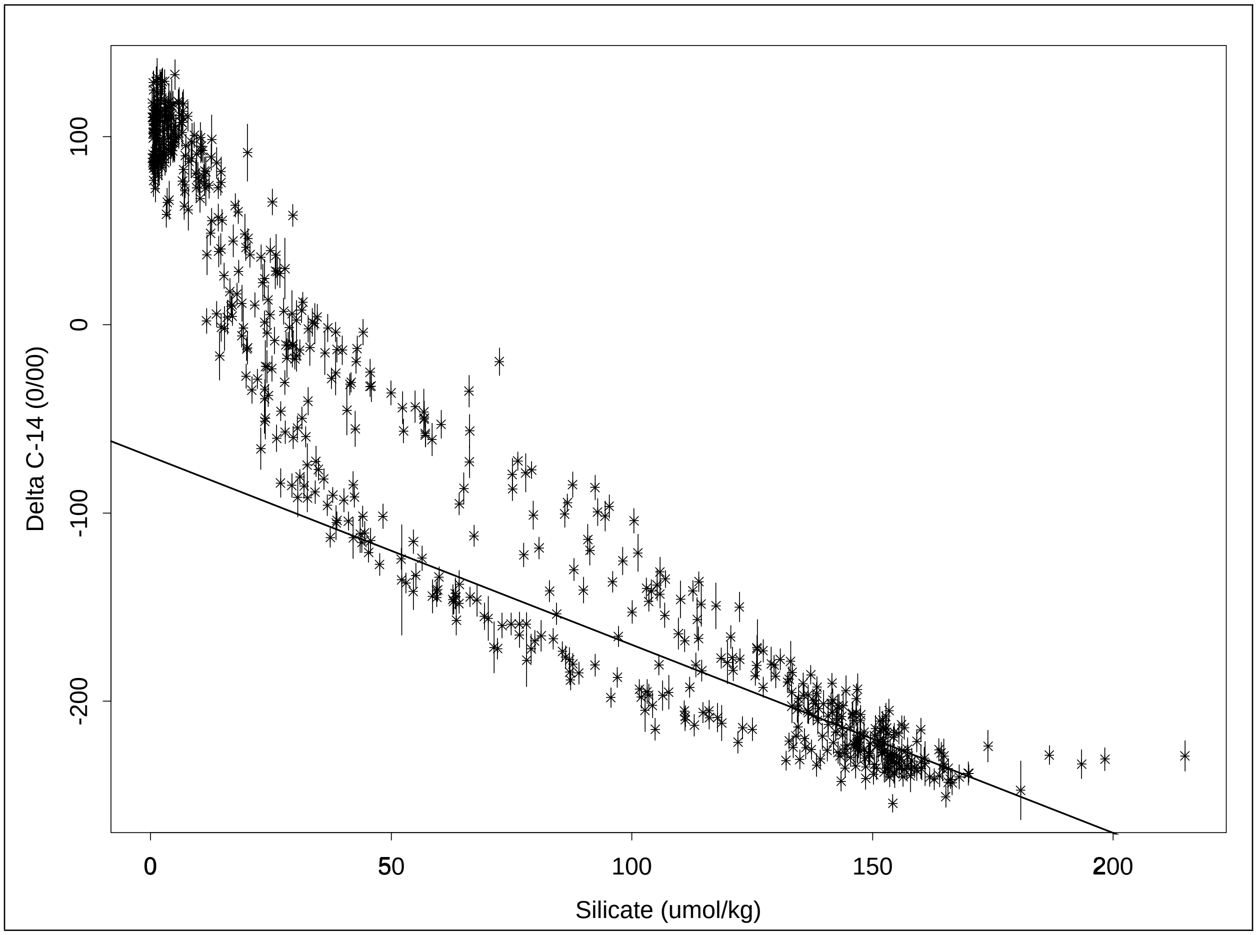

Figure 3: $\Delta^{14}C$ as a function of silicate for P13N AMS samples. The straight line shows the relationship proposed by Broecker, *et al.*, 1995 ($\Delta^{14}C$ = -70 - Si with radiocarbon in ‰ and silicate in μmol/kg).

than 100 μm/kg are elevated due to the addition of bomb-produced $\Delta^{14}C$. If the GEOSECS Pacific data from the same latitude range were added to Figure 3, the points would fall within the envelop of the WOCE data. Two trends are evident in Figure 3 for silicate concentrations between 25 and 130 μm/kg. The points in the upper trend (higher ^{14}C for a given silicate concentration) are from those stations which are north of about 25°N. The lower trend are from the tropical stations. This bimodal distribution is similar to results from other WOCE cruises in the North Pacific. The trend for the tropical stations generally falls below Broecker's global regression line, but the shape of the trend is typical for the Pacific. There is a fairly linear relationship for samples from these stations which were collected at depths shallower than the $\Delta^{14}C$ minimum and deeper than about 800 meters (silicate > ~50). Samples collected from shallower depths at these stations show an upward curving trend with decreasing silicate values reflecting the addition of bomb produced ^{14}C. The data from the more northern stations, however, shows an atypical linear trend from the $\Delta^{14}C$ minimum up to very near the surface. All of these points fall well above the global regression line, however, it is unlikely that this is solely due to addition of bomb produced ^{14}C.

Another way to visualize the ^{14}C - silicate correlation is as a section. Figure 4 shows $\Delta^{14}C$ as contour lines in silicate - latitude space for samples collected at depths between 500 and 2200 meters. In this space, shallow waters are toward the bottom of the figure. The 500 meter cutoff was selected to eliminate those samples having a very large bomb produced ^{14}C component. The 2200 meter cutoff was selected because this is the approximate depth of the ^{14}C minimum and silicate maximum for the western Pacific. For reference the 1000 meter depth contour is also shown (dashed line). If Broecker's simple correlation held throughout this region, then in waters which had no bomb ^{14}C component, the $\Delta^{14}C$ contours would be straight horizontal lines. In Figure 4 the contour lines are essentially horizontal between the equator and approximately 15°N and again north of approximately 25°N, but there is a strong upward slope to the contours between 15°N and 25°N. If we focus, for example, on the $\Delta^{14}C$ = -200‰ contour, it changes in silicate

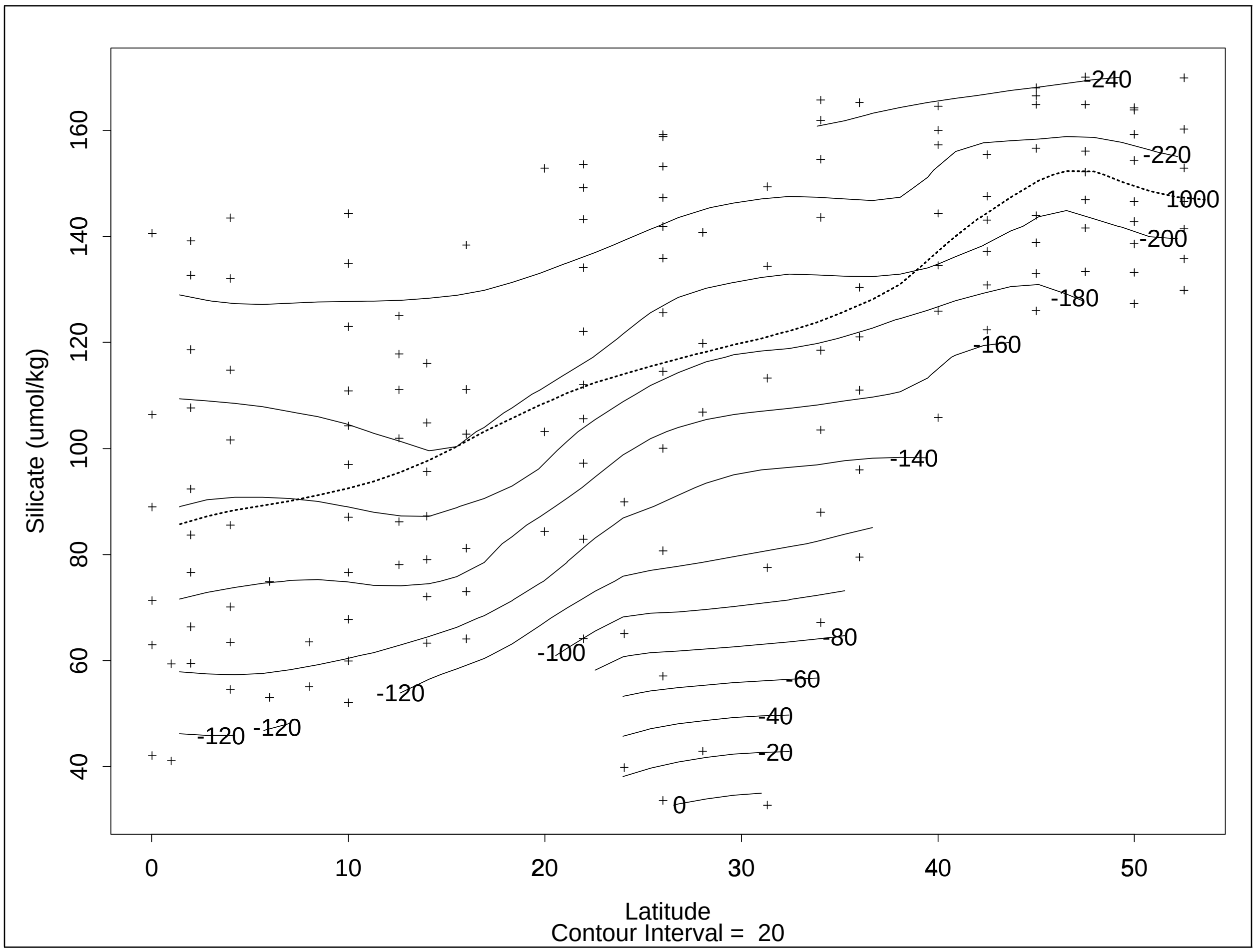

Figure 4: Section of ^{14}C along latitude in silicate space for the 500-2200m depth range. Note that for this section, "shallow" is toward the bottom. The 1000m depth contour is added for orientation (heavy, dashed line). See text for explanation.

space from approximately 100 µmol/kg near the equator to approximately 130 µmol/kg at the north end of the section. At the far northern end of the section, this contour is somewhat shallower than 1000 meters, but else where it is deeper, therefore, it is unlikely that there is significant bomb ^{14}C contamination with the possible exception of the small upward bump in the contour at 45°N (full justification of this statement will be left to formal publication). The upward shift in the contours is probably due to the large addition of silicate in the North Pacific (Talley and Joyce, 1992). This "extra" silicate would, in the most simple case, change the intercept term in Broecker's relationship.

Figure 5 compares the surface $\Delta^{14}C$ values for P13N to those from the northwestern (west of the dateline) Pacific GEOSECS data set. The greatest change in concentration is in the 10°N to 40°N latitude range where the $\Delta^{14}C$ levels decreased by as much as 75‰. The low latitude region shows essentially no change since GEOSECS and there is indication that the same may hold true for the high latitude region along this section. Figure 6 shows contoured sections of the $\Delta^{14}C$ distribution along the cruise track. The "A" portion shows the upper kilometer of the section and "B" the remainder of the water column. The data were gridded using the "loess" methods described in Chambers *et al.* (1983), Chambers and Hastie (1991), Cleveland (1979) and Cleveland and Devlin (1988). Figure 7 shows the same data as Figure 6A except the section is plotted in potential den-

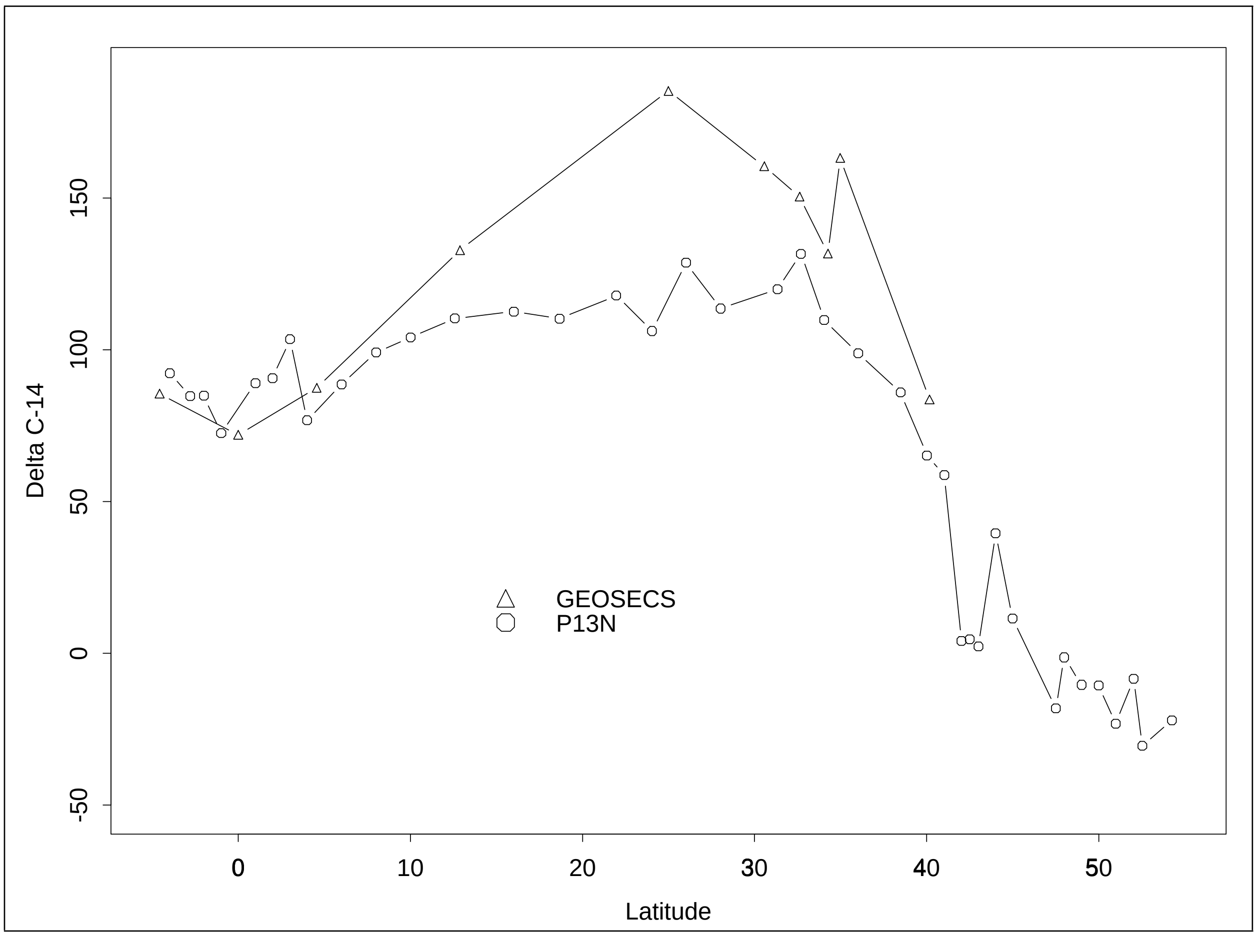

Figure 5: Surface distribution of $\Delta^{14}C$ along WOCE section P13N. For comparison the GEOSECS data from the northwestern Pacific are also plotted.

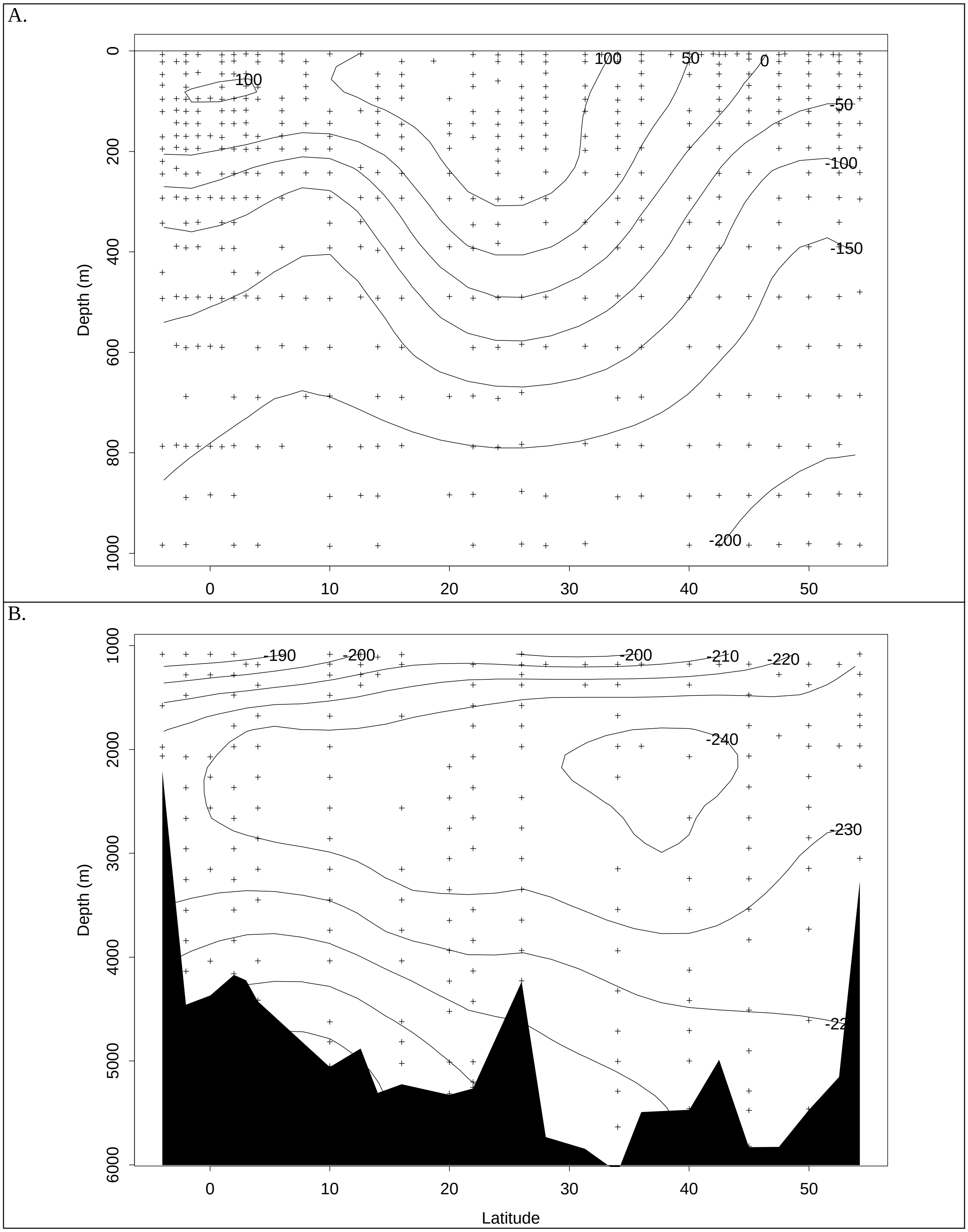

Figure 6: $\Delta^{14}C$ sections for WOCE P13N along 165°E. The section in shown in two parts to allow more detail. See text for gridding method. The bottom topography in B is taken from cruise data, but only using those stations on which $\Delta^{14}C$ was measured.

sity (σ_θ) - latitude space. For this section, the maximum $\Delta^{14}C$ concentration was found at the sur-

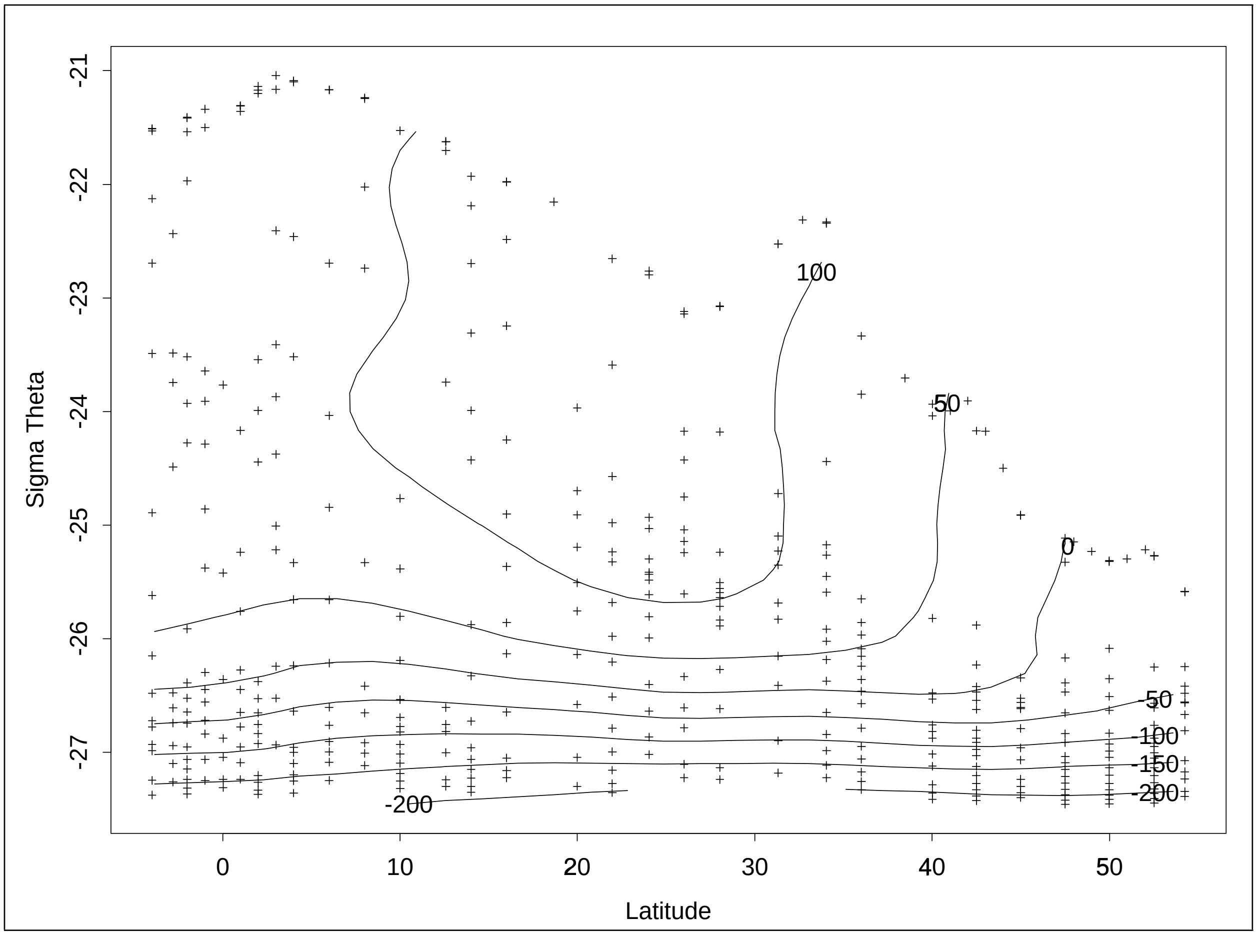

Figure 7: $\Delta^{14}C$ along WOCE section P13N plotted in potential density (σ_θ) - latitude space.

face except for a few stations near the equator which had a weak subsurface maximum around 75 meters. Both Figure 6A and Figure 7 clearly indicate those surfaces which are being directly ventilated by contact with the surface at the northern end of the section. For this section it is quite likely that there is additional ventilation and, therefore, input of bomb ^{14}C from the Sea of Okhotsk region.

G.1.5.1 References and Supporting Documentation

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NOSAMS, National Ocean Sciences AMS Facility Data Report #97-023, Woods Hole Oceanographic Institution, Woods Hole, MA, 02543, 1997.

Talley, L.D. and T.M. Joyce, The double silica maximum in the North Pacific, *J. Geophys. Res.*, *97*, 5465-5480, 1992.

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G.2 COMMENTS ON DQ EVALUATION OF WOCE P13 CTD DATA.

(Michio AOYAMA)
24 May 1996

GENERAL:
The data quality of WOCE P13 CTD data (EXPOCODE: 3220CGC92/0/1/2) and the CTD salinity and oxygen found in dot sea file are examined. . The individual 1 dbar profiles were observed in temperature, salinity and oxygen by comparing the profiles obtained in the same basin. The 86 profiles of P13 CTD data were divided into four groups as follows;

Station number	corresponding basin name
from 4 to 5	
from 6 to 42	Northwest Pacific Basin
from 46 to 48	
from 49 to 52	
from 54 to 61	East Mariana Basin
from 62 to 63	
from 65 to 88	Melanesia Basin

The CTD salinity and oxygen calibrations are examined using the water sample data file p13.mka. DQE used the water sample data flagged "2" only for the DQE work.

DETAILS

G.2.1. CTD PROFILES

The temperature, salinity and oxygen profiles generally look good.

G.2.2 EVALUATION OF CTD CALIBRATIONS TO WATER SAMPLES

G.2.2.1 SALINITY CALIBRATION

The onboard calibration for salinity looks good in general. Standard deviation of Ds, Ds = CTD salinity in dot sea file - bottle salinity, is 0.0114 PSS for deeper than 2000 dbar. This becomes small to 0.0022 PSS when DQE ignored one Ds data of -0.3178 PSS at station 29, cast 1, 3900.0 dbar where CTD salinity is bounced fresher far from the surroundings. However, 0.0022 PSS in standard deviation of Ds is still larger than that one would expect from good salinometer operation and CTD salinity calibrations. DQE also observed relatively large station dependency (fig.1) and weak pressure dependency (fig. 2). Although DQE could not find the description on the CTD calibrations in the cruise report of P13, DQE guesses that the station dependency has originated from the inappropriate station groupings to decide the cell factors.

DQE found that bottle salinities bounce mostly saltier (occasionally fresher) up to +/- 0.01 PSS, though they are flagged "good" by the data originator (See DQE comment for P13

Hydrographic data.). These "questionable/bad" data flagged by DQE may affect the CTD conductivity/salinity calibration.

DQE suggests that the CTD conductivity/salinity calibration should be applied in more station groups taking into account the Ds trend as shown fig. 1 and "questionable/bad" data flagged by DQE. DQE also suggests additional calibration for decreasing the pressure dependency will improve the quality of CTD salinity.

G.2.2.2 OXYGEN CALIBRATION;

The calibration for CTD oxygen looks good in general. DQE observed large station dependency (fig.3) and clear pressure dependency (fig. 4). Although DQE could not find the description on the CTD oxygen calibrations in the cruise report of P13, DQE guesses that the station dependency has originated from the inappropriate station groupings during the oxygen calibration.

DQE suggest that the further CTD oxygen calibration using more station groupings will improve the quality of CTD oxygen. DQE also suggest additional calibration for decreasing the pressure dependency will improve the quality of CTD oxygen.

G.2.3. The following are some specific problems that should be looked at:

st. 50	from ca. 2500 dbar to ca. 3500 dbar, from ca. 5000 dbar to ca. 5200 dbar and from 5400 dbar to bottom:	Salinity profile looks noisy.	Suggest flg. "3"
st. 82	at 2710 dbar.	Salinity spikes/noises are observed	Suggest flg. "3"
st. 83	at near bottom:	Salinity spikes/noises are observed	Suggest flg. "3"
st. 87	at near bottom:	Salinity spikes/noises are observed	Suggest flg. "3"

G.2.4 RECALIBRATION OF P13 CONDUCIVITY

November, 1997

Conductivity calibrations were re-examined after WOCE DQE input to reduce station-to-station trends in the residuals for the majority of station groupings. Calibration files were restored from 8mm tape saveset CGC92.BCK created October 27, 1993. They were 1111_DOWN.CAL of calibrated pressure, calibrated temperature, and cell-corrected conductivity from downcast CTD data matched (MATCH.FOR) corrected (PBIAS.FOR) bottle pressure. CAST53_PCOR.CAL of corrected (PBIAS.FOR) and calibrated pressure, uncalibrated temperature, and uncorrected conductivity from upcast CTD data. There were no downcast data to match for station 53 but it was carried along independently to account for it's bottle data. 1111_FIN.CAL of uncalibrated pressure, uncalibrated temperature, and uncorrected conductivity from upcast CTD data. For CTD s/n 1111, slightly different groupings than before were chosen, and full and deep station-dependent fits were considered. We concluded again that only bottles greater than 1500 db be used in the fits. The results were

Stat Group	NPts Used	NPts Total	%Pts Used	Fit Order	StdDev	FitBias	MinFit Slope	MaxFit Slope
02-10	70	78	89.7	2	0.0014	-0.0567979	1.001918	1.002002
11-14	48	53	90.6	1	0.0012	-0.1109544	1.003234	1.003559
15-42	348	367	94.8	3	0.0017	-0.0489930	1.001296	1.001432
47-55	94	98	95.9	2	0.0014	-0.0379626	1.001040	1.001136
56	13	13	100.0	0	0.0009	-0.1231880	1.003534	1.003534
57-74	212	215	98.6	2	0.0020	-0.0516512	1.001034	1.001107
75-88	111	125	88.1	1	0.0014	-0.0196148	0.999910	0.999954

Final conductivity calibration coefficients were applied to 1111_DOWN.CAL using DCALMSTR.FOR; and to CAST53_PCOR.CAL using DCALMSTR_53.FOR. DCALMSTR_53 also applied pre-cruise temperature calibrations and a conductivity cell correction. For CTD s/n 1112, a station-dependent fit did not improve the results of the original fit in 1993, which were

Stat Group	NPts Used	NPts Total	%Pts Used	Fit Order	Std Dev	FitBias	MinFit Slope	MaxFit Slope
3,28,43-36	63	67	94.0	0	0.0024	-0.0043094	1.001918	1.000126

However, 1112_FIN.CLB was ammended to include a change to station 43, remove zero bottle salinities, and have the same format as the newly calibrated .CLB files.

A plot of station-to-station means and medians helped to identify three profiles that needed additional conductivity offsets. Using the same process as before, stations 24, 68, and 84 were moved closer to their neighbors.

Poor Cast	Good Cast	Mean Delta-s	Mean Delta-C	Navg	Theta Range
24	23&25	-0.0048	-0.0039	11	1.10-1.23
68	67&69	-0.0037	-0.0030	13	1.12-1.28
84	82	-0.0230	-0.0187	17	1.39-1.59

As before, programs EPCTDW and EPCTD92 were used to apply all calibrations and corrections to downcast data and create EPIC .CTD files. Program EPICBOMSTRP was used to create EPIC .BOT files, however bottle data should be requested from Dr. John Bullister, Ocean Chemistry Data Manager. EPIC .CTD and .BOT files were copied to disk

epic1:[hayes.data.cgc92.ctd], along with EPCTD*.COM command files. It was not necessary to reload anything into the data base tables. All working files were archived on the same 8mm tape as the original calibration savesets from 1993/94. CTD data were put into WOCE format using the same program as before, WOCELST, and copied to our anonymous ftp site on hilo /ctd/p13. A new .sea file created by WOCESEA.FOR was given to John Bullister to incorporate into the ocean chemistry data base. He will put an updated P13.sea file on hilo /ctd/p13. These were then resubmitted to the WHPO.

Figure 1; CTD DQE

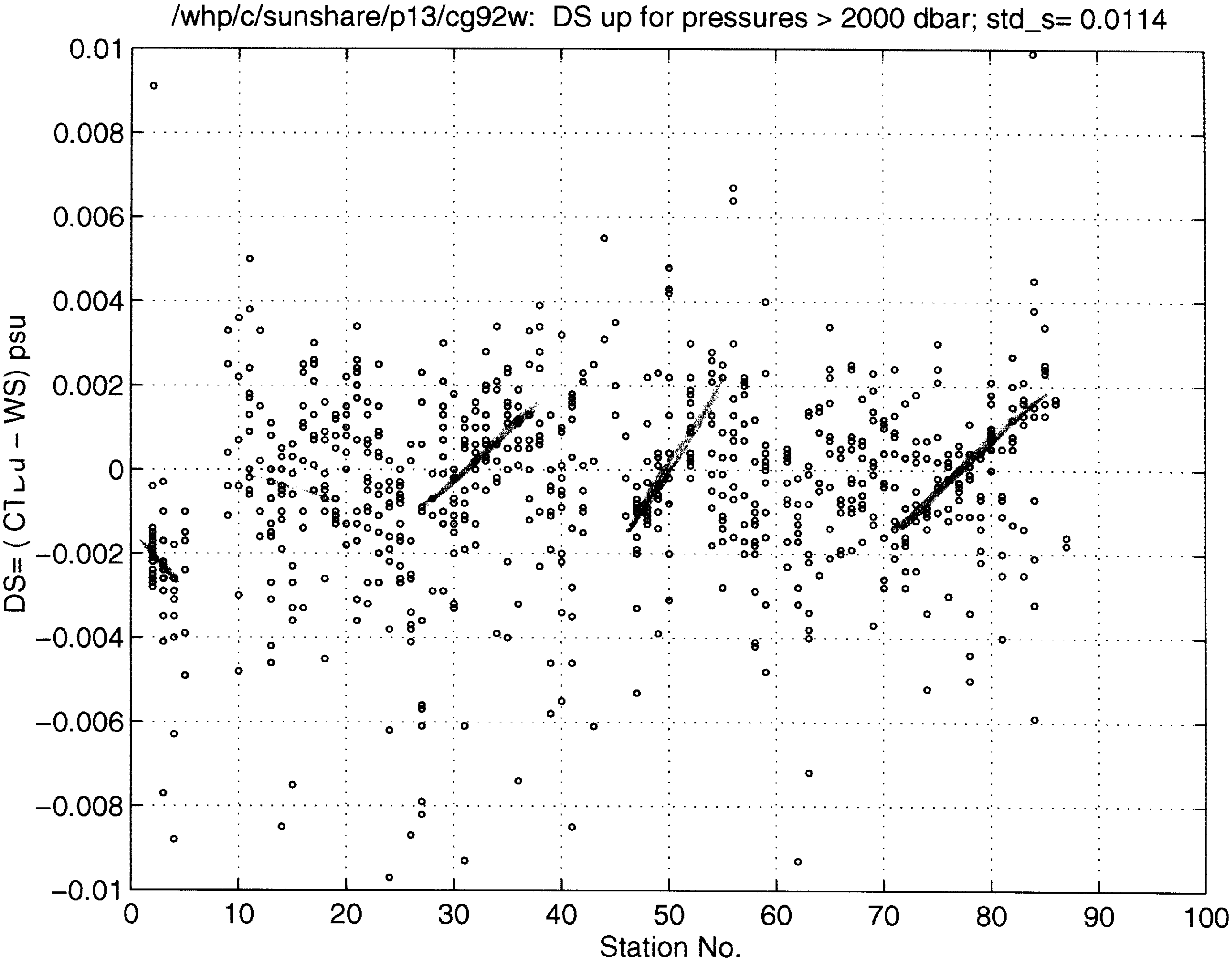


Figure 2; CTD DQE

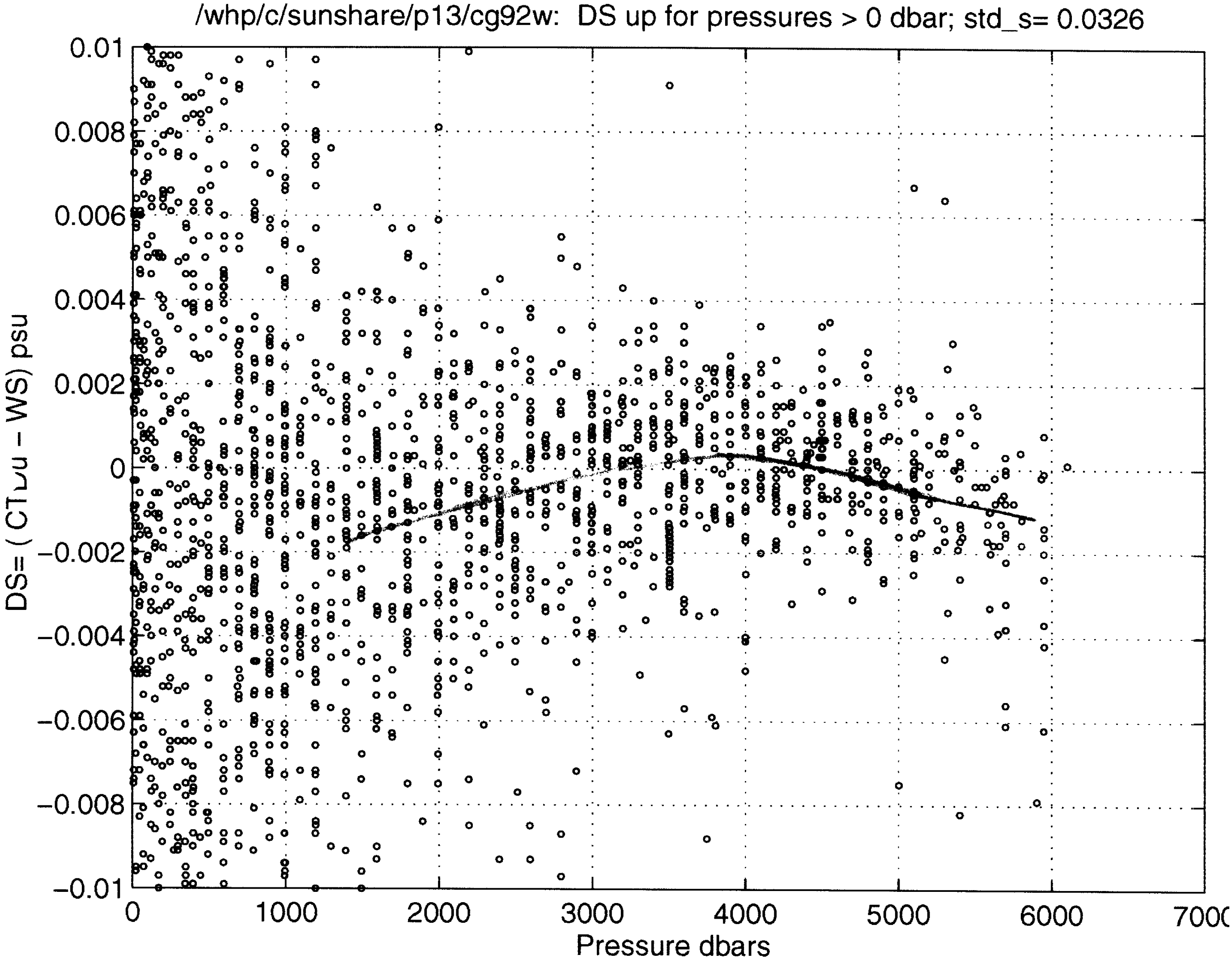


Figure 3; CTD DQE

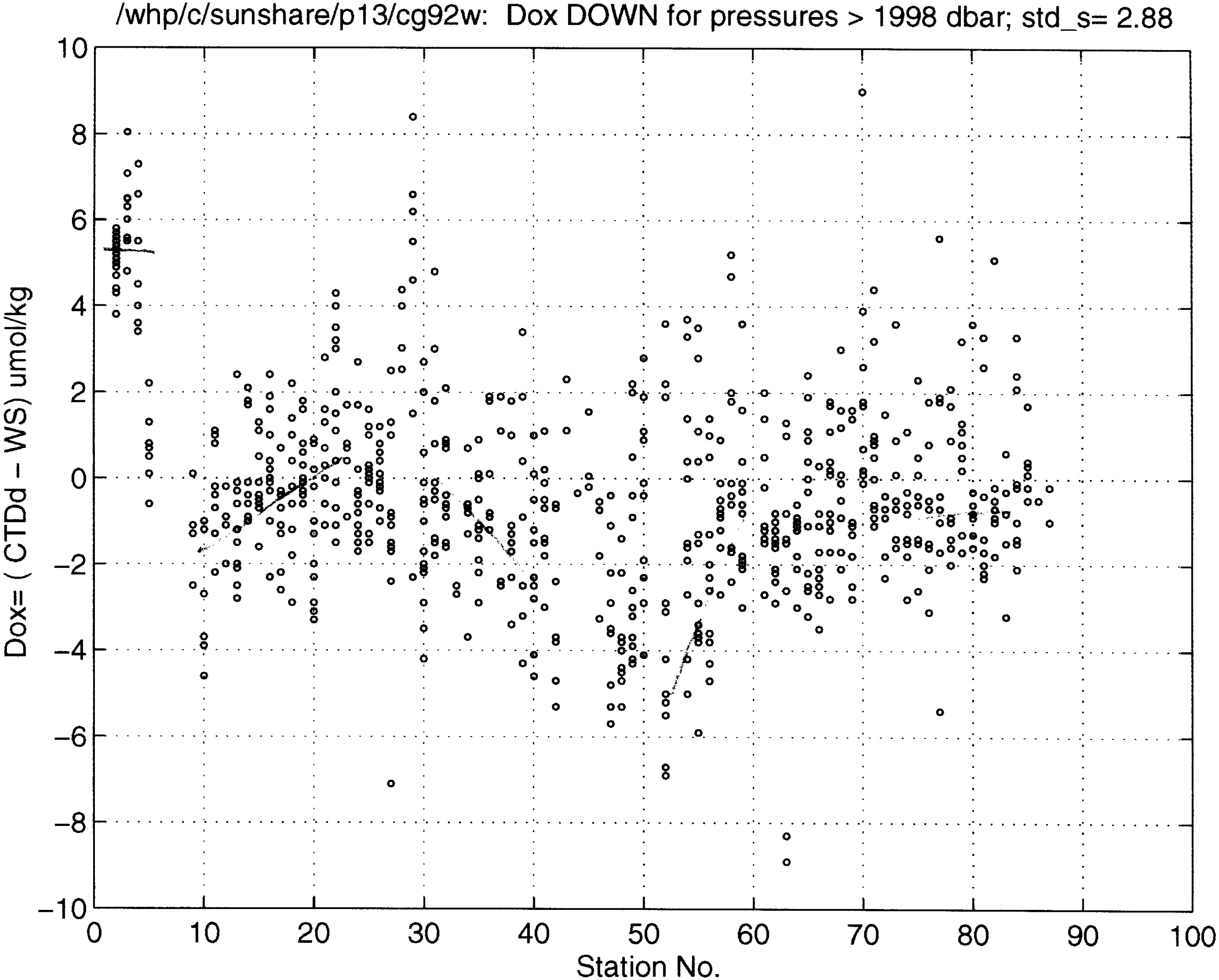
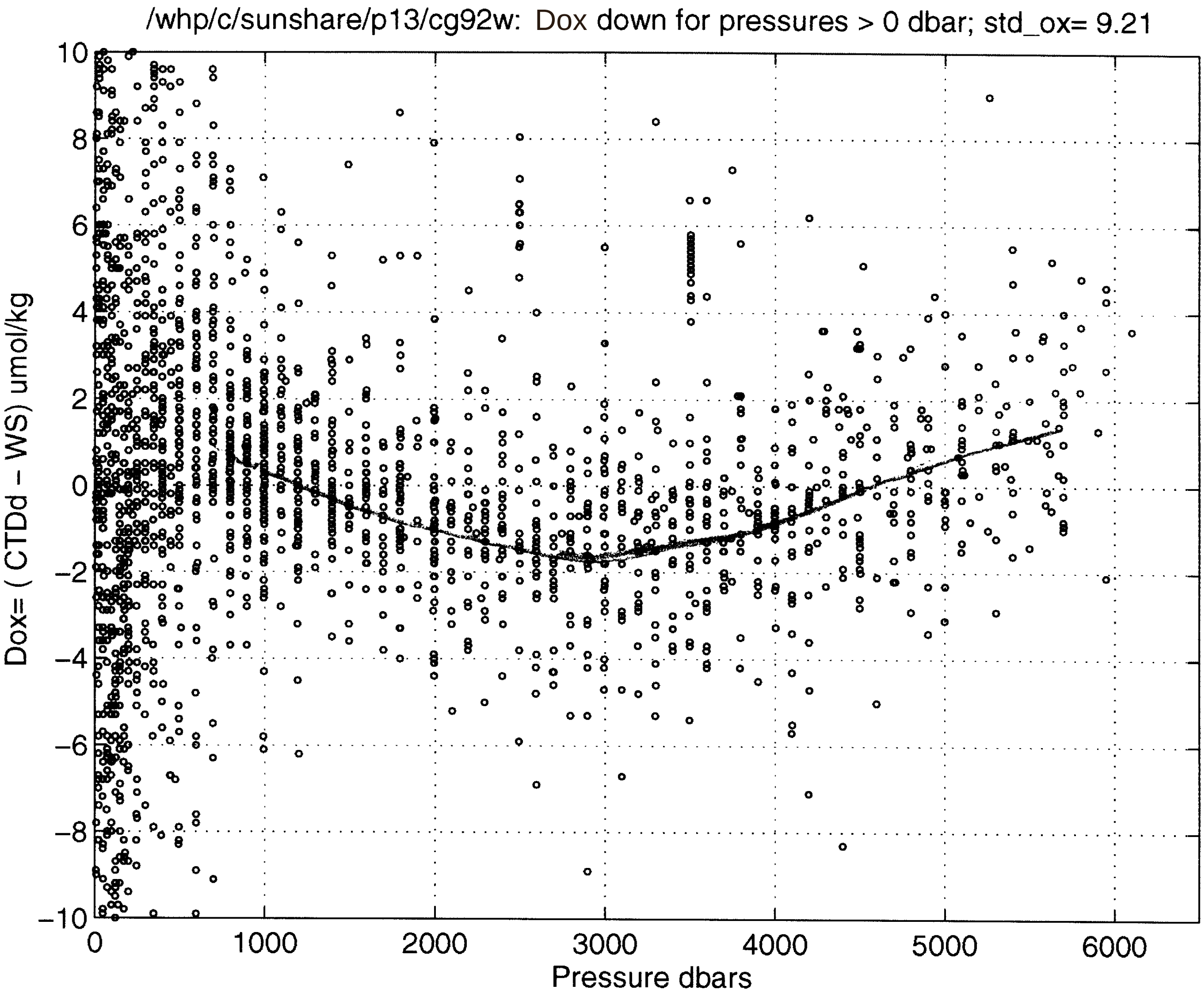


Figure 4; CTD DQE



G.3 COMMENTS ON DQ EVALUATION OF WOCE P13 HYDROGRAPHIC DATA

(Michio AOYAMA)
24 May 1996

The data quality of the hydrographic data of the WOCE P13 cruise (EXPOCODE: 3220CGC92/0/1/2) are examined. The data files for this DQE work was P13.sum and P13.mka (this P13.mka file is created for DQE, then it has a new column of quality 2 word) provided by WHPO.

GENERAL

The station spacing is basically 30 nautical miles and the sampling layer spacing was kept ca. 300 dbar in the deeper layers during this P13 cruise. The ctd lowerings were made to within several ten meters to the sea bottom except some stations. DQE observed major problems on phosphate, nitrite and nitrate and minor problem on bottle salinity. DQE asks the data originator to make a detail data report describing the quality of the water sample data. Aside from the problems described in detail in this comments, the P13 cruise data along 165 deg. E will improve our knowledge on the western North Pacific and update the deep water data set in this area.

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

DQE examined 6 profiles and 5 property vs. property plots as listed below; salinity, oxygen, silicate, nitrate, nitrite and phosphate profiles

theta vs. salinity plot
theta vs. oxygen plot
salinity vs. oxygen plot
nitrate vs. phosphate plot
salinity vs. silicate plot

G.3.1. SALINITY;

Bottle salinity profile looks good. Salinity vs. oxygen and theta vs. salinity plots also looks reasonable. DQE, however, thinks that the some flags of the bottle salinity data are not reliable. Some of the bottle salinity bounced saltier (occasionally fresher) up to +/- 0.01 PSS. The details are listed in Sec. 4.1.

G.3.2. OXYGEN;

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

G.3.3. NUTRIENTS;

The phosphate and nitrate profiles look very noisy and varying both layer by layer and station by station especially among the first half of the stations. The silicate profiles look good in general. DQE estimates the precision of phosphate, nitrate and silicate analyses from the data at station 3, where 11 bottles are closed almost same depths and the results of the replicate analyses are available. The estimated precisions are summarized in Table 1.

Table 1.

Parameter	Number of data	Mean µmol/kg	Sigma µmol/kg	CV %	Range µmol/kg
Nitrate	11	37.02	0.83	2.2	35.06 - 38.24
Phosphate	11	2.83	0.17	6.0	2.51 - 3.27
Silicate	11	182.9	0.52	0.28	181.80 - 183.95

The analytical precisions of nitrate and phosphate shown in table 1 are one order of magnitude larger than those which are required for WOCE one time WHP standards for water samples (WHPO 90-1). Both these larger values of analytical precision and observed variability of nitrate and phosphate profiles are consistent, DQE, then asks the data originator to check raw data and make a detail data report on the nutrients analyses and describe the quality of nutrient data.

DQE observes that the nitrite concentrations in the deeper layers at entire stations are unreasonably high and show unreliable values up to 0.4 µmol/kg even at deeper layers. In the deeper layers, this 0.4 µmol.kg of nitrite correspond 1 % of the nitrate concentrations there and obviously affect the precision of nitrate analyses considering the required precision for nitrate analyses in WOCE WHP one-time survey standards of seawater samples. DQE, then, thinks that we can not ignore these high nitrite concentrations. DQE guesses two possibilities of the reason of these unreasonable high concentrations as follows;

1. The sample water are contaminated during the sampling/handling.
2. The data originator had got a very noisy output from nitrite colorimeter and accounted those noises as a peak of sample.

DQE shows one example of this problem in Table 2 and discusses on the Possibilities mentioned above.

Table 2.

station/cast/layer	depth dbar	nitrate µmol/kg	nitrite µmol/kg	sum of nitrate and nitrite µmol/kg
61/1/104	3997	34.70	0.02	34.72
61/1/105	3695	35.06	0.04	35.10
61/1/106	3396	34.85	0.43	35.28
61/1/107	3095	35.87	0.05	35.92
61/1/108	2795	36.75	0.00	36.75
61/1/109	2498	36.55	0.08	36.63
61/1/110	2191	36.80	0.04	36.84

As shown in Table 2, nitrate profile originally shows unreasonable/unusual depletion at 3396 dbar. However, the profile of 'sum of nitrate and nitrite' does not show the unreasonable depletion. DQE thinks that this example clearly shows that the nitrite concentration should have originated from the noisy output from colorimeter not the case of contaminated samples. Since nitrate concentration is obtained by the subtraction of nitrite concentration from the 'nitrate plus nitrite' concentration, the data originator got wrong/artifact profiles of nitrate caused by the wrong/artifact nitrite profiles.

DQE, however, can not entirely exclude the possibility of the contamination case, because DQE does not see the raw data of the analyses and some of the nitrate profiles look good where the nitrite profiles look bad.

Anyway the nitrite concentration usually shows a peak at the nitracline, DQE, then, did not list the questionable/bad data shallower than ca. 500 dbar.

In conclusion, DQE asks the data originator to check all of the nitrite data by using the raw data. This also means that nitrate concentration should be checked following the nitrite concentration revisions. If the unreasonable high nitrite concentrations are identified as a results of noisy output of calorimeter, DQE suggests that the data originator assumes nitrite concentrations in the deeper layers are zero then recalculate the nitrate concentrations. If the unreasonable high nitrite concentrations are contaminated results, DQE suggests that those data should be flagged "3" or "4". In this case, the nitrate concentrations should be good basically. DQE, however, asks the data originator to pay attention the reduction rate from nitrate to nitrite during the analyses because relatively low reduction rate might affect the nitrate concentration when the nitrite concentration is high.

The details are listed in Sec. 4.2 - 4.4.

G.3.4. The following are specific problems that should be looked at:

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

G.3.4.1 SALINITY AND OXYGEN

st. 11/1/114	at 1994 dbar:	Bottle salinity looks low. Suggest flg. "3".
st. 11/1/115	at 1794 dbar:	Bottle salinity looks low. Suggest flg. "3".
st. 12/1/112	at 2796 dbar:	Bottle salinity looks low. Suggest flg. "3".
st. 12/1/110	at 3597 dbar:	Bottle salinity looks low. Suggest flg. "3".
st. 12/1/108	at 4399 dbar:	Bottle salinity looks low. Suggest flg. "3".
st. 13/1/115	at 1794 dbar:	Bottle salinity looks high. Suggest flg. "3".
st. 13/1/102	at 5948 dbar:	Bottle salinity looks high. Suggest flg. "3".
st. 14/1/111	at 2593 dbar:	Bottle salinity looks high. Suggest flg. "3".
st. 14/1/102	at 5252 dbar:	Bottle oxygen Suggest high. Suggest flg. "3".
st. 15/1/101	at 5003 dbar:	Bottle salinity looks high. Suggest flg. "3".

G.3.4.1 **SALINITY AND OXYGEN** (continued)

st. 17/1/102	at 4499 dbar:	CTD oxygen looks very low. Bottle flg. "4".
st. 18/1/102	at 5299 dbar:	Bottle salinity looks high. Suggest flg. "3".
st. 20/1/113	at 1989 dbar:	Bottle oxygen looks high. Suggest flg. "3".
st. 20/1/112	at 2293 dbar:	Bottle oxygen looks high. Suggest flg. "3".
st. 21/1/110	at 2896 dbar:	Bottle salinity looks high. Suggest flg. "3".
st. 21/1/104	at 4699 dbar:	Bottle salinity looks high. Suggest flg. "3".
st. 23/1/114	at 2094 dbar:	Bottle salinity looks low. Suggest flg. "3".
st. 24/1/111	at 2796 dbar:	Bottle salinity looks high. Suggest flg. "3".
st. 26/1/114	at 1893 dbar:	Bottle salinity looks low. Suggest flg. "3".
st. 26/1/111	at 2795 dbar:	Bottle salinity looks high. Suggest flg. "3".
st. 26/1/109	at 3596 dbar:	Bottle salinity looks high. Suggest flg. "3".
st. 26/1/108	at 3998 dbar:	Bottle salinity looks high. Suggest flg. "3".
st. 27/1/109	at 3598 dbar:	Bottle salinity looks high. Suggest flg. "3".
st. 27/1/107	at 4198 dbar:	Bottle oxygen looks high. Suggest flg. "3".
st. 27/1/104	at 5398 dbar:	Bottle salinity looks high. Suggest flg. "3".
st. 27/1/103	at 5697 dbar:	Bottle salinity looks high. Suggest flg. "3".
st. 27/1/102	at 5697 dbar:	Bottle salinity looks high. Suggest flg. "3".
st. 27/1/101	at 5902 dbar:	Bottle salinity looks high. Suggest flg. "3".
st. 29/1/108	at 3900 dbar:	CTD salinity looks very low. Suggest flg. "4"
st. 29/1/105	at 5000 dbar:	Bottle oxygen looks high. Suggest flg. "3".
st. 34/1/110	at 2294 dbar:	Bottle salinity looks low. Suggest flg. "3".
st. 34/1/111	at 1991 dbar:	Bottle salinity looks low. Suggest flg. "3".
st. 37/1/107	at 3596 dbar:	Bottle oxygen looks high. Suggest flg. "3".
st. 39/1/113	at 1793 dbar:	Bottle oxygen looks high. Suggest flg. "3".
st. 43/1/102	at 3803 dbar:	Bottle salinity looks high. Suggest flg. "3".
st. 46/1/105	at 1997 dbar:	Bottle salinity looks low. Suggest flg. "3".
st. 47/1/111	at 2293 dbar:	Bottle salinity looks low. Suggest flg. "3".
st. 50/1/108	at 3597 dbar:	Bottle salinity looks high. Suggest flg. "3".
st. 52/1/114	at 2596 dbar:	Bottle oxygen looks high. Suggest flg. "3".
st. 57/1/112	at 2390 dbar:	Bottle oxygen looks high. Suggest flg. "3".
st. 62/1/110	at 2393 dbar:	Bottle salinity looks high. Suggest flg. "3".
st. 63/1/109	at 2896 dbar:	Bottle salinity looks high. Suggest flg. "3".
st. 75/1/105	at 3197 dbar:	Bottle salinity looks low. Suggest flg. "3".
st. 77/1/104	at 3496 dbar:	Bottle oxygen looks high. Suggest flg. "3".
st. 77/1/103	at 3795 dbar:	Bottle oxygen looks low. Suggest flg. "3".
st. 78/1/103	at 3797 dbar:	Bottle salinity looks high. Suggest flg. "3".

G.3.4.2 PHOSPHATE

3/1/108	at 2494 dbar:	Phosphate concentration looks high. Suggest flg. "4".
3/1/101	at 2498 dbar:	Phosphate concentration looks low. Suggest flg. "4".
3/1/102	at 2498 dbar:	Phosphate concentration looks low. Suggest flg. "3".
9/1/121	at 295 dbar:	Phosphate concentration looks low. Suggest flg. "3".
9/1/120	at 345 dbar:	Phosphate concentration looks low. Suggest flg. "3".
9/1/119	at 394 dbar:	Phosphate concentration looks low. Suggest flg. "3".
9/1/110	at 1392 dbar:	Phosphate concentration looks low. Suggest flg. "3".
20/1/113	at 1989 dbar:	Phosphate concentration looks low. Suggest flg. "3".
20/1/112	at 2293 dbar:	Phosphate concentration looks low. Suggest flg. "3".
30/1/113	at 2392 dbar:	Phosphate concentration looks low. Suggest flg. "3".
30/1/112	at 2692 dbar:	Phosphate concentration looks low. Suggest flg. "3".
46/1/109	at 398 dbar:	Phosphate concentration looks high. Suggest flg. "3".
46/1/108	at 700 dbar:	Phosphate concentration looks high. Suggest flg. "3".
46/1/107	at 997 dbar:	Phosphate concentration looks high. Suggest flg. "3".
46/1/106	at 1496 dbar:	Phosphate concentration looks high. Suggest flg. "3".
46/1/105	at 1997 dbar:	Phosphate concentration looks high. Suggest flg. "3".
56/1/117	at 1193 dbar:	Phosphate concentration looks low. Suggest flg. "3".
56/1/115	at 1595 dbar:	Phosphate concentration looks low. Suggest flg. "3".
58/1/123	at 496 dbar:	Phosphate concentration looks low. Suggest flg. "3".
58/1/122	at 593 dbar:	Phosphate concentration looks low. Suggest flg. "3".
58/1/103	at 5099 dbar:	Phosphate concentration looks low. Suggest flg. "3".
58/1/101	at 5630 dbar:	Phosphate concentration looks low. Suggest flg. "3".
67/1/125	at 345 dbar:	Phosphate concentration looks high. Suggest flg. "3".
67/1/124	at 400 dbar:	Phosphate concentration looks high. Suggest flg. "3".
87/1/117	at 495 dbar:	Phosphate concentration looks high. Suggest flg. "3".

G.3.4.3 NITRITE

Nitrite concentrations listed below look high/noisy/contaminated. Suggest to revise the data according the DQE comments in Sec. 3. DQE flagged quality2 word only some of the listed data.

8/1/101-109	from 1816 dbar	to 793 dbar
12/1/108-114	from 4399 dbar	to 1994 dbar
14/1/101-120	from 5252 dbar	to 792 dbar
15/1/115-120	from 1591 dbar	to 791 dbar
16/1/115-120	from 1591 dbar	to 795 dbar
19/1/115-116	from 1393 dbar	to 1193 dbar
21/1/106-111	from 4097 dbar	to 2595 dbar
24/1/104-120	from 5387 dbar	to 695 dbar
25/1/113-693	from 2394 dbar	to 693 dbar
26/1/107-120	from 4397 dbar	to 694 dbar
28/1/101-106	from 5001 dbar	to 1197 dbar
29/1/107-121	from 4200 dbar	to 693 dbar
30/1/107-121	from 4200 dbar	to 694 dbar
31/1/101-121	from 5803 dbar	to 590 dbar
32/1/101-121	from 5658 dbar	to 493 dbar
34/1/101-121	from 5076 dbar	to 494 dbar
35/1/108-110	from 3244 dbar	to 2745 dbar
36/1/101-121	from 4861 dbar	to 594 dbar
37/1/101-121	from 5361 dbar	to 595 dbar
38/1/101-121	from 5599 dbar	to 494 dbar
39/1/101-121	from 5574 dbar	to 594 dbar
40/1/101-121	from 5320 dbar	to 594 dbar
41/1/101-121	from 5488 dbar	to 497 dbar
42/1/101-121	from 4676 dbar	to 593 dbar
43/1/101-106	from 4710 dbar	to 796 dbar
44/1/101-106	from 3398 dbar	to 699 dbar
45/1/101-106	from 4551 dbar	to 799 dbar
46/1/102-108	from 5001 dbar	to 700 dbar
47/1/101-121	from 5592 dbar	to 493 dbar
48/1/101-121	from 4729 dbar	to 592 dbar
49/1/101-123	from 5648 dbar	to 494 dbar
50/1/101-122	from 5751 dbar	to 492 dbar
51/1/117-122	from 993 dbar	to 494 dbar
52/1/101-123	from 5931 dbar	to 498 dbar

53/1/102-111	from 1994 dbar	to 494 dbar
54/1/103-122	from 5801 dbar	to 486 dbar
55/1/101-122	from 5579 dbar	to 495 dbar
56/1/102-123	from 5300 dbar	to 496 dbar
57/1/101-121	from 5686 dbar	to 690 dbar
58/1/101-110	from 5630 dbar	to 2994 dbar
59/1/101-123	from 5415 dbar	to 494 dbar
61/1/101-122	from 4539 dbar	to 496 dbar
62/1/101-121	from 5148 dbar	to 494 dbar
63/1/101-121	from 5497 dbar	to 495 dbar
64/1/102-122	from 4298 dbar	to 494 dbar
65/1/101-123	from 5541 dbar	to 494 dbar
66/1/101-123	from 5112 dbar	to 496 dbar
67/1/101-123	from 5317 dbar	to 495 dbar
68/1/101-123	from 4753 dbar	to 493 dbar
69/1/101-123	from 5139 dbar	to 493 dbar
70/1/101-122	from 5262 dbar	to 495 dbar
71/1/101-120	from 4939 dbar	to 492 dbar
72/1/101-120	from 4486 dbar	to 595 dbar
73/1/101-117	from 4278 dbar	to 590 dbar
74/1/101-122	from 4225 dbar	to 495 dbar
75/1/101-119	from 4308 dbar	to 785 dbar
76/1/109-120	from 1995 dbar	to 594 dbar
77/1/101-119	from 4423 dbar	to 793 dbar
78/1/101-117	from 4429 dbar	to 994 dbar
79/1/103-119	from 3797 dbar	to 795 dbar
80/1/101-120	from 4483 dbar	to 698 dbar
81/1/106-118	from 2997 dbar	to 893 dbar
82/1/101-109	from 4519 dbar	to 2094 dbar
84/1/101-118	from 3780 dbar	to 892 dbar
85/1/101-112	from 3286 dbar	to 1390 dbar
86/1/101-117	from 2221 dbar	to 496 dbar
87/1/101-117	from 2388 dbar	to 495 dbar
88/1/104-118	from 1836 dbar	to 492 dbar

G.3.4.4 Nitrate

3/1/101	at 2498 dbar:	Nitrate concentration looks low. Suggest flg. "3".
13/1/109	at 3695 dbar:	Nitrate concentration looks high. Suggest flg. "3".
13/1/108	at 4098 dbar:	Nitrate concentration looks high. Suggest flg. "3".
13/1/107	at 4499 dbar:	Nitrate concentration looks high. Suggest flg. "3".
30/1/101	at 5947 dbar:	Nitrate concentration looks low. Suggest flg. "3".
58/1/102	at 5399 dbar:	Nitrate concentration looks low. Suggest flg. "3".

G.3.4.5 Silicate

77/1/109	at 2086 dbar:	Silicate concentration looks low. Suggest flg. "3".
85/1/109	at 1791 dbar:	Silicate concentration looks low. suggest flg. "3".

G.4 NUTRIENTS DQE

(George Anderson)
9/13/2000

NOTES ON THE REPROCESSING OF THE NO2 DATA FROM THE P13 CRUISE.

The original DQE work clearly recognized and addressed the problems with the nutrient data set from Cruise P13. Relevant to the nitrite and nitrate data processing, let me reiterate some of these comments:

"The...nitrate profiles look very noisy and varying both layer by layer and station by station especially among the first half of the stations." (page 2). "DQE observes that the nitrite concentrations in the deeper layers at entire stations are unreasonably high and show unreliable values up to 0.4 µmol/kg even at deeper layers....this 0.4 µmol/kg of nitrite correspond 1% of the nitrate concentrations there and obviously affect the precision of the nitrate analyses...DQE, then, thinks that we can not ignore these high nitrite concentrations." (page 2).

Continuing page 2 and on page 3 of the report, the problems and two possible reasons for these problems are discussed.

In response, the data originator reviewed the "deep" nitrite data. Reprocessing has been done; the revised data listing incorporates the following:

- all nitrite values of 0.05 or less have been changed to 0.00,
- the Q1 flag for these values has been changed from 3 to 2 if not originally flagged 2,
- the number in the nitrate column is now the nitrate + nitrite value, in other words, the value calculated from the nitrate channel is tabulated with no correction for the value calculated from the nitrite channel.
- for nitrite values greater than 0.05µmoles/kg, the nitrite value is shown in the data listing and is flagged 3
- as in the original data listing the corresponding nitrate value has been corrected for the "high" nitrite value.
- in the case of nitrite values exceeding 0.28 µmol/kg, the nitrate value has been flagged 3.

I have some concerns about the reprocessed data:

1. The DQE gave an example (page 3) which indicated that at station 61, the high nitrite value (0.43 µmol/kg) shouldn't be subtracted from the nitrate channel calculation before listing the corrected nitrate value. Examining the nitrate versus db curve and the phosphate/nitrate relationship in the deeper water column are excellent ways of evaluating the "goodness" of a particularly nitrate value. This doesn't seem to have been done on the 13 stations where high nitrite values occurred. This would not have taken very much time and certainly would have been helpful in evaluating all "high" deep nitrite data and in turn the corresponding nitrate value. I plotted the nitrate and phosphate data from Table 2 for station 61. The uncorrected nitrate value at 3396 db

fits better on the N03-db curve than the corrected value and the corrected value definitely falls below the PO4/NO3 curve for this station. In this case, the high nitrite value clearly shows a problem with the nitrite channel and not a general sample contamination problem.

2. based on measurements of duplicates, the data originator chose a detection limit of 0.05 µmol/kg for nitrite and 0.28 for nitrate. These relatively large values indicate problems with both analyses. Full span for the nitrite channel is generally set at ~2. An absorbance difference of ~0.025 with a factor of ~2 gives a nitrite value of 0.05 µmol/kg. An absorbance of 0.025 or even 0.0125 (1 std. dev.) is significantly different than zero. If 0.05 is taken as being equivalent to zero, why aren't all nitrite values decreased by 0.05 before being subtracted from the results of the nitrate channel computation? Why make the treatment of the nitrite data concentration dependent? I believe it is critical that data be handled consistently. This certainly has not been done with the revised nitrite data set.

G.4.1 NUTRIENTS DQE (continued)

(George Anderson)
9/13/2000

The estimates of precision for phosphate and nitrate were recalculated from the corrected data from station 3. These corrections are summarized in Table 1. The revised analytical precision of nitrate and phosphate shown in Table 1 are within the acceptable range required for WOCE one time WHP standards for water samples (WHP Office Report 90-1).

Parameter	Number of Data	Mean µmol/kg	Sigma µmol/kg	CV %	Range µmol/kg
Nitrate	9	37.10	0.51	1.4	36.09 ñ 37.68
Phosphate	10	2.82	0.05	1.74	2.70 ñ 2.86

The high nitrite concentrations below 500 dbar were given special consideration. DQE suggested two possibilities for the observed high values:

1) The sample water was contaminated during sampling/handling.
2) The output from the nitrite colorimeter was very noisy and accounted for the observed peaks.

All nutrient samples were run as duplicates. Based on Studentís t test, a detection limit (D.L.) for both nitrite and nitrate was estimated from the standard deviation (s) of a population of differences between duplicate measurements:

D.L. = t s, where t was taken at the 0.05 probability level

Enough duplicates were measured during WOCE P13 that t = 2. Therefore, any concentration equal to or less than twice the corresponding values of s can be considered zero. Limits based on duplicates from WOCE P13 were 0.05 µmol/kg for nitrite and 0.28 µmol/kg for nitrate. Therefore, any nitrite sample below 500 dbar with a concentration of

0.05 µmol/kg was indistinguishable from zero and recorded as zero (nitrate samples were adjusted accordingly). These nitrite samples were flagged acceptable (2). Nitrite samples below 500 dbar greater than 0.05 µmol/kg were flagged as questionable (3). A noisy nitrite colorimeter output would have given a larger detection limit for nitrite than the estimated 0.05 µmol/kg.

Nitrite values greater than 0.05 µmol/kg truly are nonzero since they occurred so frequently in the same deep bottle samples. Therefore, while we do not claim that the high nitrite values necessarily represent actual in situ concentra- tions, we do not think they are the result of bogus analyses. The remarkable consistency of high deep nitrite values in the same Niskin bottles on many casts suggests some contamination during the sampling process. The high deep nitrite values must be flagged as questionable (3) of course, and we will probably never know how they came to be.

Any nitrate sample below 500 dbar with a corresponding nitrite concentration equal to or less than 0.28 µmol/kg was flagged as acceptable (2). Nitrate samples with corresponding nitrite values greater than 0.28 µmol/kg were flagged as questionable (3). There were 13 nitrate samples below 500 dbar identified as such.

Specific problems identified by DQE.

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
3	1	101	2498.2						2.51	35.06		~~~~~43~
3	1	102	2498						2.7			~~~~~3~~
3	1	108	2493.9						2.86			~~~~~2~~
8	1	101	1816	.	.	.	.	.		41.38	0.08	~~~~~~~3
8	1	102	1695	.	.	.	.	.	.	42.11	0	~~~~~~~2
8	1	103	1544	.	.	.	.	.	.	43.23	0.09	~~~~~~~3
8	1	104	1394	.	.	.	.	.	.	44.37	0	~~~~~~~2
8	1	105	1242	.	.	.	.	.	.	43.38	0	~~~~~~~2
8	1	106	1095	.	.	.	.	.	.	43.33	0	~~~~~~~2
8	1	107	994	.	.	.	.	.	.	44.2	0	~~~~~~~2
8	1	108	892	.	.	.	.	.	.	44.33	0	~~~~~~~2
8	1	109	793	.	.	.	.	.	.	44.69	0.08	~~~~~~~3
9	1	110	1392						2.89			~~~~~3~~
9	1	119	394						2.73			~~~~~3~~
9	1	120	345						2.83			~~~~~3~~
9	1	121	295						2.82			~~~~~3~~
12	1	108	4399	.	.	.	.	.	.	36.86	0	~~~~~~~2
12	1	109	3998	.	.	.	.	.	.	37.05	0	~~~~~~~2
12	1	110	3597	.	.	.	.	.	.	37.57	0	~~~~~~~2
12	1	111	3196	.	.	.	.	.	.	37.7	0	~~~~~~~~
12	1	112	2796	.	.	.	.	.	.	38.86	0.26	~~~~~~~3
12	1	113	2394	.	.	.	.	.	.	39.26	0.23	~~~~~~~3
12	1	114	1994	.	.	.	.	.	.	40.79	0.28	~~~~~~~3
13	1	107	4499							37.86		~~~~~~2~
13	1	108	4098							38.5		~~~~~~2~
13	1	109	3698							38.46		~~~~~~2~
14	1	101	5252	.	.	.	.	.	.	35.74	0	~~~~~~~2
14	1	102	5252	.	.	.	.	.	.	35.83	0.08	~~~~~~~3
14	1	103	4998	.	.	.	.	.	.	35.97	0.09	~~~~~~~3
14	1	104	4698	.	.	.	.	.	.	36.49	0.1	~~~~~~~3
14	1	105	4399	.	.	.	.	.	.	36.89	0	~~~~~~~2
14	1	106	4096	.	.	.	.	.	.	36.57	0.06	~~~~~~~3
14	1	107	3796	.	.	.	.	.	.	37.23	0	~~~~~~~2
14	1	108	3498	.	.	.	.	.	.	37.51	0	~~~~~~~2
14	1	109	3194	.	.	.	.	.	.	-9	-9	~~~~~~~~
14	1	110	2898	.	.	.	.	.	.	38.57	0.07	~~~~~~~3
14	1	111	2593	.	.	.	.	.	.	38.87	0.09	~~~~~~~3
14	1	112	2293	.	.	.	.	.	.	39.62	0.14	~~~~~~~3
14	1	113	1992	.	.	.	.	.	.	39.99	0.09	~~~~~~~3
14	1	114	1794	.	.	.	.	.	.	41.89	0.09	~~~~~~~3
14	1	115	1593	.	.	.	.	.	.	42.31	0.13	~~~~~~~3
14	1	116	1393	.	.	.	.	.	.	42.6	0.14	~~~~~~~3
14	1	117	1196	.	.	.	.	.	.	42.98	0	~~~~~~~2
14	1	118	993	.	.	.	.	.	.	43.7	0	~~~~~~~2

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
14	1	119	892	.	.	.	.	.	.	44.02	0	~~~~~~~2
14	1	120	792	.	.	.	.	.	.	43.98	0.1	~~~~~~~3
15	1	115	1591	.	.	.	.	.	.	41.95	0.06	~~~~~~~3
15	1	116	1394	.	.	.	.	.	.	41.99	0.07	~~~~~~~3
15	1	117	1193	.	.	.	.	.	.	42.69	0	~~~~~~~~
15	1	118	992	.	.	.	.	.	.	43.12	0	~~~~~~~~
15	1	119	894	.	.	.	.	.	.	43.13	0	~~~~~~~~
15	1	120	791	.	.	.	.	.	.	31.35	0.06	~~~~~~~3
16	1	115	1591	.	.	.	.	.	.	42.51	0.06	~~~~~~~3
16	1	116	1392	.	.	.	.	.	.	43.47	0.06	~~~~~~~3
16	1	117	1193	.	.	.	.	.	.	43.59	0	~~~~~~~2
16	1	118	994	.	.	.	.	.	.	43.93	0	~~~~~~~2
16	1	119	893	.	.	.	.	.	.	43.28	0	~~~~~~~2
16	1	120	795	.	.	.	.	.	.	43.46	0	~~~~~~~2
19	1	115	1393	.	.	.	.	.	.	42.45	0	~~~~~~~2
19	1	116	1193	.	.	.	.	.	.	43.17	0	~~~~~~~2
20	1	112	2293						2.73			~~~~~3~~
20	1	113	1989						2.74			~~~~~3~~
21	1	106	4097	.	.	.	.	.	.	36.72	0.06	~~~~~~~3
21	1	107	3798	.	.	.	.	.	.	36.7	0	~~~~~~~2
21	1	108	3497	.	.	.	.	.	.	36.92	0	~~~~~~~2
21	1	109	3196	.	.	.	.	.	.	37.68	0	~~~~~~~2
21	1	110	2896	.	.	.	.	.	.	38.36	0	~~~~~~~2
21	1	111	2595	.	.	.	.	.	.	39.06	0	~~~~~~~2
24	1	104	5387	.	.	.	.	.	.	36.62	0	~~~~~~~2
24	1	105	5099	.	.	.	.	.	.	36.63	0	~~~~~~~2
24	1	106	4798	.	.	.	.	.	.	36.58	0	~~~~~~~2
24	1	107	4399	.	.	.	.	.	.	36.22	0	~~~~~~~2
24	1	108	3998	.	.	.	.	.	.	36.76	0	~~~~~~~2
24	1	109	3597	.	.	.	.	.	.	37.3	0.07	~~~~~~~3
24	1	110	3193	.	.	.	.	.	.	37.67	0.06	~~~~~~~3
24	1	111	2796	.	.	.	.	.	.	38.73	0.06	~~~~~~~3
24	1	112	2495	.	.	.	.	.	.	39.12	0	~~~~~~~2
24	1	113	2194	.	.	.	.	.	.	39.55	0.06	~~~~~~~3
24	1	114	1893	.	.	.	.	.	.	40.65	0.09	~~~~~~~3
24	1	115	1596	.	.	.	.	.	.	41.25	0.11	~~~~~~~3
24	1	116	1294	.	.	.	.	.	.	42.59	0.12	~~~~~~~3
24	1	117	994	.	.	.	.	.	.	43.55	0	~~~~~~~2
24	1	118	894	.	.	.	.	.	.	43.62	0	~~~~~~~2
24	1	119	795	.	.	.	.	.	.	43.55	0	~~~~~~~2
24	1	120	695	.	.	.	.	.	.	43.25	0.07	~~~~~~~3
25	1	113	2394	.	.	.	.	.	.	38.85	0	~~~~~~~2
25	1	114	2094	.	.	.	.	.	.	39.71	0	~~~~~~~2
25	1	115	1793	.	.	.	.	.	.	41.02	0.06	~~~~~~~3
25	1	116	1492	.	.	.	.	.	.	41.83	0.07	~~~~~~~3
25	1	117	1198	.	.	.	.	.	.	42.2	0	~~~~~~~2

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
25	1	118	994	.	.	.	.	.	.	-9	-9	~~~~~~~~
25	1	119	893	.	.	.	.	.	.	43.13	0	~~~~~~~~
25	1	120	793	.	.	.	.	.	.	43.52	0	~~~~~~~2
25	1	121	693	.	.	.	.	.	.	43.12	0	~~~~~~~2
26	1	107	4397	.	.	.	.	.	.	36.08	0	~~~~~~~2
26	1	108	3998	.	.	.	.	.	.	36.16	0	~~~~~~~~
26	1	109	3596	.	.	.	.	.	.	36.9	0	~~~~~~~2
26	1	110	3199	.	.	.	.	.	.	-9	-9	~~~~~~~~
26	1	111	2795	.	.	.	.	.	.	38.3	0	~~~~~~~2
26	1	112	2494	.	.	.	.	.	.	38.51	0	~~~~~~~2
26	1	113	2194	.	.	.	.	.	.	-9	-9	~~~~~~~~
26	1	114	1893	.	.	.	.	.	.	40.05	0	~~~~~~~2
26	1	115	1592	.	.	.	.	.	.	41.25	0.1	~~~~~~~3
26	1	116	1295	.	.	.	.	.	.	41.87	0.07	~~~~~~~3
26	1	117	994	.	.	.	.	.	.	42.21	0	~~~~~~~2
26	1	118	894	.	.	.	.	.	.	-9	-9	~~~~~~~~
26	1	119	794	.	.	.	.	.	.	42.22	0	~~~~~~~2
26	1	120	694	.	.	.	.	.	.	42.14	0.06	~~~~~~~3
28	1	101	5001.2	.	.	.	.	.	.	36.43	0	~~~~~~~2
28	1	102	4601.9	.	.	.	.	.	.	36.34	0.09	~~~~~~~3
28	1	103	3596.9	.	.	.	.	.	.	37.45	0.08	~~~~~~~3
28	1	104	2595.7	.	.	.	.	.	.	39.29	0.09	~~~~~~~3
28	1	105	1594.5	.	.	.	.	.	.	42.43	0.07	~~~~~~~3
28	1	106	1196.5	.	.	.	.	.	.	43.2	0.07	~~~~~~~3
29	1	107	4200	.	.	.	.	.	.	36.88	0.07	~~~~~~~3
29	1	108	3900	.	.	.	.	.	.	37.39	0	~~~~~~~~
29	1	109	3597	.	.	.	.	.	.	38.06	0	~~~~~~~2
29	1	110	3297	.	.	.	.	.	.	38.46	0	~~~~~~~2
29	1	111	2996	.	.	.	.	.	.	38.47	0.07	~~~~~~~3
29	1	112	2698	.	.	.	.	.	.	39	0.1	~~~~~~~3
29	1	113	2394	.	.	.	.	.	.	39.24	0.07	~~~~~~~3
29	1	114	2090	.	.	.	.	.	.	40.91	0.11	~~~~~~~3
29	1	115	1794	.	.	.	.	.	.	41.49	0.07	~~~~~~~3
29	1	116	1491	.	.	.	.	.	.	42.63	0	~~~~~~~2
29	1	117	1191	.	.	.	.	.	.	43.37	0.13	~~~~~~~3
29	1	118	994	.	.	.	.	.	.	43.2	0	~~~~~~~2
29	1	119	894	.	.	.	.	.	.	42.52	0	~~~~~~~2
29	1	120	793	.	.	.	.	.	.	42.49	0.08	~~~~~~~3
29	1	121	693	.	.	.	.	.	.	42.34	0.16	~~~~~~~3
30	1	101	5947							34.78		~~~~~~3~
30	1	107	4200	.	.	.	.	.	.	36.28	0.07	~~~~~~~3
30	1	108	3897	.	.	.	.	.	.	36.78	0	~~~~~~~~
30	1	109	3597	.	.	.	.	.	.	37.45	0	~~~~~~~2
30	1	110	3295	.	.	.	.	.	.	37.86	0	~~~~~~~2
30	1	111	2994	.	.	.	.	.	.	38.24	0.07	~~~~~~~3
30	1	112	2692	.	.	.	.	.	2.65	38.66	0.06	~~~~~2~3

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
30	1	113	2392	.	.	.	.	.	2.73	38.91	0.06	~~~~~2~3
30	1	114	2095	.	.	.	.	.	.	40.46	0.08	~~~~~~~3
30	1	115	1795	.	.	.	.	.	.	41.56	0.09	~~~~~~~3
30	1	116	1493	.	.	.	.	.	.	42.38	0.06	~~~~~~~3
30	1	117	1192	.	.	.	.	.	.	42.18	0.14	~~~~~~~3
30	1	118	994	.	.	.	.	.	.	42.47	0	~~~~~~~2
30	1	119	894	.	.	.	.	.	.	42.64	0	~~~~~~~2
30	1	120	794	.	.	.	.	.	.	42.83	0	~~~~~~~2
30	1	121	694	.	.	.	.	.	.	42.57	0.13	~~~~~~~3
31	1	101	5803	.	.	.	.	.	.	36.44	0.1	~~~~~~~3
31	1	102	5497	.	.	.	.	.	.	36.43	0	~~~~~~~2
31	1	103	5198	.	.	.	.	.	.	36.38	0	~~~~~~~2
31	1	104	4798	.	.	.	.	.	.	36.38	0	~~~~~~~2
31	1	105	4398	.	.	.	.	.	.	37	0	~~~~~~~2
31	1	106	3998	.	.	.	.	.	.	37.52	0	~~~~~~~2
31	1	107	3697	.	.	.	.	.	.	37.69	0.06	~~~~~~~3
31	1	108	3396	.	.	.	.	.	.	38.1	0	~~~~~~~2
31	1	109	3095	.	.	.	.	.	.	38.47	0	~~~~~~~2
31	1	110	2895	.	.	.	.	.	.	38.69	0	~~~~~~~2
31	1	111	2594	.	.	.	.	.	.	39.23	0.07	~~~~~~~3
31	1	112	2293	.	.	.	.	.	.	40.27	0	~~~~~~~2
31	1	113	1993	.	.	.	.	.	.	40.81	0	~~~~~~~2
31	1	114	1693	.	.	.	.	.	.	41.84	0.06	~~~~~~~3
31	1	115	1393	.	.	.	.	.	.	42.63	0	~~~~~~~2
31	1	116	1192	.	.	.	.	.	.	43.22	0	~~~~~~~2
31	1	117	993	.	.	.	.	.	.	43.26	0.11	~~~~~~~3
31	1	118	893	.	.	.	.	.	.	43.34	0	~~~~~~~2
31	1	119	794	.	.	.	.	.	.	43.29	0	~~~~~~~2
31	1	120	694	.	.	.	.	.	.	42.93	0.06	~~~~~~~3
31	1	121	590	.	.	.	.	.	.	42.1	0.11	~~~~~~~3
32	1	101	5658	.	.	.	.	.	.	36.53	0.09	~~~~~~~3
32	1	102	5198	.	.	.	.	.	.	36.46	0	~~~~~~~2
32	1	103	4799	.	.	.	.	.	.	36.59	0	~~~~~~~2
32	1	104	4399	.	.	.	.	.	.	36.75	0	~~~~~~~~
32	1	105	3996	.	.	.	.	.	.	37.34	0	~~~~~~~~
32	1	106	3697	.	.	.	.	.	.	37.77	0	~~~~~~~~
32	1	107	3399	.	.	.	.	.	.	38.2	0	~~~~~~~2
32	1	108	3096	.	.	.	.	.	.	38.69	0	~~~~~~~2
32	1	109	2896	.	.	.	.	.	.	38.91	0	~~~~~~~2
32	1	110	2594	.	.	.	.	.	.	39.27	0	~~~~~~~~
32	1	111	2295	.	.	.	.	.	.	40.45	0	~~~~~~~2
32	1	112	1992	.	.	.	.	.	.	40.66	0	~~~~~~~2
32	1	113	1691	.	.	.	.	.	.	41.36	0.06	~~~~~~~3
32	1	114	1393	.	.	.	.	.	.	42.14	0	~~~~~~~2
32	1	115	1192	.	.	.	.	.	.	42.6	0	~~~~~~~2
32	1	116	993	.	.	.	.	.	.	42.69	0.06	~~~~~~~3

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
32	1	117	892	.	.	.	.	.	.	42.51	0.1	~~~~~~~3
32	1	118	794	.	.	.	.	.	.	42.09	0	~~~~~~~2
32	1	119	694	.	.	.	.	.	.	41.58	0	~~~~~~~2
32	1	120	590	.	.	.	.	.	.	41.76	0	~~~~~~~2
32	1	121	493	.	.	.	.	.	.	41.22	0.11	~~~~~~~3
34	1	101	5076	.	.	.	.	.	.	35.88	0.15	~~~~~~~3
34	1	102	4699	.	.	.	.	.	.	35.63	0	~~~~~~~2
34	1	103	4399	.	.	.	.	.	.	36.58	0	~~~~~~~2
34	1	104	4099	.	.	.	.	.	.	36.65	0.06	~~~~~~~3
34	1	105	3798	.	.	.	.	.	.	36.34	0	~~~~~~~2
34	1	106	3497	.	.	.	.	.	.	36.72	0	~~~~~~~2
34	1	107	3197	.	.	.	.	.	.	37.57	0.09	~~~~~~~3
34	1	108	2894	.	.	.	.	.	.	38.29	0	~~~~~~~2
34	1	109	2593	.	.	.	.	.	.	38.74	0.07	~~~~~~~3
34	1	110	2294	.	.	.	.	.	.	39.39	0	~~~~~~~2
34	1	111	1991	.	.	.	.	.	.	40.66	0.06	~~~~~~~3
34	1	112	1794	.	.	.	.	.	.	41.23	0.08	~~~~~~~3
34	1	113	1594	.	.	.	.	.	.	41.68	0.11	~~~~~~~3
34	1	114	1392	.	.	.	.	.	.	41.76	0.11	~~~~~~~3
34	1	115	1194	.	.	.	.	.	.	42.02	0.08	~~~~~~~3
34	1	116	993	.	.	.	.	.	.	42.6	0.06	~~~~~~~3
34	1	117	894	.	.	.	.	.	.	42.69	0.2	~~~~~~~3
34	1	118	793	.	.	.	.	.	.	42.93	0	~~~~~~~2
34	1	119	693	.	.	.	.	.	.	42.06	0	~~~~~~~2
34	1	120	595	.	.	.	.	.	.	41.92	0	~~~~~~~2
34	1	121	494	.	.	.	.	.	.	41.74	0.18	~~~~~~~3
35	1	108	3244	.	.	.	.	.	.	37.65	0	~~~~~~~2
35	1	109	2996	.	.	.	.	.	.	37.75	0	~~~~~~~2
35	1	110	2745	.	.	.	.	.	.	38.46	0	~~~~~~~2
36	1	101	4861	.	.	.	.	.	.	36.11	0	~~~~~~~2
36	1	102	4699	.	.	.	.	.	.	36.26	0	~~~~~~~2
36	1	103	4299	.	.	.	.	.	.	36.14	0	~~~~~~~2
36	1	104	3997	.	.	.	.	.	.	36.69	0	~~~~~~~2
36	1	105	3697	.	.	.	.	.	.	37.12	0	~~~~~~~2
36	1	106	3395	.	.	.	.	.	.	37.33	0	~~~~~~~2
36	1	107	3096	.	.	.	.	.	.	37.58	0.08	~~~~~~~3
36	1	108	2793	.	.	.	.	.	.	38.61	0	~~~~~~~~
36	1	109	2495	.	.	.	.	.	.	39.61	0.07	~~~~~~~3
36	1	110	2194	.	.	.	.	.	.	-9	-9	~~~~~~~~
36	1	111	1893	.	.	.	.	.	.	40.7	0	~~~~~~~2
36	1	112	1692	.	.	.	.	.	.	-9	-9	~~~~~~~~
36	1	113	1492	.	.	.	.	.	.	41.46	0.06	~~~~~~~3
36	1	114	1294	.	.	.	.	.	.	42.46	0.08	~~~~~~~3
36	1	115	1191	.	.	.	.	.	.	42.8	0.14	~~~~~~~3
36	1	116	1093	.	.	.	.	.	.	42.74	0.1	~~~~~~~3
36	1	117	993	.	.	.	.	.	.	42.12	0.26	~~~~~~~3

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
36	1	118	893	.	.	.	.	.	.	42.04	0	~~~~~~~2
36	1	119	793	.	.	.	.	.	.	41.43	0.06	~~~~~~~3
36	1	120	693	.	.	.	.	.	.	40.9	0.16	~~~~~~~3
36	1	121	594	.	.	.	.	.	.	39.11	0.28	~~~~~~~3
37	1	101	5361	.	.	.	.	.	.	35.69	0	~~~~~~~2
37	1	102	5099	.	.	.	.	.	.	35.78	0	~~~~~~~2
37	1	103	4799	.	.	.	.	.	.	36.27	0	~~~~~~~2
37	1	104	4503	.	.	.	.	.	.	36.58	0	~~~~~~~2
37	1	105	4199	.	.	.	.	.	.	36.77	0	~~~~~~~2
37	1	106	3898	.	.	.	.	.	.	36.78	0	~~~~~~~2
37	1	107	3596	.	.	.	.	.	.	36.58	0.12	~~~~~~~3
37	1	108	3299	.	.	.	.	.	.	37.4	0	~~~~~~~2
37	1	109	2994	.	.	.	.	.	.	38.36	0.11	~~~~~~~3
37	1	110	2694	.	.	.	.	.	.	-9	-9	~~~~~~~~
37	1	111	2396	.	.	.	.	.	.	39.92	0.12	~~~~~~~3
37	1	112	2092	.	.	.	.	.	.	-9	-9	~~~~~~~~
37	1	113	1791	.	.	.	.	.	.	41.72	0.1	~~~~~~~3
37	1	114	1495	.	.	.	.	.	.	41.9	0.12	~~~~~~~3
37	1	115	1195	.	.	.	.	.	.	42.84	0.16	~~~~~~~3
37	1	116	1092	.	.	.	.	.	.	42.25	0.09	~~~~~~~3
37	1	117	992	.	.	.	.	.	.	41.97	0.25	~~~~~~~3
37	1	118	894	.	.	.	.	.	.	42.49	0	~~~~~~~2
37	1	119	794	.	.	.	.	.	.	41.73	0.06	~~~~~~~3
37	1	120	692	.	.	.	.	.	.	40.37	0.15	~~~~~~~3
37	1	121	595	.	.	.	.	.	.	38.98	0.24	~~~~~~~3
38	1	101	5599	.	.	.	.	.	.	36.35	0.06	~~~~~~~3
38	1	102	5198	.	.	.	.	.	.	36.06	0	~~~~~~~2
38	1	103	4900	.	.	.	.	.	.	36.69	0	~~~~~~~2
38	1	104	4498	.	.	.	.	.	.	36.74	0.06	~~~~~~~3
38	1	105	4099	.	.	.	.	.	.	36.64	0	~~~~~~~2
38	1	106	3697	.	.	.	.	.	.	37.07	0	~~~~~~~2
38	1	107	3397	.	.	.	.	.	.	37.67	0.09	~~~~~~~3
38	1	108	3097	.	.	.	.	.	.	38.57	0	~~~~~~~2
38	1	109	2795	.	.	.	.	.	.	39.11	0.1	~~~~~~~3
38	1	110	2494	.	.	.	.	.	.	39.73	0.06	~~~~~~~3
38	1	111	2192	.	.	.	.	.	.	40.62	0.08	~~~~~~~3
38	1	112	1893	.	.	.	.	.	.	41.51	0	~~~~~~~2
38	1	113	-9	.	.	.	.	.	.	-9	-9	~~~~~~~~
38	1	114	1391	.	.	.	.	.	.	42.65	0.07	~~~~~~~3
38	1	115	1193	.	.	.	.	.	.	43	0	~~~~~~~2
38	1	116	992	.	.	.	.	.	.	41.81	0.09	~~~~~~~3
38	1	117	892	.	.	.	.	.	.	41.72	0.22	~~~~~~~3
38	1	118	782	.	.	.	.	.	.	41.52	0	~~~~~~~2
38	1	119	693	.	.	.	.	.	.	40.79	0	~~~~~~~2
38	1	120	592	.	.	.	.	.	.	38.7	0.14	~~~~~~~3
38	1	121	494	.	.	.	.	.	.	35.99	0.24	~~~~~~~3

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
39	1	101	5574	.	.	.	.	.	.	35.04	0.22	~~~~~~~3
39	1	102	5098	.	.	.	.	.	.	35.34	0.06	~~~~~~~3
39	1	103	4797	.	.	.	.	.	.	35.92	0.06	~~~~~~~3
39	1	104	4497	.	.	.	.	.	.	36.08	0.1	~~~~~~~3
39	1	105	4197	.	.	.	.	.	.	35.9	0	~~~~~~~2
39	1	106	3897	.	.	.	.	.	.	36.19	0	~~~~~~~2
39	1	107	3598	.	.	.	.	.	.	36.75	0.14	~~~~~~~3
39	1	108	3295	.	.	.	.	.	.	37.26	0	~~~~~~~2
39	1	109	2995	.	.	.	.	.	.	37.41	0.12	~~~~~~~3
39	1	110	2697	.	.	.	.	.	.	38.6	0.07	~~~~~~~3
39	1	111	2398	.	.	.	.	.	.	40.02	0.16	~~~~~~~3
39	1	112	2095	.	.	.	.	.	.	40.65	0.06	~~~~~~~3
39	1	113	1793	.	.	.	.	.	.	40.95	0.06	~~~~~~~3
39	1	114	1593	.	.	.	.	.	.	-9	-9	~~~~~~~~~
39	1	115	1393	.	.	.	.	.	.	41.67	0.2	~~~~~~~3
39	1	116	1192	.	.	.	.	.	.	42.2	0	~~~~~~~2
39	1	117	994	.	.	.	.	.	.	41.99	0.13	~~~~~~~3
39	1	118	895	.	.	.	.	.	.	41.78	0	~~~~~~~2
39	1	119	794	.	.	.	.	.	.	41.05	0	~~~~~~~2
39	1	120	694	.	.	.	.	.	.	40.96	0.18	~~~~~~~3
39	1	121	594	.	.	.	.	.	.	39.5	0.28	~~~~~~~3
40	1	101	5320	.	.	.	.	.	.	35.49	0.06	~~~~~~~3
40	1	102	5099	.	.	.	.	.	.	35.65	0.06	~~~~~~~3
40	1	103	4798	.	.	.	.	.	.	35.48	0	~~~~~~~2
40	1	104	4498	.	.	.	.	.	.	35.76	0.06	~~~~~~~3
40	1	105	4198	.	.	.	.	.	.	36.22	0	~~~~~~~2
40	1	106	3898	.	.	.	.	.	.	36.64	0	~~~~~~~2
40	1	107	3598	.	.	.	.	.	.	36.63	0.11	~~~~~~~3
40	1	108	3297	.	.	.	.	.	.	36.89	0	~~~~~~~2
40	1	109	2996	.	.	.	.	.	.	37.68	0.13	~~~~~~~3
40	1	110	2695	.	.	.	.	.	.	38.78	0.08	~~~~~~~3
40	1	111	2394	.	.	.	.	.	.	39.51	0.1	~~~~~~~3
40	1	112	2095	.	.	.	.	.	.	40.45	0.08	~~~~~~~3
40	1	113	1793	.	.	.	.	.	.	40.89	0.07	~~~~~~~3
40	1	114	1592	.	.	.	.	.	.	42.03	0.11	~~~~~~~3
40	1	115	1392	.	.	.	.	.	.	42.18	0.14	~~~~~~~3
40	1	116	1192	.	.	.	.	.	.	42.03	0.06	~~~~~~~3
40	1	117	994	.	.	.	.	.	.	41.31	0.17	~~~~~~~3
40	1	118	894	.	.	.	.	.	.	41.44	0.07	~~~~~~~3
40	1	119	793	.	.	.	.	.	.	40.32	0.06	~~~~~~~3
40	1	120	694	.	.	.	.	.	.	39.3	0.12	~~~~~~~3
40	1	121	594	.	.	.	.	.	.	38.32	0.22	~~~~~~~3
41	1	101	5488	.	.	.	.	.	.	36.2	0.18	~~~~~~~3
41	1	102	5097	.	.	.	.	.	.	36.01	0	~~~~~~~2
41	1	103	4799	.	.	.	.	.	.	36.35	0.07	~~~~~~~3
41	1	104	4501	.	.	.	.	.	.	36.24	0.08	~~~~~~~3

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
41	1	105	4098	.	.	.	.	.	.	36.62	0	~~~~~~~2
41	1	106	3695	.	.	.	.	.	.	37.29	0	~~~~~~~2
41	1	107	3395	.	.	.	.	.	.	37.67	0.12	~~~~~~~3
41	1	108	3097	.	.	.	.	.	.	38.08	0	~~~~~~~2
41	1	109	2795	.	.	.	.	.	.	38.59	0.13	~~~~~~~3
41	1	110	2495	.	.	.	.	.	.	40.06	0.08	~~~~~~~3
41	1	111	2196	.	.	.	.	.	.	41.27	0.11	~~~~~~~3
41	1	112	1894	.	.	.	.	.	.	41.2	0.07	~~~~~~~3
41	1	113	1595	.	.	.	.	.	.	41.98	0.07	~~~~~~~3
41	1	114	1395	.	.	.	.	.	.	42.11	0.1	~~~~~~~3
41	1	115	1195	.	.	.	.	.	.	41.91	0.11	~~~~~~~3
41	1	116	996	.	.	.	.	.	.	41.77	0.08	~~~~~~~3
41	1	117	896	.	.	.	.	.	.	40.61	0.17	~~~~~~~3
41	1	118	807	.	.	.	.	.	.	40.13	0	~~~~~~~2
41	1	119	696	.	.	.	.	.	.	38.28	0	~~~~~~~2
41	1	120	601	.	.	.	.	.	.	35.48	0.11	~~~~~~~3
41	1	121	497	.	.	.	.	.	.	30.28	0.2	~~~~~~~3
42	1	101	4676	.	.	.	.	.	.	35.71	0.1	~~~~~~~3
42	1	102	4301	.	.	.	.	.	.	36.26	0.09	~~~~~~~3
42	1	103	3999	.	.	.	.	.	.	36.32	0.08	~~~~~~~3
42	1	104	3699	.	.	.	.	.	.	37.17	0.08	~~~~~~~3
42	1	105	3396	.	.	.	.	.	.	37.79	0	~~~~~~~2
42	1	106	3096	.	.	.	.	.	.	38.13	0.06	~~~~~~~3
42	1	107	2794	.	.	.	.	.	.	38.46	0.15	~~~~~~~3
42	1	108	2495	.	.	.	.	.	.	40.02	0	~~~~~~~2
42	1	109	2192	.	.	.	.	.	.	41.38	0.18	~~~~~~~3
42	1	110	1992	.	.	.	.	.	.	42.38	0.12	~~~~~~~3
42	1	111	1791	.	.	.	.	.	.	42.15	0.15	~~~~~~~3
42	1	112	1594	.	.	.	.	.	.	42.43	0.08	~~~~~~~3
42	1	113	1392	.	.	.	.	.	.	41.9	0.06	~~~~~~~3
42	1	114	1293	.	.	.	.	.	.	42.14	0.15	~~~~~~~3
42	1	115	1192	.	.	.	.	.	.	41.8	0.18	~~~~~~~3
42	1	116	1095	.	.	.	.	.	.	41.05	0.12	~~~~~~~3
42	1	117	995	.	.	.	.	.	.	40.09	0.25	~~~~~~~3
42	1	118	893	.	.	.	.	.	.	39.14	0.09	~~~~~~~3
42	1	119	793	.	.	.	.	.	.	37.19	0.06	~~~~~~~3
42	1	120	693	.	.	.	.	.	.	33.55	0.16	~~~~~~~3
42	1	121	593	.	.	.	.	.	.	27.66	0.18	~~~~~~~3
43	1	101	4709.5	.	.	.	.	.	.	35.08	0.18	~~~~~~~3
43	1	102	3803.1	.	.	.	.	.	.	35.72	0.22	~~~~~~~3
43	1	103	2798	.	.	.	.	.	.	38.61	0.18	~~~~~~~3
43	1	104	1995.4	.	.	.	.	.	.	41.93	0.14	~~~~~~~3
43	1	105	1195.9	.	.	.	.	.	.	41.81	0.07	~~~~~~~3
43	1	106	796.2	.	.	.	.	.	.	35.29	0.09	~~~~~~~3
44	1	101	3398.8	.	.	.	.	.	.	37.46	0	~~~~~~~2
44	1	102	2795.2	.	.	.	.	.	.	38.82	0	~~~~~~~2

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
44	1	103	1998.6	.	.	.	.	.	.	41.23	0.06	~~~~~~~3
44	1	104	1495.2	.	.	.	.	.	.	43.38	0	~~~~~~~2
44	1	105	998.2	.	.	.	.	.	.	41.9	0	~~~~~~~2
44	1	106	698.9	.	.	.	.	.	.	34.66	0	~~~~~~~2
45	1	101	4551.4	.	.	.	.	.	.	35.16	0.11	~~~~~~~3
45	1	102	4001.3	.	.	.	.	.	.	35.98	0	~~~~~~~2
45	1	103	2994.7	.	.	.	.	.	.	37.22	0	~~~~~~~2
45	1	104	1999.5	.	.	.	.	.	.	41.09	0	~~~~~~~2
45	1	105	1397.1	.	.	.	.	.	.	42.93	0.06	~~~~~~~3
45	1	106	798.7	.	.	.	.	.	.	39.45	0.06	~~~~~~~3
46	1	102	5001.4	.	.	.	.	.	.	35.25	0	~~~~~~~2
46	1	103	4001.2	.	.	.	.	.	.	35.65	0	~~~~~~~2
46	1	104	2998.7	.	.	.	.	.	.	37.64	0	~~~~~~~2
46	1	105	1996.9	.	.	.	.	.	3.01	41.62	0.07	~~~~~2~3
46	1	106	1496.4	.	.	.	.	.	3.12	42.51	0	~~~~~2~2
46	1	107	996.6	.	.	.	.	.	3.05	40.16	0	~~~~~2~2
46	1	108	700.4	.	.	.	.	.	2.76	36.7	0	~~~~~2~2
46	1	109	397.6						1.53			~~~~~2~2
47	1	101	5592	.	.	.	.	.	.	34.83	0.11	~~~~~~~3
47	1	102	5000	.	.	.	.	.	.	36.07	0	~~~~~~~2
47	1	103	4698	.	.	.	.	.	.	35.54	0.06	~~~~~~~3
47	1	104	4400	.	.	.	.	.	.	36.28	0	~~~~~~~2
47	1	105	4097	.	.	.	.	.	.	36.47	0	~~~~~~~2
47	1	106	3795	.	.	.	.	.	.	36.83	0	~~~~~~~2
47	1	107	3497	.	.	.	.	.	.	37.25	0	~~~~~~~2
47	1	108	3196	.	.	.	.	.	.	37.52	0	~~~~~~~2
47	1	109	2895	.	.	.	.	.	.	38.02	0.06	~~~~~~~3
47	1	110	2592	.	.	.	.	.	.	38.83	0	~~~~~~~2
47	1	111	2293	.	.	.	.	.	.	39.92	0.07	~~~~~~~3
47	1	112	1993	.	.	.	.	.	.	40.43	0.06	~~~~~~~3
47	1	113	1693	.	.	.	.	.	.	40.89	0.11	~~~~~~~3
47	1	114	1394	.	.	.	.	.	.	41.39	0.14	~~~~~~~3
47	1	115	1192	.	.	.	.	.	.	41.32	0.22	~~~~~~~3
47	1	116	993	.	.	.	.	.	.	40.9	0.17	~~~~~~~3
47	1	117	894	.	.	.	.	.	.	40.54	0.29	~~~~~~33
47	1	118	793	.	.	.	.	.	.	39.15	0.13	~~~~~~~3
47	1	119	695	.	.	.	.	.	.	37.23	0.06	~~~~~~~3
47	1	120	595	.	.	.	.	.	.	34.14	0.12	~~~~~~~3
47	1	121	493	.	.	.	.	.	.	28.77	0.18	~~~~~~~3
48	1	101	4709	.	.	.	.	.	.	36.33	0	~~~~~~~2
48	1	102	4500	.	.	.	.	.	.	36.05	0	~~~~~~~2
48	1	103	4200	.	.	.	.	.	.	36.6	0	~~~~~~~2
48	1	104	3899	.	.	.	.	.	.	36.85	0.07	~~~~~~~3
48	1	105	3598	.	.	.	.	.	.	37.16	0	~~~~~~~2
48	1	106	3295	.	.	.	.	.	.	37.55	0	~~~~~~~2
48	1	107	2995	.	.	.	.	.	.	38.09	0	~~~~~~~2

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
48	1	108	2697	.	.	.	.	.	.	39.14	0	~~~~~~~2
48	1	109	2396	.	.	.	.	.	.	39.91	0.07	~~~~~~~3
48	1	110	2196	.	.	.	.	.	.	40.15	0	~~~~~~~2
48	1	111	1994	.	.	.	.	.	.	40.57	0.09	~~~~~~~3
48	1	112	1794	.	.	.	.	.	.	41.23	0	~~~~~~~2
48	1	113	1595	.	.	.	.	.	.	41.59	0.13	~~~~~~~3
48	1	114	1394	.	.	.	.	.	.	41.03	0.1	~~~~~~~3
48	1	115	1193	.	.	.	.	.	.	41.28	0	~~~~~~~2
48	1	116	1094	.	.	.	.	.	.	40.63	0.2	~~~~~~~3
48	1	117	993	.	.	.	.	.	.	40.85	0.28	~~~~~~~3
48	1	118	893	.	.	.	.	.	.	41.18	0.1	~~~~~~~3
48	1	119	789	.	.	.	.	.	.	40.84	0	~~~~~~~2
48	1	120	694	.	.	.	.	.	.	39.6	0.17	~~~~~~~3
48	1	121	592	.	.	.	.	.	.	36.63	0.2	~~~~~~~3
49	1	101	5648	.	.	.	.	.	.	34.75	0.11	~~~~~~~3
49	1	102	5498	.	.	.	.	.	.	34.83	0	~~~~~~~2
49	1	103	5298	.	.	.	.	.	.	34.75	0.07	~~~~~~~3
49	1	104	5000	.	.	.	.	.	.	35.16	0.08	~~~~~~~3
49	1	105	4698	.	.	.	.	.	.	35.68	0	~~~~~~~2
49	1	106	4400	.	.	.	.	.	.	12.3	0.07	~~~~~~~3
49	1	107	4098	.	.	.	.	.	.	36.16	0	~~~~~~~2
49	1	108	3792	.	.	.	.	.	.	36.68	0	~~~~~~~2
49	1	109	3494	.	.	.	.	.	.	36.88	0.14	~~~~~~~3
49	1	110	3192	.	.	.	.	.	.	37.45	0	~~~~~~~2
49	1	111	2895	.	.	.	.	.	.	37.7	0.11	~~~~~~~3
49	1	112	2597	.	.	.	.	.	.	38.52	0.07	~~~~~~~3
49	1	113	2270	.	.	.	.	.	.	38.76	0.17	~~~~~~~3
49	1	114	1995	.	.	.	.	.	.	40.22	0.12	~~~~~~~3
49	1	115	1691	.	.	.	.	.	.	41.19	0.12	~~~~~~~3
49	1	116	1395	.	.	.	.	.	.	41.92	0.2	~~~~~~~3
49	1	117	1194	.	.	.	.	.	.	41.64	0.09	~~~~~~~3
49	1	118	992	.	.	.	.	.	.	41.39	0.12	~~~~~~~3
49	1	119	894	.	.	.	.	.	.	40.76	0.1	~~~~~~~3
49	1	120	794	.	.	.	.	.	.	39.48	0.17	~~~~~~~3
49	1	121	696	.	.	.	.	.	.	37.54	0.21	~~~~~~~3
49	1	122	595	.	.	.	.	.	.	30.9	0.06	~~~~~~~3
49	1	123	494	.	.	.	.	.	.	30.01	0.1	~~~~~~~3
50	1	101	5751	.	.	.	.	.	.	34.4	0.17	~~~~~~~3
50	1	102	5599	.	.	.	.	.	.	34.36	0	~~~~~~~2
50	1	103	5396	.	.	.	.	.	.	34.44	0.11	~~~~~~~3
50	1	104	5100	.	.	.	.	.	.	34.8	0.12	~~~~~~~3
50	1	105	4800	.	.	.	.	.	.	35.15	0	~~~~~~~2
50	1	106	4400	.	.	.	.	.	.	35.71	0.06	~~~~~~~3
50	1	107	4003	.	.	.	.	.	.	36.28	0.07	~~~~~~~3
50	1	108	3597	.	.	.	.	.	.	36.44	0.06	~~~~~~~3
50	1	109	3196	.	.	.	.	.	.	37.31	0.2	~~~~~~~3

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
50	1	110	2899	.	.	.	.	.	.	37.96	0.06	~~~~~~~3
50	1	111	2593	.	.	.	.	.	.	-9	-9	~~~~~~~~~
50	1	112	2296	.	.	.	.	.	.	39.6	0	~~~~~~~2
50	1	113	1995	.	.	.	.	.	.	39.78	0.24	~~~~~~~3
50	1	114	1694	.	.	.	.	.	.	40.87	0.13	~~~~~~~3
50	1	115	1389	.	.	.	.	.	.	42.17	0.14	~~~~~~~3
50	1	116	1193	.	.	.	.	.	.	42.23	0.23	~~~~~~~3
50	1	117	995	.	.	.	.	.	.	-9	-9	~~~~~~~~~
50	1	118	896	.	.	.	.	.	.	39.72	0.13	~~~~~~~3
50	1	119	792	.	.	.	.	.	.	37.98	0.06	~~~~~~~3
50	1	120	697	.	.	.	.	.	.	35.61	0.19	~~~~~~~3
50	1	121	596	.	.	.	.	.	.	31.06	0.23	~~~~~~~3
50	1	122	492	.	.	.	.	.	.	23.06	0.07	~~~~~~~3
51	1	117	993	.	.	.	.	.	.	41.27	0	~~~~~~~2
51	1	118	881	.	.	.	.	.	.	39.47	0.06	~~~~~~~3
51	1	119	794	.	.	.	.	.	.	37.61	0.06	~~~~~~~3
51	1	120	695	.	.	.	.	.	.	34.02	0.12	~~~~~~~3
51	1	121	594	.	.	.	.	.	.	15.04	0.1	~~~~~~~3
51	1	122	494	.	.	.	.	.	.	18.88	0	~~~~~~~2
52	1	101	5931	.	.	.	.	.	.	34.36	0.13	~~~~~~~3
52	1	102	5696	.	.	.	.	.	.	34.23	0.07	~~~~~~~3
52	1	103	5399	.	.	.	.	.	.	34.66	0.11	~~~~~~~3
52	1	104	5103	.	.	.	.	.	.	35.01	0.16	~~~~~~~3
52	1	105	4799	.	.	.	.	.	.	35.27	0.07	~~~~~~~3
52	1	106	6101	.	.	.	.	.	.	34.34	0.09	~~~~~~~3
52	1	107	5797	.	.	.	.	.	.	34.38	0.12	~~~~~~~3
52	1	108	5397	.	.	.	.	.	.	34.72	0.08	~~~~~~~3
52	1	109	4999	.	.	.	.	.	.	35.04	0.08	~~~~~~~3
52	1	110	4598	.	.	.	.	.	.	35.19	0.07	~~~~~~~3
52	1	111	4100	.	.	.	.	.	.	36.02	0.1	~~~~~~~3
52	1	112	3596	.	.	.	.	.	.	36.51	0.09	~~~~~~~3
52	1	113	3096	.	.	.	.	.	.	37.11	0.1	~~~~~~~3
52	1	114	2596	.	.	.	.	.	.	37.87	0.11	~~~~~~~3
52	1	115	2100	.	.	.	.	.	.	39.89	0.11	~~~~~~~3
52	1	116	1592	.	.	.	.	.	.	42.34	0.12	~~~~~~~3
52	1	117	1391	.	.	.	.	.	.	42.49	0.14	~~~~~~~3
52	1	118	1195	.	.	.	.	.	.	40.98	0.16	~~~~~~~3
52	1	119	994	.	.	.	.	.	.	40.59	0.08	~~~~~~~3
52	1	120	787	.	.	.	.	.	.	36.9	0.09	~~~~~~~3
52	1	121	698	.	.	.	.	.	.	32.05	0.11	~~~~~~~3
52	1	122	597	.	.	.	.	.	.	25.8	0.09	~~~~~~~3
52	1	123	498	.	.	.	.	.	.	18.11	0.07	~~~~~~~3
53	1	102	1993.8	.	.	.	.	.	.	41.2	0.07	~~~~~~~3
53	1	103	1691.3	.	.	.	.	.	.	42.33	0.07	~~~~~~~3
53	1	104	1394.6	.	.	.	.	.	.	42.27	0.1	~~~~~~~3
53	1	105	1195.1	.	.	.	.	.	.	41.55	0.06	~~~~~~~3

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
53	1	106	993.4	.	.	.	.	.	.	39.99	0.08	~~~~~~~3
53	1	107	891.2	.	.	.	.	.	.	37.52	0.08	~~~~~~~3
53	1	108	794.3	.	.	.	.	.	.	21.78	0	~~~~~~~2
53	1	109	693.4	.	.	.	.	.	.	25.81	0.06	~~~~~~~3
53	1	110	596.3	.	.	.	.	.	.	18.94	0.06	~~~~~~~3
53	1	111	494.2	.	.	.	.	.	.	13.44	0.08	~~~~~~~3
54	1	103	5801	.	.	.	.	.	.	34.85	0	~~~~~~~2
54	1	104	5699	.	.	.	.	.	.	34.47	0.1	~~~~~~~3
54	1	105	5299	.	.	.	.	.	.	34.79	0	~~~~~~~2
54	1	106	4899	.	.	.	.	.	.	35	0	~~~~~~~2
54	1	107	4499	.	.	.	.	.	.	35.68	0.08	~~~~~~~3
54	1	108	4099	.	.	.	.	.	.	36.2	0	~~~~~~~2
54	1	109	3796	.	.	.	.	.	.	36.88	0	~~~~~~~2
54	1	110	3498	.	.	.	.	.	.	36.72	0	~~~~~~~2
54	1	111	3197	.	.	.	.	.	.	37.26	0.09	~~~~~~~3
54	1	112	2895	.	.	.	.	.	.	37.33	0.11	~~~~~~~3
54	1	113	2593	.	.	.	.	.	.	37.95	0.06	~~~~~~~3
54	1	114	2290	.	.	.	.	.	.	38.96	0.1	~~~~~~~3
54	1	115	1993	.	.	.	.	.	.	40.95	0.1	~~~~~~~3
54	1	116	1694	.	.	.	.	.	.	42.25	0.12	~~~~~~~3
54	1	117	1393	.	.	.	.	.	.	42.42	0.13	~~~~~~~3
54	1	118	1195	.	.	.	.	.	.	42.27	0.07	~~~~~~~3
54	1	119	990	.	.	.	.	.	.	40.3	0.1	~~~~~~~3
54	1	120	789	.	.	.	.	.	.	34.52	0.15	~~~~~~~3
54	1	121	593	.	.	.	.	.	.	20.55	0.23	~~~~~~~3
54	1	122	496	.	.	.	.	.	.	14.4	0.08	~~~~~~~3
55	1	101	5579	.	.	.	.	.	.	34.64	0	~~~~~~~2
55	1	102	5402	.	.	.	.	.	.	34.52	0	~~~~~~~2
55	1	103	5197	.	.	.	.	.	.	35.03	0	~~~~~~~2
55	1	104	4899	.	.	.	.	.	.	35.34	0	~~~~~~~2
55	1	105	4498	.	.	.	.	.	.	35.52	0.06	~~~~~~~3
55	1	106	4099	.	.	.	.	.	.	35.88	0	~~~~~~~2
55	1	107	3698	.	.	.	.	.	.	36.44	0	~~~~~~~2
55	1	108	3398	.	.	.	.	.	.	37.07	0.06	~~~~~~~3
55	1	109	3097	.	.	.	.	.	.	37.56	0.07	~~~~~~~3
55	1	110	2793	.	.	.	.	.	.	37.73	0.07	~~~~~~~3
55	1	111	2493	.	.	.	.	.	.	39.09	0.07	~~~~~~~3
55	1	112	2192	.	.	.	.	.	.	40.19	0.07	~~~~~~~3
55	1	113	1897	.	.	.	.	.	.	40.86	0.06	~~~~~~~3
55	1	114	1594	.	.	.	.	.	.	42.17	0.09	~~~~~~~3
55	1	115	1393	.	.	.	.	.	.	42.22	0.07	~~~~~~~3
55	1	116	1194	.	.	.	.	.	.	42.14	0.06	~~~~~~~3
55	1	117	994	.	.	.	.	.	.	40.39	0.08	~~~~~~~3
55	1	118	894	.	.	.	.	.	.	38.32	0.07	~~~~~~~3
55	1	119	794	.	.	.	.	.	.	34.8	0.07	~~~~~~~3
55	1	120	694	.	.	.	.	.	.	29.51	0.06	~~~~~~~3

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
55	1	121	595	.	.	.	.	.	.	20.62	0	~~~~~~~~2
55	1	122	495	.	.	.	.	.	.	15.26	0	~~~~~~~~2
56	1	102	5300	.	.	.	.	.	.	33.49	0	~~~~~~~~2
56	1	103	5099	.	.	.	.	.	.	33.35	0	~~~~~~~~2
56	1	104	4800	.	.	.	.	.	.	-9	-9	~~~~~~~~~
56	1	105	4501	.	.	.	.	.	.	34.07	0.25	~~~~~~~~3
56	1	106	4199	.	.	.	.	.	.	34.3	0.36	~~~~~~~33
56	1	107	3899	.	.	.	.	.	.	35.03	0.2	~~~~~~~~3
56	1	108	3595	.	.	.	.	.	.	34.77	0	~~~~~~~~2
56	1	109	3294	.	.	.	.	.	.	-9	-9	~~~~~~~~~
56	1	110	2993	.	.	.	.	.	.	35.65	0.39	~~~~~~~33
56	1	111	2692	.	.	.	.	.	.	35.88	0.52	~~~~~~~33
56	1	112	2396	.	.	.	.	.	.	35.22	0.38	~~~~~~~33
56	1	113	2094	.	.	.	.	.	.	36.2	0.19	~~~~~~~~3
56	1	114	1792	.	.	.	.	.	.	37.08	0.11	~~~~~~~~3
56	1	115	1595	.	.	.	.	.	2.74	38.29	0	~~~~~~2~2
56	1	116	1391	.	.	.	.	.	.	37.51	0.34	~~~~~~~33
56	1	117	1193	.	.	.	.	.	2.69	37.82	0.27	~~~~~~2~3
56	1	118	993	.	.	.	.	.	.	37.17	0.4	~~~~~~~33
56	1	119	890	.	.	.	.	.	.	38.94	0	~~~~~~~~2
56	1	120	794	.	.	.	.	.	.	37.39	0.36	~~~~~~~33
56	1	121	692	.	.	.	.	.	.	35.62	0.24	~~~~~~~~3
56	1	122	596	.	.	.	.	.	.	32.49	0	~~~~~~~~2
56	1	123	496	.	.	.	.	.	.	22.58	0.07	~~~~~~~~3
57	1	101	5686	.	.	.	.	.	.	33.75	0	~~~~~~~~~
57	1	102	5401	.	.	.	.	.	.	33.44	0	~~~~~~~~~
57	1	103	5098	.	.	.	.	.	.	33.55	0	~~~~~~~~2
57	1	104	4800	.	.	.	.	.	.	33.98	0	~~~~~~~~2
57	1	105	4497	.	.	.	.	.	.	34.4	0	~~~~~~~~~
57	1	106	4200	.	.	.	.	.	.	34.38	0	~~~~~~~~2
57	1	107	3899	.	.	.	.	.	.	35	0.17	~~~~~~~~3
57	1	108	3597	.	.	.	.	.	.	35.19	0	~~~~~~~~2
57	1	109	3298	.	.	.	.	.	.	33.66	0.53	~~~~~~~33
57	1	110	2989	.	.	.	.	.	.	35.99	0	~~~~~~~~2
57	1	111	2691	.	.	.	.	.	.	36.72	0	~~~~~~~~2
57	1	112	2390	.	.	.	.	.	.	36.12	0	~~~~~~~~2
57	1	113	2093	.	.	.	.	.	.	36.68	0.08	~~~~~~~~3
57	1	114	1795	.	.	.	.	.	.	37.03	0.31	~~~~~~~33
57	1	115	1590	.	.	.	.	.	.	38.47	0	~~~~~~~~2
57	1	116	1387	.	.	.	.	.	.	37.54	0.23	~~~~~~~~3
57	1	117	1194	.	.	.	.	.	.	38.43	0	~~~~~~~~2
57	1	118	992	.	.	.	.	.	.	38.52	0.06	~~~~~~~~3
57	1	119	893	.	.	.	.	.	.	38.69	0.12	~~~~~~~~3
57	1	120	792	.	.	.	.	.	.	38.13	0.07	~~~~~~~~3
57	1	121	690	.	.	.	.	.	.	35.11	0.19	~~~~~~~~3
58	1	101	5630	.	.	.	.	.	2.2	33.47	0.08	~~~~~~2~3

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
58	1	102	5399	.	.	.	.	.	.	32.11	0.37	~~~~~~~33
58	1	103	5099	.	.	.	.	.	2.23	32.92	0.3	~~~~~~233
58	1	104	4799	.	.	.	.	.	.	34.45	0	~~~~~~~~2
58	1	105	4499	.	.	.	.	.	.	34.43	0.2	~~~~~~~~3
58	1	106	4198	.	.	.	.	.	.	34.13	0.26	~~~~~~~~3
58	1	107	3898	.	.	.	.	.	.	35.48	0	~~~~~~~~~
58	1	108	3596	.	.	.	.	.	.	36.1	0	~~~~~~~~~
58	1	109	3296	.	.	.	.	.	.	36.19	0	~~~~~~~~2
58	1	110	2994	.	.	.	.	.	.	36.18	0.21	~~~~~~~~3
58	1	122	593						2.11			~~~~~~2~~
58	1	123	496						1.48			~~~~~~2~~
59	1	101	5415	.	.	.	.	.	.	33.84	0	~~~~~~~~2
59	1	102	5101	.	.	.	.	.	.	33.59	0	~~~~~~~~2
59	1	103	4900	.	.	.	.	.	.	34.09	0	~~~~~~~~2
59	1	104	4599	.	.	.	.	.	.	34.83	0	~~~~~~~~2
59	1	105	4300	.	.	.	.	.	.	34.77	0	~~~~~~~~2
59	1	106	3997	.	.	.	.	.	.	35.04	0.22	~~~~~~~~3
59	1	107	3700	.	.	.	.	.	.	35.75	0	~~~~~~~~2
59	1	108	3398	.	.	.	.	.	.	35.68	0	~~~~~~~~~
59	1	109	3092	.	.	.	.	.	.	36.55	0.09	~~~~~~~~3
59	1	110	2795	.	.	.	.	.	.	36.91	0	~~~~~~~~2
59	1	111	2496	.	.	.	.	.	.	37.89	0.06	~~~~~~~~3
59	1	112	2190	.	.	.	.	.	.	37.56	0	~~~~~~~~2
59	1	113	1893	.	.	.	.	.	.	37.62	0.07	~~~~~~~~3
59	1	114	1693	.	.	.	.	.	.	38.15	0	~~~~~~~~2
59	1	115	1493	.	.	.	.	.	.	38.53	0	~~~~~~~~2
59	1	116	1293	.	.	.	.	.	.	38.76	0	~~~~~~~~~
59	1	117	1094	.	.	.	.	.	.	39.04	0	~~~~~~~~2
59	1	118	994	.	.	.	.	.	.	38.51	0.07	~~~~~~~~3
59	1	119	891	.	.	.	.	.	.	38.48	0.06	~~~~~~~~3
59	1	120	794	.	.	.	.	.	.	38.53	0.06	~~~~~~~~3
59	1	121	693	.	.	.	.	.	.	37.53	0	~~~~~~~~~
59	1	122	594	.	.	.	.	.	.	32.63	0.1	~~~~~~~~3
59	1	123	493	.	.	.	.	.	.	25.63	0	~~~~~~~~2
61	1	101	4539	.	.	.	.	.	.	34.61	0.08	~~~~~~~~3
61	1	102	4400	.	.	.	.	.	.	34.25	0.08	~~~~~~~~3
61	1	103	4298	.	.	.	.	.	.	34.77	0.11	~~~~~~~~3
61	1	104	3997	.	.	.	.	.	.	34.72	0	~~~~~~~~2
61	1	105	3695	.	.	.	.	.	.	35.1	0	~~~~~~~~2
61	1	106	3396	.	.	.	.	.	.	34.85	0.43	~~~~~~~33
61	1	107	3095	.	.	.	.	.	.	35.92	0	~~~~~~~~2
61	1	108	2795	.	.	.	.	.	.	36.75	0	~~~~~~~~~
61	1	109	2498	.	.	.	.	.	.	36.55	0.08	~~~~~~~~3
61	1	110	2191	.	.	.	.	.	.	36.84	0	~~~~~~~~2
61	1	111	1988	.	.	.	.	.	.	37.56	0	~~~~~~~~2
61	1	112	1792	.	.	.	.	.	.	37.57	0	~~~~~~~~2

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
61	1	113	1595	.	.	.	.	.	.	37.74	0	~~~~~~~2
61	1	114	1393	.	.	.	.	.	.	38.01	0	~~~~~~~2
61	1	115	1192	.	.	.	.	.	.	37.92	0	~~~~~~~2
61	1	116	1091	.	.	.	.	.	.	38.07	0	~~~~~~~2
61	1	117	993	.	.	.	.	.	.	38.16	0	~~~~~~~2
61	1	118	892	.	.	.	.	.	.	38.5	0	~~~~~~~2
61	1	119	792	.	.	.	.	.	.	38.2	0.06	~~~~~~~3
61	1	120	690	.	.	.	.	.	.	37.47	0	~~~~~~~2
61	1	121	591	.	.	.	.	.	.	33.65	0	~~~~~~~2
61	1	122	496	.	.	.	.	.	.	27.12	0	~~~~~~~2
62	1	101	5148	.	.	.	.	.	.	33.29	0.09	~~~~~~~3
62	1	102	4799	.	.	.	.	.	.	33.35	0.09	~~~~~~~3
62	1	103	4499	.	.	.	.	.	.	34.25	0.06	~~~~~~~3
62	1	104	4199	.	.	.	.	.	.	34.79	0	~~~~~~~2
62	1	105	3898	.	.	.	.	.	.	34.93	0.07	~~~~~~~3
62	1	106	3598	.	.	.	.	.	.	34.55	0.22	~~~~~~~3
62	1	107	3297	.	.	.	.	.	.	35.09	0.06	~~~~~~~3
62	1	108	2996	.	.	.	.	.	.	36.07	0	~~~~~~~2
62	1	109	2696	.	.	.	.	.	.	36.51	0.1	~~~~~~~3
62	1	110	2393	.	.	.	.	.	.	37.01	0.09	~~~~~~~3
62	1	111	2095	.	.	.	.	.	.	36.96	0.07	~~~~~~~3
62	1	112	1790	.	.	.	.	.	.	37.11	0	~~~~~~~2
62	1	113	1591	.	.	.	.	.	.	36.79	0.06	~~~~~~~3
62	1	114	1390	.	.	.	.	.	.	37.17	0.06	~~~~~~~3
62	1	115	1194	.	.	.	.	.	.	38.15	0	~~~~~~~2
62	1	116	990	.	.	.	.	.	.	37.3	0.06	~~~~~~~3
62	1	117	892	.	.	.	.	.	.	37.55	0.07	~~~~~~~3
62	1	118	793	.	.	.	.	.	.	37.07	0.06	~~~~~~~3
62	1	119	693	.	.	.	.	.	.	37.41	0.07	~~~~~~~3
62	1	120	594	.	.	.	.	.	.	33.78	0.07	~~~~~~~3
62	1	121	494	.	.	.	.	.	.	24.52	0.06	~~~~~~~3
63	1	101	5497	.	.	.	.	.	.	33.42	0.09	~~~~~~~3
63	1	102	5401	.	.	.	.	.	.	33.32	0	~~~~~~~2
63	1	103	5096	.	.	.	.	.	.	33.16	0.07	~~~~~~~3
63	1	104	4796	.	.	.	.	.	.	32.72	0.07	~~~~~~~3
63	1	105	4399	.	.	.	.	.	.	33.82	0.12	~~~~~~~3
63	1	106	3998	.	.	.	.	.	.	34.13	0.25	~~~~~~~3
63	1	107	3597	.	.	.	.	.	.	34.94	0.11	~~~~~~~3
63	1	108	3197	.	.	.	.	.	.	34.84	0.07	~~~~~~~3
63	1	109	2896	.	.	.	.	.	.	35.03	0.12	~~~~~~~3
63	1	110	2597	.	.	.	.	.	.	36.97	0.06	~~~~~~~3
63	1	111	2293	.	.	.	.	.	.	37.22	0.12	~~~~~~~3
63	1	112	1995	.	.	.	.	.	.	36.25	0	~~~~~~~2
63	1	113	1696	.	.	.	.	.	.	36.96	0.09	~~~~~~~3
63	1	114	1392	.	.	.	.	.	.	37.98	0.07	~~~~~~~3
63	1	115	1192	.	.	.	.	.	.	39.34	0.07	~~~~~~~3

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
63	1	116	998	.	.	.	.	.	.	39.71	0	~~~~~~~2
63	1	117	897	.	.	.	.	.	.	38.51	0.08	~~~~~~~3
63	1	118	796	.	.	.	.	.	.	35.9	0.1	~~~~~~~3
63	1	119	698	.	.	.	.	.	.	31.14	0.08	~~~~~~~3
63	1	120	595	.	.	.	.	.	.	23.99	0	~~~~~~~2
63	1	121	495	.	.	.	.	.	.	18.93	0	~~~~~~~~
64	1	102	4298	.	.	.	.	.	.	35.21	0	~~~~~~~2
64	1	103	3999	.	.	.	.	.	.	35.41	0	~~~~~~~2
64	1	104	3700	.	.	.	.	.	.	35.78	0	~~~~~~~2
64	1	105	3397	.	.	.	.	.	.	36.09	0	~~~~~~~2
64	1	106	3095	.	.	.	.	.	.	36.38	0	~~~~~~~2
64	1	107	2793	.	.	.	.	.	.	37.3	0	~~~~~~~2
64	1	108	2495	.	.	.	.	.	.	37.84	0	~~~~~~~2
64	1	109	2192	.	.	.	.	.	.	37.92	0.08	~~~~~~~3
64	1	110	1995	.	.	.	.	.	.	38.24	0	~~~~~~~2
64	1	111	1792	.	.	.	.	.	.	38.66	0	~~~~~~~2
64	1	112	1593	.	.	.	.	.	.	39.99	0	~~~~~~~2
64	1	113	1393	.	.	.	.	.	.	40.1	0	~~~~~~~2
64	1	114	1292	.	.	.	.	.	.	39.95	0.08	~~~~~~~3
64	1	115	1194	.	.	.	.	.	.	40.68	0.07	~~~~~~~3
64	1	116	1091	.	.	.	.	.	.	39.7	0	~~~~~~~2
64	1	117	991	.	.	.	.	.	.	38.99	0.07	~~~~~~~3
64	1	118	885	.	.	.	.	.	.	37.82	0.07	~~~~~~~3
64	1	119	790	.	.	.	.	.	.	33.62	0.07	~~~~~~~3
64	1	120	686	.	.	.	.	.	.	28.58	0	~~~~~~~2
64	1	121	589	.	.	.	.	.	.	21.66	0	~~~~~~~2
64	1	122	494	.	.	.	.	.	.	15.18	0.09	~~~~~~~3
65	1	101	5541	.	.	.	.	.	.	33.4	0.06	~~~~~~~3
65	1	102	5297	.	.	.	.	.	.	34.17	0	~~~~~~~2
65	1	103	5099	.	.	.	.	.	.	33.7	0.07	~~~~~~~3
65	1	104	4799	.	.	.	.	.	.	34.29	0.07	~~~~~~~3
65	1	105	4499	.	.	.	.	.	.	34.43	0.09	~~~~~~~3
65	1	106	4199	.	.	.	.	.	.	-9	-9	~~~~~~~~
65	1	107	3899	.	.	.	.	.	.	35.42	0.08	~~~~~~~3
65	1	108	3597	.	.	.	.	.	.	35.31	0	~~~~~~~2
65	1	109	3297	.	.	.	.	.	.	35.51	0.07	~~~~~~~3
65	1	110	2998	.	.	.	.	.	.	36.07	0.06	~~~~~~~3
65	1	111	2698	.	.	.	.	.	.	36.36	0.07	~~~~~~~3
65	1	112	2396	.	.	.	.	.	.	35.63	0	~~~~~~~2
65	1	113	2096	.	.	.	.	.	.	37.03	0.07	~~~~~~~3
65	1	114	1795	.	.	.	.	.	.	39.33	0.1	~~~~~~~3
65	1	115	1593	.	.	.	.	.	.	39.86	0.1	~~~~~~~3
65	1	116	1393	.	.	.	.	.	.	40.34	0	~~~~~~~2
65	1	117	1192	.	.	.	.	.	.	40.56	0.09	~~~~~~~3
65	1	118	994	.	.	.	.	.	.	38.86	0.07	~~~~~~~3
65	1	119	894	.	.	.	.	.	.	37.5	0.11	~~~~~~~3

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
65	1	120	793	.	.	.	.	.	.	34.56	0	~~~~~~~2
65	1	121	694	.	.	.	.	.	.	29.02	0	~~~~~~~2
65	1	122	594	.	.	.	.	.	.	23.27	0.08	~~~~~~~3
65	1	123	494	.	.	.	.	.	.	16.9	0.07	~~~~~~~3
66	1	101	5112	.	.	.	.	.	.	32.17	0.18	~~~~~~~3
66	1	102	4900	.	.	.	.	.	.	32.34	0.13	~~~~~~~3
66	1	103	4699	.	.	.	.	.	.	32.43	0.12	~~~~~~~3
66	1	104	4400	.	.	.	.	.	.	33.15	0.1	~~~~~~~3
66	1	105	4099	.	.	.	.	.	.	34.04	0.23	~~~~~~~3
66	1	106	3797	.	.	.	.	.	.	34.25	0.17	~~~~~~~3
66	1	107	3498	.	.	.	.	.	.	34.43	0.15	~~~~~~~3
66	1	108	3196	.	.	.	.	.	.	35.09	0	~~~~~~~2
66	1	109	2895	.	.	.	.	.	.	-9	-9	~~~~~~~~
66	1	110	2595	.	.	.	.	.	.	35.95	0.1	~~~~~~~3
66	1	111	2292	.	.	.	.	.	.	36.2	0.15	~~~~~~~3
66	1	112	1995	.	.	.	.	.	.	37.36	0.06	~~~~~~~3
66	1	113	1695	.	.	.	.	.	.	36.53	0.17	~~~~~~~3
66	1	114	1493	.	.	.	.	.	.	35.3	0.18	~~~~~~~3
66	1	115	1292	.	.	.	.	.	.	36.96	0.17	~~~~~~~3
66	1	116	1192	.	.	.	.	.	.	37.29	0.09	~~~~~~~3
66	1	117	1095	.	.	.	.	.	.	37.63	0.21	~~~~~~~3
66	1	118	993	.	.	.	.	.	.	38.52	0.19	~~~~~~~3
66	1	119	895	.	.	.	.	.	.	38.1	0.17	~~~~~~~3
66	1	120	792	.	.	.	.	.	.	37.5	0.06	~~~~~~~3
66	1	121	695	.	.	.	.	.	.	37.44	0	~~~~~~~2
66	1	122	594	.	.	.	.	.	.	36.22	0.24	~~~~~~~3
66	1	123	496	.	.	.	.	.	.	34.33	0.11	~~~~~~~3
67	1	101	5317	.	.	.	.	.	.	33.24	0	~~~~~~~2
67	1	102	4899	.	.	.	.	.	.	32.85	0	~~~~~~~~
67	1	103	4598	.	.	.	.	.	.	33.22	0	~~~~~~~2
67	1	104	4299	.	.	.	.	.	.	34.03	0	~~~~~~~2
67	1	105	3999	.	.	.	.	.	.	33.91	0	~~~~~~~2
67	1	106	3699	.	.	.	.	.	.	34.35	0	~~~~~~~2
67	1	107	3396	.	.	.	.	.	.	34.38	0.06	~~~~~~~3
67	1	108	3094	.	.	.	.	.	.	36.31	0	~~~~~~~~
67	1	109	2794	.	.	.	.	.	.	36.37	0.06	~~~~~~~3
67	1	110	2596	.	.	.	.	.	.	36.44	0	~~~~~~~2
67	1	111	2379	.	.	.	.	.	.	36.7	0	~~~~~~~2
67	1	112	2193	.	.	.	.	.	.	37.6	0	~~~~~~~~
67	1	113	1899	.	.	.	.	.	.	36.71	0	~~~~~~~2
67	1	114	1689	.	.	.	.	.	.	38.01	0.06	~~~~~~~3
67	1	115	1492	.	.	.	.	.	.	37.99	0.08	~~~~~~~3
67	1	116	1291	.	.	.	.	.	.	38.77	0	~~~~~~~2
67	1	117	1121	.	.	.	.	.	.	39.23	0.12	~~~~~~~3
67	1	118	993	.	.	.	.	.	.	38.99	0	~~~~~~~2
67	1	119	893	.	.	.	.	.	.	38.86	0.07	~~~~~~~3

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
67	1	120	793	.	.	.	.	.	.	37.67	0	~~~~~~~2
67	1	121	693	.	.	.	.	.	.	38.12	0	~~~~~~~~
67	1	122	593	.	.	.	.	.	.	35.2	0.09	~~~~~~~3
67	1	123	495	.	.	.	.	.	.	34.25	0.07	~~~~~~~3
67	1	124	400						2.46			~~~~~2~~
67	1	125	345						2.23			~~~~~2~~
68	1	101	4753	.	.	.	.	.	.	33.38	0.09	~~~~~~~3
68	1	102	4498	.	.	.	.	.	.	34.31	0	~~~~~~~2
68	1	103	4298	.	.	.	.	.	.	33.9	0.09	~~~~~~~3
68	1	104	3998	.	.	.	.	.	.	34.95	0.06	~~~~~~~3
68	1	105	3699	.	.	.	.	.	.	35.52	0.07	~~~~~~~3
68	1	106	3396	.	.	.	.	.	.	35.39	0.11	~~~~~~~3
68	1	107	3096	.	.	.	.	.	.	35.49	0.1	~~~~~~~3
68	1	108	2796	.	.	.	.	.	.	36.24	0	~~~~~~~2
68	1	109	2491	.	.	.	.	.	.	37.11	0	~~~~~~~2
68	1	110	2194	.	.	.	.	.	.	37.19	0	~~~~~~~2
68	1	111	1992	.	.	.	.	.	.	37.37	0	~~~~~~~2
68	1	112	1792	.	.	.	.	.	.	37.08	0	~~~~~~~2
68	1	113	1593	.	.	.	.	.	.	36.69	0.07	~~~~~~~3
68	1	114	1394	.	.	.	.	.	.	37.71	0.08	~~~~~~~3
68	1	115	1290	.	.	.	.	.	.	37.94	0.12	~~~~~~~3
68	1	116	1193	.	.	.	.	.	.	37.7	0.09	~~~~~~~3
68	1	117	1094	.	.	.	.	.	.	36.93	0.1	~~~~~~~3
68	1	118	992	.	.	.	.	.	.	36.82	0.08	~~~~~~~3
68	1	119	892	.	.	.	.	.	.	36.72	0.08	~~~~~~~3
68	1	120	794	.	.	.	.	.	.	35.88	0	~~~~~~~2
68	1	121	692	.	.	.	.	.	.	35.28	0	~~~~~~~2
68	1	122	592	.	.	.	.	.	.	33.88	0.07	~~~~~~~3
68	1	123	493	.	.	.	.	.	.	32.62	0.09	~~~~~~~3
69	1	101	5139	.	.	.	.	.	.	32.29	0.06	~~~~~~~3
69	1	102	4899	.	.	.	.	.	.	33.19	0.08	~~~~~~~3
69	1	103	4701	.	.	.	.	.	.	33.33	0.14	~~~~~~~3
69	1	104	4375	.	.	.	.	.	.	33.95	0.08	~~~~~~~3
69	1	105	4099	.	.	.	.	.	.	34.18	0.11	~~~~~~~3
69	1	106	3797	.	.	.	.	.	.	34.82	0.1	~~~~~~~3
69	1	107	3497	.	.	.	.	.	.	34.86	0.12	~~~~~~~3
69	1	108	3195	.	.	.	.	.	.	36.33	0.06	~~~~~~~3
69	1	109	2895	.	.	.	.	.	.	36.42	0.12	~~~~~~~3
69	1	110	2596	.	.	.	.	.	.	36.7	0	~~~~~~~2
69	1	111	2293	.	.	.	.	.	.	37.6	0.07	~~~~~~~3
69	1	112	1995	.	.	.	.	.	.	37.65	0.07	~~~~~~~3
69	1	113	1694	.	.	.	.	.	.	37.97	0.08	~~~~~~~3
69	1	114	1492	.	.	.	.	.	.	38.11	0.1	~~~~~~~3
69	1	115	1294	.	.	.	.	.	.	38.68	0.13	~~~~~~~3
69	1	116	1189	.	.	.	.	.	.	38.64	0.09	~~~~~~~3
69	1	117	1092	.	.	.	.	.	.	38.66	0.11	~~~~~~~3

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
69	1	118	994	.	.	.	.	.	.	38.57	0.08	~~~~~~~3
69	1	119	894	.	.	.	.	.	.	38.18	0.09	~~~~~~~3
69	1	120	794	.	.	.	.	.	.	38.34	0.08	~~~~~~~3
69	1	121	692	.	.	.	.	.	.	37.91	0	~~~~~~~2
69	1	122	594	.	.	.	.	.	.	35.72	0.11	~~~~~~~3
69	1	123	496	.	.	.	.	.	.	34.73	0.09	~~~~~~~3
70	1	101	5262	.	.	.	.	.	.	33.49	0.08	~~~~~~~3
70	1	102	4899	.	.	.	.	.	.	33.96	0	~~~~~~~2
70	1	103	4598	.	.	.	.	.	.	32.69	0.09	~~~~~~~3
70	1	104	4299	.	.	.	.	.	.	34.33	0.06	~~~~~~~3
70	1	105	3998	.	.	.	.	.	.	35	0.09	~~~~~~~3
70	1	106	3698	.	.	.	.	.	.	34.44	0.08	~~~~~~~3
70	1	107	3396	.	.	.	.	.	.	36.23	0.08	~~~~~~~3
70	1	108	3095	.	.	.	.	.	.	36.26	0	~~~~~~~2
70	1	109	2794	.	.	.	.	.	.	36.12	0.07	~~~~~~~3
70	1	110	2493	.	.	.	.	.	.	37.53	0	~~~~~~~2
70	1	111	2191	.	.	.	.	.	.	37.79	0.07	~~~~~~~3
70	1	112	1890	.	.	.	.	.	.	37.92	0.08	~~~~~~~3
70	1	113	1692	.	.	.	.	.	.	38.53	0.08	~~~~~~~3
70	1	114	1493	.	.	.	.	.	.	38.5	0.12	~~~~~~~3
70	1	115	1293	.	.	.	.	.	.	38.69	0.13	~~~~~~~3
70	1	116	1092	.	.	.	.	.	.	38.36	0.1	~~~~~~~3
70	1	117	992	.	.	.	.	.	.	38.74	0.11	~~~~~~~3
70	1	118	893	.	.	.	.	.	.	39.28	0.08	~~~~~~~3
70	1	119	795	.	.	.	.	.	.	39.85	0.08	~~~~~~~3
70	1	120	693	.	.	.	.	.	.	39.04	0.08	~~~~~~~3
70	1	121	595	.	.	.	.	.	.	37.44	0	~~~~~~~2
70	1	122	495	.	.	.	.	.	.	34.72	0.06	~~~~~~~3
71	1	101	4939	.	.	.	.	.	.	32.55	0	~~~~~~~2
71	1	102	4796	.	.	.	.	.	.	33.52	0	~~~~~~~2
71	1	103	4497	.	.	.	.	.	.	33.84	0.07	~~~~~~~3
71	1	104	4198	.	.	.	.	.	.	34.79	0	~~~~~~~2
71	1	105	3894	.	.	.	.	.	.	34.08	0.08	~~~~~~~3
71	1	106	3595	.	.	.	.	.	.	35.8	0.1	~~~~~~~3
71	1	107	3294	.	.	.	.	.	.	36.07	0.07	~~~~~~~3
71	1	108	2992	.	.	.	.	.	.	35.58	0	~~~~~~~2
71	1	109	2693	.	.	.	.	.	.	36.62	0	~~~~~~~2
71	1	110	2391	.	.	.	.	.	.	37.84	0	~~~~~~~2
71	1	111	2089	.	.	.	.	.	.	38.51	0	~~~~~~~2
71	1	112	1790	.	.	.	.	.	.	37.55	0	~~~~~~~2
71	1	113	1490	.	.	.	.	.	.	37.81	0	~~~~~~~2
71	1	114	1193	.	.	.	.	.	.	37.93	0	~~~~~~~2
71	1	115	992	.	.	.	.	.	.	37.61	0.08	~~~~~~~3
71	1	116	892	.	.	.	.	.	.	38.45	0.06	~~~~~~~3
71	1	117	793	.	.	.	.	.	.	38.34	0.1	~~~~~~~3
71	1	118	691	.	.	.	.	.	.	38.8	0.06	~~~~~~~3

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
71	1	119	591	.	.	.	.	.	.	36.21	0.07	~~~~~~~3
71	1	120	492	.	.	.	.	.	.	33.69	0.06	~~~~~~~3
72	1	101	4486	.	.	.	.	.	.	34.38	0	~~~~~~~2
72	1	102	4099	.	.	.	.	.	.	34.9	0	~~~~~~~2
72	1	103	3797	.	.	.	.	.	.	35.35	0	~~~~~~~2
72	1	104	3497	.	.	.	.	.	.	36.42	0	~~~~~~~2
72	1	105	3195	.	.	.	.	.	.	36.55	0.06	~~~~~~~3
72	1	106	2894	.	.	.	.	.	.	37.13	0.07	~~~~~~~3
72	1	107	2594	.	.	.	.	.	.	36.42	0.06	~~~~~~~3
72	1	108	2292	.	.	.	.	.	.	38.22	0	~~~~~~~2
72	1	109	1992	.	.	.	.	.	.	38.98	0	~~~~~~~2
72	1	110	1692	.	.	.	.	.	.	39.61	0	~~~~~~~2
72	1	112	1393	.	.	.	.	.	.	38.38	0	~~~~~~~2
72	1	114	1193	.	.	.	.	.	.	37.89	0	~~~~~~~2
72	1	116	992	.	.	.	.	.	.	38.42	0.06	~~~~~~~3
72	1	117	894	.	.	.	.	.	.	38.22	0.08	~~~~~~~3
72	1	118	794	.	.	.	.	.	.	38.31	0	~~~~~~~2
72	1	119	695	.	.	.	.	.	.	38.12	0.06	~~~~~~~3
72	1	120	595	.	.	.	.	.	.	36.87	0	~~~~~~~2
73	1	101	4278	.	.	.	.	.	.	33.47	0	~~~~~~~2
73	1	102	4099	.	.	.	.	.	.	34.01	0	~~~~~~~2
73	1	103	3797	.	.	.	.	.	.	36.01	0	~~~~~~~2
73	1	104	3498	.	.	.	.	.	.	35.2	0	~~~~~~~2
73	1	105	3196	.	.	.	.	.	.	35.42	0	~~~~~~~2
73	1	106	2895	.	.	.	.	.	.	36.47	0	~~~~~~~2
73	1	107	2594	.	.	.	.	.	.	35.49	0	~~~~~~~2
73	1	108	2294	.	.	.	.	.	.	36.87	0	~~~~~~~2
73	1	109	1992	.	.	.	.	.	.	37.93	0.08	~~~~~~~3
73	1	110	1692	.	.	.	.	.	.	38.05	0	~~~~~~~2
73	1	112	1190	.	.	.	.	.	.	-9	-9	~~~~~~~~~
73	1	114	890	.	.	.	.	.	.	38.04	0	~~~~~~~2
73	1	116	691	.	.	.	.	.	.	-9	-9	~~~~~~~~~
73	1	117	590	.	.	.	.	.	.	38.69	0.08	~~~~~~~3
74	1	101	4225	.	.	.	.	.	.	34.04	0	~~~~~~~2
74	1	102	3898	.	.	.	.	.	.	34.64	0	~~~~~~~2
74	1	103	3595	.	.	.	.	.	.	35.47	0	~~~~~~~2
74	1	104	3297	.	.	.	.	.	.	36.07	0	~~~~~~~2
74	1	105	2994	.	.	.	.	.	.	36.8	0.06	~~~~~~~3
74	1	106	2695	.	.	.	.	.	.	37.55	0	~~~~~~~2
74	1	107	2394	.	.	.	.	.	.	37.63	0.06	~~~~~~~3
74	1	108	2193	.	.	.	.	.	.	37.51	0	~~~~~~~2
74	1	109	1993	.	.	.	.	.	.	38.13	0	~~~~~~~2
74	1	110	1790	.	.	.	.	.	.	38.73	0	~~~~~~~2
74	1	112	1490	.	.	.	.	.	.	38.17	0.07	~~~~~~~3
74	1	114	1294	.	.	.	.	.	.	38.3	0	~~~~~~~2
74	1	116	1092	.	.	.	.	.	.	37.75	0.11	~~~~~~~3

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
74	1	117	992	.	.	.	.	.	.	37.65	0.07	~~~~~~~3
74	1	118	892	.	.	.	.	.	.	36.9	0.06	~~~~~~~3
74	1	119	792	.	.	.	.	.	.	36.14	0.06	~~~~~~~3
74	1	120	694	.	.	.	.	.	.	36.22	0	~~~~~~~2
74	1	121	593	.	.	.	.	.	.	33.88	0	~~~~~~~2
74	1	122	495	.	.	.	.	.	.	30.42	0	~~~~~~~2
75	1	101	4308	.	.	.	.	.	.	33.83	0	~~~~~~~2
75	1	102	4098	.	.	.	.	.	.	33.49	0	~~~~~~~2
75	1	103	3796	.	.	.	.	.	.	35.45	0	~~~~~~~2
75	1	104	3499	.	.	.	.	.	.	35.11	0	~~~~~~~2
75	1	105	3197	.	.	.	.	.	.	36.54	0	~~~~~~~2
75	1	106	2895	.	.	.	.	.	.	36.52	0	~~~~~~~2
75	1	107	2593	.	.	.	.	.	.	36.2	0	~~~~~~~2
75	1	108	2293	.	.	.	.	.	.	37.2	0	~~~~~~~2
75	1	109	1994	.	.	.	.	.	.	37.5	0	~~~~~~~2
75	1	110	1692	.	.	.	.	.	.	38.29	0	~~~~~~~2
75	1	112	1292	.	.	.	.	.	.	37.51	0	~~~~~~~2
75	1	114	1293	.	.	.	.	.	.	-9	-9	~~~~~~~~
75	1	116	1093	.	.	.	.	.	.	37.08	0	~~~~~~~2
75	1	117	993	.	.	.	.	.	.	37.47	0	~~~~~~~2
75	1	118	892	.	.	.	.	.	.	37.07	0	~~~~~~~2
75	1	119	795	.	.	.	.	.	.	36.3	0	~~~~~~~2
76	1	109	1995	.	.	.	.	.	.	37.82	0.08	~~~~~~~3
76	1	110	1692	.	.	.	.	.	.	37.68	0	~~~~~~~2
76	1	112	1394	.	.	.	.	.	.	37.39	0	~~~~~~~2
76	1	114	1193	.	.	.	.	.	.	36.72	0.07	~~~~~~~3
76	1	116	995	.	.	.	.	.	.	36.41	0.06	~~~~~~~3
76	1	117	893	.	.	.	.	.	.	36.52	0	~~~~~~~2
76	1	118	794	.	.	.	.	.	.	35.04	0	~~~~~~~2
76	1	119	694	.	.	.	.	.	.	35.25	0	~~~~~~~2
76	1	120	594	.	.	.	.	.	.	30.95	0	~~~~~~~2
77	1	101	4423	.	.	.	.	.	.	33.57	0	~~~~~~~2
77	1	102	4096	.	.	.	.	.	.	34.57	0	~~~~~~~2
77	1	103	3795	.	.	.	.	.	.	35.27	0	~~~~~~~2
77	1	104	3496	.	.	.	.	.	.	35.77	0	~~~~~~~2
77	1	105	3193	.	.	.	.	.	.	36.58	0	~~~~~~~2
77	1	106	2892	.	.	.	.	.	.	37.04	0	~~~~~~~2
77	1	107	2592	.	.	.	.	.	.	37.41	0	~~~~~~~2
77	1	108	2290	.	.	.	.	.	.	37.64	0	~~~~~~~2
77	1	109	2086	.	.	.	.	123.04.		38.04	0	~~~~3~~2
77	1	110	1793	.	.	.	.	.	.	37.9	0	~~~~~~~2
77	1	112	1491	.	.	.	.	.	.	37.73	0	~~~~~~~2
77	1	114	1293	.	.	.	.	.	.	38.31	0	~~~~~~~2
77	1	116	1097	.	.	.	.	.	.	37.71	0	~~~~~~~2
77	1	117	993	.	.	.	.	.	.	37.12	0.06	~~~~~~~3
77	1	118	891	.	.	.	.	.	.	37.28	0	~~~~~~~2

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
77	1	119	793	.	.	.	.	.	.	35.94	0	~~~~~~~2
78	1	101	4429	.	.	.	.	.	.	33.76	0.06	~~~~~~~3
78	1	102	4099	.	.	.	.	.	.	34.23	0	~~~~~~~2
78	1	103	3797	.	.	.	.	.	.	35.54	0	~~~~~~~2
78	1	104	3497	.	.	.	.	.	.	36.41	0	~~~~~~~2
78	1	105	3196	.	.	.	.	.	.	35.14	0	~~~~~~~2
78	1	106	2895	.	.	.	.	.	.	37.53	0.08	~~~~~~~3
78	1	107	2594	.	.	.	.	.	.	37.19	0	~~~~~~~2
78	1	108	2291	.	.	.	.	.	.	37.86	0	~~~~~~~2
78	1	109	2093	.	.	.	.	.	.	38.19	0	~~~~~~~2
78	1	110	1792	.	.	.	.	.	.	38.54	0	~~~~~~~2
78	1	112	1492	.	.	.	.	.	.	38.23	0	~~~~~~~2
78	1	114	1293	.	.	.	.	.	.	38.47	0	~~~~~~~2
78	1	116	1092	.	.	.	.	.	.	37.49	0	~~~~~~~2
78	1	117	994	.	.	.	.	.	.	37.81	0	~~~~~~~2
79	1	103	3797	.	.	.	.	.	.	35.17	0	~~~~~~~2
79	1	104	3497	.	.	.	.	.	.	35.88	0	~~~~~~~2
79	1	105	3195	.	.	.	.	.	.	36.11	0	~~~~~~~2
79	1	106	2895	.	.	.	.	.	.	36.47	0	~~~~~~~2
79	1	107	2595	.	.	.	.	.	.	36.75	0	~~~~~~~2
79	1	108	2294	.	.	.	.	.	.	37.01	0	~~~~~~~2
79	1	109	1992	.	.	.	.	.	.	37.48	0.06	~~~~~~~3
79	1	110	1793	.	.	.	.	.	.	37.82	0	~~~~~~~2
79	1	112	1494	.	.	.	.	.	.	37.08	0.06	~~~~~~~3
79	1	114	1294	.	.	.	.	.	.	37.65	0	~~~~~~~2
79	1	116	1094	.	.	.	.	.	.	36.93	0.08	~~~~~~~3
79	1	117	994	.	.	.	.	.	.	36.7	0.07	~~~~~~~3
79	1	118	893	.	.	.	.	.	.	36.28	0	~~~~~~~2
79	1	119	795	.	.	.	.	.	.	36.12	0	~~~~~~~2
80	1	101	4483	.	.	.	.	.	.	33.12	0	~~~~~~~2
80	1	102	4095	.	.	.	.	.	.	33.46	0	~~~~~~~2
80	1	103	3797	.	.	.	.	.	.	34.51	0	~~~~~~~2
80	1	104	3498	.	.	.	.	.	.	35.1	0	~~~~~~~2
80	1	105	3189	.	.	.	.	.	.	35.35	0	~~~~~~~2
80	1	106	2896	.	.	.	.	.	.	36.1	0	~~~~~~~2
80	1	107	2594	.	.	.	.	.	.	36.53	0	~~~~~~~2
80	1	108	2293	.	.	.	.	.	.	36.96	0	~~~~~~~2
80	1	109	2093	.	.	.	.	.	.	36.95	0.08	~~~~~~~3
80	1	110	1893	.	.	.	.	.	.	36.37	0	~~~~~~~2
80	1	112	1591	.	.	.	.	.	.	37.04	0	~~~~~~~2
80	1	114	1292	.	.	.	.	.	.	36.74	0	~~~~~~~2
80	1	116	1093	.	.	.	.	.	.	36.79	0	~~~~~~~2
80	1	117	993	.	.	.	.	.	.	36.49	0.06	~~~~~~~3
80	1	118	892	.	.	.	.	.	.	36.14	0	~~~~~~~2
80	1	119	793	.	.	.	.	.	.	36.06	0	~~~~~~~2
80	1	120	698	.	.	.	.	.	.	34.02	0	~~~~~~~2

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
81	1	106	2997	.	.	.	.	.	.	35.6	0	~~~~~~~2
81	1	107	2695	.	.	.	.	.	.	36.39	0	~~~~~~~2
81	1	108	2395	.	.	.	.	.	.	36.59	0	~~~~~~~2
81	1	109	2095	.	.	.	.	.	.	36.58	0	~~~~~~~2
81	1	110	1793	.	.	.	.	.	.	36.78	0	~~~~~~~~
81	1	112	1492	.	.	.	.	.	.	36.54	0	~~~~~~~2
81	1	114	1293	.	.	.	.	.	.	36.95	0	~~~~~~~2
81	1	116	1095	.	.	.	.	.	.	36.1	0	~~~~~~~2
81	1	117	994	.	.	.	.	.	.	36.21	0	~~~~~~~2
81	1	118	893	.	.	.	.	.	.	35.51	0	~~~~~~~2
82	1	101	4519	.	.	.	.	.	.	32.58	0	~~~~~~~2
82	1	102	4200	.	.	.	.	.	.	32.75	0	~~~~~~~2
82	1	103	3899	.	.	.	.	.	.	33.83	0	~~~~~~~2
82	1	104	3599	.	.	.	.	.	.	34.41	0	~~~~~~~2
82	1	105	3297	.	.	.	.	.	.	34.85	0	~~~~~~~2
82	1	106	2994	.	.	.	.	.	.	35.63	0	~~~~~~~2
82	1	107	2696	.	.	.	.	.	.	36.01	0	~~~~~~~2
82	1	108	2395	.	.	.	.	.	.	36.17	0	~~~~~~~2
82	1	109	2094	.	.	.	.	.	.	36.36	0	~~~~~~~2
84	1	101	3780	.	.	.	.	.	.	33.4	0.06	~~~~~~~3
84	1	102	3597	.	.	.	.	.	.	33.59	0	~~~~~~~2
84	1	103	3400	.	.	.	.	.	.	34.16	0	~~~~~~~2
84	1	104	3196	.	.	.	.	.	.	34.78	0.06	~~~~~~~3
84	1	105	2996	.	.	.	.	.	.	35.14	0	~~~~~~~2
84	1	106	2793	.	.	.	.	.	.	35.18	0	~~~~~~~2
84	1	107	2592	.	.	.	.	.	.	35.21	0	~~~~~~~2
84	1	108	2395	.	.	.	.	.	.	35.14	0	~~~~~~~2
84	1	109	2193	.	.	.	.	.	.	35.82	0	~~~~~~~2
84	1	110	1993	.	.	.	.	.	.	35.95	0	~~~~~~~2
84	1	112	1695	.	.	.	.	.	.	35.15	0	~~~~~~~2
84	1	114	1394	.	.	.	.	.	.	36.55	0	~~~~~~~2
84	1	116	1095	.	.	.	.	.	.	36.64	0	~~~~~~~2
84	1	117	992	.	.	.	.	.	.	36.59	0	~~~~~~~2
84	1	118	892	.	.	.	.	.	.	37.19	0	~~~~~~~2
85	1	101	3286	.	.	.	.	.	.	34.13	0	~~~~~~~2
85	1	102	3198	.	.	.	.	.	.	33.9	0	~~~~~~~2
85	1	103	2996	.	.	.	.	.	.	34.87	0	~~~~~~~2
85	1	104	2793	.	.	.	.	.	.	34.81	0	~~~~~~~2
85	1	105	2596	.	.	.	.	.	.	34.77	0	~~~~~~~2
85	1	106	2393	.	.	.	.	.	.	34.97	0.06	~~~~~~~3
85	1	107	2191	.	.	.	.	.	.	35.59	0	~~~~~~~2
85	1	108	1997	.	.	.	.	.	.	35.95	0	~~~~~~~2
85	1	109	1791	.	.	.	.	113	.	36.14	0	~~~~~3~2
85	1	110	1591	.	.	.	.	.	.	35.64	0	~~~~~~~2
85	1	112	1390	.	.	.	.	.	.	36.37	0	~~~~~~~2
86	1	101	2221	.	.	.	.	.	.	34.09	0	~~~~~~~2

STN NBR	CAST NO	SAMP NO	CTD PRS	CTD SAL	CTD OXY	SAL NTY	OXY GEN	SILCAT	PHSPHT	NITRAT	NITRIT	QUALT
86	1	102	2086	.	.	.	.	.	.	34.25	0	~~~~~~~2
86	1	103	1996	.	.	.	.	.	.	34.81	0.08	~~~~~~~3
86	1	104	1794	.	.	.	.	.	.	35.23	0	~~~~~~~2
86	1	105	1593	.	.	.	.	.	.	35.38	0	~~~~~~~~
86	1	106	1395	.	.	.	.	.	.	35	0.06	~~~~~~~3
86	1	107	1193	.	.	.	.	.	.	35.16	0.08	~~~~~~~3
86	1	108	1093	.	.	.	.	.	.	35.05	0	~~~~~~~~
86	1	109	992	.	.	.	.	.	.	35.28	0	~~~~~~~2
86	1	110	895	.	.	.	.	.	.	35.54	0.07	~~~~~~~3
86	1	112	793	.	.	.	.	.	.	33.92	0.06	~~~~~~~3
86	1	114	694	.	.	.	.	.	.	33.77	0.09	~~~~~~~3
86	1	116	593	.	.	.	.	.	.	29.84	0.17	~~~~~~~3
86	1	117	496	.	.	.	.	.	.	29.52	0.06	~~~~~~~3
87	1	101	2388	.	.	.	.	.	.	34.92	0.12	~~~~~~~3
87	1	102	2195	.	.	.	.	.	.	35.32	0.07	~~~~~~~3
87	1	103	1995	.	.	.	.	.	.	35.41	0.06	~~~~~~~3
87	1	104	1793	.	.	.	.	.	.	34.93	0.07	~~~~~~~3
87	1	105	1591	.	.	.	.	.	.	35.34	0.06	~~~~~~~3
87	1	106	1393	.	.	.	.	.	.	35.63	0.08	~~~~~~~3
87	1	107	1194	.	.	.	.	.	.	35.67	0.07	~~~~~~~3
87	1	108	1093	.	.	.	.	.	.	36.09	0.1	~~~~~~~3
87	1	109	994	.	.	.	.	.	.	35.97	0.12	~~~~~~~3
87	1	110	893	.	.	.	.	.	.	35.88	0.07	~~~~~~~3
87	1	112	794	.	.	.	.	.	.	34.23	0.08	~~~~~~~3
87	1	114	695	.	.	.	.	.	.	34.25	0	~~~~~~~2
87	1	116	594	.	.	.	.	.	.	31.17	0	~~~~~~~2
87	1	117	495	.	.	.	.	.	2.24	28.8	0	~~~~~2~2
88	1	104	1836	.	.	.	.	.	.	36.78	0	~~~~~~~2
88	1	105	1701	.	.	.	.	.	.	36.64	0	~~~~~~~2
88	1	106	1593	.	.	.	.	.	.	-9	-9	~~~~~~~~
88	1	107	1393	.	.	.	.	.	.	37.07	0.08	~~~~~~~3
88	1	108	1191	.	.	.	.	.	.	36.25	0	~~~~~~~2
88	1	109	1091	.	.	.	.	.	.	35.97	0	~~~~~~~2
88	1	110	991	.	.	.	.	.	.	35.62	0	~~~~~~~2
88	1	112	893	.	.	.	.	.	.	34.57	0	~~~~~~~2
88	1	114	790	.	.	.	.	.	.	33.68	0.07	~~~~~~~3
88	1	116	693	.	.	.	.	.	.	35.29	0.17	~~~~~~~3
88	1	117	591	.	.	.	.	.	.	34.37	0	~~~~~~~2
88	1	118	492	.	.	.	.	.	.	31.51	0.06	~~~~~~~3

G.5 FINAL CFC DATA QUALITY EVALUATION (DQE) COMMENTS ON P13.

(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

(J. Bullister, johnb@pmel.noaa.gov) or David Wisegarver (wise@pmel.noaa.gov).

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

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

H. WHPO DATA PROCESSING NOTES

<table>
<tr><th>DATE</th><th>CONTACT</th><th>DATA TYPE</th><th>DATA STATUS SUMMARY</th></tr>
<tr><td>05/24/96</td><td>Aoyama</td><td>CTD</td><td>DQE Report rcvd @ WHPO</td></tr>
<tr><td>05/24/96</td><td>Aoyama</td><td>NUTs/S/O</td><td>DQE Report rcvd @ WHPO</td></tr>
<tr><td>06/16/97</td><td>Key</td><td>DELC14</td><td>Final Data Rcvd @ WHPO</td></tr>
<tr><td></td><td colspan="3">I have just placed C-14 data and report for P13N into the WHPO incoming directory. The data should be ok as is except that the values have too many decimal places.

The data have been through qc and flags are in the data table.

The final data report was sent in 2 formats: a postscript file a FrameMaker mif file and all of the figures in compressed epsi format. If you have FrameMaker, the mif + epsi files should be most useful, otherwise, ps file.</td></tr>
<tr><td>08/15/97</td><td>Uribe</td><td>DOC</td><td>Submitted</td></tr>
<tr><td></td><td colspan="3">2000.12.11 KJU File contained here is a CRUISE SUMMARY and NOT sumfile. Documentation is online.
2000.10.11 KJU Files were found in incoming directory under whp_reports. This directory was zipped, files were separated and placed under proper cruise. All of them are sum files. Received 1997 August 15th.</td></tr>
<tr><td>08/26/98</td><td>Bullister</td><td>BTL/NUTs</td><td>DQE Issues Unresolved</td></tr>
<tr><td></td><td colspan="3">There are still some issues for the P13 data set, especially related to the nutrients. I've tried to contact the nutrient PI a number of times over the past 18 months to resolve these, and so far received no reply. I'll try again and get back to you (hopefully with a final data set) in a couple of weeks.</td></tr>
<tr><td>09/28/98</td><td>Johnson</td><td>NUTs</td><td>DQE Report sent to PI</td></tr>
<tr><td></td><td colspan="3">We are withholding the P13 data because the nutrients are still not revised following DQE</td></tr>
<tr><td>12/14/98</td><td>Key</td><td>DELC14</td><td>Data are Public "but not published"</td></tr>
<tr><td>01/11/99</td><td>Bullister</td><td>CTD/s/o/cfc</td><td>Data are Public</td></tr>
<tr><td></td><td colspan="3">Tr/He data requested from Lupton/Jenkins c14 collected and sent to AMS/WHOI. Checking w/ Quay re c14 data status</td></tr>
<tr><td>04/16/99</td><td>Jenkins</td><td>He/Tr</td><td>Projected Submission Date 1999.05.15</td></tr>
<tr><td>04/29/99</td><td>Quay</td><td>DELC13</td><td>Data and/or Status info Requested by dmb</td></tr>
<tr><td>08/16/99</td><td>Bullister</td><td>SUM</td><td>Data Update</td></tr>
<tr><td></td><td colspan="3">I just ftp'd revised P13.sea and P13.sum files to the WHPO site. The salinity, nutrient and oxygen groups have gone over the DQE comments (made by Michio Aoyama) and made most of the suggested changes in the revised version. We have also gone over the CFC data and made some revisions.

You should have received a copy of the revised nutrient data and document file directly from the nutrient group (University of South Florida, Kent Fanning and Howard Rutherford) a while ago.</td></tr>
</table>

I have intentionally omitted the first five stations at the beginning if the expedition (stations 1-5). These were test casts made on the transit to the start of the P13 section. The locations of Sta 1-5 are still included in the P13.sum file.

We had a lot of PDR problems on this cruise, and some uncorrected depth values are missing from the .sum file. If UNC DEPTH values are unavailable for either the beginning, bottom or end (BE,BO,EN) of a cast, can the available values from the cast be used to fill in the missing slot(s)?

There are 4 stations (28,48,53,61) where no UNC depths are available for BE, BO or EN. Should these be:

a.) left blank?
b.) filled in with estimated values from a bathymetric chart or other source?
c.) interpolated from adjacent stations?
d.) other options?

There were 2 legs to this cruise, separated by a port stop in Kwajalein. I noticed that the cruise is broken into 2 sets of files (p13a and p13b) at the WHPO site. Unless there are compelling reasons, I would prefer if the data from the 2 legs were not split up.

We would welcome Michio Aoyama (or other DQE) going over the revised file and checking that we have responded satisfactorily to any problems in the original files, and adding appropriate DQE flags go the revised version.

10/21/99	Evans	Helium Deep	Data are Public

All of the data sets I submitted recently (the ones with comma delimiters between data fields) can be considered to be public.

11/15/99	Anderson	NUTs	Data Update
11/16/99	Fanning	NUTs	DQE Issues Unresolved

Clarification requested by dmb regarding the revised nutrient data for the WOCE P13 cruise (Aug-Oct, 1992; Chief Sci was John Bullister) that was sent to the WHPO on Feb 23, 1999. There were a few discrepancies between the reprocessed data and the updated bottle file from the Chief Scientist. Upon closer look at the revised nutrient values by our in-house DQE, some concerns were generated. Can you please review the attached file from the DQE and comment on his concerns and/or questions. We want make sure there aren't any uncertainties remaining regarding the nutrient data and that we get the correct values and quality flags into the bottle file.

11/16/99	Kozyr	ALKALI/TCARBN	Final Data Rcvd @ WHPO DQE Complete
02/23/00	Bartolacci	CO2	Data Merged into BTL file

- obtained p13 bottle files from WHPO. Two files were obtained (p13ahy.txt, p13bhy.txt).
- Both files had same station numbers and header lines. Ran a diff on them with no results (exited with no differences).
- Only one CO2 file sent for p13 from Alex Kozyr to WHPO on 2000.02.04.

File contains TCARBN and ALKALI with associated quality bytes.

· Used David Newton's fortran merging code mrgsea for merging.

· As per WHPO sumfiles for p13_a and p13_b were appended together.

· Changed blackslash to underscore in expocode.

· Ran sumchk with no errors. Since both files were the same, I used p13a as the representative bottle file and merged on that file. Ran wocecvt on final merged bottle file(p13mrgout2.txt). Error from wocecvt resulted from first five (test) stations being left in the sumfile. These stations were removed from the bottle files as test stations at the request of John Bullister, the Chief Sci. However since there are data in the first five stations, this will be clarified with Bullister (at the request of Jim Swift and Steve Diggs). Final file containing first five stations is p13_co2_hy.txt, file w/o stations 1-5 is _co2_edt_hy.txt. No other errors reported.

02/25/00 Bartolacci BTL/CO2 Data Update

P13 data files have been appended to one file as per John Bullister (Nov. 1999). The first five stations were test stations and have been removed at his request. CO2 data have been merged into the bottle file.

The old directory structure has been consolidated into one entry for both legs. All files and tables have been edited to reflect the change in file structure and the CO2 addition.

04/13/00 Evans HELIUM/DELHE3 Submitted for DQE

I just ftp'd 4 files to your /INCOMING directory i8nwoce.csv

p13woce.csv
p16cwoce.csv
p19cwoce.csv ...

of the same form as before, comma delimited columns of station, cast, bottle, %delta He3, delta He3 data flag, molal [He], [He] data flag.

04/14/00 Key DELC14 Data are Public

As of 3/2000 the 2 year clock expired on the last of the Pacific Ocean C14 data (P10). All Pacific Ocean WOCE C-14 data should be made public.

04/19/00 Bartolacci DELC14 Website Updated

P13 Changed to indicate data are at WHPO but not in WOCE format (RAW) and therefore not yet merged.

06/12/00 McNichol DELC13 Submitted for DQE

I have just uploaded the file p13sbmt2.csv to your ftp site. It contains the following fields in a comma-delimited file: LabID, Trackline, Station, cast, niskin, del13C, QC

**** Please tell me if this file and its format are acceptable to your office and I will start sending the remaining Pacific 13C data files.

**** The LabID is to distinguish between the two laboratories where the majority of the measurements were made--University of Washington and

NOSAMS, WHOI. I have another file associated with this one which contains descriptions of the samples flagged with a "6". Do you have an appropriate location for this file or should I keep it?

07/05/00	McNichol	DELC13	Submitted
09/25/00	Anfuso	BTL	BTL file resubmitted; remerged into hyd file

Bullister submitted an updated version of the bottle file (original/1999.08.16_P13_SEA_SUM_BULLISTER/P13.sea). This version did not have rawCTD data. Had to pull rawCTD data, CFC113 data, and CCL4 data out of the outdated version of the bottle file and reformat to merge into updated bottle file. Done - 2000.09.26 SRA.

Related files data files are in the MERGED_DATA subdir: P13.sea_edt.dat - pressure sorted bottle data file from Bullister (1999.08.16) CFC113.dat - CFC113 data pulled out of outdated bottle file; re-merged into new btl file CCL4.dat - CCL4 data pulled out of outdated bottle file; re-merged into new btl file

Merged TCARB/ALKALI data from Kozyr into updated btl file: 2000.02.04_P13_CO2_KOZYR/p13carb.txt ---> reformatted and edited. These data are slightly different than the TCARB/ALKALI data that came in the bottle data file submitted as an updated by Bullister (mostly flag changes). Overwrote existing data with this data from Kozyr.

Merged [He]/delHe from Evans into updated btl file: 2000.04.13_P13_HE_DELHE_EVANS/p13woce.csv.txt ---> reformatted and edited (p13woce_csv_edt.txt). Missing data fields were white space, edited into -9. Extracted delhel and delher data from btl file after merge, reformatted missing data to -999.0 (was -9.00); also, some missing data flags were '1', others were '9'...don't know why, couldn't make any correlation. Changed all missing data flags to '9'. **Note : no tritium data to merge on this cruise?**

Merged DelC13 data from McNichol into updated btl file: 2000.06.12_P13_C13_McNICHOL/p13submt2.csv ---> reformatted and edited (p13_delc13_edt.dat). This file needed to be opened in MSWord, and saved as 'text only w/ line breaks'. Had to edit sample numbers.

Merged C14, extracted from updated Bullister btl file and reformatted so missing values were -999.0 (not -9.00). Re-merged with existing bottle data flags.

Did not remerge NUTRIENTS. Data values in updated Bullister file are same as the resent values from Fanning's group, 1999.02.23_Nitrat_Phspht _P13/p13fla~1.txt. The Bullister nutrient data seems to be better because many of the flags on the questionable data (samples that were resubmitted by Fanning's group per DQE request) are at set at '3', where the Fanning data has many flags set as "~"....not sure what to make of this, but suspect it is better to post the nutrient data that came with the updated Bullister hyd file. Also, 00_README in 1999.08.16_P13_SEA_SUM_BULLISTER states that nutrient data is updated in this version of the hyd file. **NOTE** Do we want to mask these values as they are suspect, per DQE? YES - per conversation with sd. Masked only suspicious parameters, nitrate and nitrite. No comments made regarding problems with phosphate and silicate - these parameters not masked.

The complete hyd file is p13hy.txt in the *REMERGE dir. NO3 and NO2 will be masked out in the on-line version.

09/28/00	Anfuso	BTL	Comments concerning resubmitted file

The values in the updated Bullister hyd file and the p13fla~1.txt (revised data sent by Fanning's group) are the same, but flags are different. I think it is best to go with the flags in Bullister's file, and NOT remerge the data. In many cases, Bullister's file flags the revised data (problematic per DQE comments) as '3', where Fanning has flagged these data as '2' or "~". Not sure what to make of the flag ~. Feel most comfortable staying with the Bullister flags (3). Also, per DQE comments on the revised data set, these data still have outstanding problems regarding overall data processing methodology.

Data and flags not re-merged.

09/28/00	Jenkins	He/Tr	No Data Submitted

shallow He/Tr still missing conclusion of meeting w/ L. Talley

09/29/00	McNichol	DELC13	Data are Public

All the Pacific data (most of which I still need to send you) is public. I should be sending you a pile of data next month. Also, if the future, if you have a question that you need answered immediately, the best person to get in contact with besides me is Dana Stuart. Her contact info is dstuart@whoi.edu

10/02/00	Anfuso	SUM	.sum file from Bullister online.

10/03/00	Anfuso	DELC13	Data Merged into BTL file

Bottle: (silcat, nitrat, nitrit, phspht, delc13, c13err)

NO3 and NO2 data in the on-line hyd file have been masked pending review by nutrient PI. DQE reports concerns regarding the quality of these data. Phosphate and silicate data are from the updated Bullister hyd file; these data have not been re-merged (see comments in original subdir *REMERGE for further detail). Regarding delC13 data, A. McNichol confirmed these data are public; data unmasked. 10/3/00 Anfuso NO2/NO3 Data Update See Note: Bottle: (silcat, nitrat, nitrit, phspht, delc13, c13err)

NO3 and NO2 data in the on-line hyd file have been masked pending review by nutrient PI. DQE reports concerns regarding the quality of these data. Phosphate and silicate data are from the updated Bullister hyd file; these data have not been re-merged (see comments in original subdir *REMERGE for further detail). Regarding delC13 data, A. McNichol confirmed these data are public; data unmasked. 10/3/00 Anfuso CFCs/He/CO2 Website Updated Data merged into online file Bottle: (ctdraw, cfc113, ccl4, helium, delhe3, delc14, delc13, tcarbn, alkali, helier, delher, c14err, c13err) REMERGED various parameters into updated hyd file sent by Bullister. DelC13 data has been masked until A. McNichol confirms the data are public. Hyd file from Bullister didn't contain CTDRAW data; these were extracted from outdated hyd file and merged into updated hyd file.

10/17/00	Jenkins	TRITUM	Preliminary data submitted

- *Files for Tritium Data:

  WOCE Indian Ocean = WITrit.dat Contains all legs
  WOCE Pacific P10 = WP10Trit.dat
  WOCE Pacific P13 = WP13Trit.dat
  WOCE Pacific P14c = WP14cTrit.dat
  WOCE Pacific P18 = WP18Trit.dat
  WOCE Pacific P19 = WP19Trit.dat
  WOCE Pacific P21 = WP21Trit.dat
  SAVE South Atlnt = SAVETrit.dat

- Column Layout as follows: Station, Cast, Bottle, Pressure, Tritium, ErrTritium
- Units as follows: Tritium and ErrTritium in T.U.
- All data are unfortunately still preliminary until we have completed the laboratory intercomparision and intercalibration that is still underway.

11/08/00	Anderson	Helium/Neon	Reformatted by WHPO

I have put the Jenkins helium and neon in WOCE format. There were no quality codes so I set the HELIUM, DELHE3, and NEON to 2.

The Indian data was in one big file. I separated it into separate files for each line and also left it in one big file.

11/13/00	Anderson	TRITUM	Reformatted by WHPO

I have put the Jenkins tritium data into WOCE format. There were no quality codes so I set the TRITUM to 2.

02/26/01	Jenkins	TRITUM DEEP	Data are Public

may require minor revisions It was brought to my attention that the WOCE Pacific/Indian He-Tr data was not as yet made public. After submitting it to you last year, I had intended on going through it one more time to ensure there were no problems with it. Unfortunately, I have not had the time to do this. Is it possible, therefore, to release it as public data, and if there are any subsequent minor revisions, to make changes? I suspect there might be a few samples in the set that might have got through our initial quality control.

05/03/01	Uribe	DOC	Updated txt version put online.

06/22/01	Uribe	CTD/BTL	CSV File Online

CTD and Bottle files in exchange format have been put online.

10/04/01	Muus	NUTs/CFC/SUM	Data Merged into BTL file

CFCs merged into BTL, CSV file updated, SUM updated July 2001 CFCs merged into Sept 2000 bottle file containing all nutrients. See DQE discussion in DOC for discussion of NO3 and No2 problems. Deleted Sta 60 Ca 1 BO entry in SUM file since missing position would not allow conversion to exchange file. New bottle, sum and exchange files now on web.

Notes on P13 CFC merging Oct 4, 2001. D. Muus

1. New CFC-11 and CFC-12 from: /usr/export/html-public/data/onetime/pacific/p13/p13/original/2001.07.09_CFC_UPDT_WISEGARVER_P13/20010709.172534_WISEGARVER_P13/20010709.172534_WISEGARVER_P13_p13_CFC_DQE.dat

   merged into SEA file prepared by Stacey Anfuso containing questioned nitrates and nitrates. (20000928WHPOSIOSRA) No changes to Sept 2000 nutrients were made. SEE DQE documentation.

   Nitrate and Nitrite from:
   /usr/export/htmlpublic/data/onetime/pacific/p13/p13/original/1999.02.23_Nitrat_Phspht_P13/p13fla~1.txt

   All "1"s in QUALT1 changed to "9"s and QUALT2 replaced by new QUALT1 prior to merging.

2. SUMMARY file had no position for Station 60, Cast 1 BO. No data in Bottle file. Deleted BO line and left BE and EN lines in place to allow conversion to exchange format.

3. Exchange file checked using Java Ocean Atlas.

02/27/02	Kappa	DOC	Compiled/updated pdf and text cruise reports

Added reports on C02 from CDIAC, CTD from ODF, and C14 dqe from R. Key