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Carbon Dioxide, Hydrographic, and Chemical Data Obtained in the Central South Pacific Ocean (WOCE Sections P17S and P16S) During the Tunes-2 Expedition of the R/V Thomas Washington, July – August, 1991

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Palisades, New York

Woods Hole Oceanographic Institution
Woods Hole, Massachusetts

Carbon Dioxide Information Analysis Center
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Oak Ridge, Tennessee

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CARBON DIOXIDE, HYDROGRAPHIC, AND CHEMICAL DATA OBTAINED IN THE CENTRAL SOUTH PACIFIC OCEAN (WOCE SECTIONS P17S AND P16S) DURING THE TUNES-2 EXPEDITION OF THE R/V *THOMAS WASHINGTON*, JULY–AUGUST, 1991

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ABSTRACT

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This data documentation discusses the procedures and methods used to measure total carbon dioxide (TCO_2), discrete partial pressure of TCO_2 (pCO_2), and total alkalinity (TALK), during the Research Vessel (R/V) *Thomas Washington* TUNES Leg 2 Expedition in the central South Pacific Ocean. Conducted as part of the World Ocean Circulation Experiment (WOCE), the cruise began in Papeete, Tahiti, French Polynesia, on July 16, 1991, and returned to Papeete on August 25, 1991. WOCE Meridional Sections P17S along 135° W and P16S along 150° W were completed during the 40-day expedition. A total of 97 hydrographic stations were occupied. Hydrographic and chemical measurements made along WOCE Sections P17S and P16S included pressure, temperature, salinity, and oxygen measured by conductivity, temperature and depth sensor; bottle salinity; oxygen; phosphate; nitrate; nitrite; silicate; CFC-12; CFC-11; TCO_2; TALK; and pCO_2 measured at 20°C.

The TCO_2 concentration in 1000 seawater samples was determined with a coulometric analysis system, the pCO_2 in 940 water samples was determined with an equilibrator/gas chromatograph system, while the TALK concentration in 139 samples was determined on shore at the laboratory of C. Goyet of Woods Hole Oceanographic Institution with an alkalinity titration system. In addition, 156 coulometric measurements for the Certified Reference Material (Batch #6) were made and yielded a mean value of 2303.2 ± 1.5 μmol/kg. This mean value agrees within a standard deviation of the 2304.6 ± 1.6 μmol/kg (N=9) value determined with the manometer of C. D. Keeling at Scripps Institution of Oceanography (SIO). Replicate samples from 11 Niskin bottles at 4 stations were also collected for later shore-based reference analyses of TCO_2 and TALK by vacuum extraction and manometry in the laboratory of C. D. Keeling of SIO.

The R/V *Thomas Washington* TUNES-2 Expedition data set is available free-of-charge as a numeric data package (NDP) from the Carbon Dioxide Information Analysis Center. The NDP consists of two oceanographic data files, two FORTRAN 77 data-retrieval routine files, a readme file, and this printed documentation, which describes the contents and format of all files and the procedures and methods used to obtain the data.

Keywords: carbon dioxide; World Ocean Circulation Experiment; South Pacific Ocean; hydrographic measurements; carbon cycle; carbonate chemistry; coulometer

PART 1:

OVERVIEW

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, neither of which is completely understood, as well as the biological processes of photosynthesis and respiration. 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 held by plants, animals, and the soil. If only 2% of the carbon stored in the oceans were released, the level of atmospheric carbon dioxide (CO_2) would double. Every year, more than 15 times as much CO_2 is exchanged across the sea surface than the amount produced by 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 already been conducted, and others are currently 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 multi-agency U.S. effort is led by the National Science Foundation and supported by major contributions from the National Oceanic and Atmospheric Administration, the U.S. Department of Energy (DOE), the Office of Naval Research, and the National Aeronautics and Space Administration. Although total carbon dioxide (TCO_2) is not an official WOCE measurement, a coordinated effort, supported in the United States by the DOE, is being made on WOCE cruises to measure the global, spatial, and temporal distributions of TCO_2 and other carbon-related parameters. The goal of the CO_2 survey include estimation of the meridional transport of inorganic carbon in the Pacific Ocean 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 CO_2 between the atmosphere and the ocean, and preparation of a database suitable for carbon-cycle modeling and the subsequent assessment of the anthropogenic CO_2 increase in the oceans. The final data set is expected to cover ~23,000 stations.

This report presents CO_2-related measurements obtained during the 40-day Leg 2 of the Research Vessel (R/V) *Thomas Washington* TUNES Expedition (TUNES-2) along the WOCE Sections P17S and P16S, which are located in the central part of the South Pacific Ocean along the 135° W (between 6° S and 33° S) and 150° W (between 17.5° S and 37.5° S) meridians respectively (Fig. 1).

In addition to TCO_2, parameters measured include total alkalinity (TALK); discrete partial pressure of CO_2 (pCO_2) measured at 20°C; pressure, temperature, salinity, and oxygen measured by conductivity, temperature, and depth sensor (CTD); bottle salinity; oxygen; nutrients; chlorofluorocarbons (CFCs); tritium; and helium.

Scientists from the following institutions participated in the cruise: Scripps Institution of Oceanography (SIO), Woods Hole Oceanographic Institution (WHOI), Lamont-Doherty Earth Observatory (LDEO), Rosenstiel School of Marine and Atmospheric Science (RSMAS), University of Hawaii (UH), and Princeton University (PU).

The CO_2 investigation during the TUNES-2 Expedition was supported by a grant (No. DE-FGO2-90-ER60983) from the U.S. DOE.

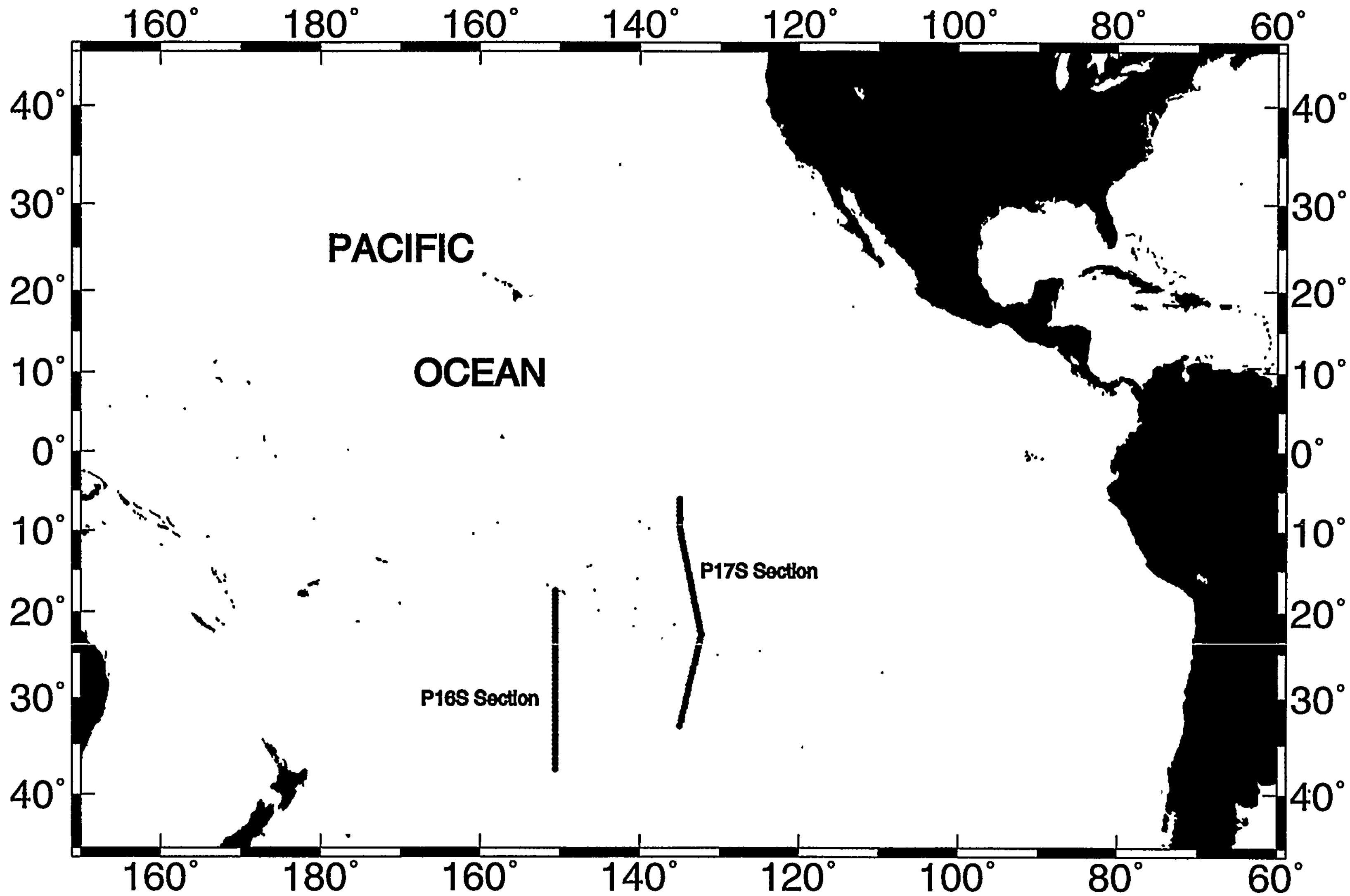

Figure 1. Station locations during R/V *Thomas Washington* TUNES-2 Expedition.

2. DESCRIPTION OF THE EXPEDITION

2.1 R/V *Thomas Washington* TUNES-2 Expedition Information

R/V *Thomas Washington* TUNES-2 Expedition information is as follows:

Ship name	*Thomas Washington*
Cruise/leg	TUNES/2
Expocode	31WTTUNES/2
WOCE Sections	P17S/P16S
Ports of call	Papeete, Tahiti, French Polynesia (round trip)
Dates	July 16–August 25, 1991
Chief Scientist	James H. Swift, (SIO)
Master	A. Arsenault

Parameters measured	**Institution**	**Principal investigators**
CTD, oxygen, and nutrients (P17S)	SIO	L. Talley, M Tsuchiya
CTD, oxygen, and nutrients (P16S)	SIO	J. Swift
Drifters	SIO	Pearn Niiler
ALACE floats	SIO	R. Davis
Tritium and helium	WHOI	W. Jenkins
TCO_2 and pCO_2 (shipboard)	LDEO	D. Chipman, T Takahashi
TCO_2 and TALK (shore)	SIO	C. Keeling
TALK (shore)	WHOI	C. Goyet
pCO_2 (underway)	SIO	R. Weiss
CFCs	RSMAS	R. Fine
ADCP	UH	P. Hacker
^{14}C, $^{226}Ra/^{228}Ra$, and Ba	PU	R. Key

Participating Institutions

SIO	Scripps Institution of Oceanography (University of California, San Diego)
WHOI	Woods Hole Oceanographic Institution
LDEO	Lamont-Doherty Earth Observatory (Columbia University)
RSMAS	Rosenstiel School of Marine and Atmospheric Science (University of Miami)
UH	University of Hawaii
PU	Princeton University

2.2 Brief Cruise Summary

Scientific work for the first portion of the TUNES-2 Expedition (Section P17S) was proposed by Lynne Talley and Mizuki Tsuchiya (both SIO); the second portion (P16S) was planned by James Swift (SIO). The overall purpose of both sections was to contribute to a planned WOCE Hydrographic Program multi-cruise examination of the meridional circulation and water mass transportation in the Pacific Ocean, in this case emphasizing the central subtropical gyros of the North and South Pacific.

After departure from Papeete, Tahiti, on July 16, 1991, WOCE Section P17S began on July 21, 1991, with the occupation of Station 124 at 6° S and 135° W and continued south along 135° W meridian with stations every 30 nm. The P17S track, which followed the ridge extending from the East Pacific Rise to the Tuanotu Islands, was shifted slightly to the east, then back again, in order to cross the rise at a saddle (see Fig. 1). The planned southern Station 179 (33° 03' S and 135° 01' W) of the P17S line was reached without major problems on August 8, 1991, and the vessel steamed for 83 hours to the southern end of the P16S line. In general, the weather was relatively good during the work on the P17S line. A total of 56 stations were occupied.

WOCE Section P16S began on August 11, 1991, with the occupation of Station 180 at 37° 30' S and 150° 28' W, and continued north along 150° W meridian with stations spaced every 30 nm. The weather was still remarkably favorable considering that operations were being carried out during the middle of the austral winter. Although some instrument problems that could potentially affect CTD data quality occurred during this section of the cruise, researchers managed to complete every planned station. The last station of the TUNES-2 Expedition, station 210, was occupied on August 25, 1991, at 17° 31' S and 150° 30' W, and the same day R/V *Thomas Washington* arrived back at Papeete, Tahiti. A total of 41 stations were occupied during Section P16S.

3. DESCRIPTION OF VARIABLES AND METHODS

The data file **tun2.dat** (see description in Part 2) in this numeric data package (NDP) contains the following variables: station numbers; cast numbers; sample numbers; bottle numbers; CTD pressure, temperature, salinity, and oxygen; potential temperature; bottle salinity; concentration of dissolved oxygen, silicate, nitrate, nitrite, and phosphate; CFC-11; CFC-12; TCO_2 and TALK concentration; pCO_2 measured at 20°C; and data quality flags. The station inventory file **tun2sta.inv** (see Part 2) contains the expocode, section number, station number, latitude, longitude, sampling date (i.e., month, day, year), sampling time, and bottom depth for each station.

3.1 Hydrographic Measurements

The hydrographic measurements and water sampling were conducted by the staff of the SIO Oceanographic Data Facility (ODF). During the expedition, a 24/12 double-ring 36-bottle CTD/rosette sampler was used for sampling. An ODF-modified Neil Brown Mark III CTD, a Benthos altimeter, and a Sea Tech transmissometer were mounted on the rosette frame. Seawater samples were collected in PVC 10-L Niskin and ODF bottles.

A full description of CTD and bottle hydrographic measurements is provided in Takahashi et al. (1993 - a reprint is provided in Appendix B).

3.2 CFC-11 and CFC-12 Measurements

Concentrations of the dissolved chlorofluorocarbons (CFC-11 and CFC-12) were measured by shipboard electron-capture gas chromatography using the methods described by Bullister and Weiss (1988). The measurements were carried out by the group at the University of Miami under the direction of Dr. Rana A. Fine with the assistance of a technician from LDEO, Columbia University. A total of 1847 water analyses were carried out, 23 of which were duplicate analyses. The mean values of duplicate analyses are reported in the data file and are assigned a quality flag of 6 according to the WOCE Operations Manual (Joyce and Corry, 1994).

3.3 Shipboard CO_2 Measurements

The TCO_2 concentration in 1000 seawater samples (Fig. 2) was determined with a coulometric analysis system similar to the one described by Johnson et al. (1985). This system consists of a coulometer (Model 5011) manufactured by UIC, Inc. (Jolliet, Ill.) and a sample introduction/CO_2 extraction system of LDEO design.

The pCO_2 in 940 water samples was determined with a fully automated equilibrator-gas chromatograph system that has been described by Chipman et al. (1993).

A full description of shipboard TCO_2 and pCO_2 measurements is provided in Appendix B.

3.4 Shore-based CO_2 Analyses

The TALK concentration in 139 samples was determined on shore at the laboratory of C. Goyet of WHOI. Samples were collected in 250-mL, standard borosilicate glass, screw-cap bottles and poisoned with 50 µL of saturated solution of $HgCl_2$. The samples were stored at room temperature and sent to WHOI for TALK analysis. TALK was determined by potentiometric titration; the method used was derived from one first described by Dyrssen (1965) and later modified by Bradshaw et al. (1981). The automated titration was performed in a closed cell maintained at constant temperature (25 ± 0.1°C). To be similar to seawater, the ionic strength of the hydrochloric acid solution (0.1 N) was adjusted with NaCl. The ratio of the acid normality over the cell volume was calibrated before and after the sample analysis. The calibration consisted of preparing solutions of known TALK concentration and measuring them as described by Brewer et al. (1986). The precision of the measurements was estimated to be better than 0.1%.

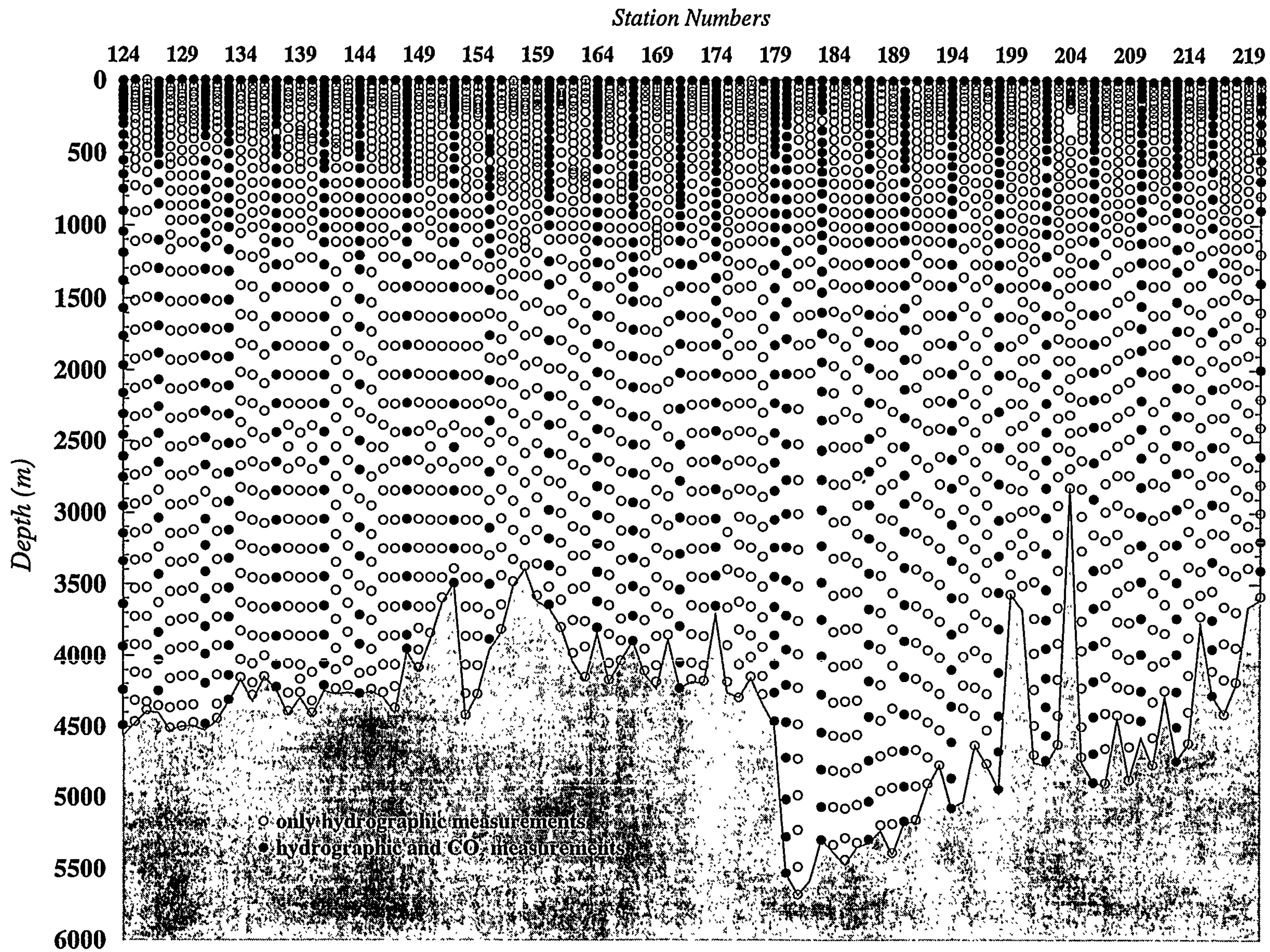

Figure 2. Sampling depths at all hydrographic stations occupied during R/V *Thomas Washington* TUNES-2 Expedition.

The replicate samples from 11 Niskin bottles at 4 stations were collected for shore-based reference analyses at the laboratory of C. D. Keeling of SIO. The TCO_2 measurements were produced by vacuum extraction/manometric analysis and the TALK values by potentiometric titration. Both measurements were performed in controlled laboratory conditions using standards. Samples were collected from the same Niskin bottles used to collect samples for shipboard analyses of TCO_2. The shore laboratory analyses of TCO_2 and TALK employed a precise and proven methodology to provide information on the quality of the shipboard analyses (Guenther et al. 1994). For all shore-based analyses, a replicate s of 1.43 μmol/kg for eleven unflagged pairs was calculated, with no deltas greater than $3s$. The average difference for eleven comparisons of single replicate samples comparing ship and shore TCO_2 values was -3.5 ± 2.0 μmol/kg. Only two surface water and two deep water comparisons exist for the TUNES-2 Expedition. These represent too few data points for meaningful comparative analysis.

Figure 3 displays the one set of profile differences from Station 180 of the TUNES-2 Expedition. There are eight comparisons from Niskin bottles at 300 m and deeper. After the one shallowest comparison (a replicate singlet) was omitted, the remaining seven are characterized by an average difference of -4.3 ± 1.6 μmol/kg. The consistency of the four deeper comparisons, all with excellent bottle pair agreement, is striking. Tables 1 and 2 summarize the replicate shore-based measurements of TCO_2 and TALK.

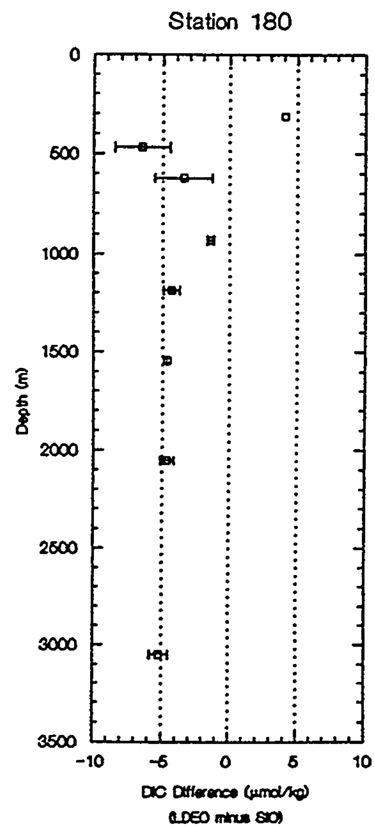

Figure 3. Shipboard total CO_2 minus shore-based total CO_2 versus depth for Station 180. Open squares represent shipboard minus average shore-based TCO_2. Horizontal bracketed lines indicate replicate pair deltas.

Table 1. Summary of total CO_2 replicate data collected during R/V *Thomas Washington* TUNES-2 Expedition

THE CARBON DIOXIDE PROJECT OF THE SCRIPPS INSTITUTION OF OCEANOGRAPHY
TUNES Leg 2 1991 Pacific WOCE Lines P17S/P16S

LEG STN	LAT. LONG.	CAST NISK	DEPTH (M)	SAMPLE DATE	EXTRAC DATE	ANALYSIS DATE	MANO TYPE	SAMPLE BOTTLE	RUN	FLAG	S.I.O. RUN	RUN DELTA	BOTTLE TCO_2	BOTTLE DELTA	"NISKIN" AVG	LDEO TCO_2	LDEO -S.I.O.
											(µMOLES/KG SW)						
2 160	23-43S 132-33W	1 19	909	01AUG91	11DEC91	11DEC91	M	S4158	001		2208.25		2208.25				
					11DEC91	20DEC91	S	S4158	001		2208.73		2208.73				
					11DEC91	12DEC91	M	S4159	001		2207.96		2207.96	-0.29	2208.10	2206.1	-2.00
					11DEC91	20DEC91	S	S4159	001		2208.23		2208.23	-0.50	2208.48	2206.1	-2.38
2 174	30-32S 134-20W	1 61	4	06AUG91	03DEC91	04DEC91	M	R4548	001		2023.46		2023.46				
					03DEC91	09DEC91	S	R4548	001		2022.97		2022.97				
					03DEC91	04DEC91	M	R4549	001		2023.77		2023.77	+0.31	2023.61	2024.2	0.59
					03DEC91	09DEC91	S	R4549	001		2024.61		2024.61	+1.64	2023.79	2024.2	0.41
		1 33	3081		03DEC91	03DEC91	M	R4546	001		2301.42		2301.42				
					03DEC91	06DEC91	S	R4546	001		2303.27		2303.27				
					03DEC91	03DEC91	M	R4547	001		2302.64		2302.64	+1.22	2302.03	2299.0	-3.03
					03DEC91	06DEC91	S	R4547	001		2302.94		2302.94	-0.33	2303.10	2299.0	-4.10
2 180	37-30S 150-30W	2 69	315	12AUG91	04DEC91	06DEC91	S	R4565	001		2121.42		2121.42		2121.42	2125.5	4.08
		2 11	469		11DEC91	11DEC91	M	R4562	001		2134.64		2134.64				
					11DEC91	19DEC91	S	R4562	001		2133.70		2133.70				
					11DEC91	11DEC91	M	R4563	001		2130.68		2130.68	-3.96	2132.66	2126.2	-6.46
					11DEC91	19DEC91	S	R4563	001		2129.14		2129.14	-4.56	2131.42	2126.2	-5.22
		2 13	622		16DEC91	17DEC91	M	R4560	001		2138.07		2138.07				
					16DEC91	20DEC91	S	R4560	001		2137.74		2137.74				
					16DEC91	17DEC91	M	R4561	001		2133.80		2133.80	-4.27	2135.94	2132.5	-3.44
					16DEC91	20DEC91	S	R4561	001		2134.91		2134.91	-2.83	2136.32	2132.5	-3.82
		2 16	931		06MAY92	17JUL92	E	R4558	001		2169.51						
					06MAY92	17JUL92	E	R4558	002		2168.19	-1.32	2168.85				
					06MAY92	17JUL92	E	R4559	001		2168.22						
					06MAY92	17JUL92	E	R4559	002		2168.53	+0.31	2168.38	-0.47	2168.61	2167.2	-1.41
		2 18	1188		05MAY92	17JUL92	E	R4556	001		2207.85						
					05MAY92	17JUL92	E	R4556	002		2207.82	-0.03	2207.84				
					05MAY92	17JUL92	E	R4557	001		2207.12						
					05MAY92	17JUL92	E	R4557	002		2206.20	-0.92	2206.66	-1.18	2207.25	2202.9	-4.35
		2 20	1543		04DEC91	04DEC91	M	R4554	001		2258.59		2258.59				
					04DEC91	09DEC91	S	R4554	001		2259.74		2259.74				
					04DEC91	05DEC91	M	R4555	001		2258.58		2258.58	-0.01	2258.59	2253.9	-4.69
					04DEC91	09DEC91	S	R4555	001		2257.71		2257.71	-2.03	2258.73	2253.9	-4.83

MANOMETER TYPE:
- M = CONSTANT VOLUME MERCURY MANOMETER DATUM
- S = QUARTZ SPIRAL MANOMETER DATUM
- E = ELECTRONIC CONSTANT-VOLUME MANOMETER DATUM

BOTTLE TYPE:
- R = RODAVISS   S = S TYPE

FLAGS:
- F: No Hg found in bottle
- G: Severe bottle leak
- EX: Data excluded from analysis

Table 1 (continued)

THE CARBON DIOXIDE PROJECT OF THE SCRIPPS INSTITUTION OF OCEANOGRAPHY
TUNES Leg 2 1991 Pacific WOCE Lines P17S/P16S

LEG STN	LAT. LONG.	CAST NISK	DEPTH (M)	SAMPLE DATE	EXTRAC DATE	ANALYSIS DATE	MANO TYPE	SAMPLE BOTTLE	RUN	FLAG	S.I.O. RUN	RUN DELTA	BOTTLE TCO_2	BOTTLE DELTA	"NISKIN" AVG	LDEO TCO_2	LDEO -S.I.O.
											(µMOLES/KG SW)						
2	37-30S	2 22	2052	12AUG91	05MAY92	10JUL92	E	R4552	001	EX	2299.71						
180	150-30W				05MAY92	10JUL92	E	R4552	002		2294.57		2294.57				
					05MAY92	10JUL92	E	R4553	001		2295.61						
					05MAY92	10JUL92	E	R4553	002		2295.46	-0.15	2295.54	+0.97	2295.06	2290.4	-4.66
		2 26	3051		04MAY92	10JUL92	E	R4550	001		2309.37						
					04MAY92	10JUL92	E	R4550	002		2309.74	+0.37	2309.56				
					04MAY92	10JUL92	E	R4551	001		2308.23						
					04MAY92	10JUL92	E	R4551	002	EX	2299.35		2308.23	-1.33	2308.90	2303.7	-5.20
2	21- 0S	1 3	62	23AUG91	12DEC91	13DEC91	M	S4118	001		1997.57		1997.57				
213	150-30W				12DEC91	19DEC91	S	S4118	001		1998.22		1998.22				
					12DEC91	13DEC91	M	S4119	001		1995.37		1995.37	-2.20	1996.47	1992.9	-3.57
					12DEC91	20DEC91	S	S4119	001		1995.98		1995.98	-2.24	1997.10	1992.9	-4.20

MANOMETER TYPE:
M = CONSTANT VOLUME MERCURY MANOMETER DATUM
S = QUARTZ SPIRAL MANOMETER DATUM
E = ELECTRONIC CONSTANT-VOLUME MANOMETER DATUM
BOTTLE TYPE:
R = RODAVISS S = S TYPE

FLAGS:
F: No Hg found in bottle
G: Severe bottle leak
EX: Data excluded from analysis

NOTE: Dilution factor of 1.000170 has been applied.

Table 2. Summary of total alkalinity replicate data collected during R/V *Thomas Washington* TUNES-2 Expedition

THE CARBON DIOXIDE PROJECT OF THE SCRIPPS INSTITUTION OF OCEANOGRAPHY
TUNES Leg 2 1991 WOCE Pacific Line P17S/P16S

LEG STN	LAT. LONG.	CAST NISK	DEPTH (M)	SAMPLE DATE	ANALYSIS DATE	TITR SYST	SAMPLE BOTTLE	TRIAL	FLAG	S.I.O. TRIAL	TRIAL DELTA	BOTTLE ALK	BOTTLE DELTA	"NISKIN" AVG
										(µEQUIV/KG SW)				
2	23-43S	1 19	909	01AUG91	20JAN92	V	S4158	1		2300.18		2300.18		
160	132-33W				20JAN92	V	S4159	1		2302.05		2302.05	+1.87	2301.11
2	30-32S	1 61	4	06AUG91	10JAN92	V	R4548	1		2318.15		2318.15		
174	134-20W				10JAN92	V	R4549	1		2324.19		2324.19	+6.04	2321.17
		1 33	3081		10JAN92	V	R4546	1		2395.78		2395.78		
					10JAN92	V	R4547	1		2396.62		2396.62	+0.84	2396.20
2	37-30S	2 69	315	12AUG91	14JAN92	V	R4564	1		2277.74		2277.74		
180	150-30W				14JAN92	V	R4565	1		2280.79		2280.79	+3.05	2279.27
		2 11	469		14JAN92	V	R4562	1		2275.55		2275.55		
					14JAN92	V	R4563	1		2273.45		2273.45	-2.10	2274.50
		2 13	622		17JAN92	V	R4560	1		2275.23		2275.23		
					17JAN92	V	R4561	1		2281.82		2281.82	+6.59	2278.53
		2 16	931		22JUN92	V	R4558	1		2290.65		2290.65		
					22JUN92	V	R4559	1		2285.23		2285.23	-5.42	2287.94
		2 18	1188		22JUN92	V	R4556	1		2304.57		2304.57		
					22JUN92	V	R4557	1		2304.45		2304.45	-0.12	2304.51
		2 20	1543		13JAN92	V	R4554	1		2343.31		2343.31		
					13JAN92	V	R4555	1		2343.93		2343.93	+0.62	2343.62
		2 22	2052		18JUN92	V	R4552	1		2380.77		2380.77		
					18JUN92	V	R4553	1		2382.52		2382.52	+1.75	2381.65
		2 26	3051		18JUN92	V	R4550	1		2403.47		2403.47		
					18JUN92	V	R4551	1		2404.50		2404.50	+1.03	2403.99
2	21- 0S	1 3	62	23AUG91	20JAN92	V	S4118	1		2365.81		2365.81		
213	150-30W				20JAN92	V	S4119	1		2366.34		2366.34	+0.53	2366.08

TITRATION SYSTEM:
G = GRAVIMETRIC
V = VOLUMETRIC
BOTTLE TYPE:
R = RODAVISS S = S TYPE

FLAGS:
F: No Hg found in bottle
X: Titrator malfunction
EX: Data excluded from analysis

NOTE: Dilution factor of 1.000170 has been applied.

4. DATA CHECKS AND PROCESSING PERFORMED BY CDIAC

An important part of the NDP 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. Although they have common objectives, these reviews are tailored to each data set and often require extensive programming efforts. In short, 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 *Thomas Washington* TUNES-2 Expedition in the South Pacific Ocean (WOCE Sections P17S and P16S).

1. Carbon-related data and preliminary hydrographic measurements were provided to CDIAC by Taro Takahashi and Stewart Sutherland of LDEO. The final hydrographic and chemical measurements and the station information files were provided by the WOCE Hydrographic Program Office after quality evaluation. A FORTRAN 77 retrieval code was written and used to merge and reformat all data files.

2. The designation for missing values, given as −9.0 in the original files, was changed to −999.9.

3. To check for obvious outliers, all data were plotted with a PLOTNEST.C program written by Stewart C. Sutherland (LDEO). 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 (Figs. 4–6). Several outliers were identified and removed after consultation with the principal investigators.

4. 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 South Pacific Ocean.

5. All variables were checked for values exceeding physical limits, such as sampling depth values that are greater than the given bottom depths.

6. Dates and times were checked for bogus values (e.g., values of MONTH < 1 or > 12, DAY < 1 or > 31, YEAR < or > 1991, TIME < 0000 or > 2400.

7. Station locations (latitudes and longitudes) and sampling times were examined for consistency with maps and cruise information supplied by Takahashi et al. (1993).

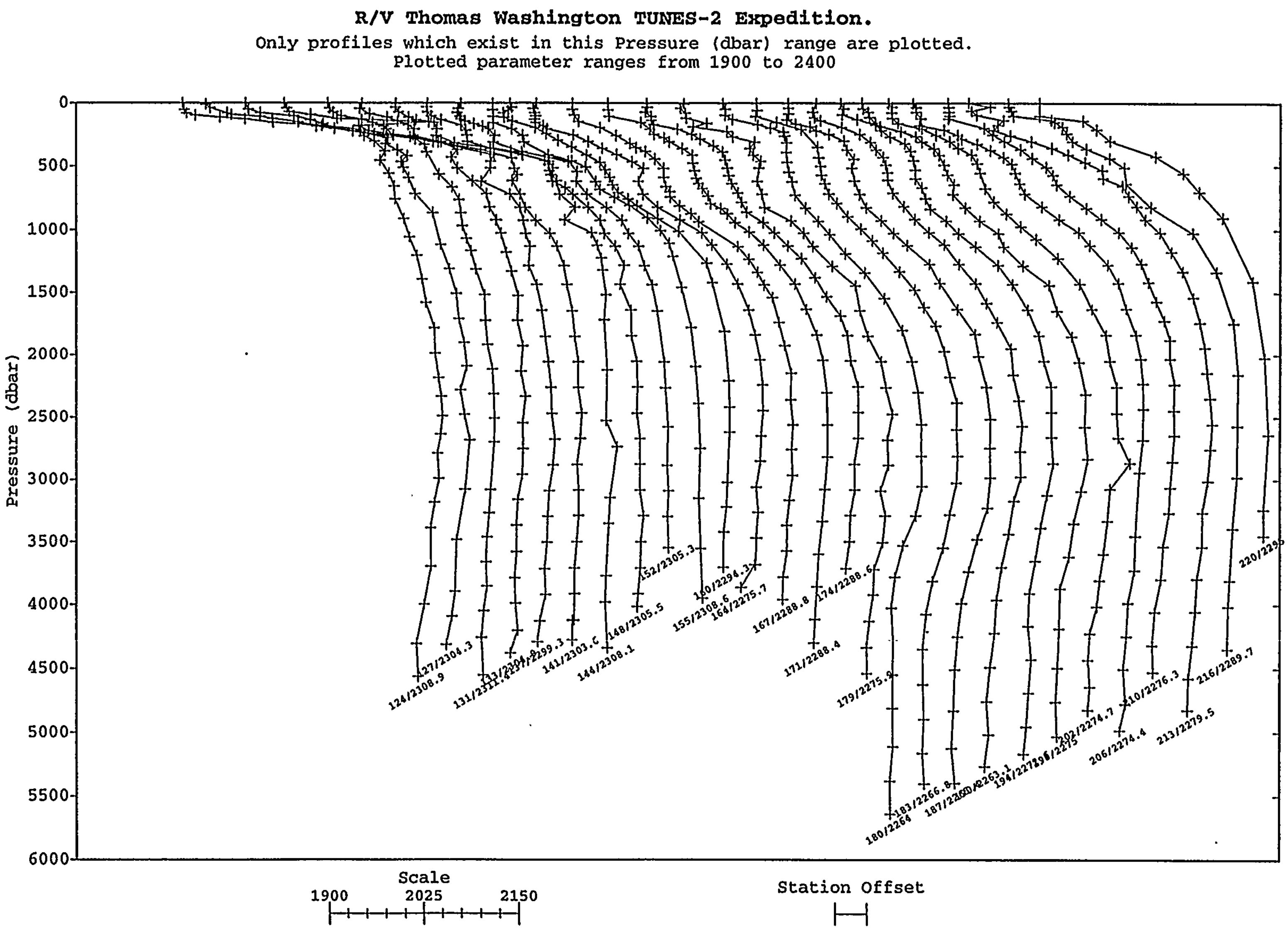

Figure 4. Nested profiles: total CO_2 (μmol/kg) vs pressure (dbar).

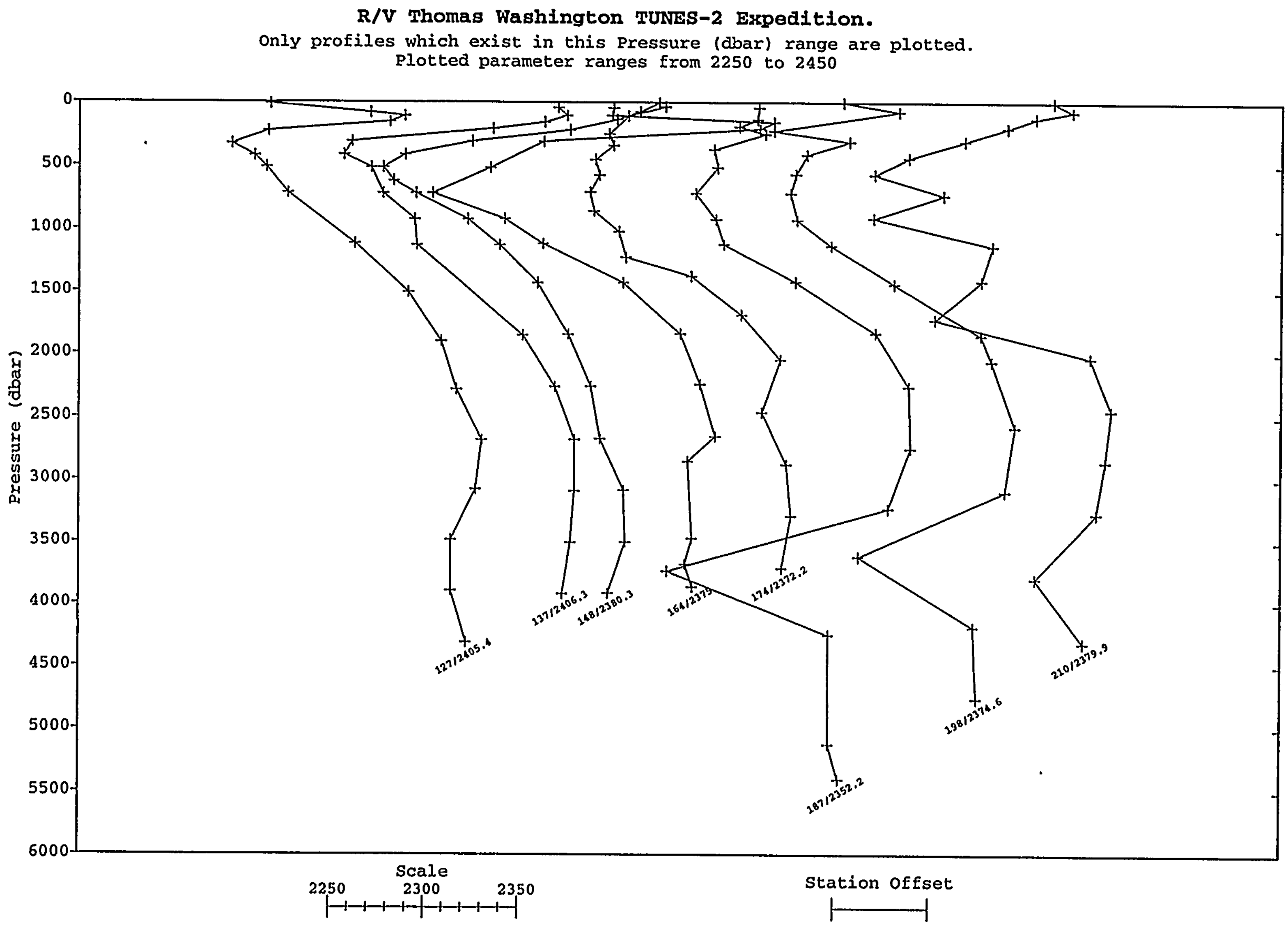

Figure 5. Nested profiles: total alkalinity (μmol/kg) vs pressure (dbar).

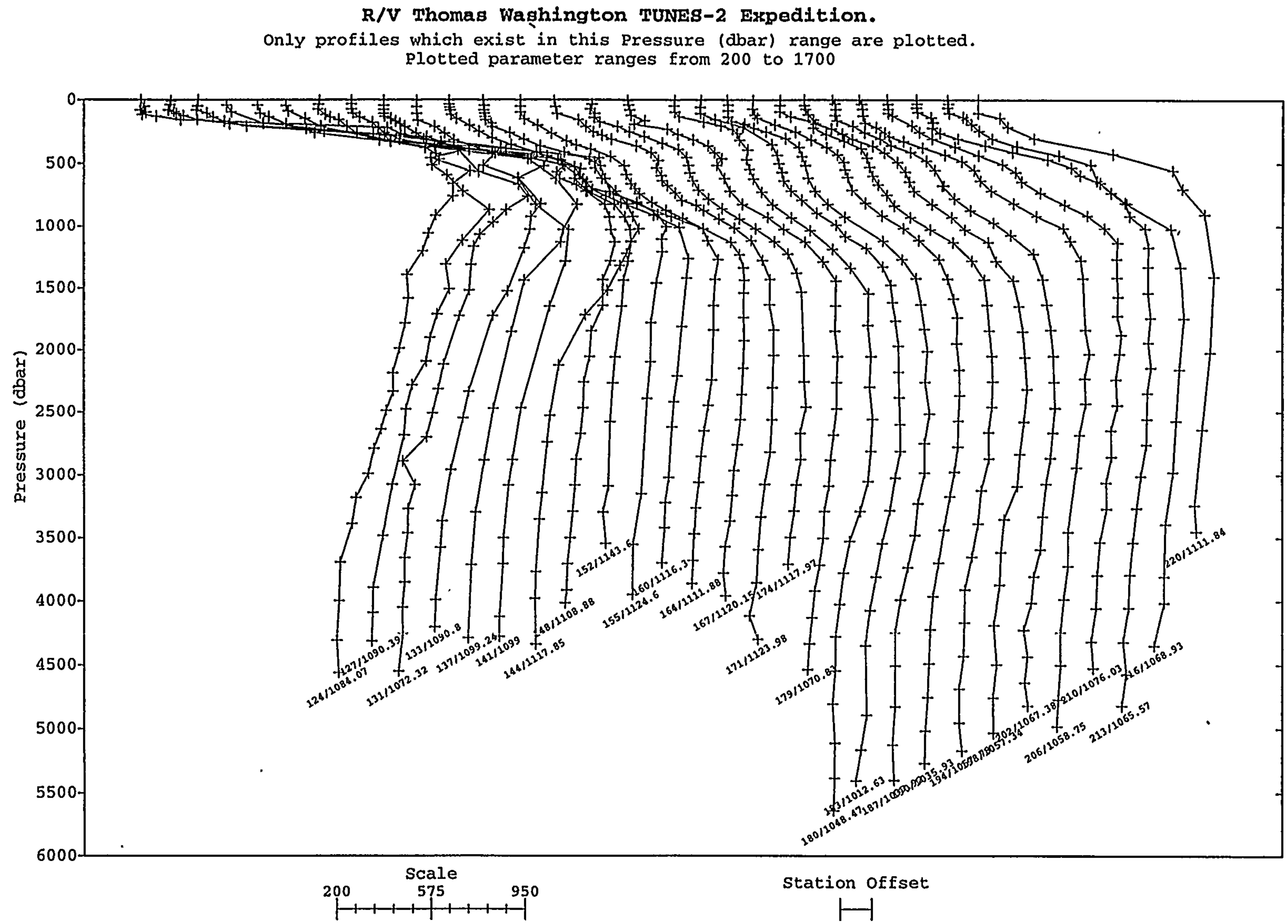

Figure 6. Nested profiles: partial pressure of CO_2 (μatm) vs pressure (dbar).

5. HOW TO OBTAIN THE DATA AND DOCUMENTATION

This database is available on request in machine-readable form, without charge, from CDIAC. CDIAC will also distribute subsets of the database as needed. It can be acquired on 9-track magnetic tape; on 8-mm tape; on 150-mB, quarter-inch tape cartridge; on MAC- or IBM-formatted floppy diskettes; or from CDIAC's anonymous File Transfer Protocol (FTP) area via Internet (see FTP address below). Requests should include any specific media instructions required by the user to access the data (e.g., 1600 or 6250 BPI, labeled or nonlabeled, ASCII or EBCDIC characters, and variable- or fixed-length records; 3.5- or 5.25-in. floppy diskettes, high or low density; and 8200 or 8500 format, 8-mm tape). Magnetic tape requests not accompanied by specific instructions will be filled on 9-track, 6250-BPI, non-labeled tapes with ASCII characters. Requests should be addressed to

Carbon Dioxide Information Analysis Center
Oak Ridge National Laboratory
Post Office Box 2008
Oak Ridge, Tennessee 37831-6335
U.S.A.

Telephone: (423) 574-0390 or (423) 574-3645
Fax: (423) 574-2232

Electronic Mail:
INTERNET: cdiac@ornl.gov

The data files can also be acquired from CDIAC's anonymous FTP account via Internet:

- FTP to cdiac.esd.ornl.gov (128.219.24.36),
- Enter "ftp" or "anonymous" as the user ID,
- Enter your electronic mail address as the password (e.g.,"alex@alex.esd.ornl.gov")[1],
- Change to the directory "/pub/ndp054", and
- Acquire the files using the FTP "get" or "mget" command.

or

World Wide Web URL: http://cdiac.esd.ornl.gov/cdiac/

[1]Please enter your correct address. This address is used by CDIAC to inform data recipients of data revisions and updates.

6. REFERENCES

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PART 2:

CONTENT AND FORMAT OF DATA FILES

7. FILE DESCRIPTIONS

This section describes the content and format of each of the five files that comprise this NDP (see Table 3). Because CDIAC distributes the data set in several ways (e.g., via anonymous FTP, on floppy diskette, and on 9-track magnetic tape), each of the five files is referenced by both an ASCII file name, which is given in lower-case, bold-faced type (e.g., **readme**), and a file number. The remainder of this section describes (or lists, where appropriate) the contents of each file. The files are discussed in the order in which they appear on the magnetic tape.

Table 3. Content, size, and format of data files

File number, name, and description	Logical records	File size in bytes	Block size	Record length
1. **readme:** a detailed description of the cruise network, the two FORTRAN 77 data retrieval routines, and the two oceanographic data files	1,008	60,305	8,000	80
2. **stainv.for:** a FORTRAN 77 data retrieval routine to read and print **tun2sta.inv** (File 4)	32	1,006	8,000	80
3. **tun2dat.for:** a FORTRAN 77 data retrieval routine to read and print **tun2.dat** (File 5)	50	2,239	8,000	80
4. **tun2sta.inv:** a listing of the station locations, sampling dates, and sounding bottom depths for each of the 97 stations	108	7,850	4,100	41
5. **tun2.dat:** hydrographic, carbon dioxide, and chemical data from 97 stations	3,479	653,054	16,000	160
Total	4,677	724,454		

readme (File 1)

This file contains a detailed description of: the data set, the two FORTRAN 77 data retrieval routines, and the two oceanographic data files. It exists primarily for the benefit of individuals who acquire this database as machine-readable data files from CDIAC.

stainv.for (File 2)

This file contains a FORTRAN 77 data retrieval routine to read and print **tun2sta.inv** (File 4). The following is a listing of this program. For additional information regarding variable definitions, variable lengths, variable types, units, and codes, please see the description for **tun2sta.inv**.

```
c****************************************************************
c* FORTRAN 77 data retrieval routine to read and print the     *
c* file named "tun2sta.inv" (File 4)                           *
c****************************************************************

      INTEGER  stat, depth
      REAL lat, lon
      CHARACTER expo*11, sect*8, date*8, time*4
      OPEN (unit=1, file='tun2sta.inv')
      OPEN (unit=2, file='tun2stat.inv')
      write (2, 5)

 5    format (3X,'EXPOCODE',4X,'SECTION',3X,'STNNBR',3X,'LATDCM',
     1 4X,'LONDCM',6X,'DATE',2X,'TIME',1X,'DEPTH',/)

      read (1, 6)
 6    format (///////////)

 7    CONTINUE
      read (1, 10, end=999) expo, sect, stat, lat, lon, date,
     1 time, depth

 10   format (A11, 3X, A8, 6X, I3, 2X, F7.3, 2X, F8.3, 2X, A8,
     1 2X, A4, 2X, I4)

      write (2, 10)  expo, sect, stat, lat, lon, date,
     1 time, depth

      GOTO 7
 999  close(unit=1)
      close(unit=2)
      stop
      end
```

tun2dat.for (File 3)

This file contains a FORTRAN 77 data retrieval routine to read and print **tun2.dat** (File 5). The following is a listing of this program. For additional information regarding variable definitions, variable lengths, variable types, units, and codes, please see the description for **tun2.dat**.

```
c******************************************************************
c* FORTRAN 77 data retrieval routine to read and print the        *
c* file named "tun2.dat" (File 5).                                 *
c******************************************************************

      CHARACTER qualt*14
      INTEGER sta, cast, samp, bot
      REAL pre, ctdtmp, ctdsal, ctdoxy, theta, sal, oxy, silca
      REAL nitrat, nitrit, phspht, cfc11, cfc12, tcarb, talk
      REAL pco2, pco2tmp
      OPEN (unit=1, file='tun2.dat')
      OPEN (unit=2, file='tunes2.dat')
      write (2, 5)

 5    format (2X,'STNNBR',2X,'CASTNO',2X,'SAMPNO',2X,'BTLNBR',2X,
     1 'CTDPRS',2X,'CTDTMP',2X,'CTDSAL',2X,'CTDOXY',3X,'THETA',4X,
     2 'SALNTY',2X,'OXYGEN',2X,'SILCAT',2X,'NITRAT',2X,'NITRIT',2X,
     3 'PHSPHT',3X,'CFC-11',3X,'CFC-12',2X,'TCARBN',2X,'ALKALI',4X,
     4 'PCO2',1X,'PCO2TMP',9X,'QUALT1',/,
     5 36X,'DBAR',2X,'ITS-90',2X,'PSS-78',1X,'UMOL/KG',3X,'DEG C',
     6 4X,'PSS-78',1X,5('UMOL/KG',1X,),1X,'PMOL/KG',2X,'PMOL/KG',1X,
     7 2('UMOL/KG',1X,),3X,'UATM',3X,'DEG C'14X,'*',/,25X,'*******',
     8 17X,2('*******',1X,),10X,6('*******',1X,),1X,'*******',
     9 2X,4('*******',1X,),21X,'*',/)

      read (1, 6)
 6    format (////////////)

 7    CONTINUE
      read (1, 10, end=999) sta, cast, samp, bot, pre, ctdtmp,
     1 ctdsal, ctdoxy, theta, sal, oxy, silca, nitrat, nitrit,
     2 phspht, cfc11, cfc12, tcarb, talk, pco2, pco2tmp, qualt

 10   format (5X, I3, 7X, I1, 6X, I2, 5X, I3, 1X, F7.1, 1X, F7.4,
     1 1X, F7.4, 1X, F7.1, 1X, F7.4, 1X, F9.4, 1X, F7.1, 1X, F7.2,
     2 1X, F7.2, 1X, F7.2, 1X, F7.2, 1X, F8.3, 1X, F8.3, 1X, F7.1,
     3 1X, F7.1, 1X, F7.2, 1X, F7.2, 1X, A14)

      write (2, 20) sta, cast, samp, bot, pre, ctdtmp,
     1 ctdsal, ctdoxy, theta, sal, oxy, silca, nitrat, nitrit,
     2 phspht, cfc11, cfc12, tcarb, talk, pco2, pco2tmp, qualt

 20   format (5X, I3, 7X, I1, 6X, I2, 5X, I3, 1X, F7.1, 1X, F7.4,
     1 1X, F7.4, 1X, F7.1, 1X, F7.4, 1X, F9.4, 1X, F7.1, 1X, F7.2,
     2 1X, F7.2, 1X, F7.2, 1X, F7.2, 1X, F8.3, 1X, F8.3, 1X, F7.1,
     3 1X, F7.1, 1X, F7.2, 1X, F7.2, 1X, A14)

      GOTO 7
 999  close(unit=1)
      close(unit=2)
      stop
      end
```

tun2sta.inv (File 4)

This file provides station inventory information for each of the 97 stations occupied during the R/V *Thomas Washington* TUNES-2 Expedition. Each record of the file contains an expocode, section number, station number, coordinate, sampling date, sampling time, and sounding depth. The file is sorted by station number and can be read by using the following FORTRAN 77 code (contained in **stainv.for**, File 2):

```
      INTEGER  stat, depth
      REAL lat, lon
      CHARACTER expo*11, sect*8, date*8, time*4

      read (1, 10, end=999) expo, sect, stat, lat, lon, date,
     1 time, depth

 10   format (A11, 3X, A8, 6X, I3, 2X, F7.3, 2X, F8.3, 2X, A8,
     1 2X, A4, 2X, I4)
```

Stated in tabular form, the contents include the following:

Variable	Variable type	Variable width	Starting column	Ending column
`expo`	Character	11	1	11
`sect`	Character	8	15	22
`stat`	Numeric	3	29	31
`lat`	Numeric	7	34	40
`lon`	Numeric	8	43	50
`date`	Character	8	53	60
`time`	Character	4	63	66
`depth`	Numeric	4	69	72

where

`expo` is the expocode of the cruise;

`sect` is the WOCE section number;

`stat` is the station number (values range from 124 to 220);

`lat` is the latitude of the station (in decimal degrees; negative values indicate the Southern Hemisphere);

`lon` is the longitude of the station (in decimal degrees; negative values indicate the Western Hemisphere);

`date` is the sampling date (month/day/year);

time	is the sampling time (GMT);
depth	is the sounding depth of the station (in meters).

tun2.dat (File 5)

This file provides hydrographic, carbon dioxide, and chemical data for the 97 stations occupied during the R/V *Thomas Washington* TUNES-2 Expedition. Each record contains a station number; cast number; sample number; bottle number; CTD pressure, temperature, salinity, and oxygen; potential temperature; bottle salinity; concentrations of oxygen, silicate, nitrate, nitrite, phosphate, CFC-11, CFC-12, and TCO_2; TALK; pCO_2; pCO_2 temperature; and data quality flags. The file is sorted by station number and pressure and can be read by using the following FORTRAN 77 code (contained in **tun2dat.for,** File 3):

```
      CHARACTER qualt*14
      INTEGER sta, cast, samp, bot
      REAL pre, ctdtmp, ctdsal, ctdoxy, theta, sal, oxy, silca
      REAL nitrat, nitrit, phspht, cfc11, cfc12, tcarb, talk
      REAL pco2, pco2tmp

      read (1, 10, end=999) sta, cast, samp, bot, pre, ctdtmp,
     1 ctdsal, ctdoxy, theta, sal, oxy, silca, nitrat, nitrit,
     2 phspht, cfc11, cfc12, tcarb, talk, pco2, pco2tmp, qualt

 10   format (5X, I3, 7X, I1, 6X, I2, 5X, I3, 1X, F7.1, 1X, F7.4,
     1 1X, F7.4, 1X, F7.1, 1X, F7.4, 1X, F9.4, 1X, F7.1, 1X, F7.2,
     2 1X, F7.2, 1X, F7.2, 1X, F7.2, 1X, F8.3, 1X, F8.3, 1X, F7.1,
     3 1X, F7.1, 1X, F7.2, 1X, F7.2, 1X, A14)
```

Stated in tabular form, the contents include the following:

Variable	Variable type	Variable width	Starting column	Ending column
sta	Numeric	3	6	8
cast	Numeric	1	16	16
samp	Numeric	2	23	24
bot	Numeric	3	30	32
pre	Numeric	7	35	40
ctdtmp	Numeric	7	42	48
ctdsal	Numeric	7	50	56
ctdoxy	Numeric	7	58	64
theta	Numeric	7	66	72
sal	Numeric	9	74	82
oxy	Numeric	7	84	90
silca	Numeric	7	92	98
nitrat	Numeric	7	100	106

nitrit	Numeric	7	108	114
phspht	Numeric	7	116	122
cfc11	Numeric	8	124	131
cfc12	Numeric	8	133	140
tcarb	Numeric	7	142	148
talk	Numeric	7	150	156
pco2	Numeric	7	158	164
pco2tmp	Numeric	7	166	172
qualt	Character	14	174	187

where

sta is the station number;

cast is the cast number;

samp is the sample number;

bot* is the bottle number;

pre is the CTD pressure (in dbar);

ctdtmp is the CTD temperature (in °C);

ctdsal* is the CTD salinity [on the Practical Salinity Scale (PSS)];

ctdoxy* is the CTD oxygen concentration (in μmol/kg);

theta is the potential temperature (in °C);

sal* is the bottle salinity;

oxy* is the oxygen concentration (in μmol/kg);

silca* is the silicate concentration (in μmol/kg);

nitrat* is the nitrate concentration (in μmol/kg);

nitrit* is the nitrite concentration (in μmol/kg);

phspht* is the phosphate concentration (in μmol/kg);

cfc11* is the trichlorofluoromethane-11 concentration (CCl_3F) (in pmol/kg);

cfc12* is the dichlorodifluoromethane-12 concentration (CCl_2F_2) (in pmol/kg);

tcarb* is the total carbon dioxide concentration (in μmol/kg);

talk* is the total alkalinity (in μmol/kg);

pco2* is the partial pressure of CO_2 (in μatm and measured at **pco2tmp**);

pco2tmp is the temperature of equilibration of the pCO_2 samples in the equilibrator (in °C);

`qualt` is a 14-digit character variable that contains data-quality flag codes for parameters marked with an asterisk (*) in the output file.

Quality flags are defined as follows:

1 = Sample for this measurement was drawn from water bottle but results of analyses were not received;
2 = Acceptable measurement;
3 = Questionable measurement;
4 = Bad measurement;
5 = Not reported;
6 = Mean of replicate measurements;
7 = Manual chromatographic peak measurement;
8 = Irregular digital chromatographic peak integration;
9 = Sample was not drawn for this measurement from this bottle.

8. VERIFICATION OF DATA TRANSPORT

The data files contained in this numeric data package can be read by using the FORTRAN 77 data retrieval programs provided. Users should visually examine each data file to verify that the data were correctly transported to their systems. To facilitate the visual inspection process, partial listings of each data file are provided in Tables 4 and 5. Each of these tables contains the first and last five lines of a data file.

Table 4. Partial listing of "tun2sta.inv" (File 4)

First five lines of the file:

31WTTUNES-2	WOCE_P17	124	-6.005	-135.003	07/21/91	2322	4562
31WTTUNES-2	WOCE_P17	125	-6.498	-135.000	07/22/91	0550	4475
31WTTUNES-2	WOCE_P17	126	-6.998	-135.003	07/22/91	1227	4393
31WTTUNES-2	WOCE_P17	127	-7.503	-135.002	07/22/91	1929	4400
31WTTUNES-2	WOCE_P17	128	-7.998	-135.000	07/23/91	0208	4525

Last five lines of the file:

31WTTUNES-2	WOCE_P16	216	-19.500	-150.498	08/24/91	0811	4264
31WTTUNES-2	WOCE_P16	217	-19.000	-150.500	08/24/91	1433	3356
31WTTUNES-2	WOCE_P16	218	-18.508	-150.497	08/24/91	2027	4201
31WTTUNES-2	WOCE_P16	219	-18.002	-150.498	08/25/91	0215	3659
31WTTUNES-2	WOCE_P16	220	-17.502	-150.498	08/25/91	0804	3604

Table 5. Partial listing of "tun2.dat" (File 5)

First five lines of the file:

```
     124       1       2        2    53.2 27.3959 35.1756   216.4 27.3836   35.1817   214.8     2.73     4.81
0.08    0.53    1.673    0.888  2000.6  -999.9  313.20   20.00 22622222228292
     124       1       3        3    78.5 27.4009 35.1940   213.6 27.3827   35.1999   213.8     2.71     4.91
0.08    0.54    1.539    0.839  2003.4  -999.9  297.66   20.00 22622222228292
     124       1       4        4    98.0 27.3409 35.4125   206.3 27.3182   35.4790   209.2     2.69     4.56
0.08    0.59    1.564    0.837  2015.1  -999.9  318.35   20.00 22622222228292
     124       1       5        5   114.0 25.9565 35.9781   193.4 25.9310   35.9803   196.4     2.48     3.08
0.11    0.63    1.768    0.993  2047.4  -999.9  304.50   20.00 22222222228292
     124       1       6        6   128.9 24.2842 36.0574   185.1 24.2567   36.0313   186.6     2.27     2.52
2.02    0.67    0.794    0.431  2080.4  -999.9  359.24   20.00 22222222244292
```

Last five lines of the file:

```
     220       1      30       30  3038.2  1.6449 34.6718   167.2  1.4213   34.6738   166.7  125.79   34.50
0.00    2.41 -999.900 -999.900   -999.9  -999.9 -999.90 -999.90 22222222299595
     220       1      31       31  3243.1  1.5769 34.6782   170.1  1.3348   34.6785   170.4  127.26   34.31
0.00    2.40 -999.900 -999.900  2295.1  -999.9 1104.49   20.00 22222222299292
     220       1      33       33  3450.9  1.5390 34.6823   170.9  1.2769   34.6828   173.1  126.77   34.11
0.00    2.38 -999.900 -999.900  2295.0  -999.9 1111.84   20.00 22222222299292
     220       1      32       32  3451.1  1.5400 34.6824   170.9  1.2778   34.6822   173.2  127.46   34.11
0.00    2.38 -999.900 -999.900   -999.9  -999.9 -999.90 -999.90 22222222299595
     220       1      38       38  3636.3  1.5220 34.6839  -999.9  1.2412   34.6848   175.1  125.50   34.01
0.00    2.37 -999.900 -999.900   -999.9  -999.9 -999.90 -999.90 22922222299595
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APPENDIX A:

STATION INVENTORY

APPENDIX A:
STATION INVENTORY

This appendix lists station inventory information for the 97 sites occupied during the R/V *Thomas Washington* TUNES-2 Expedition in the South Pacific Ocean . The meanings of the column headings in Table A-1 are as follows:

EXPOCODE is the expocode of the cruise;

SECTION is the WOCE section number;

STNNBR is the station number;

LATDCM is the latitude of the station (in decimal degrees). Stations in the Southern Hemisphere have negative latitudes;

LONDCM is the longitude of the station (in decimal degrees). Stations in the Western Hemisphere have negative longitudes;

DATE is the sampling date (month/day/year);

TIME is the sampling time (GMT);

DEPTH is the sounding bottom depth of each station (in meters).

Table A.1 Station inventory information for the 97 sites occupied during R/V *Thomas Washington* TUNES-2 Expedition

EXPOCODE	SECTION	STNNBR	LATDCM	LONDCM	DATE	TIME	DEPTH
31WTTUNES-2	WOCE_P17	124	-6.005	-135.003	07/21/91	2322	4562
31WTTUNES-2	WOCE_P17	125	-6.498	-135.000	07/22/91	0550	4475
31WTTUNES-2	WOCE_P17	126	-6.998	-135.003	07/22/91	1227	4393
31WTTUNES-2	WOCE_P17	127	-7.503	-135.002	07/22/91	1929	4400
31WTTUNES-2	WOCE_P17	128	-7.998	-135.000	07/23/91	0208	4525
31WTTUNES-2	WOCE_P17	129	-8.507	-134.988	07/23/91	0950	4449
31WTTUNES-2	WOCE_P17	130	-9.000	-135.002	07/23/91	1629	4494
31WTTUNES-2	WOCE_P17	131	-9.502	-135.000	07/23/91	2312	4527
31WTTUNES-2	WOCE_P17	132	-10.040	-134.960	07/24/91	1133	4450
31WTTUNES-2	WOCE_P17	133	-10.483	-134.898	07/25/91	0122	4320
31WTTUNES-2	WOCE_P17	134	-10.987	-134.802	07/25/91	0739	4167
31WTTUNES-2	WOCE_P17	135	-11.470	-134.698	07/25/91	1402	4319
31WTTUNES-2	WOCE_P17	136	-11.970	-134.597	07/25/91	2042	4140
31WTTUNES-2	WOCE_P17	137	-12.448	-134.500	07/26/91	0246	4237
31WTTUNES-2	WOCE_P17	138	-12.932	-134.397	07/26/91	0858	4414
31WTTUNES-2	WOCE_P17	139	-13.433	-134.280	07/26/91	1535	4294
31WTTUNES-2	WOCE_P17	140	-13.920	-134.185	07/26/91	2157	4423
31WTTUNES-2	WOCE_P17	141	-14.418	-134.083	07/27/91	0426	4245
31WTTUNES-2	WOCE_P17	142	-14.898	-133.983	07/27/91	1105	4270
31WTTUNES-2	WOCE_P17	143	-15.382	-133.882	07/28/91	0203	4258
31WTTUNES-2	WOCE_P17	144	-15.882	-133.785	07/28/91	1141	4260
31WTTUNES-2	WOCE_P17	145	-16.367	-133.663	07/28/91	1806	4252
31WTTUNES-2	WOCE_P17	146	-16.867	-133.565	07/29/91	0004	4293
31WTTUNES-2	WOCE_P17	147	-17.348	-133.467	07/29/91	0553	4404
31WTTUNES-2	WOCE_P17	148	-17.833	-133.367	07/29/91	1145	3970
31WTTUNES-2	WOCE_P17	149	-18.330	-133.250	07/29/91	1735	4107
31WTTUNES-2	WOCE_P17	150	-18.815	-133.150	07/29/91	2313	3884
31WTTUNES-2	WOCE_P17	151	-19.312	-133.052	07/30/91	0449	3629
31WTTUNES-2	WOCE_P17	152	-19.798	-132.950	07/30/91	1011	3414
31WTTUNES-2	WOCE_P17	153	-20.283	-132.833	07/30/91	2220	4430
31WTTUNES-2	WOCE_P17	154	-20.787	-132.733	07/31/91	0954	4250
31WTTUNES-2	WOCE_P17	155	-21.263	-132.618	07/31/91	1611	3959
31WTTUNES-2	WOCE_P17	156	-21.767	-132.518	07/31/91	2215	3837
31WTTUNES-2	WOCE_P17	157	-22.255	-132.418	08/01/91	0433	3512
31WTTUNES-2	WOCE_P17	158	-22.708	-132.285	08/01/91	1103	3398
31WTTUNES-2	WOCE_P17	159	-23.233	-132.435	08/01/91	1653	3619
31WTTUNES-2	WOCE_P17	160	-23.722	-132.550	08/01/91	2244	3664
31WTTUNES-2	WOCE_P17	161	-24.202	-132.668	08/02/91	0500	3777
31WTTUNES-2	WOCE_P17	162	-24.688	-132.800	08/02/91	1106	4047
31WTTUNES-2	WOCE_P17	163	-25.182	-132.920	08/02/91	1708	4178
31WTTUNES-2	WOCE_P17	164	-25.673	-133.045	08/02/91	2309	3845
31WTTUNES-2	WOCE_P17	165	-26.110	-133.088	08/03/91	0932	4187
31WTTUNES-2	WOCE_P17	166	-26.632	-133.300	08/03/91	2217	4028
31WTTUNES-2	WOCE_P17	167	-27.118	-133.435	08/04/91	1203	3758
31WTTUNES-2	WOCE_P17	168	-27.618	-133.540	08/04/91	1839	4130
31WTTUNES-2	WOCE_P17	169	-28.097	-133.682	08/05/91	0031	4230
31WTTUNES-2	WOCE_P17	170	-28.582	-133.817	08/05/91	0623	3885
31WTTUNES-2	WOCE_P17	171	-29.068	-133.932	08/05/91	1201	4206
31WTTUNES-2	WOCE_P17	172	-29.567	-134.070	08/05/91	2322	4183
31WTTUNES-2	WOCE_P17	173	-30.048	-134.203	08/06/91	0935	4190

Table A.1 (continued)

EXPOCODE	SECTION	STNNBR	LATDCM	LONDCM	DATE	TIME	DEPTH
31WTTUNES-2	WOCE_P17	174	-30.532	-134.333	08/06/91	1544	3711
31WTTUNES-2	WOCE_P17	175	-31.022	-134.465	08/06/91	2135	4258
31WTTUNES-2	WOCE_P17	176	-31.500	-134.600	08/07/91	0340	4290
31WTTUNES-2	WOCE_P17	177	-32.003	-134.715	08/07/91	1010	4156
31WTTUNES-2	WOCE_P17	178	-32.482	-134.848	08/07/91	1630	4337
31WTTUNES-2	WOCE_P17	179	-33.010	-135.022	08/08/91	0430	4493
31WTTUNES-2	WOCE_P16	180	-37.498	-150.502	08/12/91	0333	5533
31WTTUNES-2	WOCE_P16	181	-36.998	-150.498	08/12/91	1528	5686
31WTTUNES-2	WOCE_P16	182	-36.500	-150.500	08/13/91	0324	5590
31WTTUNES-2	WOCE_P16	183	-36.000	-150.497	08/13/91	1534	5293
31WTTUNES-2	WOCE_P16	184	-35.497	-150.498	08/13/91	2217	5383
31WTTUNES-2	WOCE_P16	185	-35.000	-150.498	08/14/91	0457	5470
31WTTUNES-2	WOCE_P16	186	-34.497	-150.505	08/14/91	1146	5348
31WTTUNES-2	WOCE_P16	187	-34.002	-150.500	08/15/91	0028	5318
31WTTUNES-2	WOCE_P16	188	-33.497	-150.505	08/15/91	1135	5236
31WTTUNES-2	WOCE_P16	189	-32.995	-150.492	08/16/91	0332	5401
31WTTUNES-2	WOCE_P16	190	-32.498	-150.500	08/16/91	1025	5179
31WTTUNES-2	WOCE_P16	191	-32.000	-150.502	08/16/91	1659	5170
31WTTUNES-2	WOCE_P16	192	-31.500	-150.503	08/16/91	2325	4928
31WTTUNES-2	WOCE_P16	193	-30.997	-150.510	08/17/91	0634	4547
31WTTUNES-2	WOCE_P16	194	-30.503	-150.505	08/17/91	1555	4939
31WTTUNES-2	WOCE_P16	195	-30.003	-150.512	08/17/91	2225	5029
31WTTUNES-2	WOCE_P16	196	-29.503	-150.503	08/18/91	0449	4579
31WTTUNES-2	WOCE_P16	197	-28.998	-150.503	08/18/91	1111	4772
31WTTUNES-2	WOCE_P16	198	-28.500	-150.497	08/18/91	2321	4897
31WTTUNES-2	WOCE_P16	199	-27.997	-150.497	08/19/91	0917	3452
31WTTUNES-2	WOCE_P16	200	-27.502	-150.492	08/19/91	1545	3678
31WTTUNES-2	WOCE_P16	201	-27.000	-150.495	08/19/91	2157	4753
31WTTUNES-2	WOCE_P16	202	-26.503	-150.503	08/20/91	0418	4777
31WTTUNES-2	WOCE_P16	203	-25.998	-150.498	08/20/91	1101	4628
31WTTUNES-2	WOCE_P16	204	-25.503	-150.497	08/20/91	1753	2541
31WTTUNES-2	WOCE_P16	205	-25.000	-150.498	08/21/91	0000	4749
31WTTUNES-2	WOCE_P16	206	-24.502	-150.498	08/21/91	0557	4900
31WTTUNES-2	WOCE_P16	207	-24.000	-150.500	08/21/91	1220	4910
31WTTUNES-2	WOCE_P16	208	-23.505	-150.500	08/21/91	1842	4439
31WTTUNES-2	WOCE_P16	209	-23.000	-150.500	08/22/91	0102	4843
31WTTUNES-2	WOCE_P16	210	-22.502	-150.502	08/22/91	1206	4578
31WTTUNES-2	WOCE_P16	211	-22.010	-150.495	08/23/91	0013	4788
31WTTUNES-2	WOCE_P16	212	-21.498	-150.507	08/23/91	0650	4285
31WTTUNES-2	WOCE_P16	213	-21.000	-150.498	08/23/91	1315	4714
31WTTUNES-2	WOCE_P16	214	-20.497	-150.497	08/23/91	1948	4619
31WTTUNES-2	WOCE_P16	215	-20.000	-150.498	08/24/91	0156	3777
31WTTUNES-2	WOCE_P16	216	-19.500	-150.498	08/24/91	0811	4264
31WTTUNES-2	WOCE_P16	217	-19.000	-150.500	08/24/91	1433	3356
31WTTUNES-2	WOCE_P16	218	-18.508	-150.497	08/24/91	2027	4201
31WTTUNES-2	WOCE_P16	219	-18.002	-150.498	08/25/91	0215	3659
31WTTUNES-2	WOCE_P16	220	-17.502	-150.498	08/25/91	0804	3604

APPENDIX B:

REPRINT OF PERTINENT LITERATURE

FINAL TECHNICAL REPORT

FOR GRANT DE-FGO2-90-ER60983

submitted to

CARBON DIOXIDE RESEARCH DIVISION

OFFICE OF HEALTH AND ENVIRONMENTAL RESEARCH

U.S. DEPARTMENT OF ENERGY

WASHINGTON, D. C. 20545

INVESTIGATION OF CARBON DIOXIDE IN THE CENTRAL SOUTH PACIFIC OCEAN (WOCE SECTIONS P-16C and P-17C) DURING THE TUNES/2 EXPEDITION OF THE R/V THOMAS WASHINGTON, JULY-AUGUST, 1991

by

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ABSTRACT

This report summarizes the results of CO_2 and associated hydrographic measurements made during the oceanographic expedition, TUNES/2, aboard the R/V Thomas Washington in the central South Pacific Ocean. The expedition started on July 16, 1991, from Papeete, Tahiti, and returned to Tahiti on August 25, 1991, after completing the WOCE hydrographic sections P-16C along 150°W and P-17C along 135°W. During the 40-day expedition, the total CO_2 concentration in 1000 seawater samples were determined using a coulometer system and the pCO_2 in 940 seawater samples were determined using an equilibrator/gas chromatograph system. The alkalinity values in 900 water samples were computed using these measurements. In addition, 156 coulometric measurements were made for the Certified Reference Solutions (Batch #6) and yielded a mean value of 2303.2 ± 1.5 μmol/kg. This agrees within a standard deviation with 2304.6 ± 1.6 μmol/kg (N=9) determined using the manometer of C. D. Keeling of SIO.

The tropical waters located north of about 12°S were sources for atmospheric CO_2 (positive ΔpCO_2 values), whereas the waters south of this latitude, especially those located south of about 25°S, were strong CO_2 sinks with negative ΔpCO_2 values ranging between -40 and -50 μatm. This indicates that the oceanic area south of about 25°S between 135°W and 150°W was a strong CO_2 sink during the austral winter, July-August, 1991. The chemical characteristics for the major water masses including the Antarctic Intermediate Water (AAIW), the North Pacific Deep Water (NPDW), the Circumpolar Deep Water (CPDW) and the Antarctic Bottom Water (AABW) have been determined. The NPDW located at depths between 2500 and 3500 meters north of the Tuamotu Archipelago is found to have different CO_2, alkalinity and silicate properties from that located south of it. Because of the presence of the high topographic barrier, these waters have taken different circulation paths and hence reflect different biogeochemical histories. The Revelle factor for waters throughout the main thermocline south of about 20°S has been found to be uniformly 10. This suggests that CO_2 was added to these waters with a ratio of 8 parts from the oxidation of organic debris and 1 part from the dissolution of calcareous tests.

I. INTRODUCTION

The global oceans contain about 50 times as much CO_2 as the atmosphere and actively exchange CO_2 with it. Accordingly, the atmospheric CO_2 concentration, which affects the heat balance of the earth and hence the climate, is sensitively affected by changes in the oceans' holding capacity for CO_2. In 1989, it was realized that no definitive set of CO_2 measurements for the global oceans exists. To remedy the situation, the DOE announced in the Federal Register Notice #89-7 the initiation of the Ocean CO_2 Program in collaboration with the WOCE Hydrographic and JGOFS Programs. The main purpose of the DOE program is to determine the concentration of CO_2 and associated properties in the global oceans, so that a) the data may be used to establish an accurate inventory of CO_2 in the oceans and 2) the data may be used to constrain and/or validate the global ocean carbon cycle models.

The investigation described in this report was funded by DOE under the original title of "CO_2 Measurements along the WOCE P-16 and P-19 Sections in the South Pacific Ocean: A joint LDGO/WHOI Program". After the grant was awarded in 1990, the original program was modified because of the following two events. First, the original WOCE oceanographic expedition schedule was delayed by a year or more due to delays in the major structural modifications of the R/V Knorr and R/V Melville, which had been selected for the WOCE expeditions. Second, Dr. Peter G. Brewer who was one of the co-principal investigators of the original proposal left the Woods Hole Oceanographic Institution (WHOI) to accept the chief administrative position at the Monterey Bay Aquarium and Research Institute. For this reason, the joint LDGO/WHOI program was reformulated to be operated as two independent investigations. Accordingly, our group from Lamont investigated the two WOCE sections, P-16C and P-17C, instead of the P-16 and P-19 Sections proposed originally in the South Pacific Ocean. This report summarizes the results of CO_2 measurements obtained during the 40-day long TUNES/2 Expedition aboard the R/V Thomas Washington along the WOCE P-16C and P-17C Sections, which are located in the central South Pacific Ocean along the 150°W (between 17.5°S and 37.5°S) and 135°W meridians (between 6°S and 33°S) respectively. These two sections were extended as far south as 65°S during the investigations in the following years. The WOCE Section P-17N in the North and equatorial Pacific, which constitutes the northern extension of our P-17C Section, was investigated by the WHOI group (Catherine Goyet), and the P-16N Section, which constitutes the northern extension of our

P-17C Section to about 20°N (Hawaii), was investigated by Keeling's group from the Scripps Institution of Oceanography (SIO) and the WHOI group.

II. SAMPLING AND EXPERIMENTAL METHODS

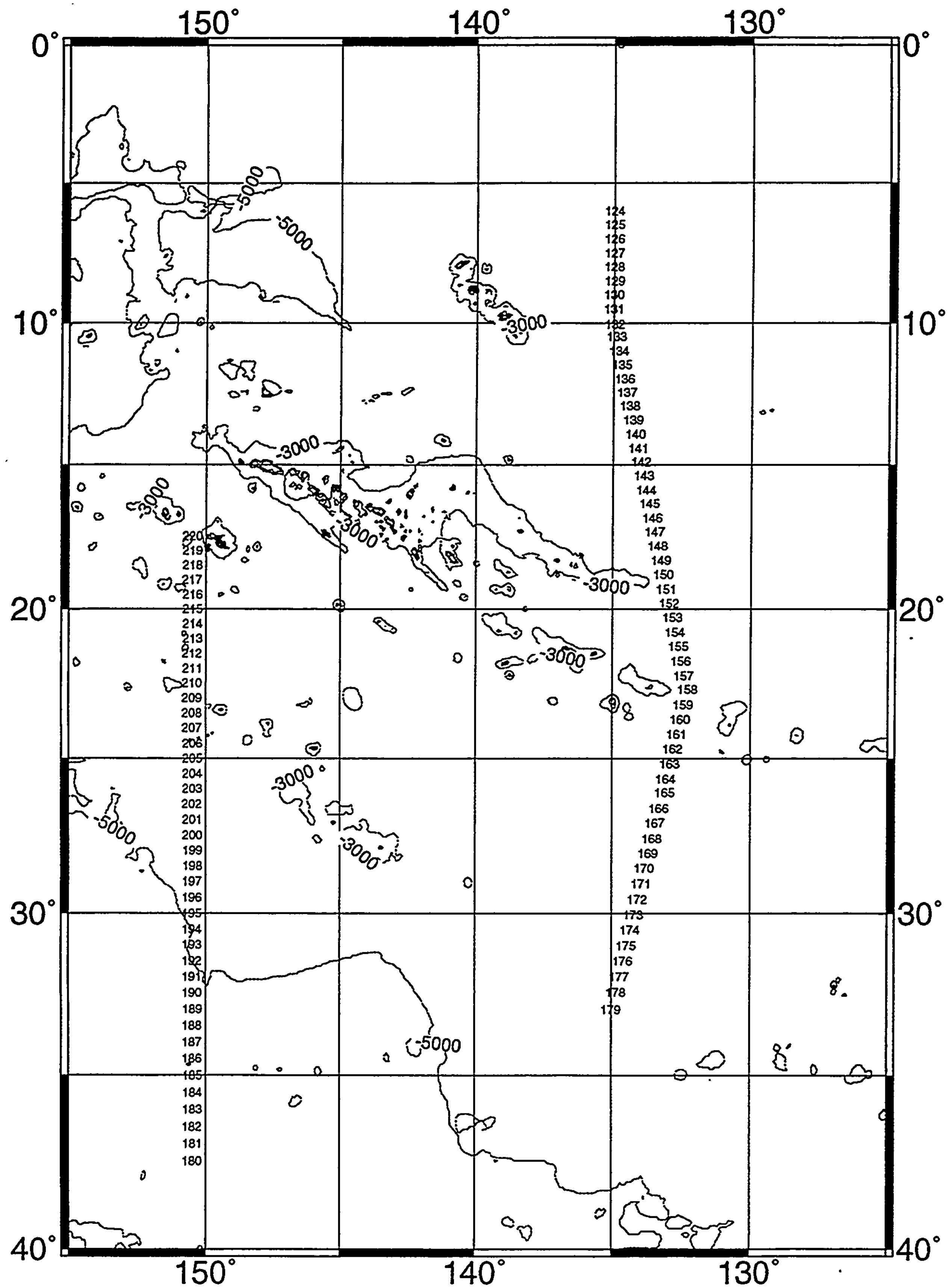
The TUNES/2 Expedition aboard the R/V Thomas Washington started from Papeete, Tahiti, on July 16, 1991, and returned to the same port on August 25, after 40 days at sea. During the expedition, the total CO_2 concentration in 1000 ocean water samples and the pCO_2 in 940 discrete water samples were determined aboard the ship. Many of the total CO_2 determinations were made in duplicate; the pCO_2 measurements were made in duplicate for all the samples and in quadruplicate for some samples. In addition, about 160 total CO_2 determinations were made for the Certified Reference Water Samples provided by A. G. Dickson of SIO, and about 20 determinations for the atmospheric CO_2 concentration. All the hydrographic measurements including pressure, temperature, salinity, the concentrations of dissolved oxygen and nutrients were made by the staff of the SIO's Oceanographic Data Facility.

II-a) Sampling Locations and Methods:

A total of 96 hydrographic stations were occupied during the TUNES/2 Expedition. Stations 124 through 179, which constitute the P-17C Section, were located approximately along the 135°W meridian between 6°S and 33°S; and Stations 180 through 220, which constitute the P-16C Section, were located along the 150°W meridian between 17.5°S and 37.5°S. Figure 1 shows the station locations and numbers. The hydrographic measurements and water sampling were conducted by the staff of the Oceanographic Data Facility of the Scripps Institution of Oceanography (ODF/SIO), and the descriptions of the shipboard equipment and procedures are based on the Chief Scientists' Report provided by James Swift of SIO.

Throughout the expedition, a 24/12 double-ring 36-bottle CTD/rosette sampler was used for sampling by the staff of ODF/SIO. An ODF-modified NBIS Mark 3 CTD, a Benthos altimeter and a SeaTech transmissometer were mounted on the rosette frame. Seawater samples were collected in PVC 10-liter Niskin and ODF bottles mounted on the rosette frame.

Fig. 1 - The locations of hydrographic stations occupied during the TUNES/2 Expedition for the WOCE Sections P-16C and P-17C during July-August, 1991.



The rosette/CTD was lowered into the ocean using a three-conductor cable which provided power to the CTD and transmitted the CTD signals to the laboratory, where the signals were recorded and processed with an on-board computer and displayed on CRTs in real time.

As soon as each rosette cast was brought on board, water samples were drawn into respective containers in the following order: CFCs, helium-3, oxygen, total CO_2, pCO_2, alkalinity, AMS carbon-14, tritium, nutrients and salinity. Status of the water sample (e. g. valve leaking, incomplete closing of lid, lanyard caught in lid etc.) was noted on the Sample Log Sheet.

II-b) Determination of Total CO_2 Concentration in Seawater:

The coulometric analysis system which was used to measure the total CO_2 concentration in seawater samples (TCO_2) during the expedition is similar to the one described by Johnson et al. (1985) and is briefly summarized below. This system consists of a coulometer (Model 5011) manufactured by the UIC Inc. (Jolliet, IL) and a sample introduction/CO_2 extraction system of the LDEO design, which differs from the Single Operator Multiparameter Metabolic Analyzer (SOMMA) system used by most of the other participants of the DOE/CO_2 program. In the LDEO system (Chipman et al., 1993), a precisely known volume of seawater sample is introduced manually into an CO_2 extraction vessel using a calibrated syringe, instead of an automated pipette used by the SOMMA system.

Samples for TCO_2 analysis were drawn from the Niskin samplers of the rosette casts directly into 250 ml glass reagent bottles with ground standard-taper stoppers, sealed with silicone vacuum grease. All samples were poisoned with 200 μl of 50% saturated mercuric chloride solution to prevent biological alteration of the TCO_2, and were analyzed within 24 hours of collection. For analysis, a calibrated volume (ranging between 19 and 20 ml) of water sample was introduced into a CO_2 extraction chamber through a Hamilton valve. The mass of the seawater sample delivered was calculated using the density of the seawater at the temperature of injection using the International Equation of State of Seawater (Millero et al., 1980). Prior to the expedition, the volume of each sampling syringe between the two reference stops was determined by repeatedly weighing it "empty" and "filled" with distilled water. The measurements were corrected for the buoyancy due to the air displaced by the water, which amounted to approximately 0.1% of the weight of the water, and the volume was computed using the density of pure water at the temperature of the measurement. Repeated measurements yielded a precision of ±0.03%. The seawater sample in the extraction vessel was acidified with 1 ml of 8.5% phosphoric acid introduced through the Hamilton valve into an extraction chamber where the evolved CO_2 was removed from the sample and transferred into the electrochemical cell of the CO_2 coulometer by a stream of CO_2-free air generated by a pure air generator. In the coulometer cell, the CO_2 was quantitatively absorbed by a solution of ethanolamine in dimethylsulfoxide (DMSO). Reaction between the CO_2 and the ethanolamine formed the weak hydroxyethylcarbamic acid. The pH change of the solution associated with the formation of this acid resulted in a color change of thymolphthalein pH indicator in the solution. The color change, from deep blue to colorless, was detected by a photodiode, which continually monitored the transmissivity of the solution. The electronic circuitry of the coulometer, on detecting the change in the color of the pH indicator, caused a current to be passed through the cell, electro-generating hydroxyl (OH^-) ions fromed a small amount of water in the solution. The OH^- generated titrated the acid, returning the solution to its original pH (and hence color), at which point the circuitry interrupted the current flow. The product of current passed through the cell and time was related by the Faraday constant to the number of moles of OH^- generated to titrate the acid and hence to the number of moles of CO_2 absorbed to form the acid. A thermostated foot-bath mounted on the base of the titration cell was used to extract the heat generated in the cell during titration, to eliminate the shifting of the endpoint of the titration due to change in temperature of the cell solutions.

The coulometer was calibrated using research grade CO_2 gas (99.998% pure) introduced into the carrier gas line upstream of the extraction tube, using alternately two fixed-volume sample loops on a gas sampling valve and measuring the pressure of the gas in the loops by venting them to the atmosphere and determining the barometric pressure using the same electronic barometer used with the pCO_2 system; the loop temperatures were measured to ±0.05 °C with a thermometer calibrated against one traceable to the NBS, and the non-ideality of CO_2 was incorporated in the computation of the loop contents. Prior to the expedition, the volume of the loops was determined by the weight difference between the loop/injection valve assembly empty and that filled with water. Repeated measurements indicated that the volumes of those loops were precise to ±0.02%. During the expedition, the coulometer was calibrated several times daily using the gas sampling system described above. The calibration factor, which represents the ratio between the number of moles of CO_2 in the loop and the reading of coulometer, changed during the use of a titration cell above or below the ideal ratio of unity by a few tenths of percent depending upon the condition of the coulometric solution in the titration cell. Fig. 2 shows the typical variation of the calibration factor as a function of the cumulative amount of CO_2 titrated by a cell and indicates that it may be represented by a quadratic form. Accordingly, the CO_2 concentration in each seawater sample was determined using a calibration factor estimated using an equation fitted to the calibration data obtained several times for each titration cell. Generally, a titration cell had to be cleaned and filled with new solution after about 40 samples were analyzed. Beyond this number of analyses, the cell began to behave erratically yielding unreliable analytical results. The working equation used for computing the coulometer/cell calibration factor (CF) is as follows.

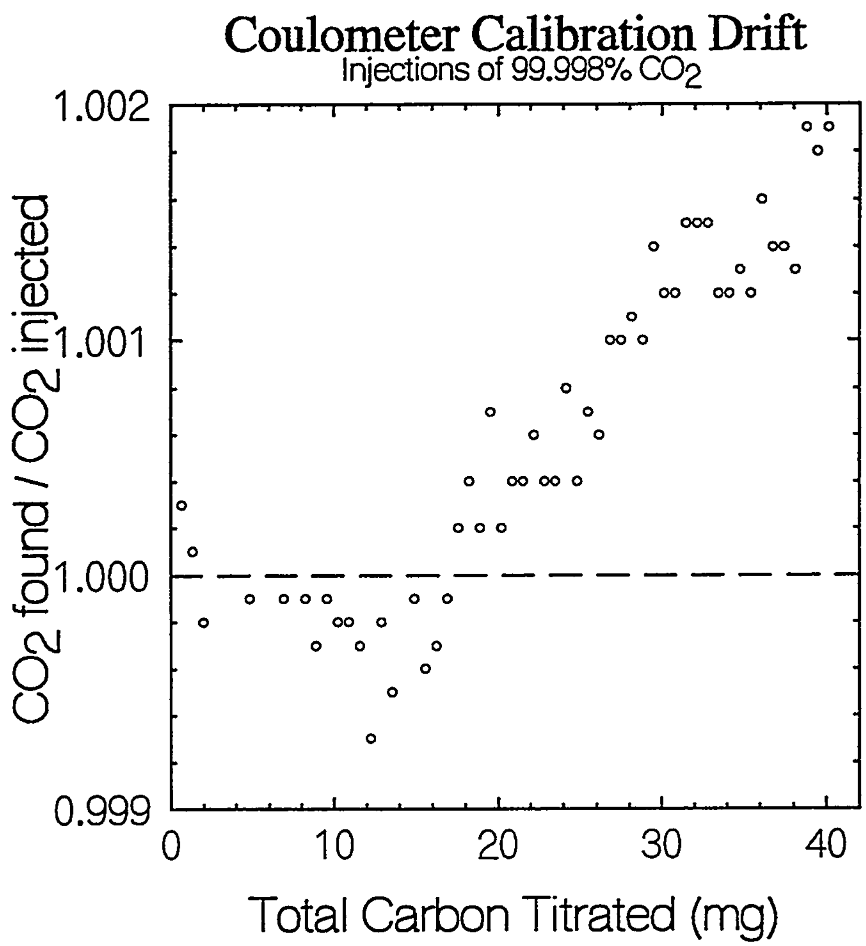
$$CF = (12.011*10^6)*PA*[LPV*(1+3*\alpha)*(TK(calib)-TK(lp))] / \{MV(CO_2)*[RD-(TM*BL)]\}$$

where	$12.011*10^6$	=	Atomic weight (in μgm) of carbon,
	PA	=	Pressure (in atm) of CO_2 gas in loop at time of calibration,
	LPV	=	Volume of calibration valve loop (in ml) at TK(lp),
	α	=	Linear thermal expansion coefficient of stainless steel, $1.73*10^{-5}$ °K^{-1},
	TK(lp)	=	Temperature (in °K) at which loop volume was determined,
	TK(calib)	=	Temperature (in °K) of CO_2 in loop at time of calibration,
	$MV(CO_2)$	=	Molar volume of CO_2 (in ml) at temperature at which loop volume was determined,
	RD	=	Coulometer reading (in μgm-Carbon),
	TM	=	Length of calibration run (in minutes), and
	BL	=	Instrumental blank (or background) rate (in μgm-Carbon/minute).

The following relationships were used for the computation of the total CO_2 concentration in seawater samples using the coulometer;

$$TCO_2\ (\mu mol/kg) = CF*DF*[RD-AB-(TM*BL)]/(12.011*VL*RHO)$$

Fig. 2 - Change in the coulometer calibration factor as a function of the amount of CO_2 titrated. The change is expressed in terms of the percentage deviation from the ideal ratio of unity.



where CF = Calibration factor of coulometer/cell combination interpolated to the time when the measurement was made,

DF = Dilution factor to account for dilution of seawater sample by CO_2-free mercuric chloride poisoning solution, DF = [(sample volume) + (poison volume)]/(sample volume) = 1.0004 for 100 μl of mercuric chloride solution in 250 ml sample,

RD = Coulometer reading (in μgm-Carbon),

AB = Acid blank (in μgm-Carbon) to account for small amount of CO_2 in phosphoric acid solution added to sample; determined by measuring CO_2 stripped from larger volume of acid, typically less than 0.03% of amount of CO_2 in seawater sample,

TM = Length of analytical run (in minutes),

BL = Instrumental blank rate (in μgm-Carbon/min), typical blank rate being 0.01 to 0.02 μgm-Carbon/min; the maximum acceptable blank rate of 0.05 μgm-Carbon/min results in a correction of approximately 0.1% over the normal length of an analytical run,

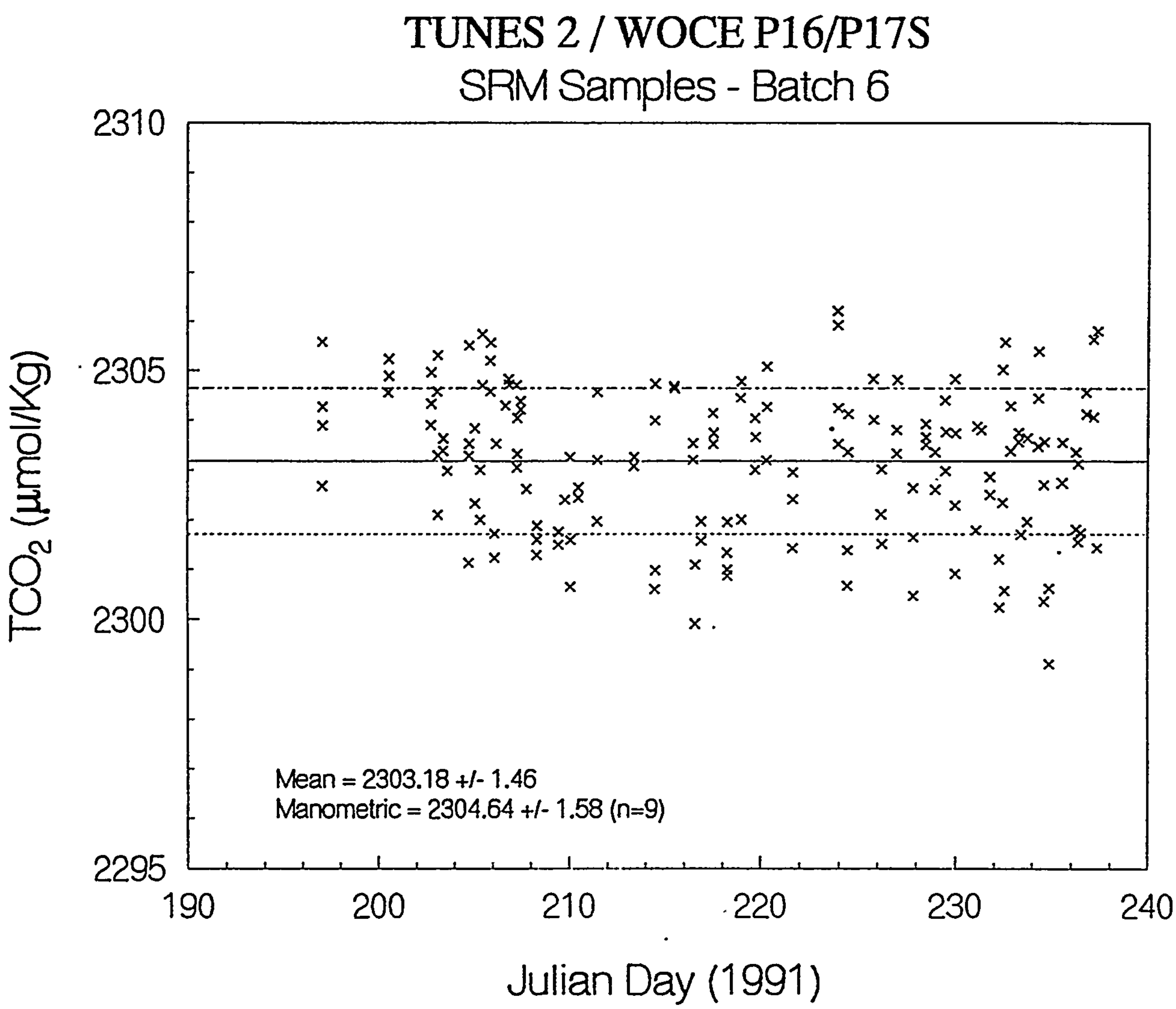
VL = Volume of seawater sample (in liters) injected into stripping chamber, determined by use of pre-calibrated fixed-volume syringes, typical sample volume being 0.019 to 0.020 liters,

RHO = Density of seawater sample at the temperature of injection into stripping chamber, calculated using the UNESCO equation of state for seawater, the salinity, and the temperature measured on the water remaining in the syringe immediately after injecting sample,

12.011 = Atomic weight (in grams) of carbon.

The precision of the total CO_2 measurements was further tested by analyzing the Certified Reference Solutions each day along with the seawater samples. These Reference Solutions were provided by Dr. A. G. Dickson of SIO and their total CO_2 concentration was determined by the staff of C. D. Keeling, SIO, using his manometric method. Fig. 3 shows a comparison between the results of our ship board measurements of these Reference Solutions during the expedition. Our shipboard measurements yielded a mean value of 2303.2 ± 1.5 μmol/kg (N = 156), which compares with 2304.6 ± 1.6 μmol/kg (N = 9) determined

Fig. 3 - Comparison between the results of the coulometric determinations of total CO_2 concentration in the SIO Reference Solutions (Batch #6) obtained during this expedition and the manometric determinations obtained by the staff of C. D. Keeling, SIO. The 158 measurements made during the expedition yield 2303.2±1.5 µmol/kg, which compares with the mean manometric value of 2304.6±1.6 µmol/kg (N = 9). The mean values for each set of measurements agree with each other within respective standard deviations.



manometrically by the staff of C. D. Keeling. Although our value is smaller than the Keeling value by 1.4 μmol/kg, these mean values overlap within one standard deviation. Thus, the total CO_2 concentration values reported in this report are consistent with the manometric values within ±1.5 μmol/kg. The total CO_2 values listed in this report are not corrected for the systematic difference of 1.4 μmol/kg.

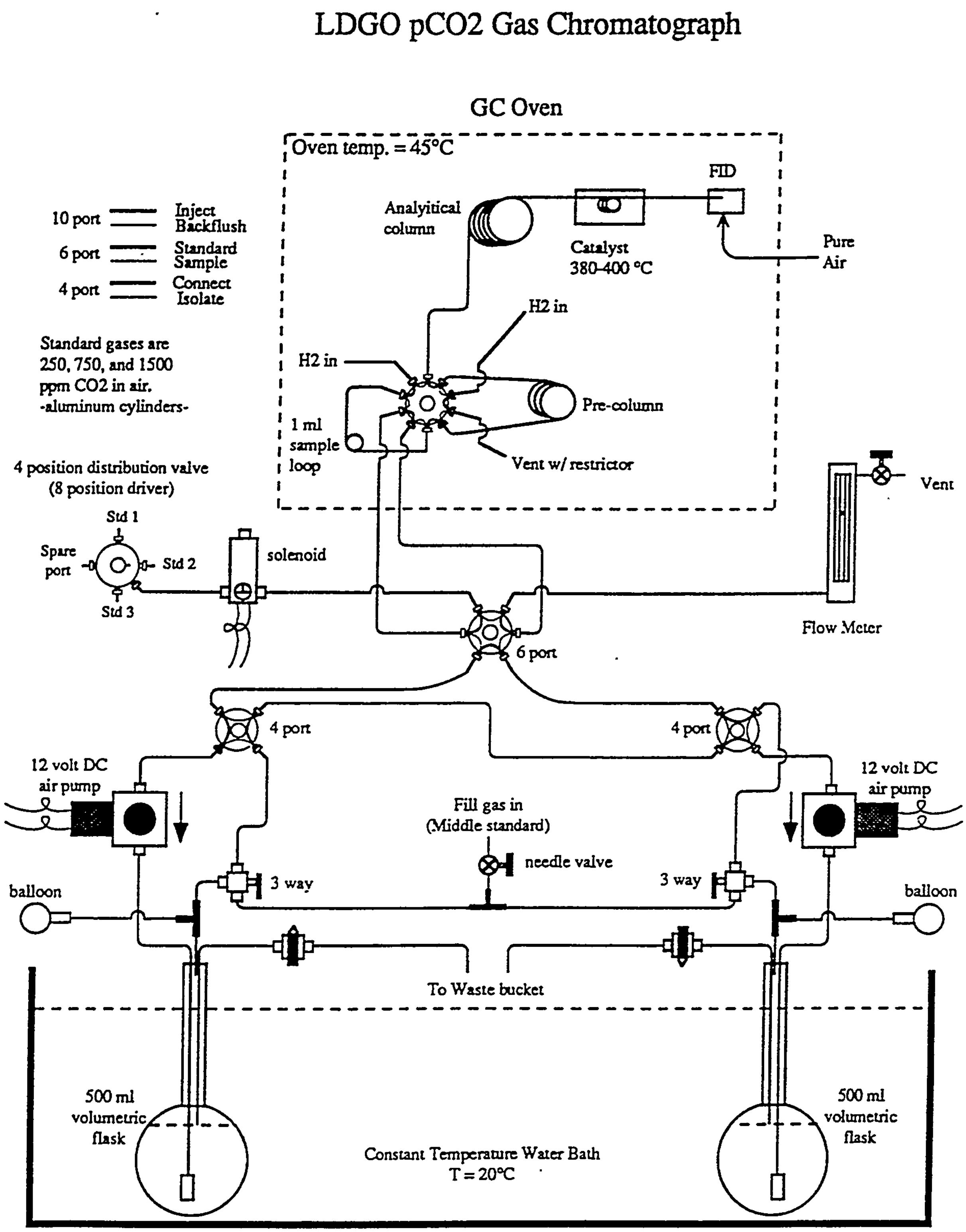
The water samples for total CO_2 analyses were collected from Niskin samplers after 1 to 2 liters of headspace was formed by the withdrawal of other water samples. Since the marine air introduced into the headspace had lower pCO_2 values than those for the seawater in the samplers, especially after several degrees of warming occurred during hoisting, it is likely that CO_2 was lost from the sample waters to the headspace. During the South Atlantic Ventilation Experiment (SAVE) program, the loss has been estimated by comparing the total CO_2 concentrations determined for those from the 10-liter Niskin samplers with that drawn from the 280-liter Gerard samplers. Because of its large mass, the water temperature in a Gerard sampler changed little during hoisting from the sampling depth. In addition, because of the height (about 1.5 meters), an water sample drawn from the base of the sampler was thought to be unaffected by the air introduced into the headspace. For these reasons, it was considered that little or no CO_2 had been lost from the water samples withdrawn from Gerard samples. The results of nearly 40 pairs of comparison indicate that the deep water samples collected from the Niskin samplers appear to have lost no more than 2 μmol/kg of CO_2 before the seawater samples were transferred into the sample bottles for analysis.

II-c) Determination of pCO_2 in Seawater and Air Samples:

A fully automated equilibrator-gas chromatograph system was used during the expedition for the determination of partial pressure of CO_2 exerted by the seawater samples, and its design has been described by Chipman et al. (1993). Fig. 4 gives a schematic diagram of this system.

The system consists of a pair of air circulation pumps (Spectrex Model AS-300-SS) plumbed to recirculated air through porous plastic gas dispersers which are immersed in two separate seawater samples. Electrically driven Valco 4-port valves were used to isolate each of the equilibrators during the initial equilibration prior to analysis of the equilibrated air. Manually operated 2-way and 3-way Whitey valves allowed part of the water in each

Fig. 4 - Schematic diagram of the automated GC/equilibrator system used for the pCO_2 measurements in discrete seawater samples (500 ml) during this expedition (Chipman et al., 1993).



equilibrator to be replaced with air of known initial CO_2 concentration, to create the necessary headspace for equilibration. A drain line in each equilibrator insured that the ratio of water to air in each equilibrator was constant, allowing accurate corrections to be made for the effect of the perturbation of the sample seawater by the headspace air. Diaphragms (thin rubber balloons) were plumbed to each equilibrator to provide "soft walls" to the system, so that the pressure in the equilibrators was kept close to the ambient laboratory atmospheric pressure which was measured with a high precision electronic barometer. Since the partial pressure of CO_2 is strongly affected by temperature changes, the equilibration flasks were kept immersed in a constant temperature water bath, held at a temperature of 20.00 °C. An electrically driven Valco 6-port valve allowed the entire equilibration system to be isolated, simultaneously connecting a calibration gas selection valve (also electrically driven Valco, Model 4SD, with 4 input ports but with an eight-position driver, so that all gas flows were blocked at the four intermediate positions). A 2-way normally-closed Skinner solenoid valve on the output of the calibration selection valve allowed the gas flows to be controlled by the system controller, and provided a necessary second means of stopping the flow of the calibration gases to prevent the accidental loss of calibration gases in the event of control malfunction.

The analysis of the CO_2 in the equilibrated air or calibration gases was performed using a Shimadzu Mini-2 gas chromatograph, which was equipped with a flame ionization detector. A one-ml sample loop and a pre-column and analytical column (both packed with Chromosorb 102, of 0.2 and 2.0 m lengths respectively) were attached to an electrically driven Valco 10-port valve within the column oven of the gas chromatograph. Ultra-high purity hydrogen gas (electrolytically generated by an Aadco hydrogen generator and purified by means of diffusion through a palladium foil using an Aadco hydrogen purifier) served as the carrier gas for the chromatographic separation of CO_2 from the other components of the air. The use of hydrogen for carrier gas also allowed the CO_2 to be converted to methane in an attached catalytic converter prior to quantification by the flame ionization detector. Unlike the method described by Weiss (1981), our system used a catalyst of ruthenium metal on Chromosorb W support and did not require a palladium pre-catalyst to remove oxygen from the carrier gas stream. Hydrocarbon-free air to support the combustion in the flame ionization detector was provided by means of a chromatographic air purifier (Aadco Model 737).

Integration of the output signal from the gas chromatograph and control of the entire equilibration and calibration procedure was provided by means of a Shimadzu Chromatopac (Model C-R6A) computing integrator.

The analytical procedure is as follows. Water samples for analysis were drawn from the 10-liter Niskin samplers of a rosette cast directly into 500-ml narrow-necked Pyrex flasks which serve both as sample containers and equilibration vessels. The samples were poisoned with 200 μl of 50% saturated mercuric chloride solution to prevent biological modification of the pCO_2, and were stored in the dark until measurement, which normally was performed within 24 hours of sampling. A headspace of 3 to 5 ml was left above the water in the flask to allow for thermal expansion during storage. The flasks were sealed air-tight using screw-caps with conical plastic liners.

The equilibrated air samples were saturated with water-vapor at the temperature of equilibration and had the same pCO_2 as the water sample. By injecting the air aliquot without removing the water vapor, the partial pressure of CO_2 was determined directly, without the need to know the water vapor pressure (Takahashi et al., 1982) using the relationship below:

$$pCO_2\ (\mu atm) = [\text{Cmeas (ppm)}]*[\text{Total pressure of equilibration (atm)}],$$

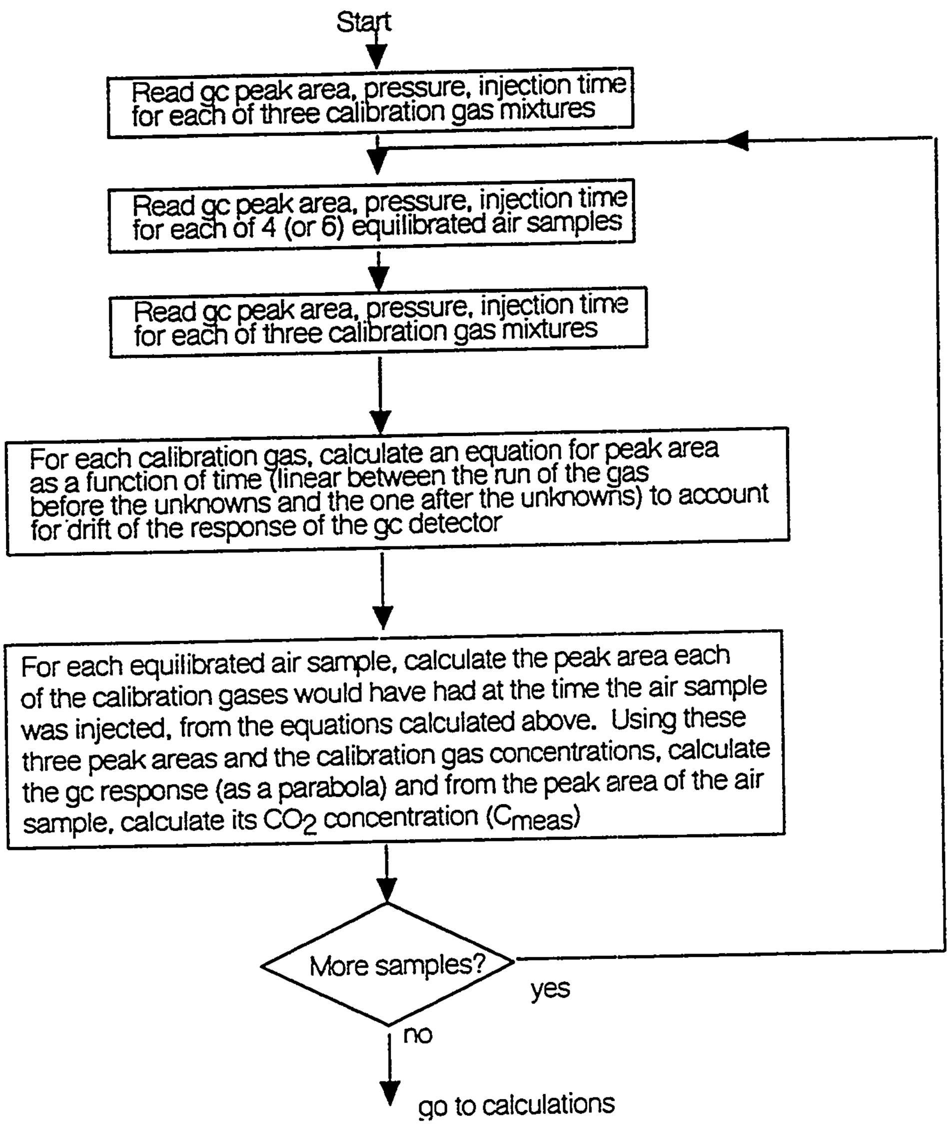
where Cmeas is the mole fraction concentration of CO_2 in equilibrated moist air. The total pressure of equilibrated air was measured by having the head space in the equilibrator flask always at atmospheric pressure which was, in turn, measured with the electronic barometer at the time each equilibrated air sample was injected into the gas chromatograph.

Corrections were made to account for the change in pCO_2 of the sample water due to the transfer of CO_2 to or from the water during equilibration with the recirculating air. The analytical steps yielding Cmeas, which have been programmed in the on-line computer, are schematically shown in Fig. 5-A; the pCO_2 correction routines in Fig. 5-B; and a list of variables in Fig. 5-C. The overall precision of the pCO_2 measurement has been estimated to be about $\pm$0.10% based on the reproducibility of replicate equilibrations.

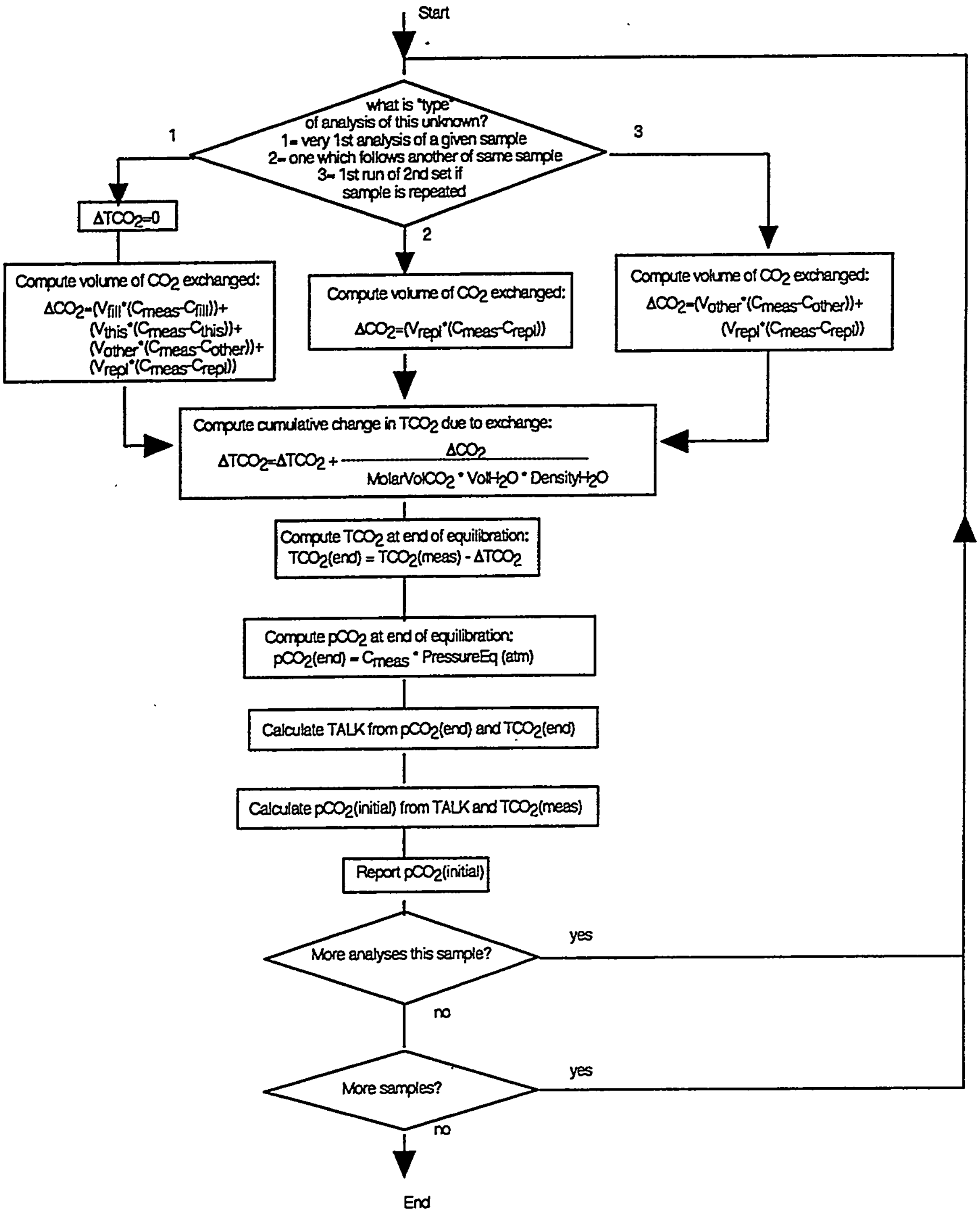
The air samples for pCO_2 analysis were collected in a 50 ml glass syringe equipped with a plastic shut-off valve. The syringe was flushed with several volumes of air from a point

Fig. 5 - Analytical steps for (A) the measurement of pCO_2 in discrete seawater samples using the LDEO GC/equilibrator system, (B) the correction procedures and equations and (C) a list of variables used in (A) and (B).

5(A)



5(B)


Start
what is "type" of analysis of this unknown?
1= very 1st analysis of a given sample
2= one which follows another of same sample
3= 1st run of 2nd set if sample is repeated
1
2
3
ΔTCO2=0
Compute volume of CO2 exchanged:
ΔCO2=(Vfill*(Cmeas-Cfill))+ (Vthis*(Cmeas-Cthis))+ (Vother*(Cmeas-Cother))+ (Vrepl*(Cmeas-Crepl))
Compute volume of CO2 exchanged:
ΔCO2=(Vrepl*(Cmeas-Crepl))
Compute volume of CO2 exchanged:
ΔCO2=(Vother*(Cmeas-Cother))+ (Vrepl*(Cmeas-Crepl))
Compute cumulative change in TCO2 due to exchange:
ΔTCO2=ΔTCO2 + ΔCO2 / MolarVolCO2 * VolH2O * DensityH2O
Compute TCO2 at end of equilibration:
TCO2(end) = TCO2(meas) - ΔTCO2
Compute pCO2 at end of equilibration:
pCO2(end) = Cmeas * PressureEq (atm)
Calculate TALK from pCO2(end) and TCO2(end)
Calculate pCO2(initial) from TALK and TCO2(meas)
Report pCO2(initial)
More analyses this sample?
yes
no
More samples?
yes
no
End

5(C)

ΔTCO_2 = change in TCO_2 concentration due to equilibration

ΔCO_2 = volume of CO_2 exchanged between water and headspace

C_{meas} = mole fraction of CO_2 in equilibrated air

V_{fill} = Volume of headspace created by displacing water in equilibrator

V_{this} = Volume of tubing & pump not swept while creating headspace

V_{other} = Volume of tubing connecting equilibrator to 6-port valve (filled with air from "other" equilibrator)

V_{repl} = Volume of tubing connecting 6-port and 10-port valves & sample loop (air "replaced" with calibration gas before each analysis)

C_{fill} = mole fraction of CO_2 in air used to create headspace

C_{this} = mole fraction of CO_2 in residual air in tubing & pump

C_{other} = mole fraction of CO_2 in preceeding sample in "other" equilibrator

C_{repl} = mole fraction of CO_2 in "replacement" air

$MolarVolCO_2$ = molar volume of CO_2 at temperature of equilibration

$VolH_2O$ = volume of water sample in equilibrator

$DensityH_2O$ = density of water sample at temperature of equilibrator

$TCO_2(end)$ = concentration of TCO_2 in sample after equilibrating with headspace

$TCO_2(meas)$ = concentration of TCO_2 measured colulometrically in fresh sample

$pCO_2(end)$ = partial pressure of CO_2 measured after equilibration

PressureEq = pressure of equilibration (in atmospheres)

TALK = Total alkalinity of sample (unchanged during equilibration)

$pCO_2(initial)$ = partial pressure of CO2 of sample water PRIOR TO equilibration (at temperature of equilibration) at the ship's rail facing into the wind, and the valve was closed to isolate the final volume of air. The syringe was then connected to the sampling loop (about 1 ml) of the gas chromatograph, and the loop was flushed with at least 40 ml of the sample air about 30 seconds before the loop contents were injected into the GC for analysis. The over-all precision for the atmospheric CO_2 measurements, including the effects of the sampling and analytical procedures, has been estimated to be about $\pm$0.2 ppm CO_2 mole fraction in dry air.

The pCO_2 values in air have been computed assuming that the air is saturated with water vapor at the seawater temperature. The following equation was used for this purpose:

$$(pCO_2)_{air} = (VCO_2)_{air} * (Pb - Pw)$$

where $(VCO_2)_{air}$ is the mole fraction concentration of CO_2 in dry air, Pb is the barometric pressure measured at each station and Pw is the equilibrium water vapor pressure at sea surface temperature and salinity. The following empirical expression was used to compute the equilibrium water vapor pressure, Pw:

$$Pw\ (atm) = (1/760) * (1 - 5.3684x10^{-4}.Sal) * EXP\{[0.0039476 - (1/TK)]/1.8752x10^{-4}\}$$

where Sal is salinity in PSU, and TK is the temperature in °K.

Since the variability of atmospheric CO_2 concentrations was expected to be small in the study area, 20 determinations were made during the expedition. The measurements yielded a mean atmospheric CO_2 concentration of 351.3$\pm$1.0 ppm (in mole fraction of CO_2 in dry air). This mean value has been used to compute the atmospheric pCO_2, and the sea-air pCO_2 difference reported in this report was computed assuming the mean barometric pressure (Pb) of 1.000 atm for the atmospheric pCO_2.

II-d) Computation of the Alkalinity in Seawater:

The alkalinity of seawater has been computed using the observed values of pCO_2, total CO_2 concentration, phosphate concentration, temperature and salinity. For our computation, the total alkalinity (TALK) in seawater is defined by:

$$TALK = Ac + Ab + Asi + Ap + Aw$$

where Ac = Carbonate alkalinity = $[HCO_3^-] + 2[CO_3^=]$

Ab = Borate alkalinity = $[H_2BO_3^-]$,

Asi = Silicate alkalinity = $[H_3SiO_4^-]$,

Ap = Phosphate alkalinity = $[H_2PO_4^-] + 2[HPO_4^=] + 3[PO_4^{-3}]$,

Aw = Water alkalinity = $[OH^-] - [H^+]$.

The total concentration of borate (TB) has been assumed to be proportional to salinity: TB (µmol/kg) = 410.6*(Sal/35). The borate alkalinity ranges between about 40 µeq/kg for deep waters and 100 µeq/kg for surface waters. Since the silicate concentration may be as high as 150 µmol/kg in deep waters, the silicate alkalinity is as high as 6 µeq/kg for deep water but it is negligibly small for surface waters. The phosphate alkalinity ranges from 0.5 µeq/kg for surface waters to about 5 µeq/kg in deep waters. The following apparent dissociation constants of acid in seawater were used; Merhbach et al. (1973) for carbonic acid; Lyman (1956) for boric acid; Kester and Pytkowicz (1967) for phosphoric acid; Ingri (1959) for silicic acid; and Millero (1979) and Culberson and Pytkowicz (1973) for water. The expressions used to compute these constants as a function of temperature and salinity and the computational scheme are described in Peng et al. (1987).

II-e) Measurements of Hydrographic Variables:

Pressure and Temperature: All pressure and temperature values for the bottle data tabulations were obtained by averaging CTD data for a brief interval at the time the bottle was closed on the rosette. All reported CTD values were calibrated with reference to the International Temperature Scale of 1990 and processed with the methodology described in the documentation accompanying the final CTD data report.

Salinity: Salinity samples were drawn into 200 ml Kimax high alumina borosilicate glass bottles with custom-made plastic insert thimbles and Nalgene screw caps. This provided low container dissolution and sample evaporation. These bottles were rinsed three times before filling, and measurements were made usually within 8 to 36 hours of collection. Salinity was determined on the basis of electrical conductivity measured with an ODF-modified Guildline Autosal Model 8400A salinometer, and the values were obtained according to the equations of the Practical Salinity Scale of 1978 (UNESCO, 1981). For the samples from Stations 124 through 140, the salinometer was calibrated using a batch of Wormley IAPSO standard seawater, P-114, with at least one fresh vial opened per cast. For the samples from Stations 141 through 220, the standard seawater from batch P-108 was used. A single comparison at sea during TUNES/2 yielded a salinity value for P-114 about 0.002 PSU higher than that of P-108, when standardized against P-108. This compares with the estimated precision of about 0.001 PSU of this instrument operated at sea under normal conditions.

Oxygen: Water samples for oxygen analyses were collected shortly after the rosette sampler was brought on board and after the samples for CFC's and helium-3 were drawn. Sampling flasks (100 to 125 ml), whose volumes (with a stopper in place) were calibrated prior to the expedition, were rinsed carefully with minimal agitation, then filled using a drawing tube after allowing to overflow for at least two flask volumes. Reagents were added to fix the oxygen before stoppering. The flasks were shaken immediately after the stoppers were placed to seal them, and then again after 20 minutes, to assure thorough dispersion of the $Mn(OH)_2$ precipitate. The oxygen concentration in these solutions were determined within 4 to 36 hour using the Winkler titration methods of Carpenter (1965) with modifications by Culberson and Williams (1991). The titrator was calibrated with 0.01N potassium iodate standard solutions prepared using pre-weighed potassium iodate crystals. Standards were run at the beginning of each session of analyses, which typically included samples from one to three stations. Several batches of standard solutions were made up and compared to assure that the results were reproducible. A correction was made for the amount of oxygen added with the reagents, and combined reagent/distilled water blanks were determined to account for oxidizing or reducing materials in the reagents.

Oxygen concentrations were converted from milliliter per liter to micromoles per kilogram of seawater using the in-situ temperature. A molar volume at STP of 22.385 liter/mole (Kester, 1975) was used for this purpose. Ideally, the temperature at which a liter of seawater is converted to kilograms should be the temperature of the water when samples were collected in the sampling flasks. However, in-flask temperatures were measured and found to be 4 to 7 °C warmer than the in-situ temperatures for mid-depths water samples.

Accordingly, the magnitude of errors induced by using about 6°C colder temperature would be about +0.08% or +0.2 μmol/kg.

The Apparent Oxygen Utilization (AOU) value was obtained by subtracting the measured value from the saturation value. The latter was computed at the potential temperature of water and 1 atm total pressure using the following expression based on the data of Murray and Riley (1969):

$$\ln(O_2 \text{ in } \mu mol/kg) = -173.9894 + 255.5907(100/TK) + 146.4813 \ln(TK/100) - 22.2040(TK/100) + Sal[-0.037362 + 0.016504(TK/100) - 0.0020564(TK/100)^2],$$

where TK is temperature in °K and Sal in PSU.

Nutrients: The concentrations of phosphate, nitrate, nitrite and silicate in seawater were determined using a Technicon AutoAnalyzer based on the procedures described by Hager et al. (1972) and Atlas et al. (1971). The analyzer was calibrated using the standard solutions prepared aboard ship from pre-weighed standards. These solutions were used before and after the analyses for each cast consisting of about 36 samples to correct for instrumental drift. Sets of 4-6 different standard solutions having different concentrations were used periodically to determine the non-linear colorimeter response and the resulting corrections. The phosphate concentration was determined using the hydrazine reduction of phosphomolybdic acid (Bernhardt and Wilhelms, 1967). The silicate concentration was determined using stannous chloride reduction of silicomolybdic acid (Armstrong et al., 1967). The nitrite concentration was determined using diazotization and coupling to form dye; the nitrate concentration was determined as nitrite after nitrate was reduced by copperized cadmium (Armstrong et al., 1967). The precision of measurements has been estimated to be ±0.1 μmol/kg for nitrate and silicate and ±0.01 μmol/kg for phosphate.

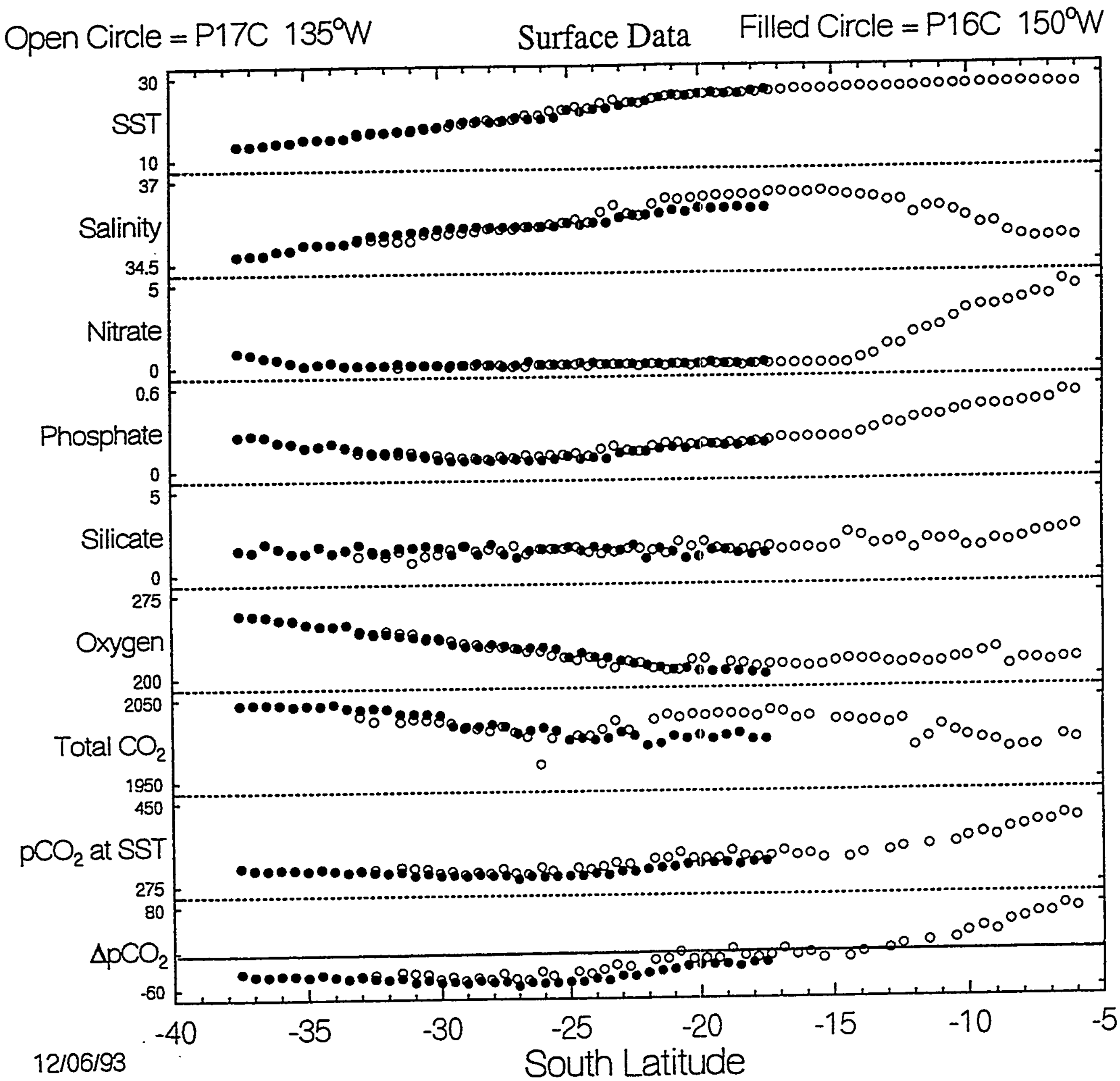
III. DISTRIBUTION OF HYDROGRAPHIC AND CO_2 PROPERTIES

III-a) Distribution of CO_2 and Other Properties in Surface Waters:

The distribution of 9 properties along the P-16C and P-17C sections are shown in Fig. 6. The data for P-16C along 150°W are shown with filled circles, and those for P-17C along 135°W with open circles. The surface water temperature varied from 28°C at 6°S to 13°C at 37.5°S. Over the latitudinal range between 17.5°S and 32.5°S investigated by both sections, the temperature and the concentrations of nitrate, phosphate and silicate were similar, whereas pCO_2 and the concentrations of oxygen and CO_2 observed along 150°W were higher than those observed along 135°W. The concentrations of nutrients in the subtropical gyre water located between 15°S and 34°S were very small as expected (nitrate = 0.1 μmol/kg, phosphate = 0.07 μmol/kg and silicate = 1.0 μmol/kg). North of 15°S, these concentrations increased gradually to the northern limit of the present investigation at 6°S where nitrate = 6 μmol/kg, phosphate = 0.6 μmol/kg, and silicate = 2.5 μmol/kg were observed. Only a minor increase in nutrient concentrations was observed in the waters south of 34°S to the southern limit of this investigation at 37.5°S.

The total CO_2 concentration increased southward from about 1990 μmol/kg at 6°S to 2050 μmol/kg at 37.5°S, whereas the pCO_2 in surface waters decreased southward from about 410 μatm at 6°S to 290 μatm at 27°S and increased to 310 μatm at 37.5°S. The greater pCO_2 values in lower latitudes are mainly attributed to the effect of increased temperature. As indicated in the lowermost panel in Fig. 6, the tropical waters north of about 12°S were sources for atmospheric CO_2 (positive ΔpCO_2 values), whereas the waters south of this latitude, especially those located south of about 25°S, were strong sinks for atmospheric CO_2 with negative ΔpCO_2 values ranging between -40 and -50 μatm. This indicates that the oceanic area south of about 25°S between 135°W and 150°W was a strong CO_2 sink during the austral winter, July-August, 1991. Murphy et al. (1991) measured the surface water pCO_2 along 105°W and 130-140°W during the austral autumn of 1989 and that along 150°W and 170°W during the austral autumn of 1984 in the South Pacific. They reported that surface between 20°S and 35°S waters along 150°W were undersaturated with respect to atmospheric CO_2 by -10 to -20 μatm, whereas those between 20°S and 30°S along 135°W were supersaturated by +15 to 0 μatm (see their Plate 1 in page 20,458). On the other hand, our data show a greater degree of undersaturation by as much as -21 to -56 μatm between 20°S and 37.5°S along 150°W and +1 to

Fig. 6 - Meridional distribution of surface water properties along the P-16C and P-17C Sections. The open circles indicate the data along the 135°W meridian (P-17C), and the filled circles those along the 150°W meridian (P-16C).



-45 μatm between 20°S and 30°S along 135°W. This means that our pCO_2 values measured in July through August are 15 to 45 μatm lower than those observed by Murphy et al. in the same areas about four months earlier in season (March-April, 1984 along 150°W; March, 1989 along 130°W-140°W). These pCO_2 differences correspond to temperature differences of 1 to 3.5°C. Although their temperature data have not been compared with ours as yet, these temperature differences are considered to be reasonable in view of the differences in the time of respective measurements: ours during the austral mid-winter whereas those of Murphy et al. during late austral summer. Thus, the observed differences between Murphy et al. and ours appear to represent seasonal changes.

III-b) Distribution of Properties along the WOCE Sections P-16C and P-17C:

In Figs. 7 through 28, the distribution along the WOCE Sections P-16C and P-17C are shown for the following properties; potential temperature, salinity, potential density, total CO_2 concentration, pCO_2 in seawater at 20°C, alkalinity, the concentrations of dissolved oxygen, phosphate, nitrate and silicate and the apparent oxygen utilization (AOU). Each figure consists of two panels: (A) the upper 1000 meters and (B) the entire water column. The potential density values computed for at sea surface (sigma-θ) are used for the upper 1000 meter section, and those at 2000 db (sigma-2) are used for the section below 1000 meters.

Potential Temperature

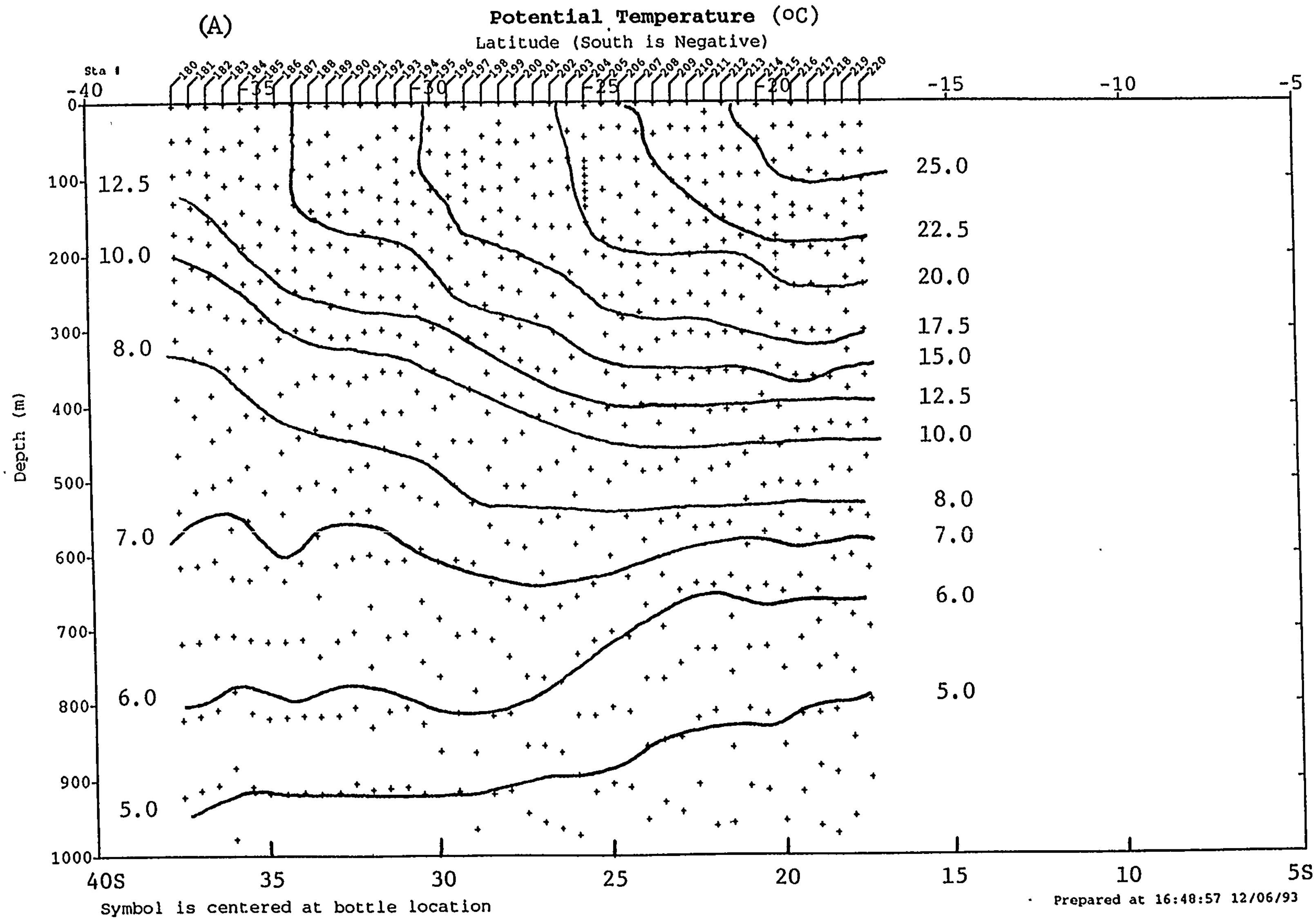
Figs. 7-A & B show the distribution of potential temperature along 150°W (WOCE Section P-16C) down to 1000 meters and to the sea floor respectively. The highest temperature of 26.5°C was found at the sea surface at 17.5°S, and the lowest temperature of 0.6°C along the sea floor (5250 meters deep) at about 36°S. Figs. 8-A & B show a section along 135°W (WOCE Section P-17C). Since this section covered a latitudinal range further north between 6°S and 33°S, higher surface water temperatures as high as 27.7°C were observed in the tropical waters. The lowest temperature of 0.9°C was observed in the abyssal waters near the southern extreme of this section.

Salinity

Figs. 9-A & B show the distribution of salinity along 150°W down to 1000 meters and to the sea floor respectively. The highest salinity values, as high as 36.12 PSU, were observed in

Fig. 7 - Distribution of potential temperature along the WOCE P-16C (150°W) section: (A) the upper 1000 meters, and (B) the entire depth range.

(A)



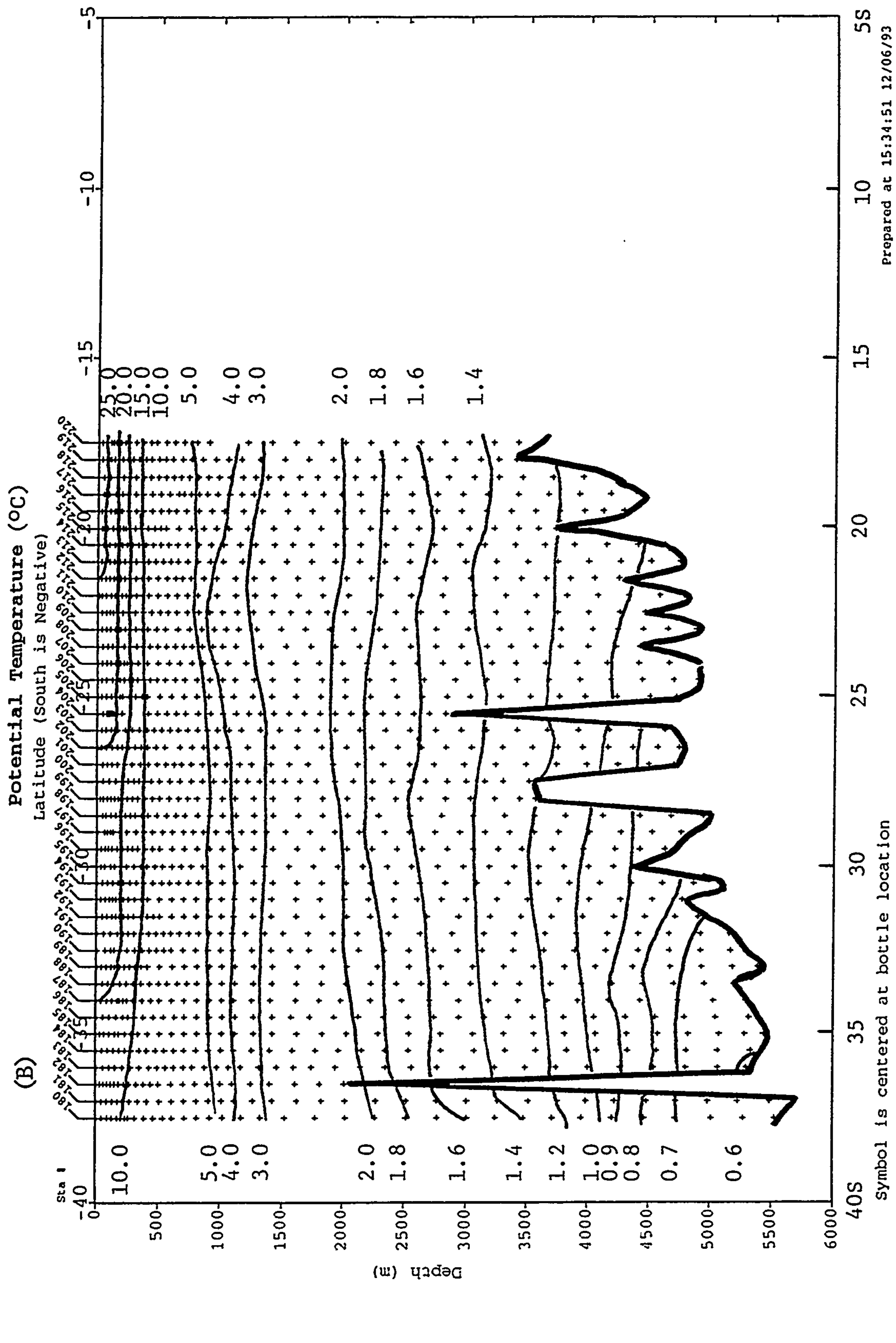
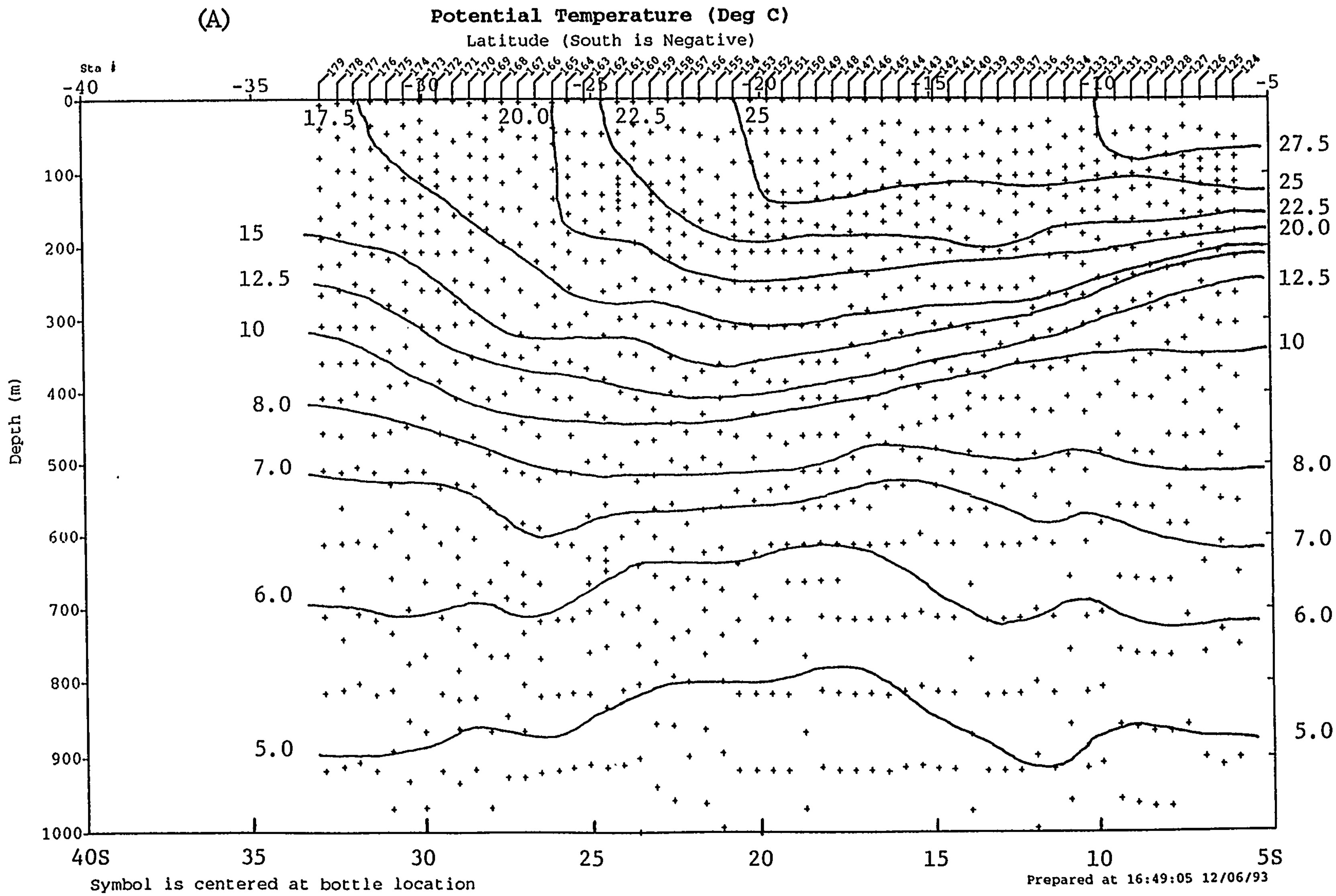

(B)
Potential Temperature (°C)
Latitude (South is Negative)
Depth (m)
Sta #
40S
35
30
25
20
15
10
5S
Symbol is centered at bottle location
Prepared at 15:34:51 12/06/93

Fig. 8 - Distribution of potential temperature along the WOCE P-17C (135°W) section: (A) the upper 1000 meters, and (B) the entire depth range.

(A)



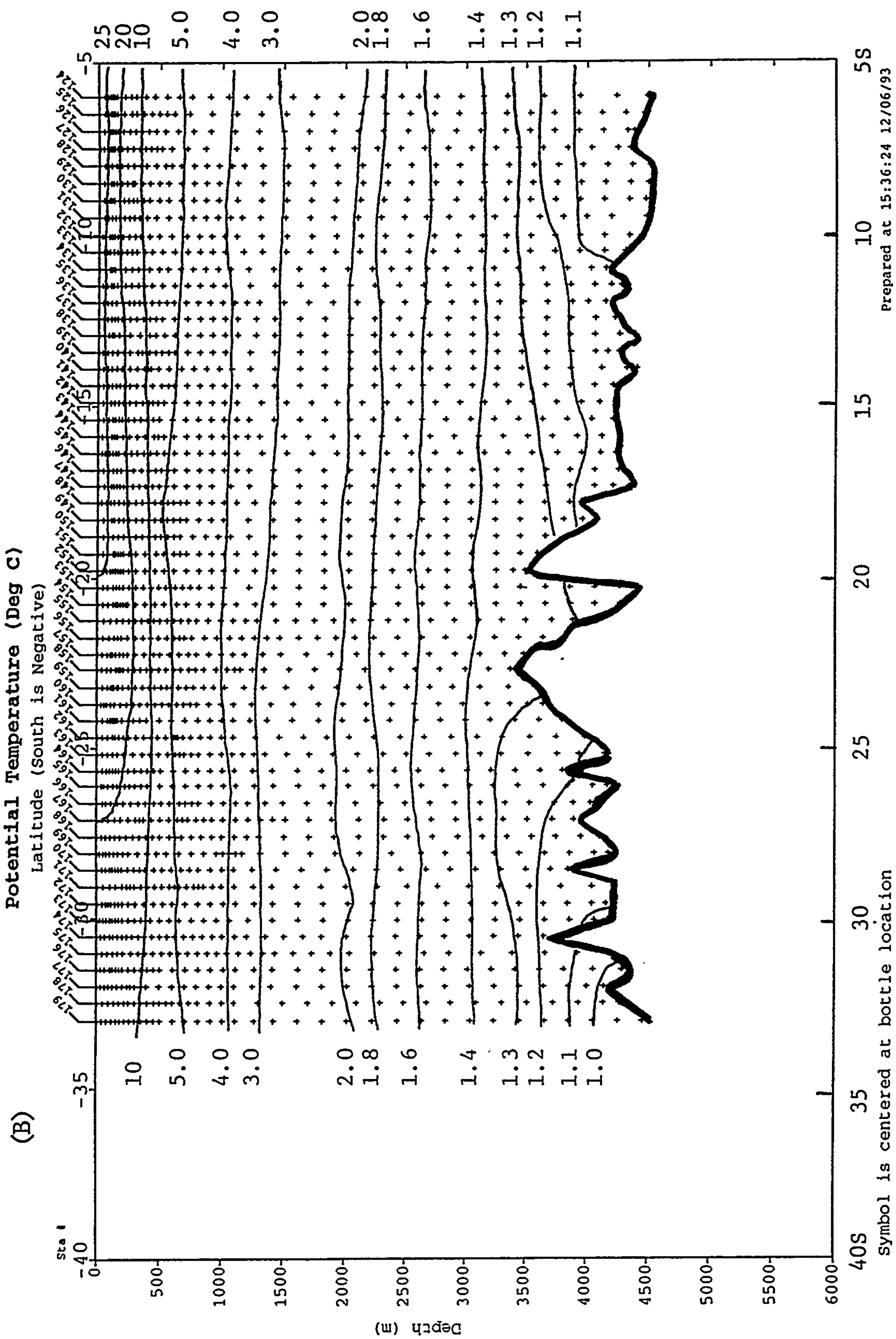
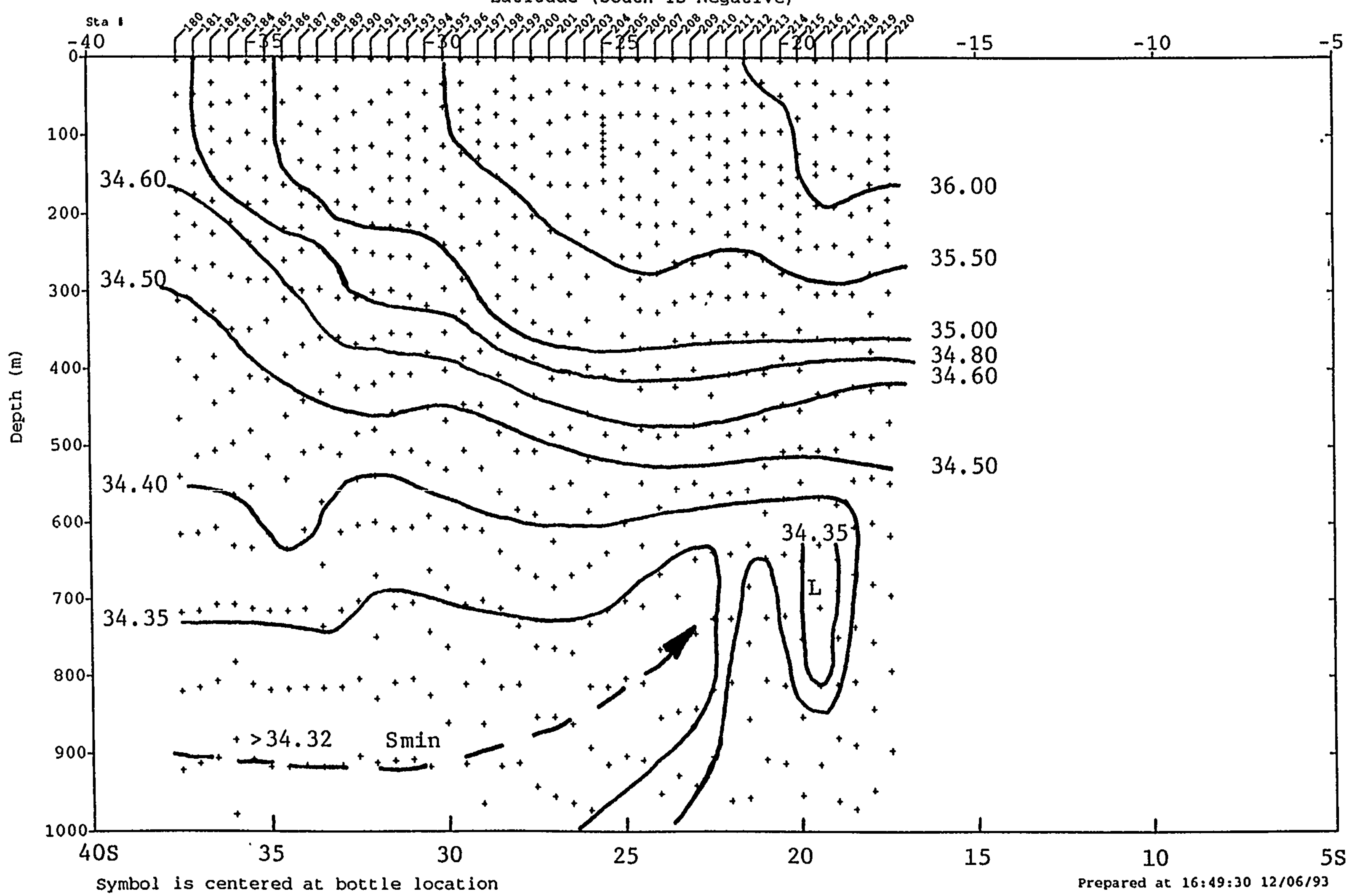
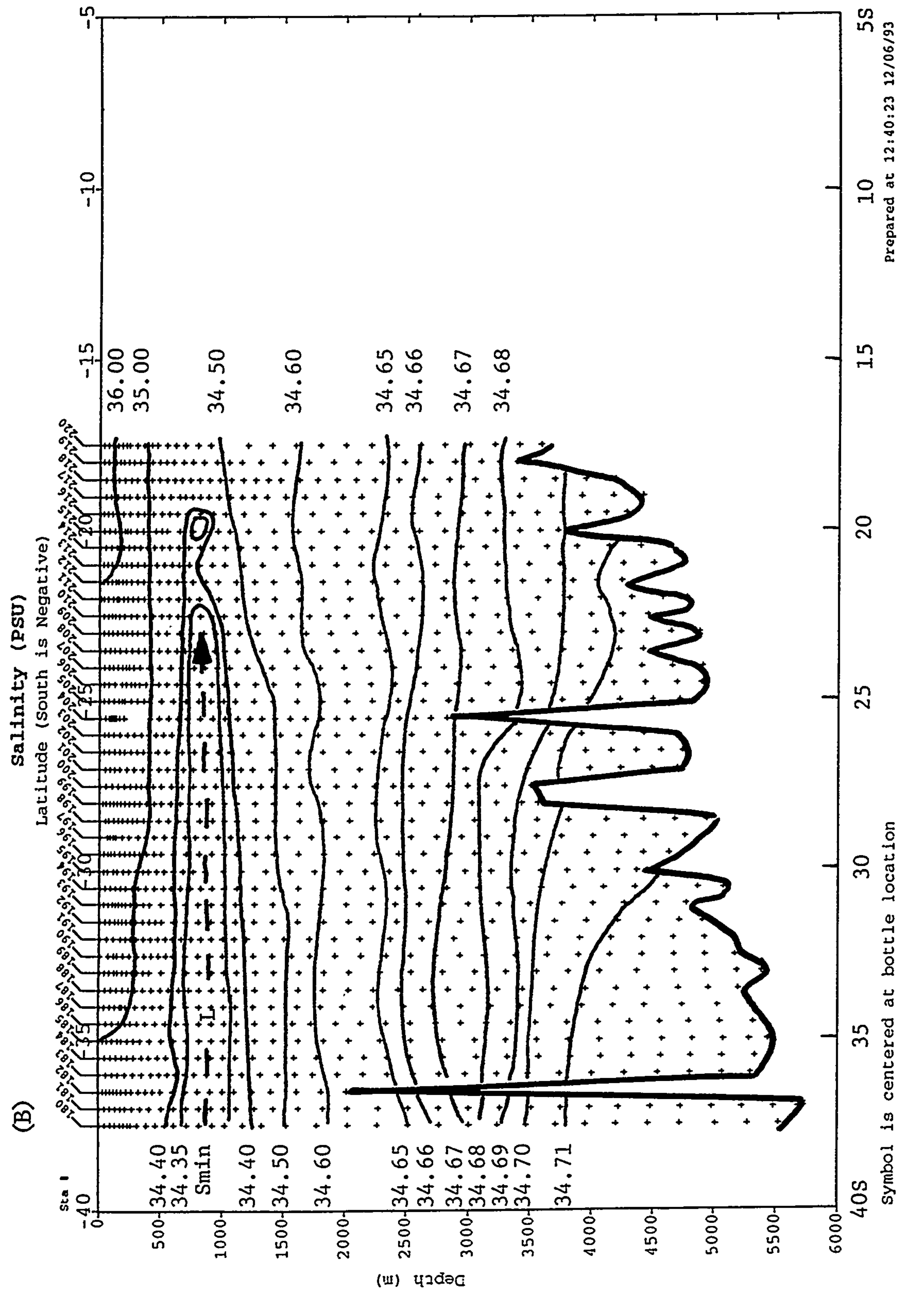

(B)
Potential Temperature (Deg C)
Latitude (South is Negative)
Depth (m)
Sta #
Symbol is centered at bottle location
Prepared at 15:36:24 12/06/93
40S
35
30
25
20
15
10
5S
-40
-35
-30
-25
-20
-15
-10
-5
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
25
20
10
5.0
4.0
3.0
2.0
1.8
1.6
1.4
1.3
1.2
1.1
1.0

Fig. 9 - Distribution of salinity along the WOCE P-16C (150°W) section: (A) the upper 1000 meters, and (B) the entire depth range. Dashed curves indicate trends of salinity minima with water depth.

(A)

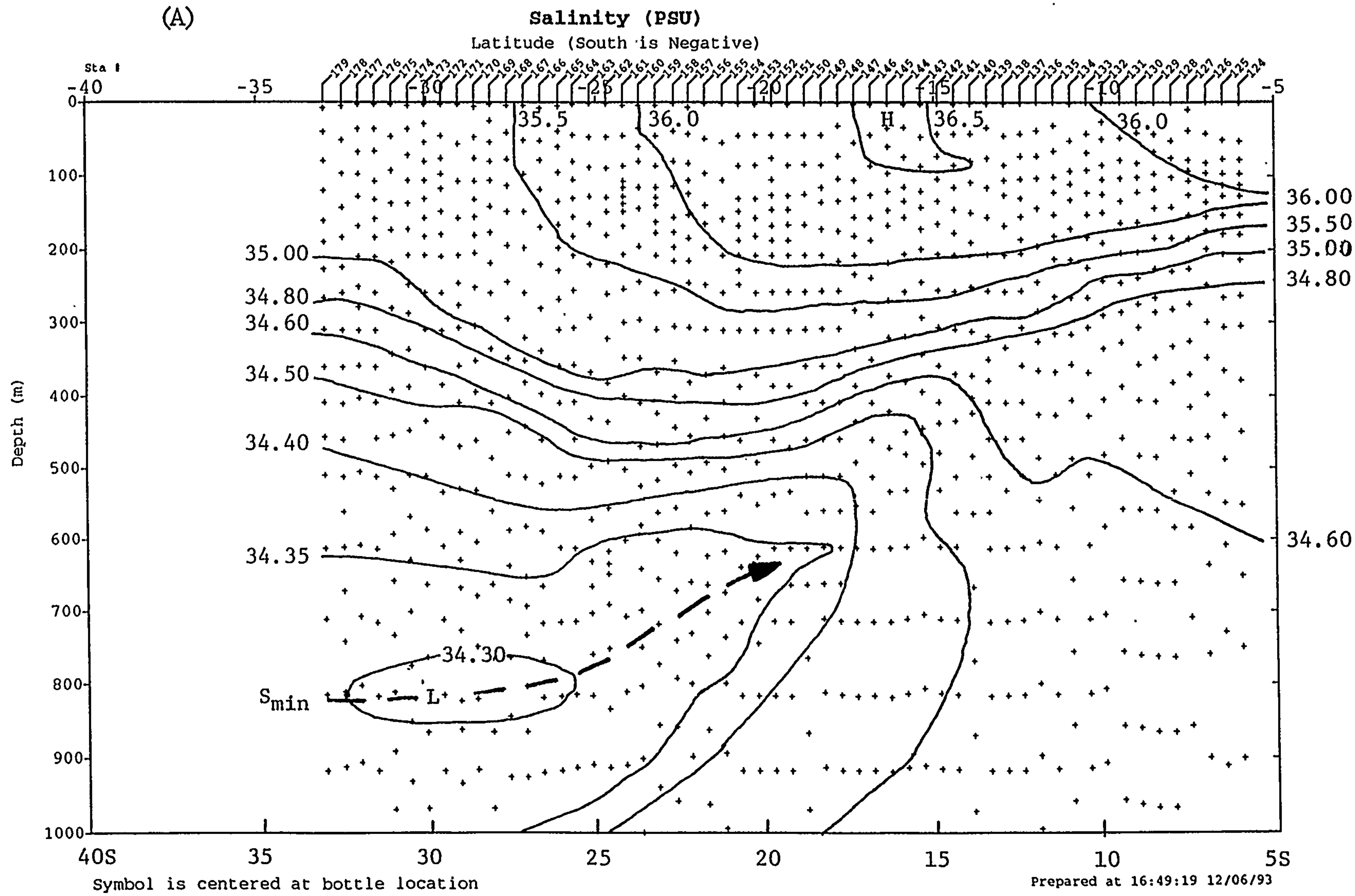




Symbol is centered at bottle location

Fig. 10 - Distribution of salinity along the WOCE P-17C (135°W) section: (A) the upper 1000 meters, and (B) the entire depth range. Dashed curves indicate trends of salinity minima with water depth.

(A)



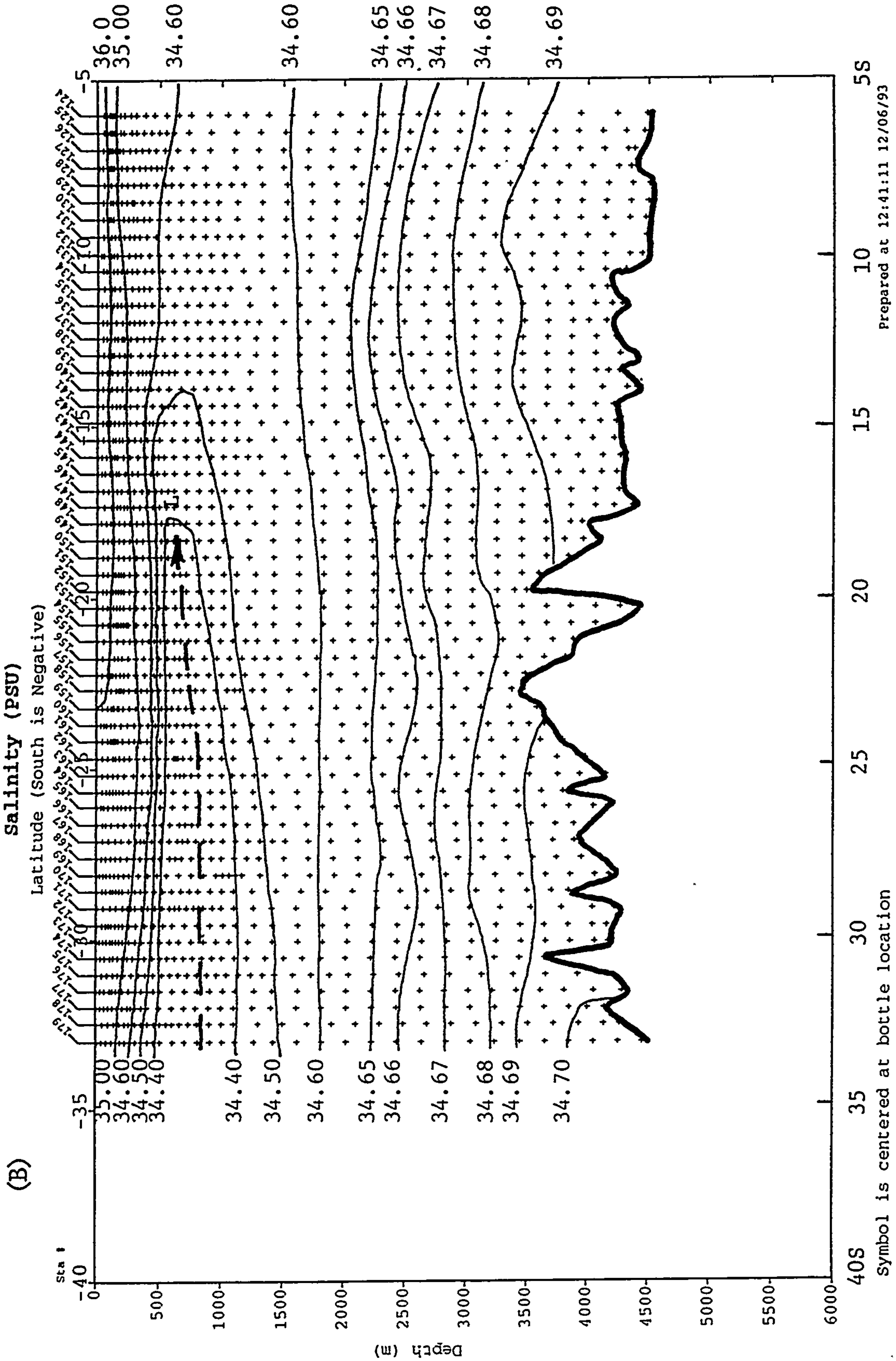
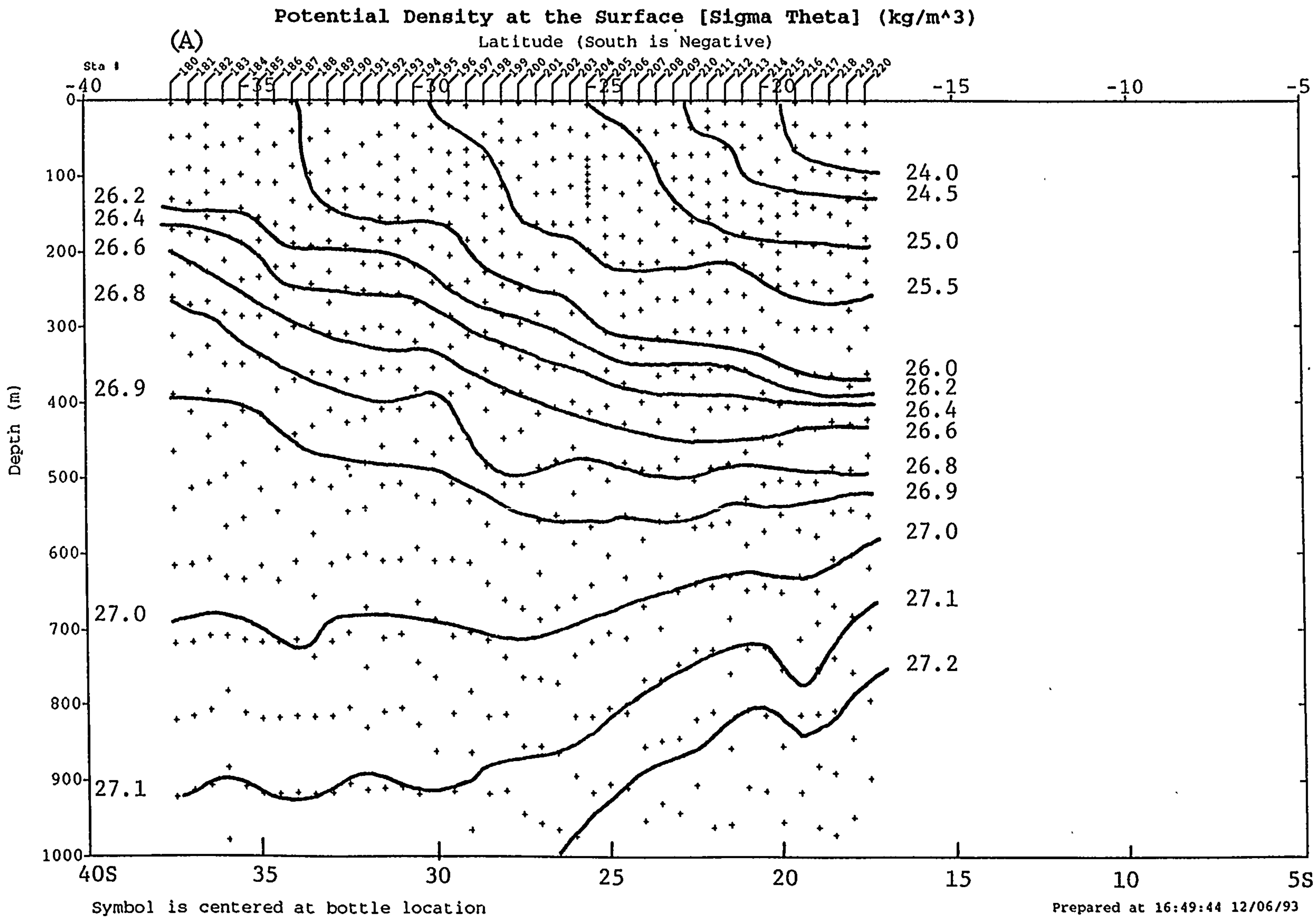

(B)
Salinity (PSU)
Latitude (South is Negative)
Sta #
-40
-35
-30
-25
-20
-15
-10
-5
36.0
35.00
34.60
34.60
34.65
34.66
34.67
34.68
34.69
35.00
34.60
34.50
34.40
34.40
34.50
34.60
34.65
34.66
34.67
34.68
34.69
34.70
Depth (m)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
40S
35
30
25
20
15
10
5S
Symbol is centered at bottle location
Prepared at 12:41:11 12/06/93

Fig. 11 - Distribution of potential density along the WOCE P-16C (150°W) section: (A) sigma-θ for the upper 1000 meters, and (B) sigma-2 from 1000 meters to the sea floor.



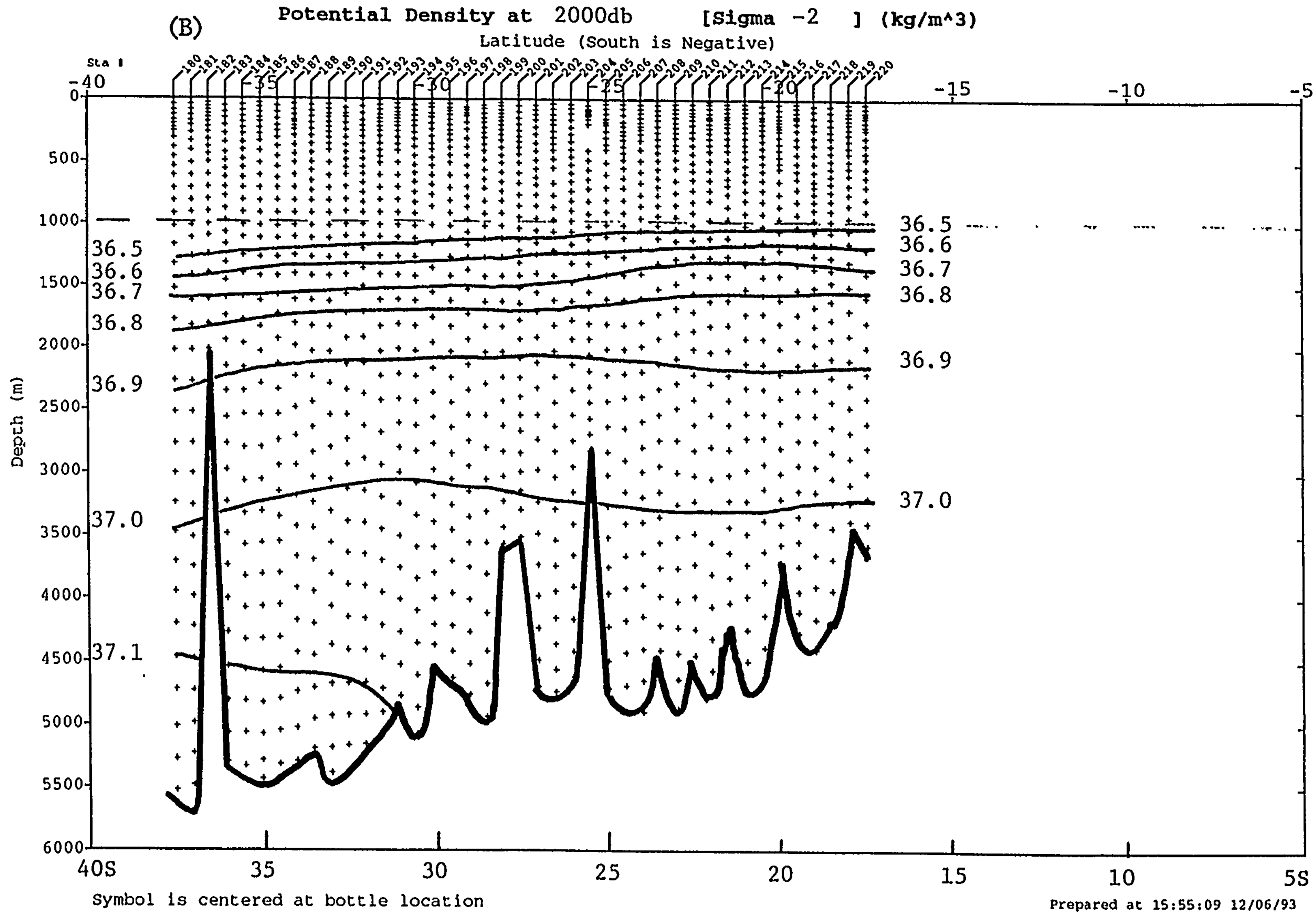
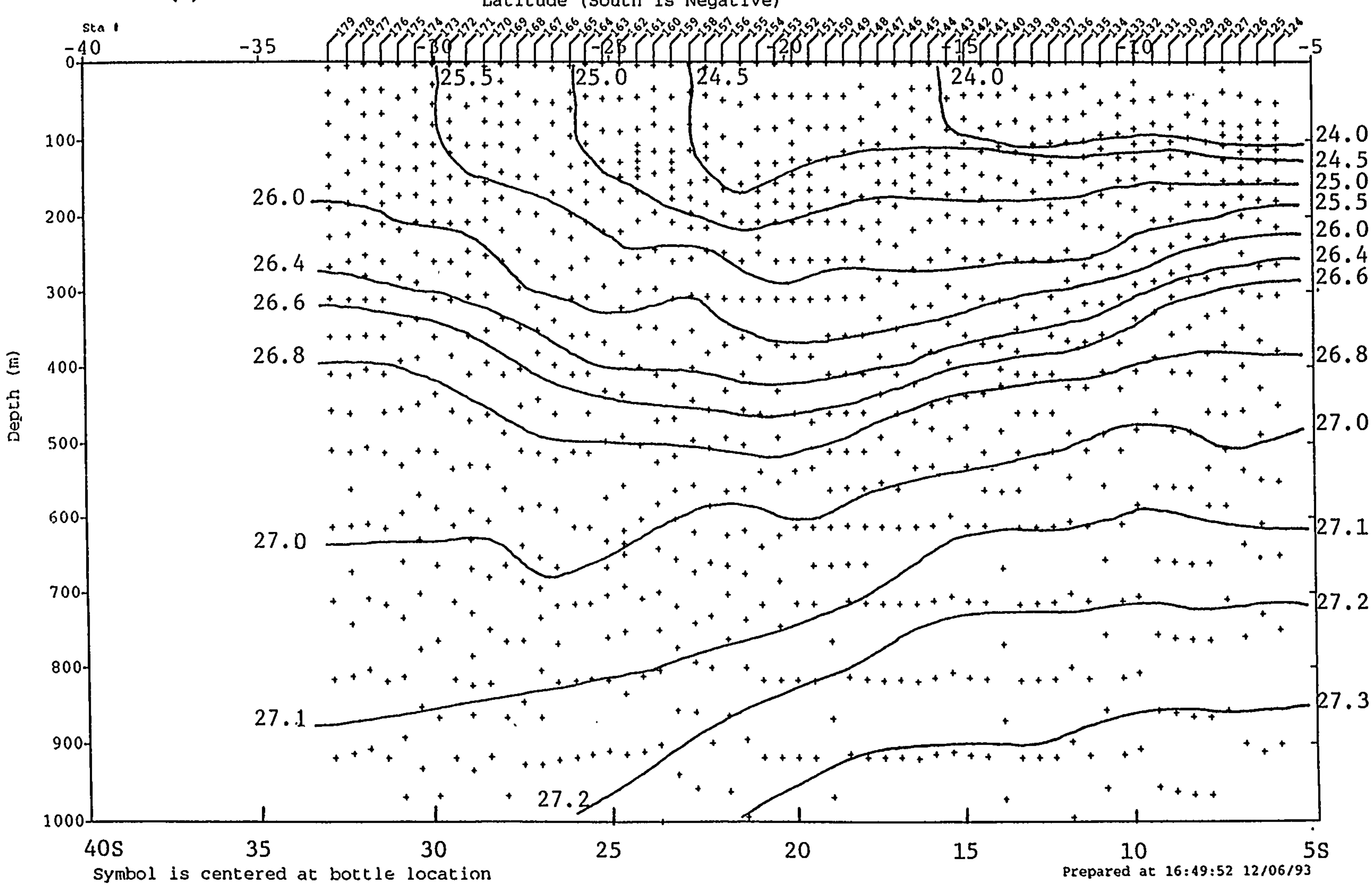
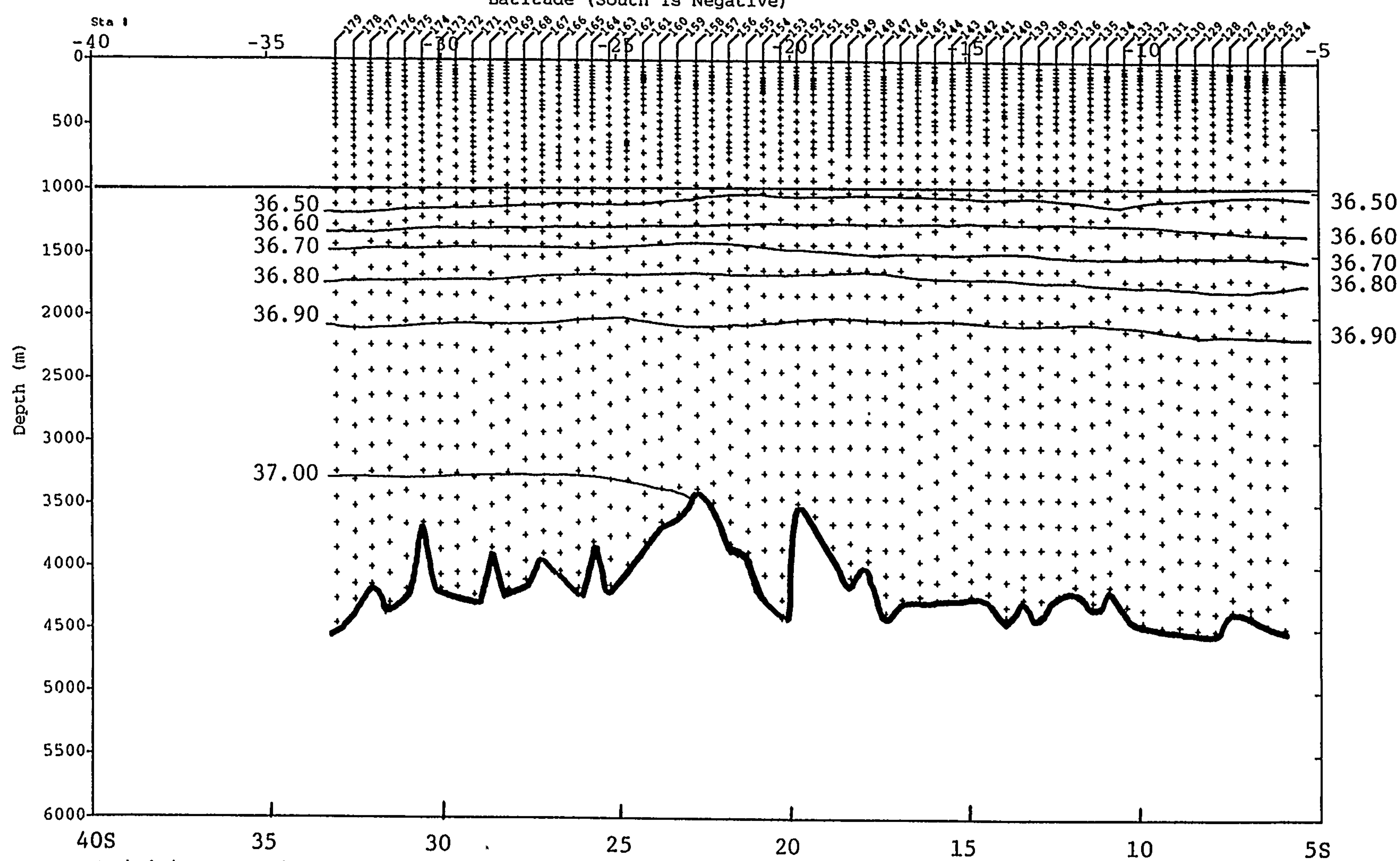

(B)
Potential Density at 2000db [Sigma -2] (kg/m^3)
Latitude (South is Negative)
Sta #
-40
-35
-30
-25
-20
-15
-10
-5
180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220
Depth (m)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
36.5
36.6
36.7
36.8
36.9
37.0
37.1
40S
35
30
25
20
15
10
5S
Symbol is centered at bottle location
Prepared at 15:55:09 12/06/93

Fig. 12 - Distribution of potential density along the WOCE P-17C (135°W) section: (A) sigma-θ for the upper 1000 meters, and (B) sigma-2 from 1000 meters to the sea floor.

(A)



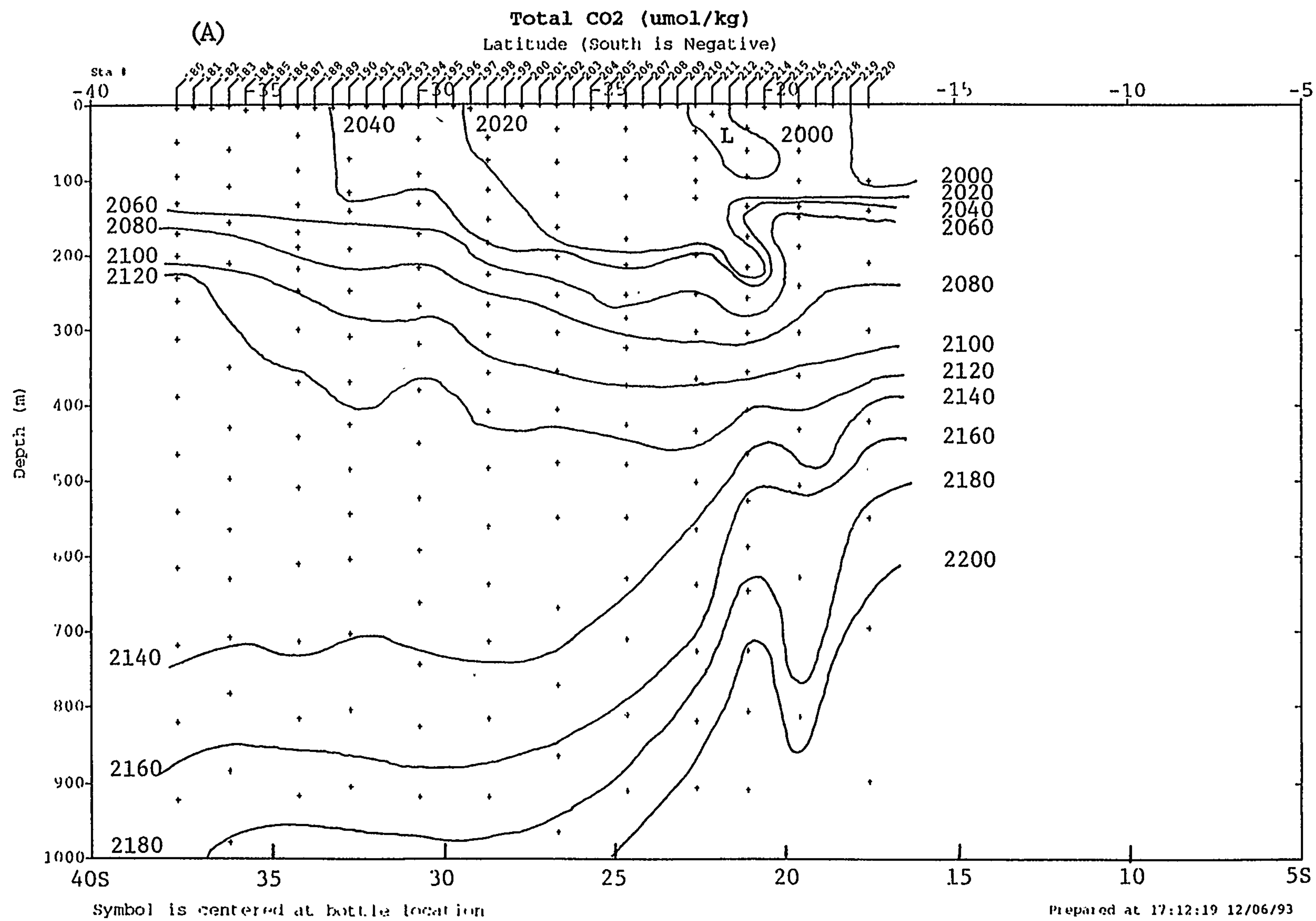
(B) **Potential Density at 2000db [Sigma -2] (kg/m^3)**

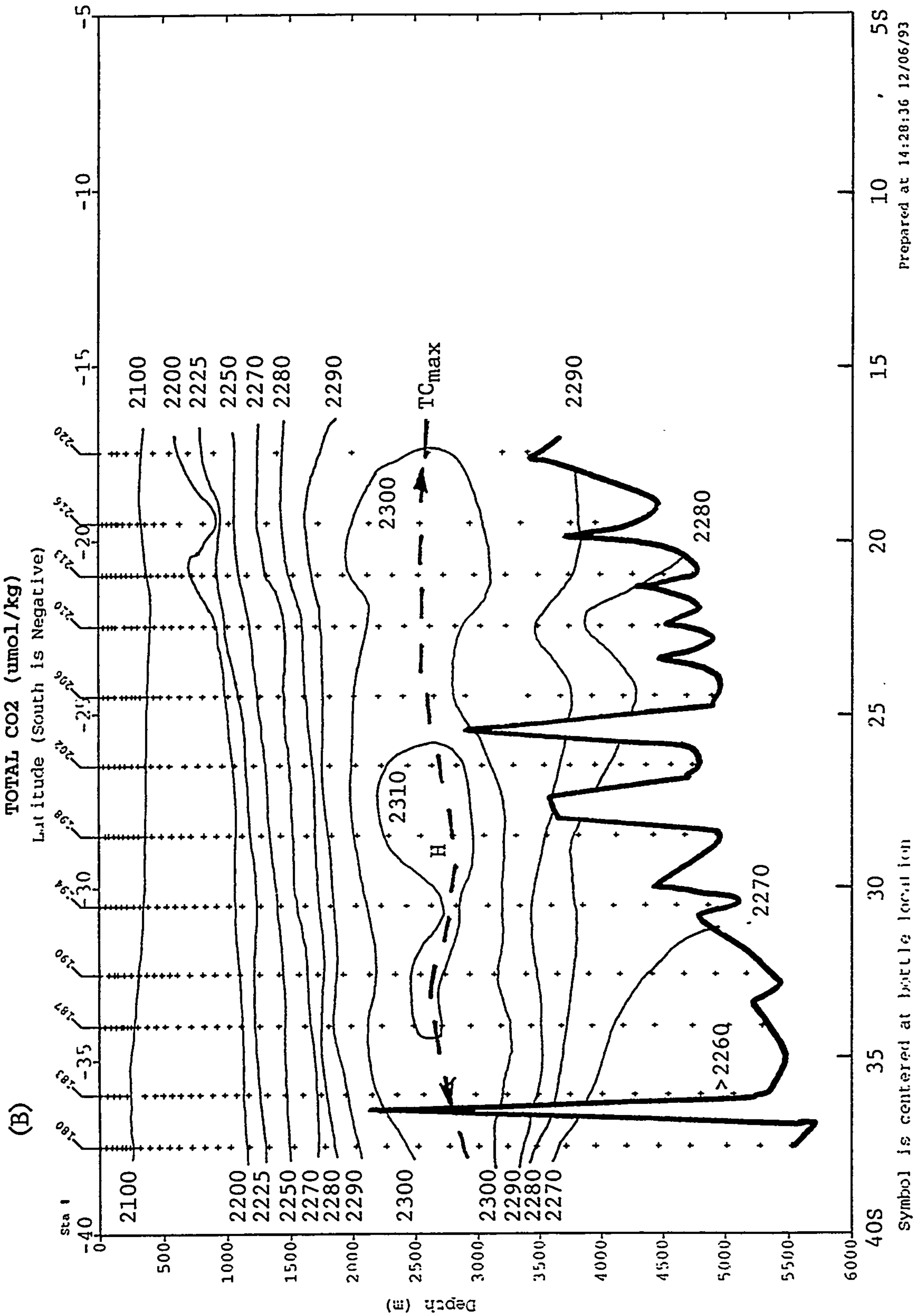


Symbol is centered at bottle location

Prepared at 15:54:50 12/06/93

Fig. 13 - Distribution of the total CO_2 concentration in seawater along the WOCE P-16C (150°W) section: (A) the upper 1000 meters, and (B) the entire depth range. Dashed curves indicate trends of total CO_2 maxima or minima.




(B)
TOTAL CO2 (umol/kg)
Latitude (South is Negative)
Depth (m)
TCmax
H
Symbol is centered at bottle location
Prepared at 14:28:36 12/06/93

the surface layer at 17.5°S, and the lowest values, as low as 34.31 PSU, in a salinity minimum layer between 800 and 900 meters representing the Antarctic Intermediate Water (AAIW). The position of the salinity minimum is indicated with a dashed curve with an arrow. Below this depth, the salinity increased with depth to 34.71 PSU, a typical value for the Antarctic Bottom Water (AABW), which was found below about 4000 meters south of about 30°S. Figs. 10-A & B show the sections along 135°W. The distribution of salinity along this section is basically identical to that along 150°W, with an exception that the minimum salinity in the AAIW was 34.29 PSU, slightly lower than the minimum value observed along the 150°W section. This suggests that the AAIW observed along 135°W was closer to the source region of the water mass than that observed further west along 150°W.

Potential Density

Figs. 11-A & B show the distribution of the potential density along 150°W down to 1000 meters and to the sea floor respectively. The potential density at the sea surface (sigma-θ) is used for waters above 1000 meters and that at 2000 db (Sigma-2) for waters below 1000 meters. The density of the core of AAIW represented by salinity minima corresponds to a sigma-θ density of about 27.1. The most dense water found in this section was 37.11 sigma-2. Figs. 12-A & B show the sections along 135°W. The densest water found in this section was sigma-2 37.07, which was slightly smaller than that observed in the 150°W section. This suggests a greater contribution of denser southern waters in the abyssal waters of the 150°W section.

Total CO_2 Concentration

Figs. 13-A & B show the distribution of the total CO_2 concentration along 150°W down to 1000 meters and to the sea floor respectively. In the upper 1000-meter section, the lowest CO_2 concentration of 2000 μmol/kg was found in subtropical waters located between 17.5°S and 30°S. North of about 25°S, the total CO_2 concentration increased much more rapidly with depth to 1000 meters than south of this latitude, reflecting the influence of the strongly bio-mediated layers of the eastern tropical Pacific. Below 1000 meters, the CO_2 concentration increased with depth to a CO_2 maximum layer located between 2500 and 3000 meters, in which CO_2 values as high as 2314 μmol/kg were observed. As will be shown in Fig. 27-B, this CO_2 maximum is closely associated with a silicate maximum. This suggests that this layer represents the southward flowing water from the North Pacific Ocean. The maximal values for both CO_2 and silicate within this layer tended to decrease both southward and northward away from 28°S suggesting that a tongue of the high CO_2 North Pacific water intruded into the southern water which had lower CO_2 and silicate concentrations. Below this layer, the total CO_2 concentration gradually decreased to the lowest value of about 2262 μmol/kg which was found in the bottom waters in the southern end of this section.

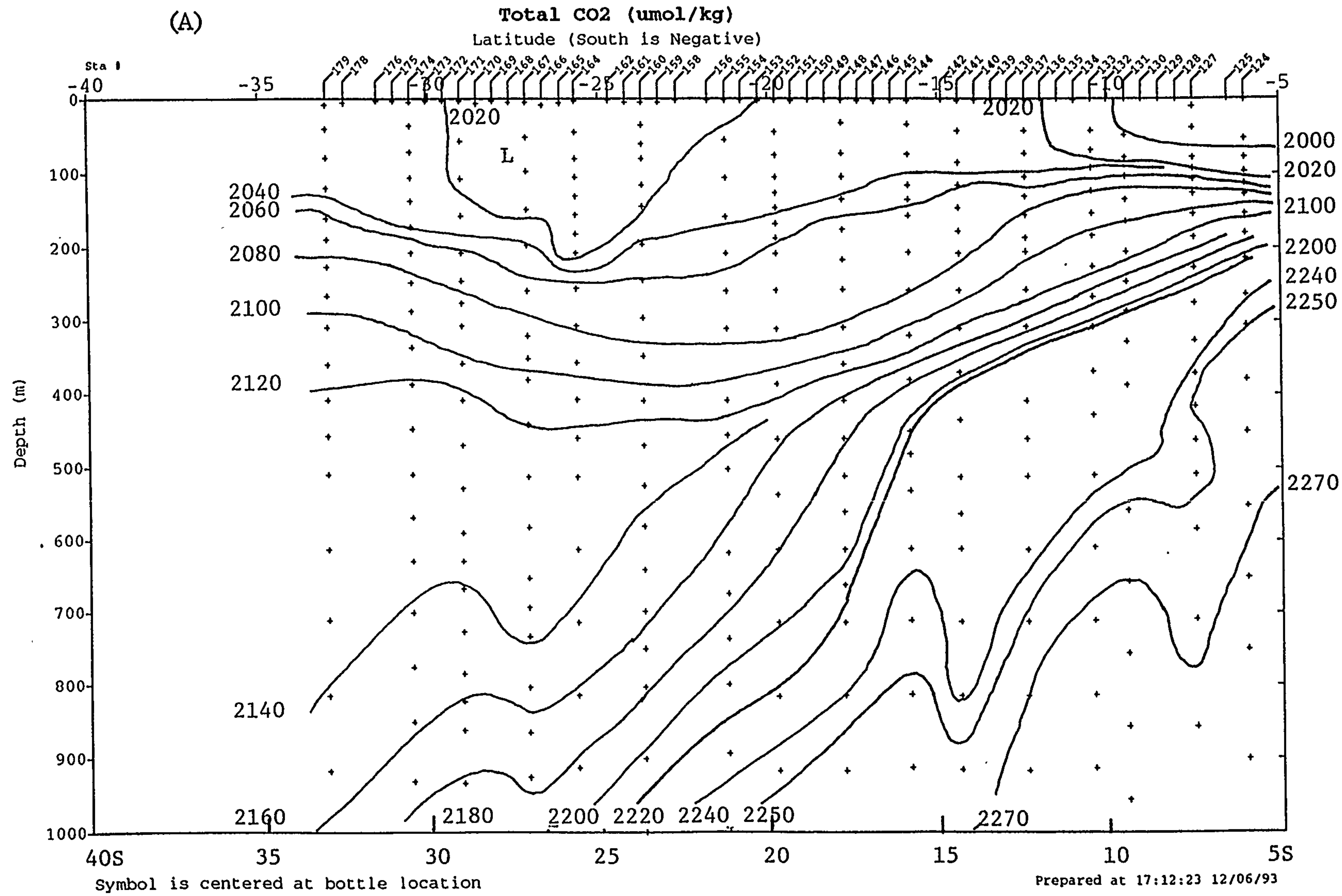
Figs. 14-A & B show the distribution along 135°W. The distribution in the upper 1000 meters was similar to that observed along 150°W. On the other hand, substantial differences were observed in waters below about 2000 meters. North of about 20°S, a tongue of the CO_2 maximum became more prominent with the maximum value reaching as high as 2339 μmol/kg at 6°S. The outline of this maximum shows clearly that it came from the North Pacific. Although a CO_2 maximum layer is observed at about 2500 meters south of about 23°S, its outline does not clearly show from which direction this feature was derived.

<u>CO_2 Partial Pressure at 20°C</u>

Figs. 15-A & B show the distribution of pCO_2 at 20°C along 150°W down to 1000 meters and to the sea floor respectively. Low pCO_2 values as low as 245 μatm (at 20°C) were found in subtropical surface waters, and they increased more rapidly with depth north of 25°S than south of it, reflecting the effect of the high pCO_2 tropical waters. Near the southern end of this section, a broad pCO_2 maximum layer with values as high as 1203 μatm was found in a depth range between 1500 and 3000 meters. Since the maximum values tend to decrease northward, this feature appears to have originated in the south. As seen in Fig. 13-B, the total CO_2 concentration is nearly constant near the depth of 2500 meters. The observed southward increase in pCO_2 indicates a southward decrease in the total alkalinity, which may be accounted for by an influx of lower alkalinity waters from the south. The pCO_2 maximum layer was not clearly defined between 32°S and 36°S. It was clearly definable north of 32°S at about 2300 meters and shallowed to about 1300 meters at the northern end of the section at 17.5°S. No meridional trend was observed along this section of the pCO_2 maximum layer. This may be attributed to the fact that the total CO_2 concentration and alkalinity decreased northward with a similar proportion. The pCO_2 maximum layer was located shallower than the total CO_2 concentration maximum layer by about 400 meters near the southern end of the section and by more than 1000 meters at the northern end of the section. Shallowing of the pCO_2 maximum

Fig. 14 - Distribution of the total CO_2 concentration in seawater along the WOCE P-17C (135°W) section: (A) the upper 1000 meters, and (B) the entire depth range. Dashed curves indicate trends of total CO_2 maxima.

(A)



(B)

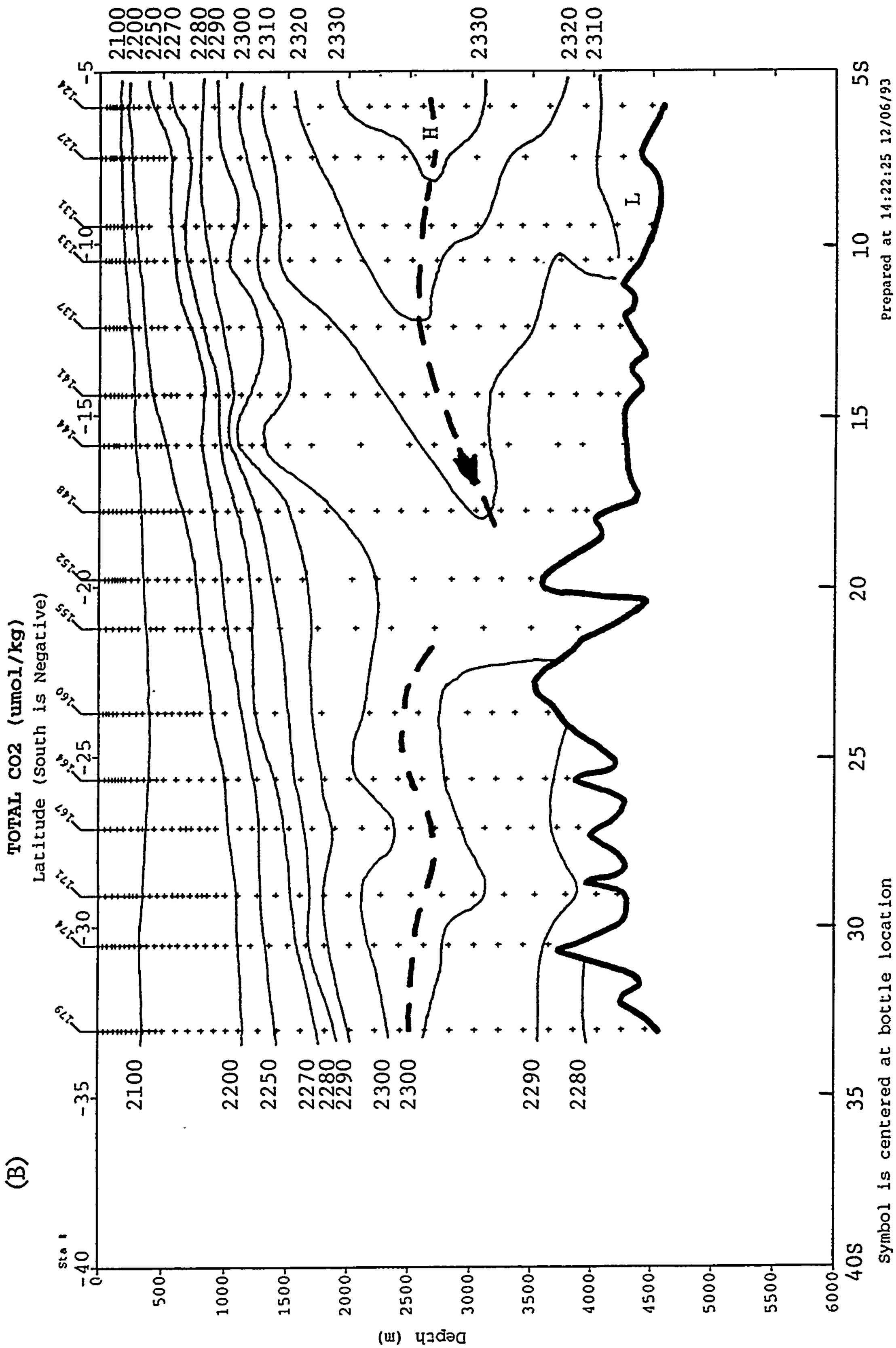
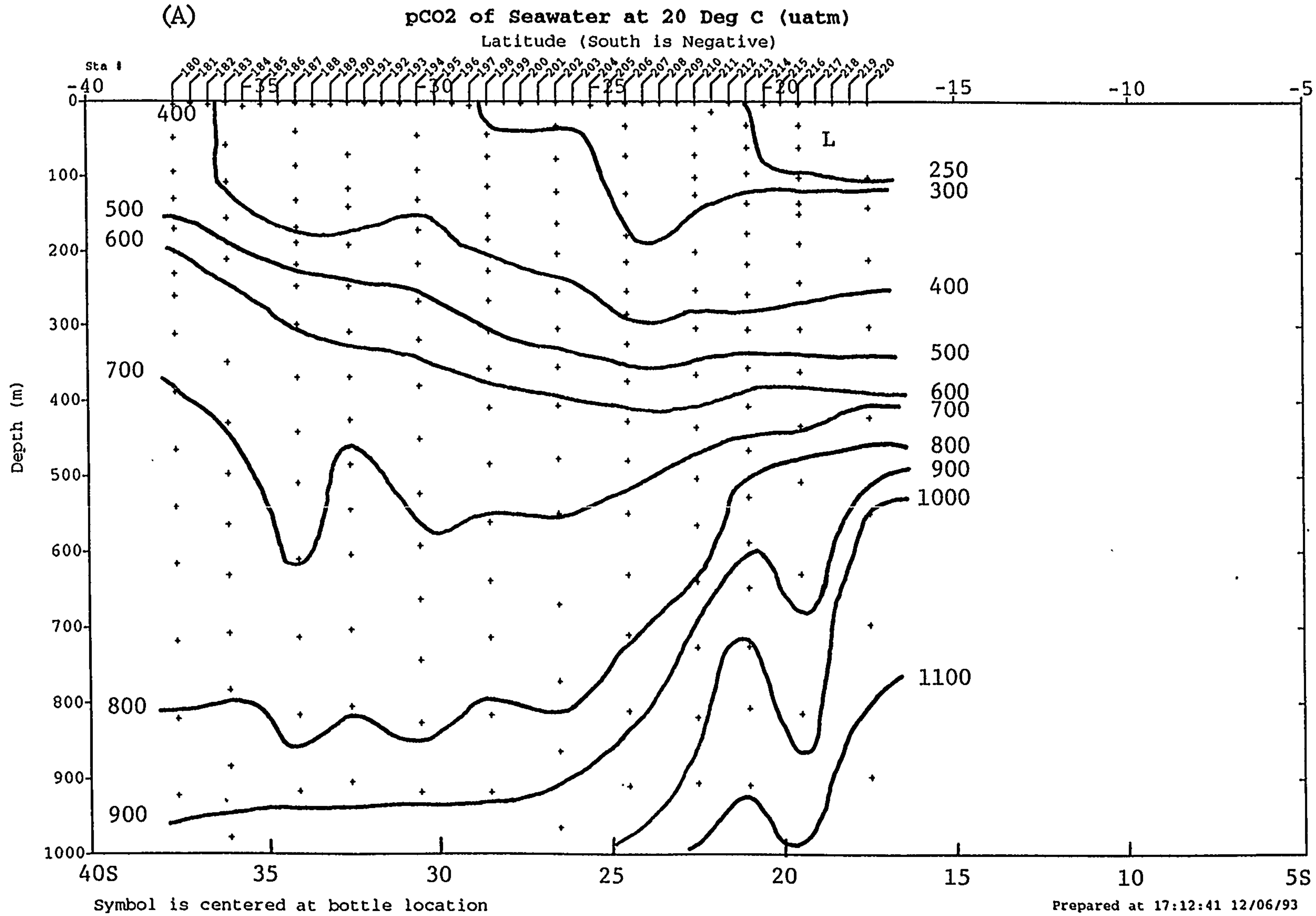
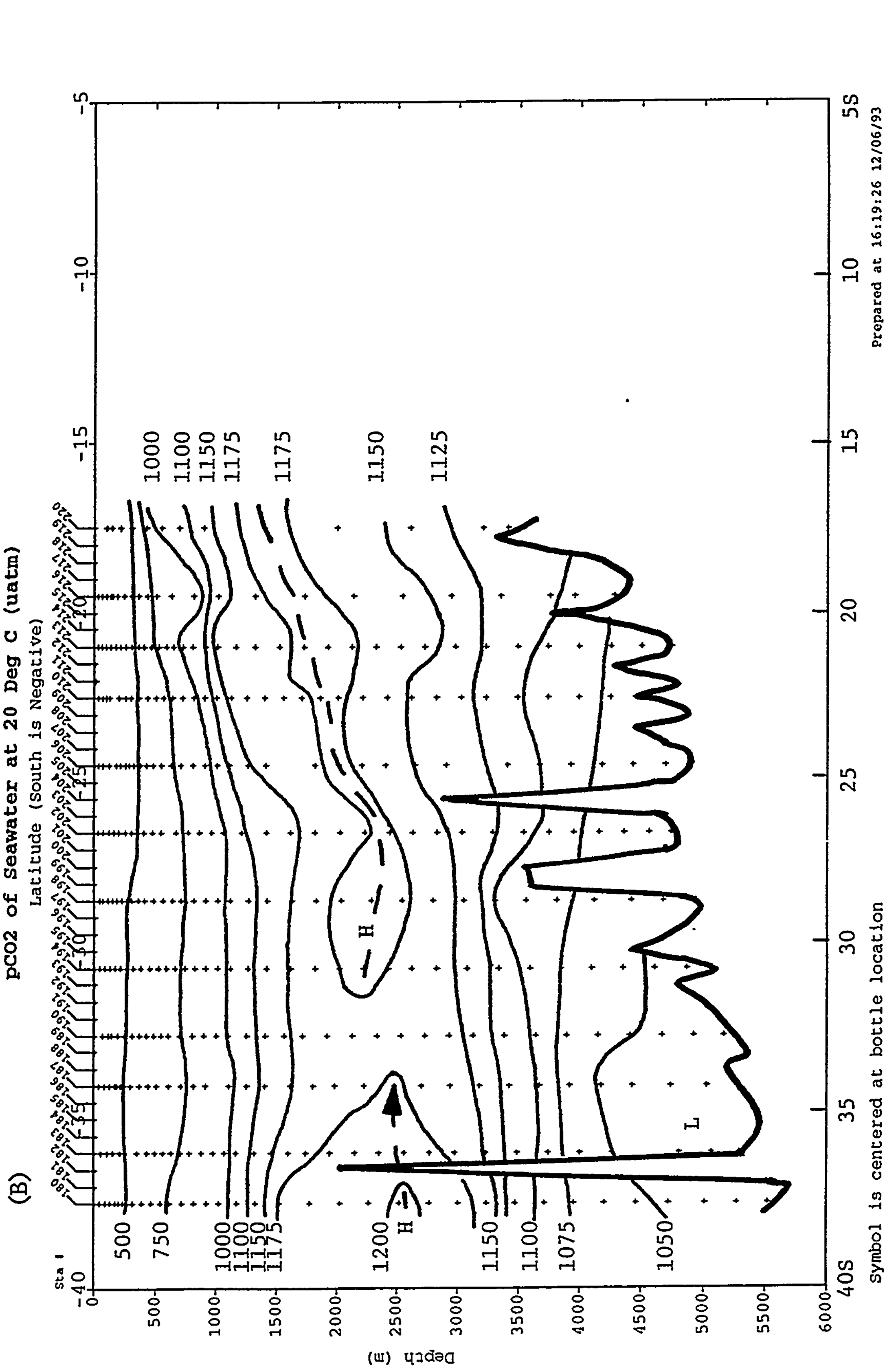

TOTAL CO2 (umol/kg)
Latitude (South is Negative)
Depth (m)
Sta #
124 127 131 133 137 141 144 148 152 155 160 164 167 171 174 179
2100 2200 2250 2270 2280 2290 2300 2310 2320 2330 2330 2320 2310
2100 2200 2250 2270 2280 2290 2300 2300 2290 2280
H
L
-5 -10 -15 -20 -25 -30 -35 -40
5S 10 15 20 25 30 35 40S
0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000
Symbol is centered at bottle location
Prepared at 14:22:25 12/06/93

Fig. 15 - Distribution of pCO_2 in seawater at 20.0°C along the WOCE P-16C (150°W) section: (A) the upper 1000 meters, and (B) the entire depth range. Dashed curves indicate trends of pCO_2 maxima.




(B)
pCO2 of Seawater at 20 Deg C (uatm)
Latitude (South is Negative)
Depth (m)
Sta #
500
750
1000
1100
1150
1175
1200
1125
1075
1050
H
L
40S
35
30
25
20
15
10
5S
Symbol is centered at bottle location
Prepared at 16:19:26 12/06/93

layer may be attributed to the effect of the overlying low oxygen water of tropical origin. Below the maximum layer; the pCO_2 values decreased with depth to 1033 and 1075 μatm respectively in the bottom waters near the southern and northern end of this section.

Figs. 16-A and -B show the distribution along 135°W. In the upper 1000 meters, a strong pCO_2 maximum (as high as 1604 μatm) was observed at about 500 meters deep near the northern end, 6°S. It deepened southward rapidly to about 1500 meters at 27°S, then to below 2000 meters near the southern end of this section.

Total Alkalinity

Figs. 17-A & B show the distribution of the total alkalinity along 150°W down to 1000 meters and to the sea floor respectively. These alkalinity values were computed using the measured values of pCO_2 and the total CO_2 concentration in seawater. Alkalinity values as high as 2392 μeq/kg were found in the warm subtropical surface waters. The alkalinity decreased with increasing depth down to a minimum layer (2290 μeq/kg) located at about 600 meters. Although this is shallower than the salinity minimum layer for the AAIW by 300 meters, this appears to be derived from the Southern Ocean. Below this, the alkalinity increased to the alkalinity maximum layer centered around 2700 meters at the northern end, where values as high as 2430 μeq/kg were observed. This layer deepened gradually to 3000 meters deep at the southern end of the section. The maximum value in this layer was found at about 30°S and decreased northward and southward away from this point. This appears to represent high alkalinity North Pacific water flowing across the meridional section. Below this maximum layer, the alkalinity decreased gradually to 2375 and 2900 μeq/kg near the sea floor respectively at the southern and north ends of the section.

Figs. 18-A & B show the sections along 135°W. In the upper 1000 meters, an alkalinity minimum layer was observed between 300 meters near the northern end and 600 meters near the southern end of the section. The magnitude of this alkalinity minimum layer is similar to that observed along 150°W. Below these depths, the alkalinity increased with depth to the alkalinity maximum layer which was centered at 2600 meters near the northern end of the section. Since the intensity of the maximum layer decreases southward, this layer is considered to represent the North Pacific water spreading southward. However, south of about 25°S, the maximum layer became more diffuse and the trend could not be clearly defined, suggesting a greater degree of mixing with southern waters. This feature is consistent with that observed with the total CO_2 concentration in Fig. 14-B.

Dissolved Oxygen

Figs. 19-A & B show the distribution of the oxygen concentration dissolved in seawater along 150°W down to 1000 meters and to the sea floor respectively. Two oxygen minimum layers were found: the upper layer was located at about 250 meters deep while the deeper layer was at about 1500 meters at the northern end of the section at 17.5°S and deepened to about 2500 meters at about 30°S. Both of these layers appear to have originated from the eastern tropical Pacific. Between these two layers, an oxygen maximum layer is found at a depth of about 600 meters. This appears to be derived from the Southern Ocean. Below the deep oxygen minimum layer, the oxygen concentration increased with depth of water to about 205 µmol/kg, indicating that younger abyssal waters originated in the Southern Ocean were entering from the southern end of this section.

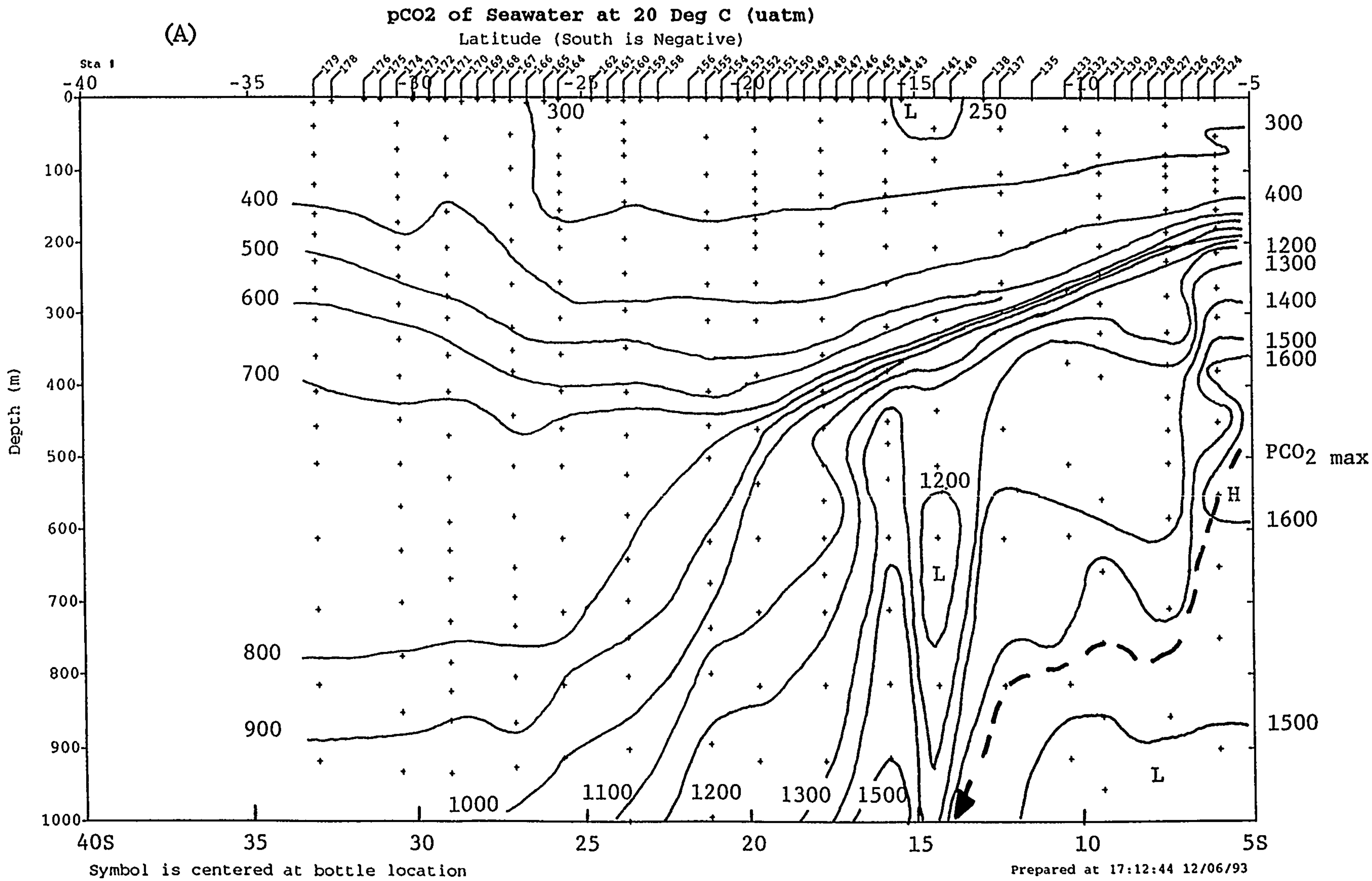
Figs. 20-A & B show the distribution along 135°W. Similar to the 150°W section, two oxygen minimum layers and one oxygen maximum layer between these two were observed. Since the observations were made further north to 6°S along this section, much lower oxygen values, as low as 20 µmol/kg, were observed in the upper oxygen minimum layer at about 300 meters deep. The deeper oxygen minimum layer was observed from 350 meters near the northern end to about 2000 meters near the southern end of the section. The oxygen concentrations observed in the oxygen maximum layer in the 135°W section were similar to those found in the 150°W section.

Apparent Oxygen Utilization

Figs. 21-A & B show the distribution of AOU along 150°W down to 1000 meters and to the sea floor respectively. South of about 23°S, the AOU values remained nearly constant at 60 ± 20 over a depth range between 300 and 800 meters. This broad area corresponds to that ventilated by the high oxygen Southern Ocean water. Below this layer, the AOU increased with depth to an AOU maximum layer at about 2750 meters deep at the southern end of the section. This layer shoaled gradually to about 1750 meters at the northern end. In the AOU maximum layer, about 50% of the original oxygen concentration was consumed. Its position

Fig. 16 - Distribution of pCO_2 in seawater at 20.0°C along the WOCE P-17C (135°W) section: (A) the upper 1000 meters, and (B) the entire depth range. Dashed curves indicate trends of pCO_2 maxima.

(A)



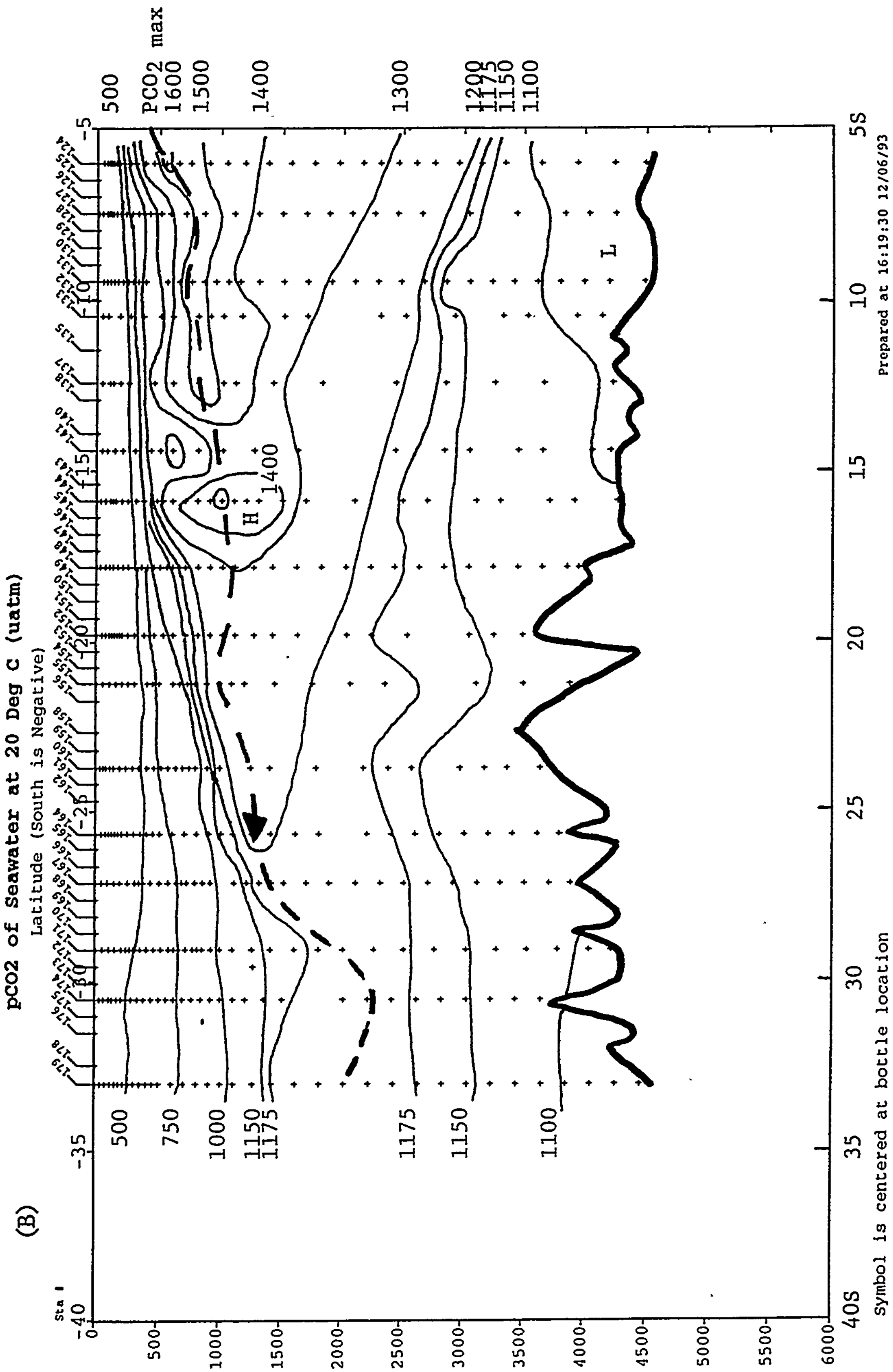
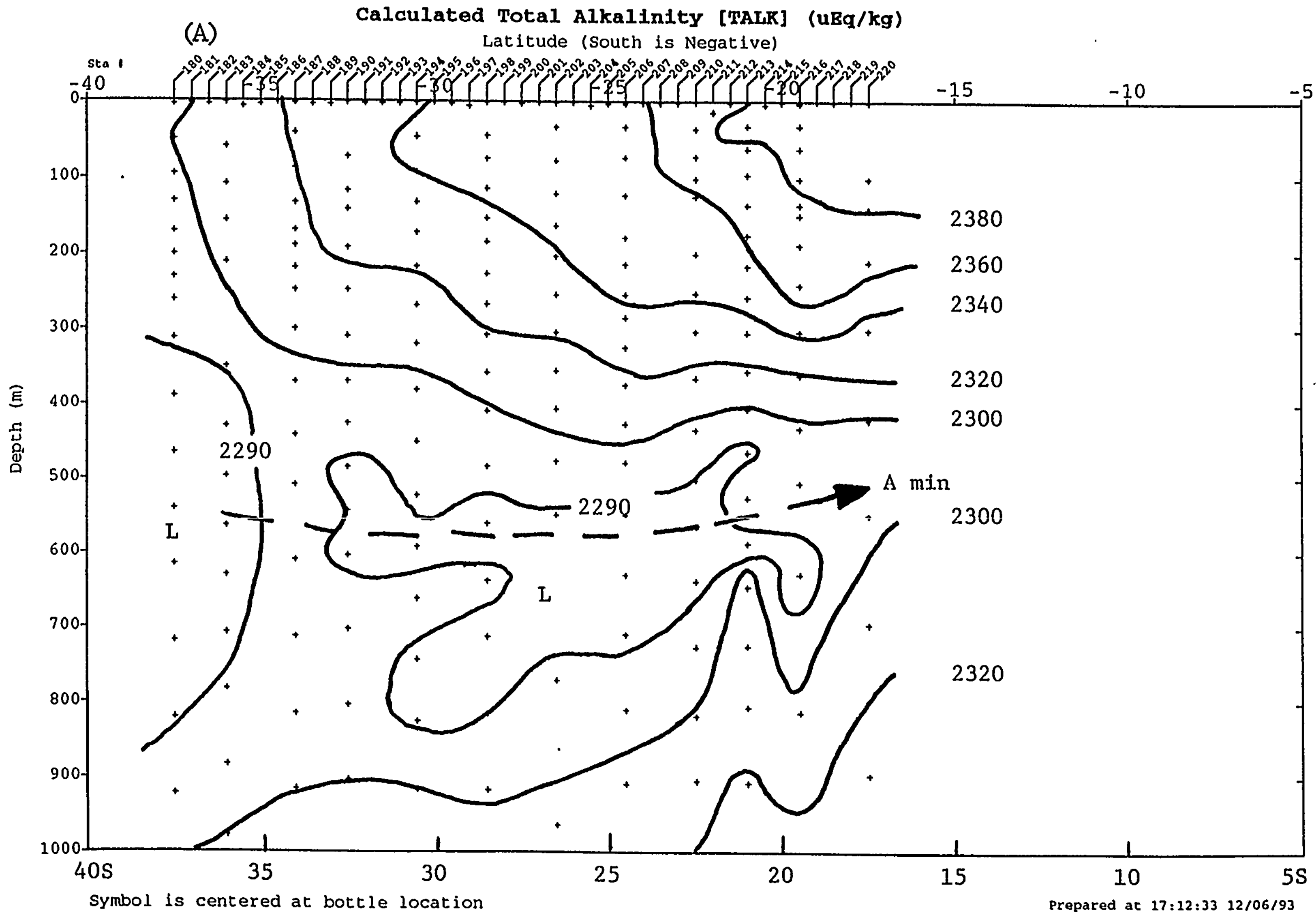

(B)
pCO2 of Seawater at 20 Deg C (uatm)
Latitude (South is Negative)
PCO2 max
H
L
Sta #
Depth (m)
Symbol is centered at bottle location
Prepared at 16:19:30 12/06/93

Fig. 17 - Distribution of alkalinity in seawater along the WOCE P-16C (150°W) section: (A) the upper 1000 meters, and (B) the entire depth range. Dashed curves indicate trends of alkalinity maxima or minima.



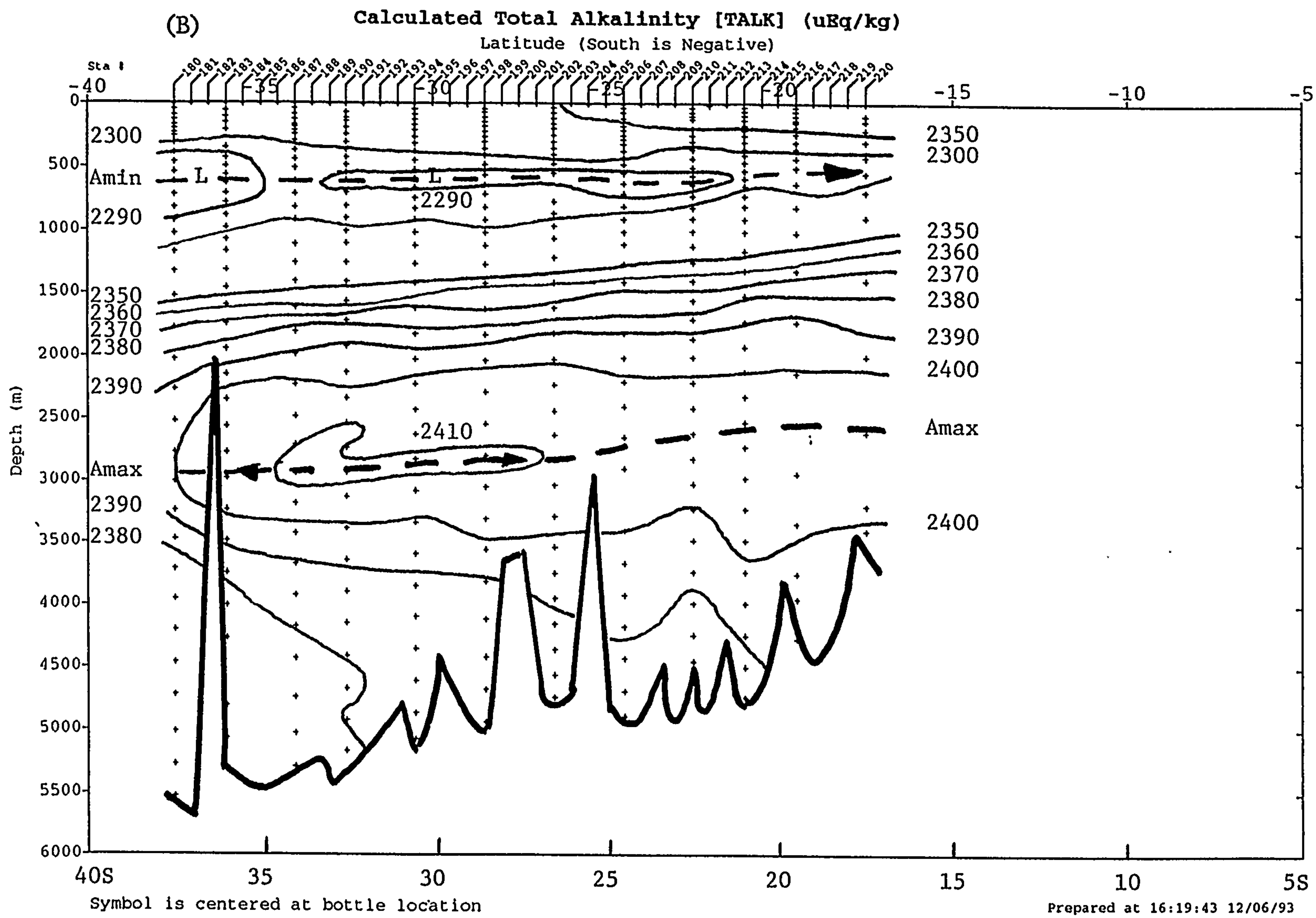
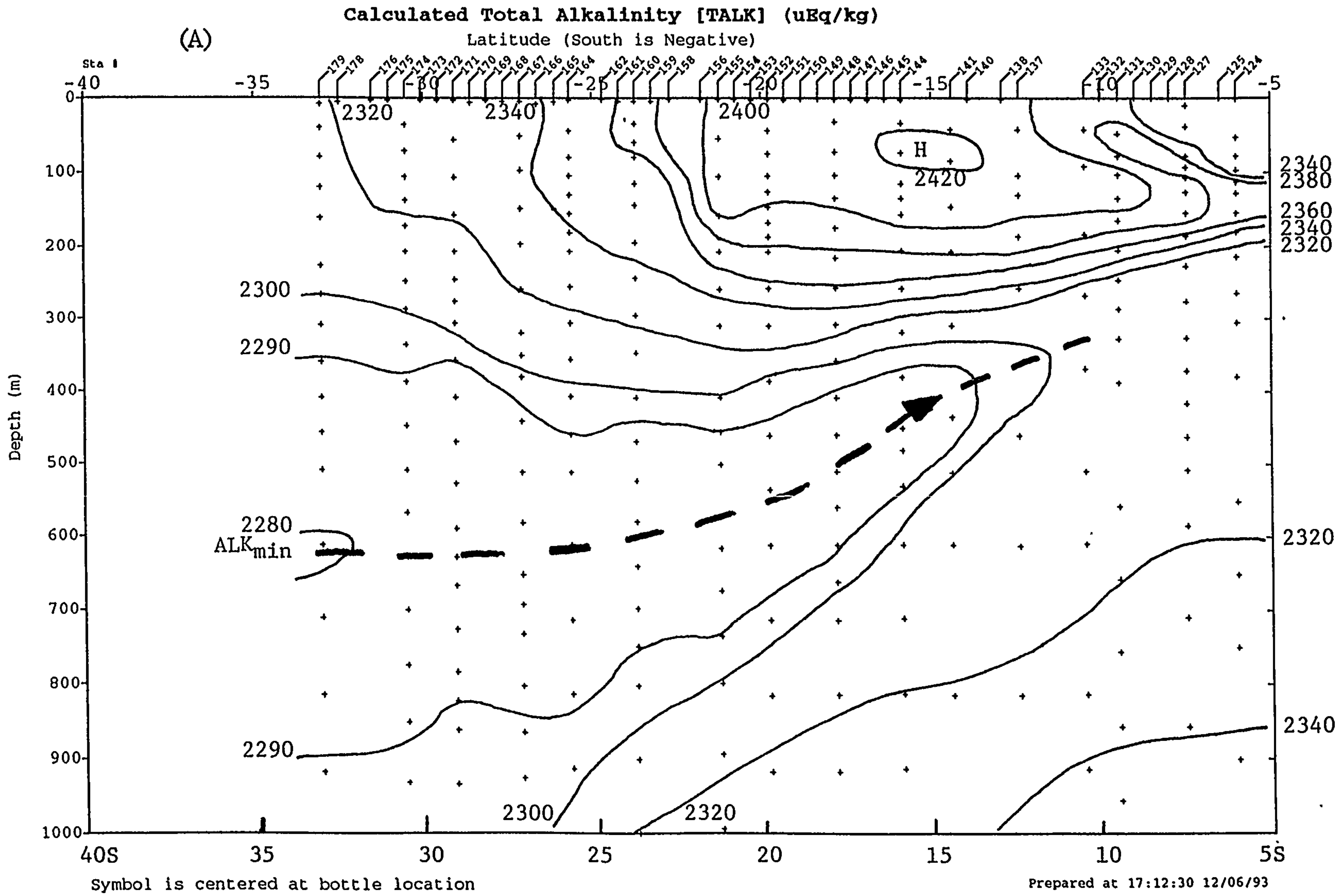

(B)
Calculated Total Alkalinity [TALK] (uEq/kg)
Latitude (South is Negative)
Sta #
Depth (m)
2300
Amin
2290
2350
2360
2370
2380
2390
2410
Amax
2400
L
Symbol is centered at bottle location
Prepared at 16:19:43 12/06/93

Fig. 18 - Distribution of alkalinity in seawater along the WOCE P-17C (135°W) section: (A) the upper 1000 meters, and (B) the entire depth range. Dashed curves indicate trends of alkalinity maxima or minima with water depth.

(A)



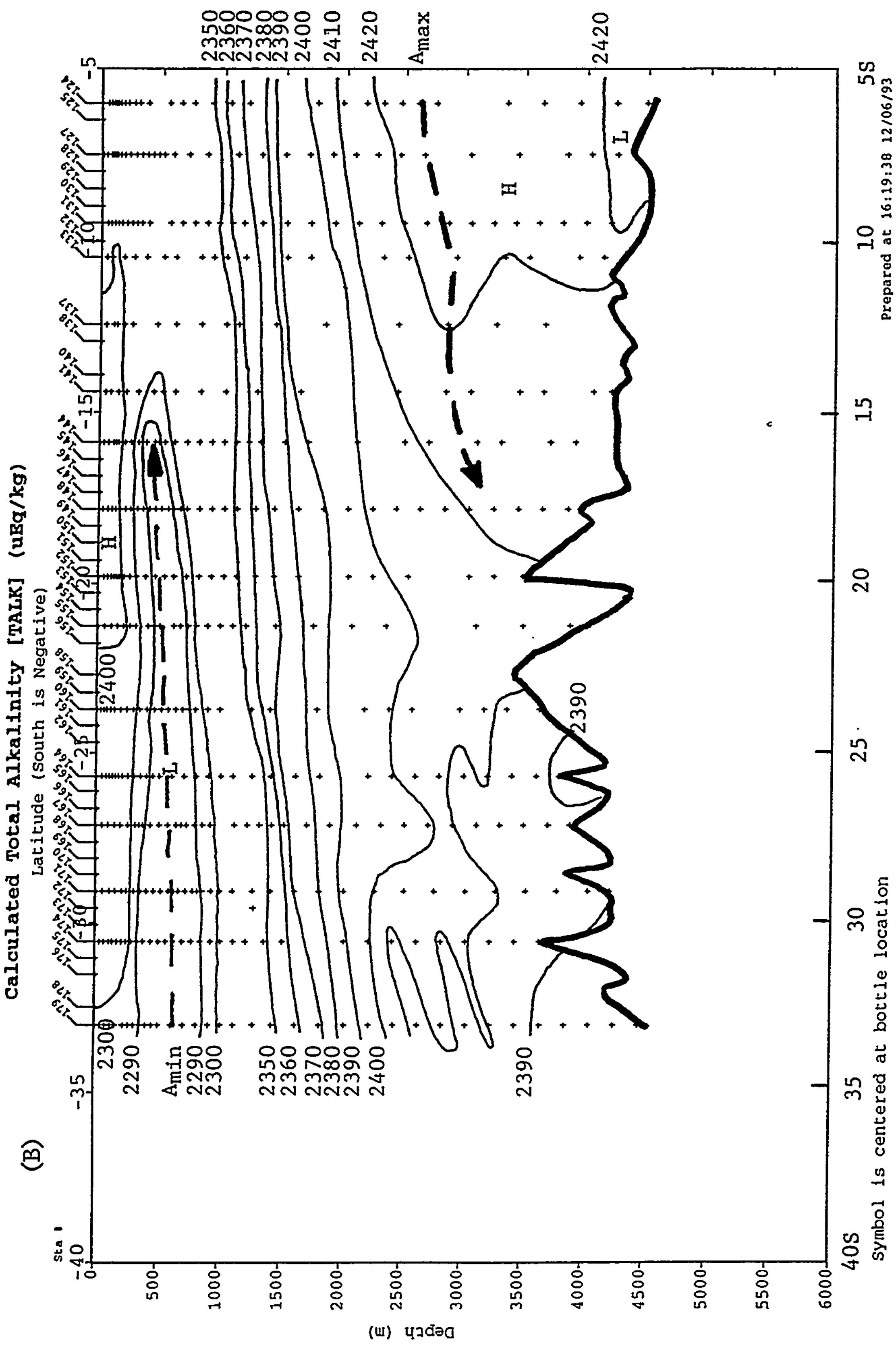
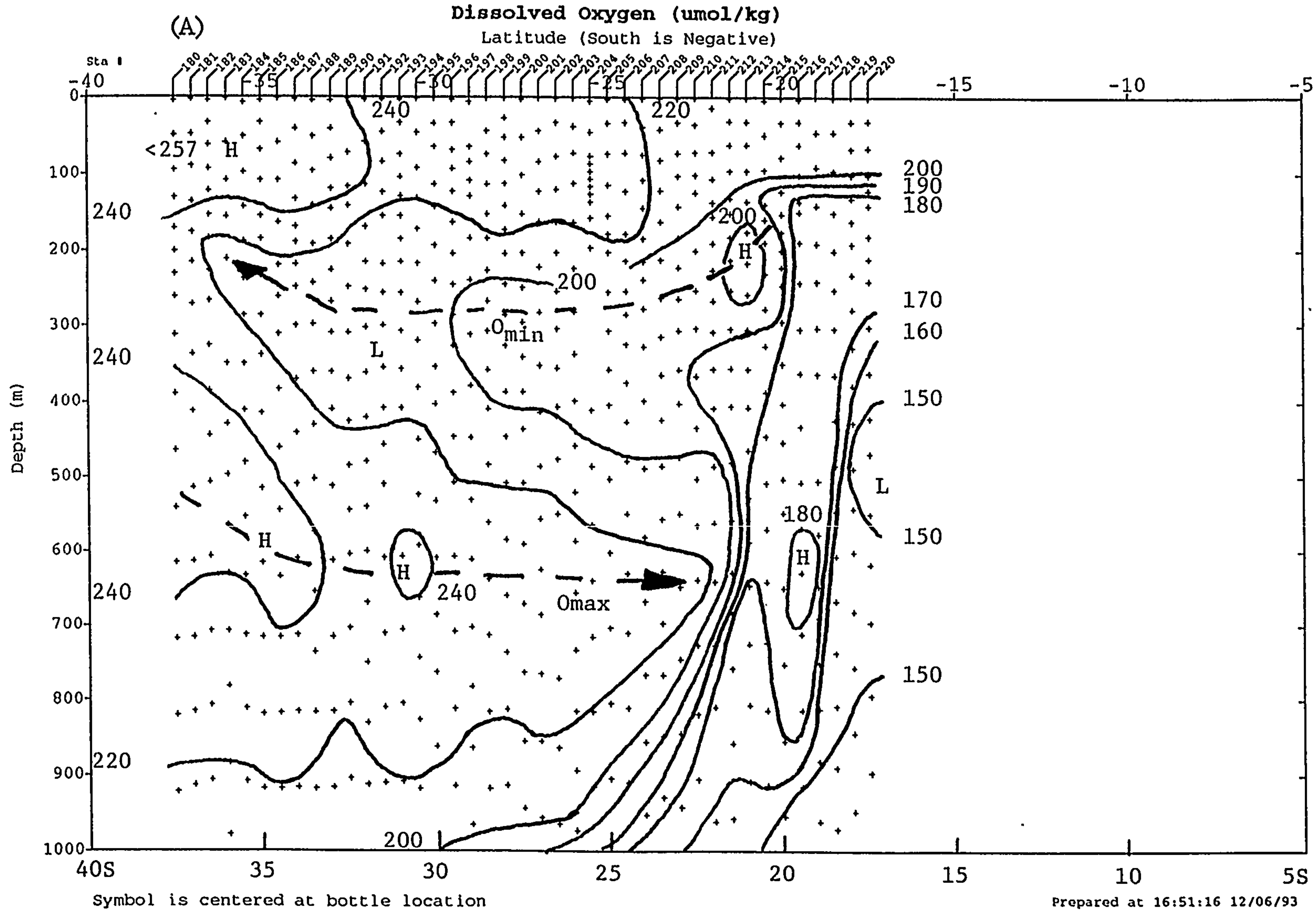

(B)
Calculated Total Alkalinity [TALK] (uEq/kg)
Latitude (South is Negative)
Depth (m)
Sta #
Symbol is centered at bottle location
Prepared at 16:19:38 12/06/93
Amin
Amax
H
L
2290
2300
2350
2360
2370
2380
2390
2400
2410
2420
40S
35
30
25
20
15
10
5S

Fig. 19 - Distribution of O_2 dissolved in seawater along the WOCE P-16C (150°W) section: (A) the upper 1000 meters, and (B) the entire depth range. Dashed curves indicate trends of O_2 maxima or minima.

(A)



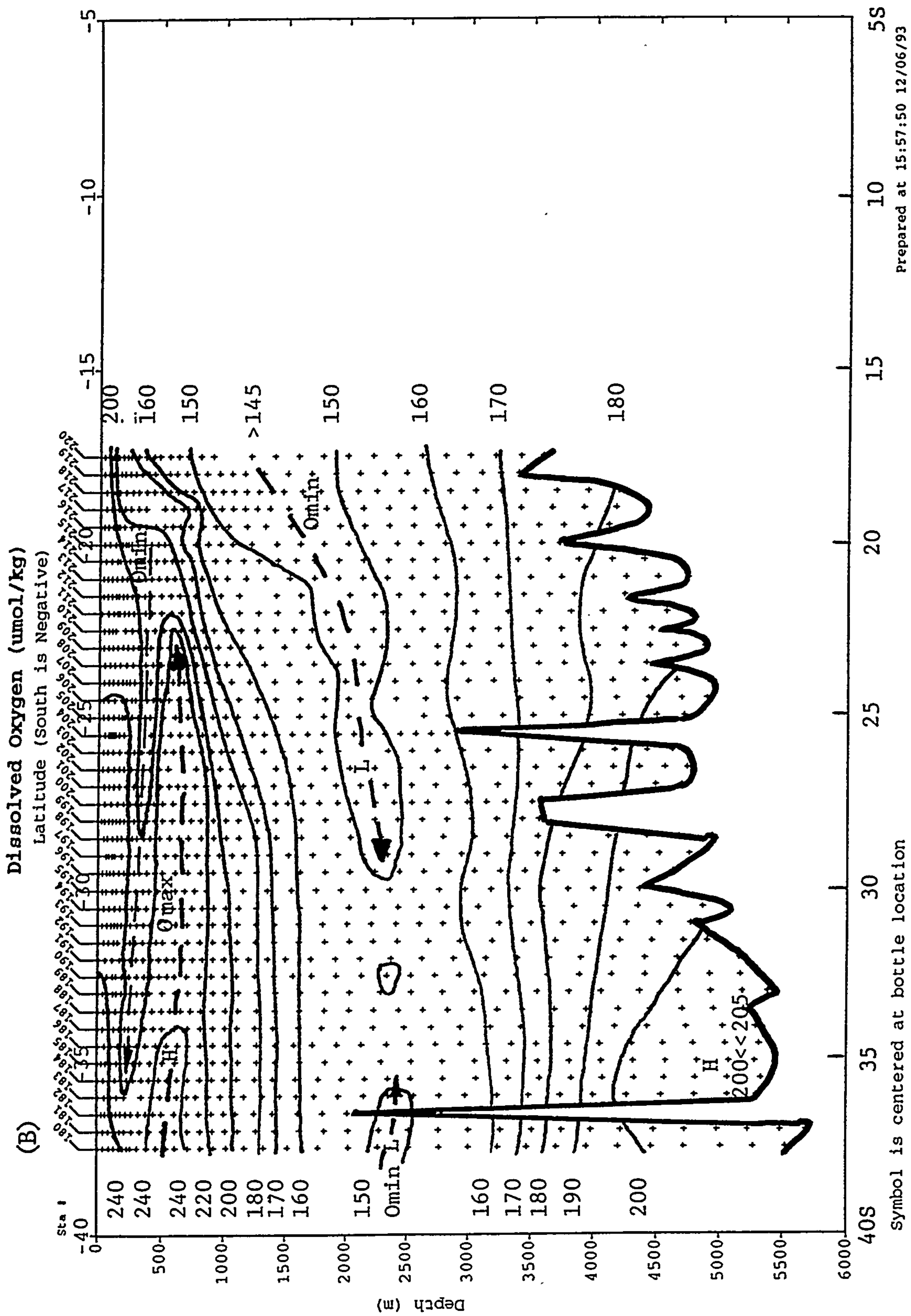
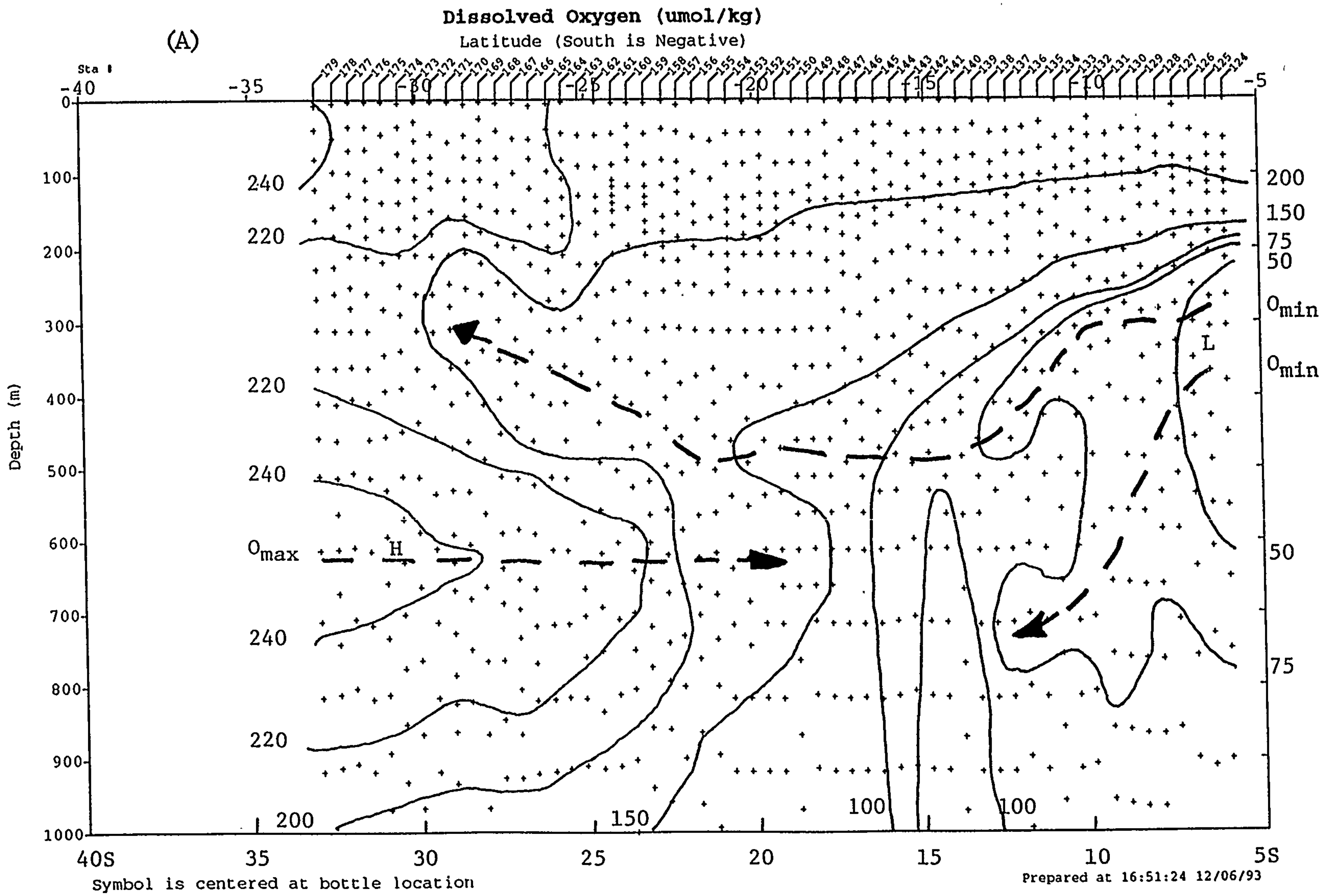

(B)
Dissolved Oxygen (umol/kg)
Latitude (South is Negative)
Depth (m)
Omax
Omin
H
L
200<<205
>145
Symbol is centered at bottle location
Prepared at 15:57:50 12/06/93

Fig. 20 - Distribution of O_2 dissolved in seawater along the WOCE P-17C (135°W) section: (A) the upper 1000 meters, and (B) the entire depth range. Dashed curves indicate trends of O_2 maxima or minima.



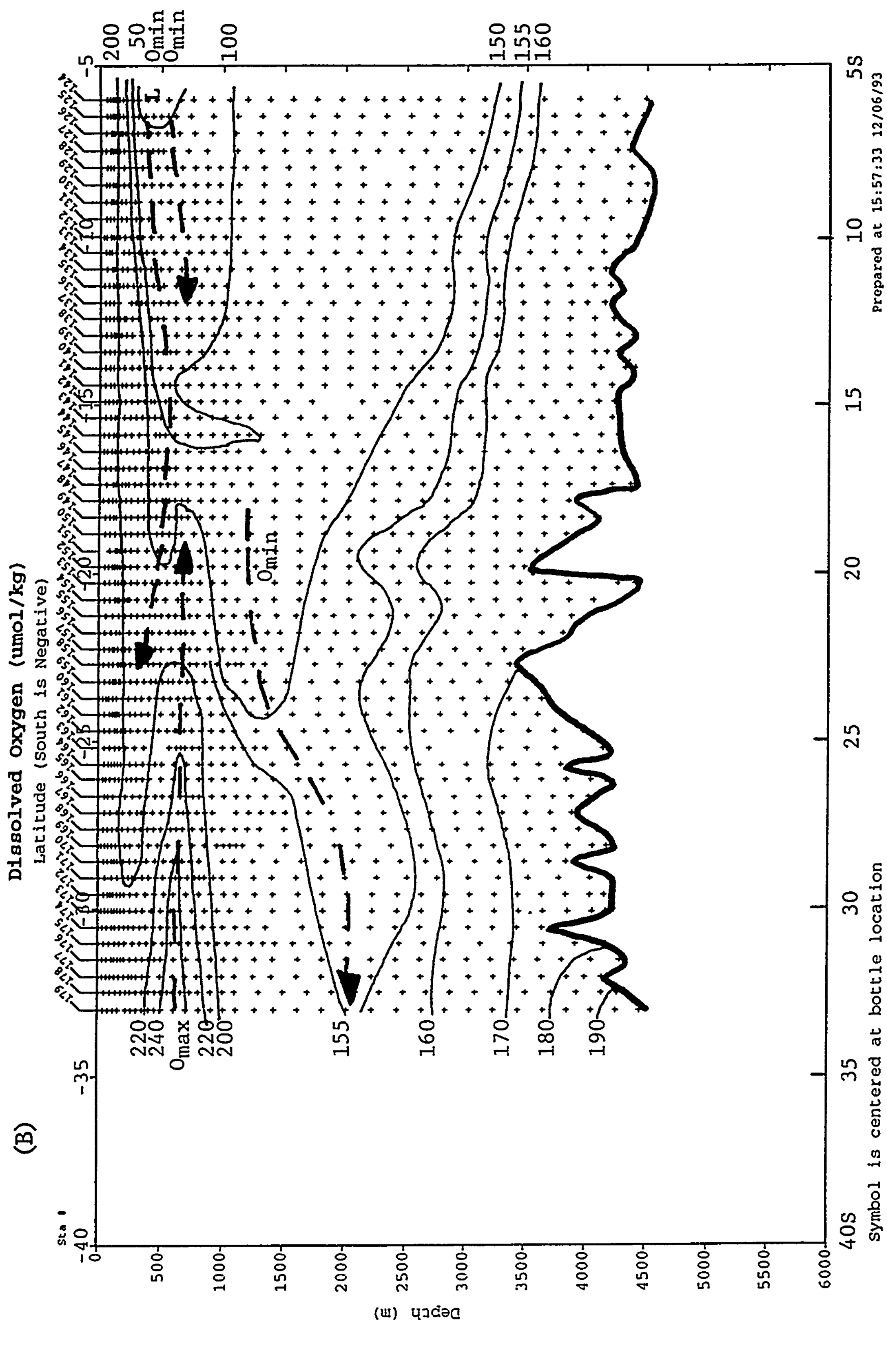
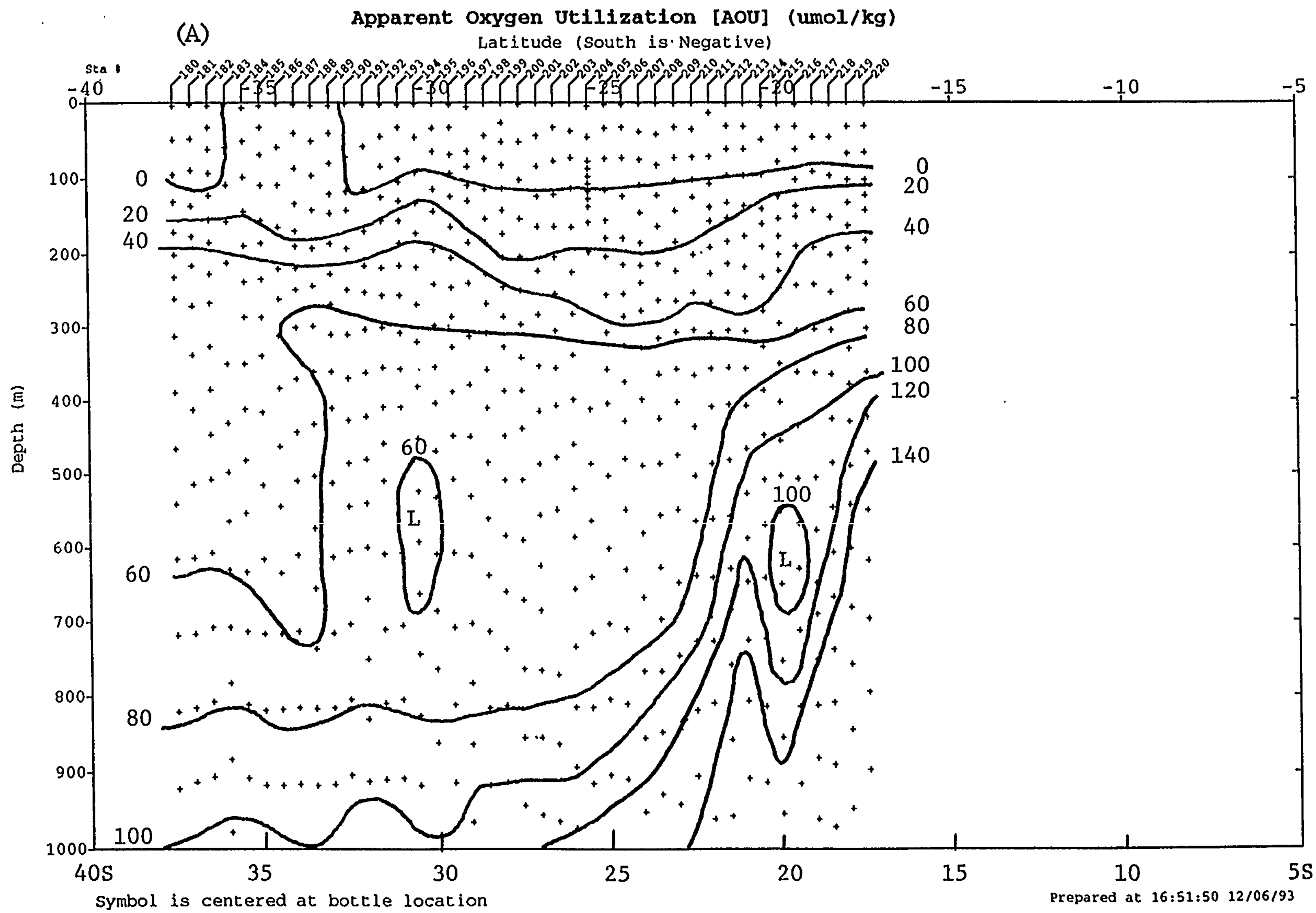

(B)
Dissolved Oxygen (umol/kg)
Latitude (South is Negative)
Depth (m)
Symbol is centered at bottle location
Prepared at 15:57:33 12/06/93

Fig. 21 - Distribution of the apparent oxygen utilization (AOU) in seawater along the WOCE P-16C (150°W) section: (A) the upper 1000 meters, and (B) the entire depth range. Dashed curves indicate trends of AOU maxima.

(A)



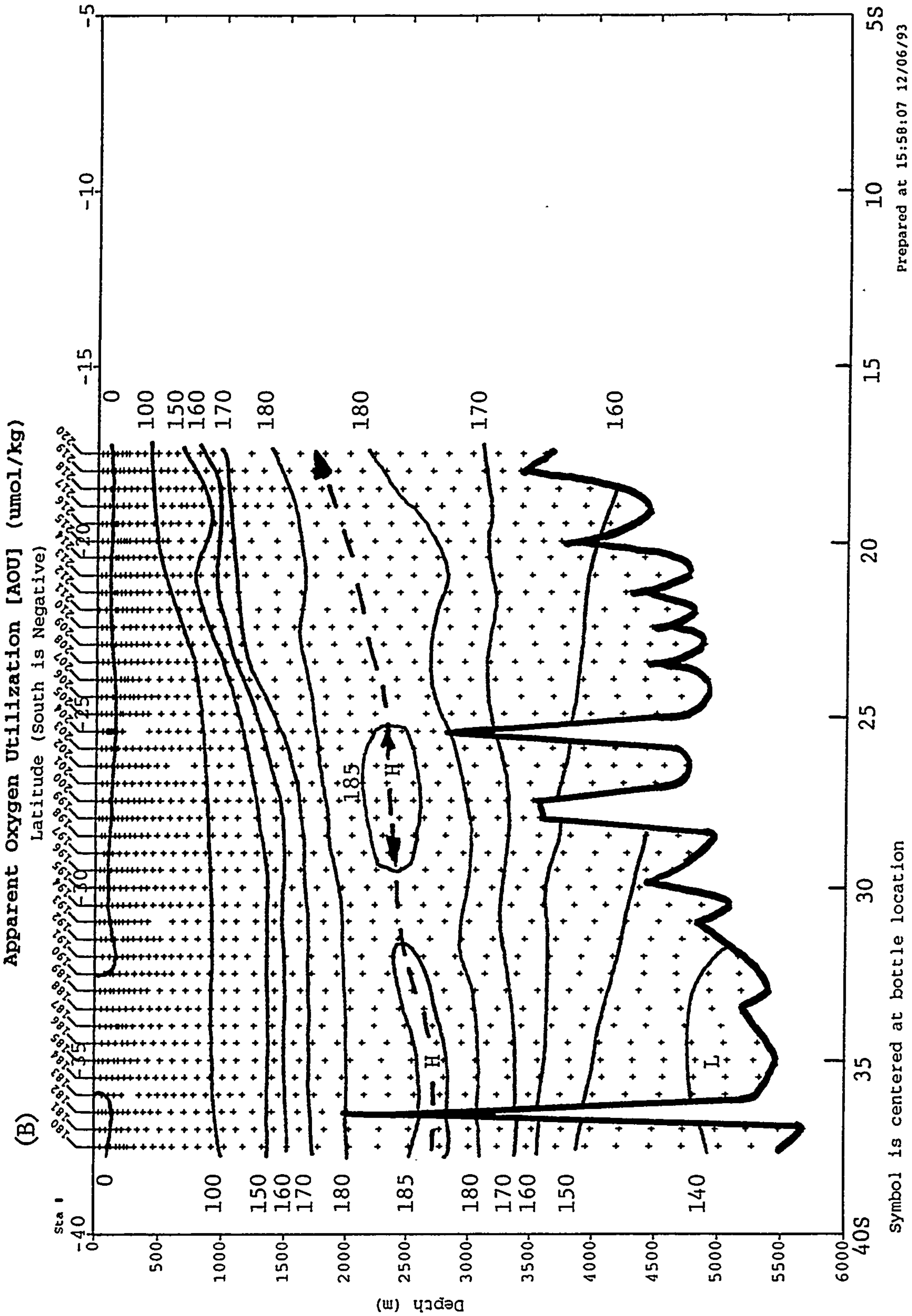
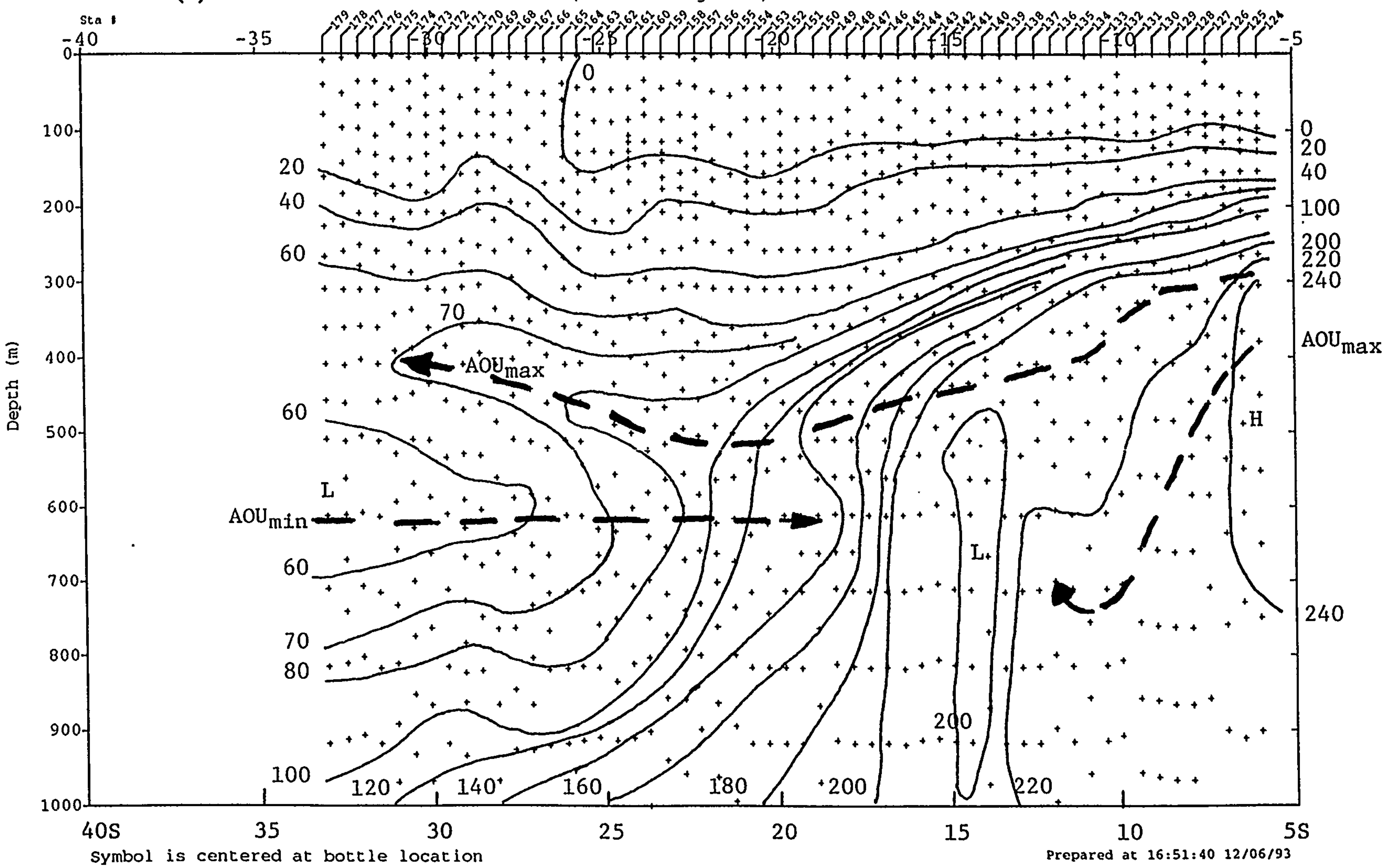

(B)
Apparent Oxygen Utilization [AOU] (umol/kg)
Latitude (South is Negative)
Depth (m)
Sta #
-40
-35
-30
-25
-20
-15
-10
-5
40S
35
30
25
20
15
10
5S
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
0
100
150
160
170
180
185
140
H
L
Symbol is centered at bottle location
Prepared at 15:58:07 12/06/93

Fig. 22 - Distribution of the apparent oxygen utilization (AOU) in seawater along the WOCE P-17C (135°W) section: (A) the upper 1000 meters, and (B) the entire depth range. Dashed curves indicate trends of AOU maxima or minima with water depth.

(A)



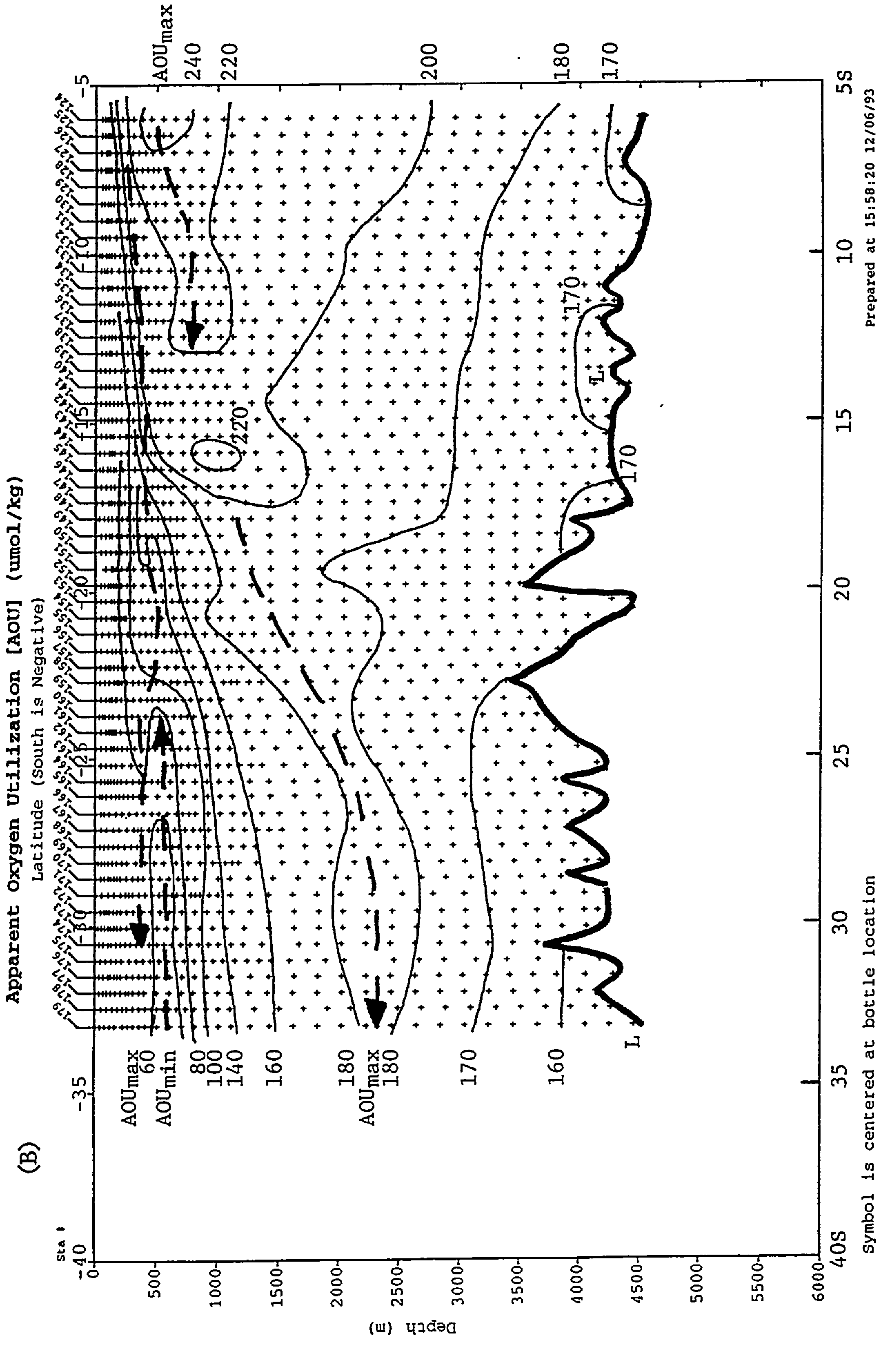
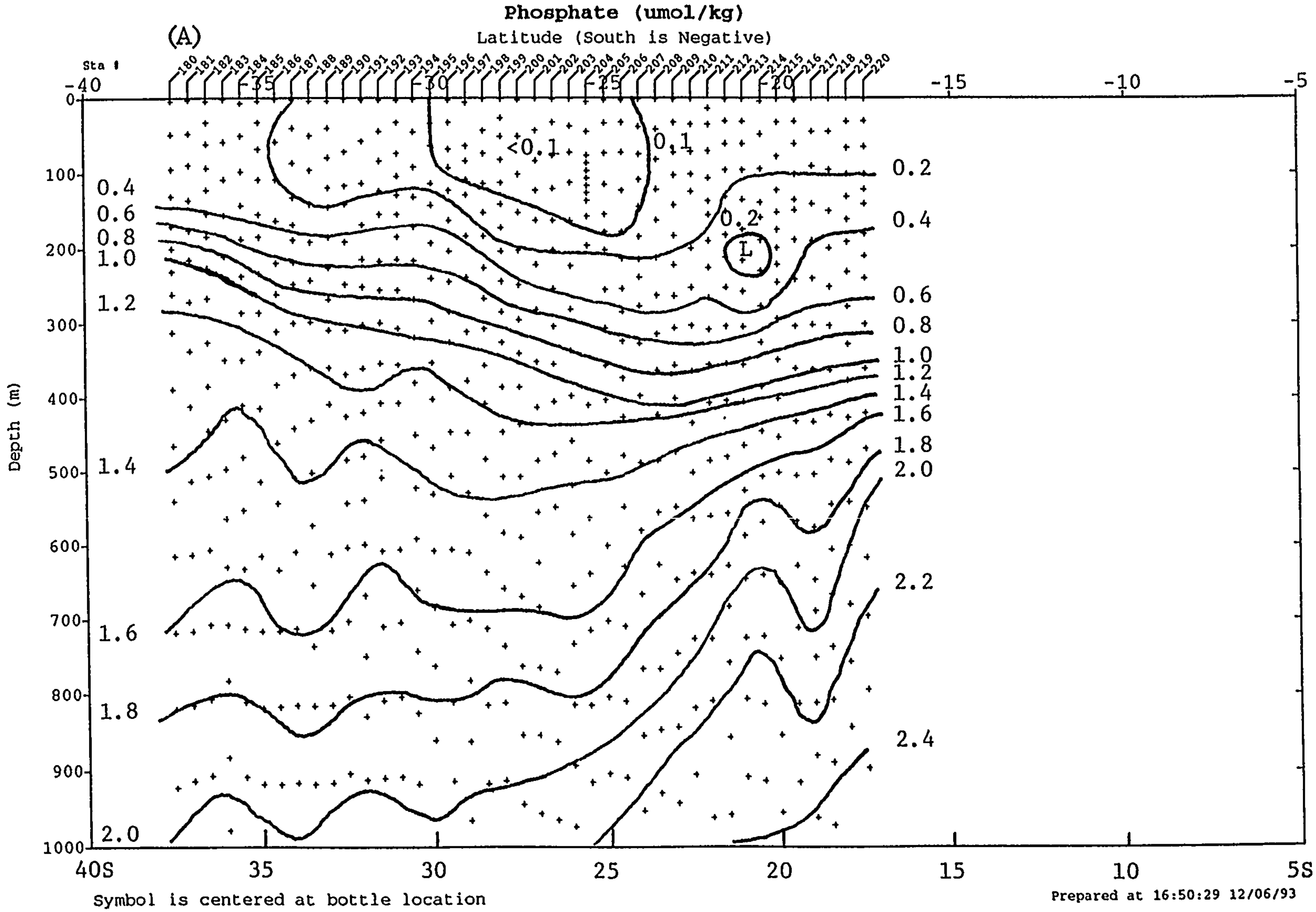

(B)
Apparent Oxygen Utilization [AOU] (umol/kg)
Latitude (South is Negative)
Depth (m)
Symbol is centered at bottle location
Prepared at 15:58:20 12/06/93
AOUmax
AOUmin
L

Fig. 23 - Distribution of phosphate dissolved in seawater along the WOCE P-16C (150°W) section: (A) the upper 1000 meters, and (B) the entire depth range. Dashed curves indicate trends of phosphate maxima.



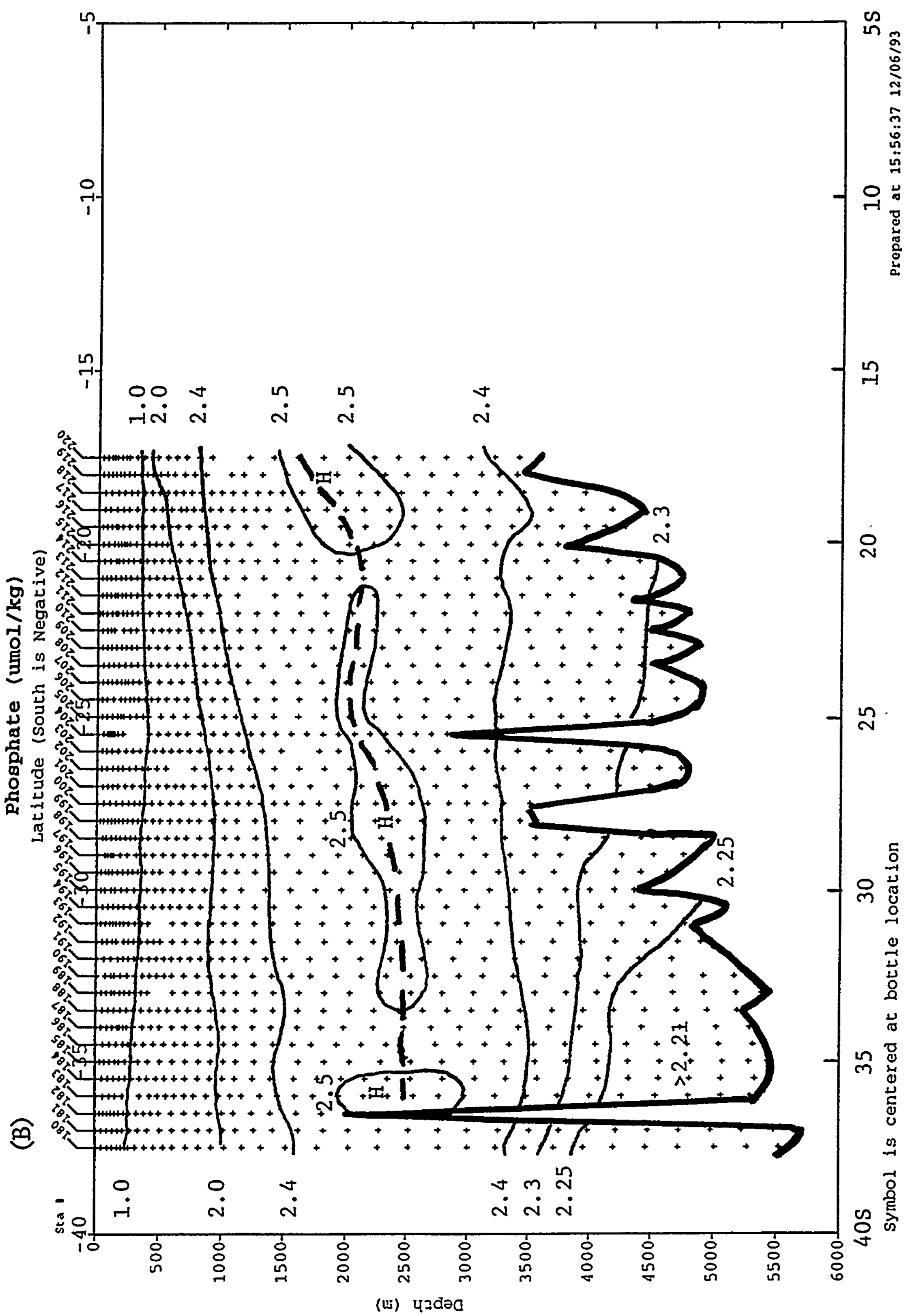
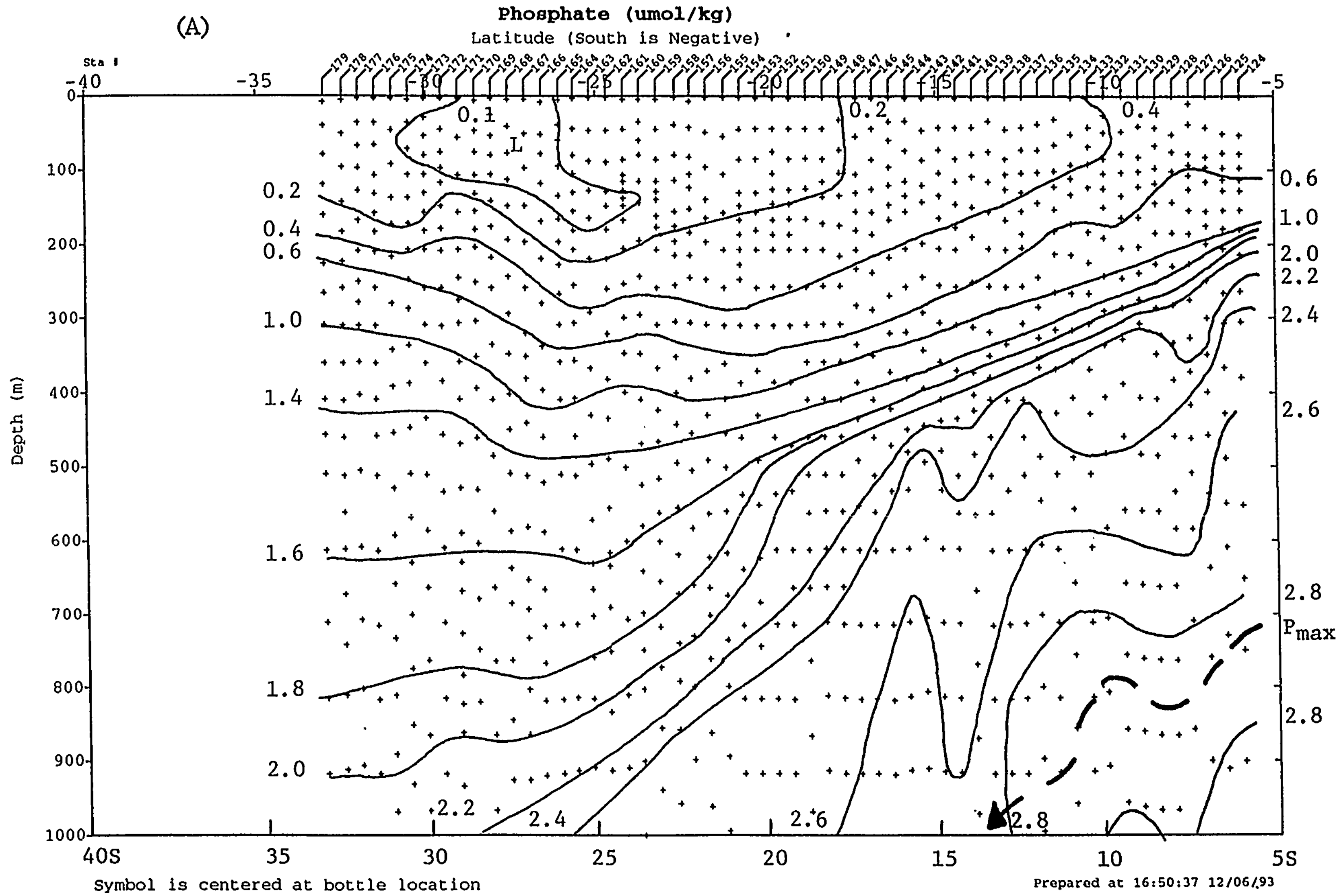
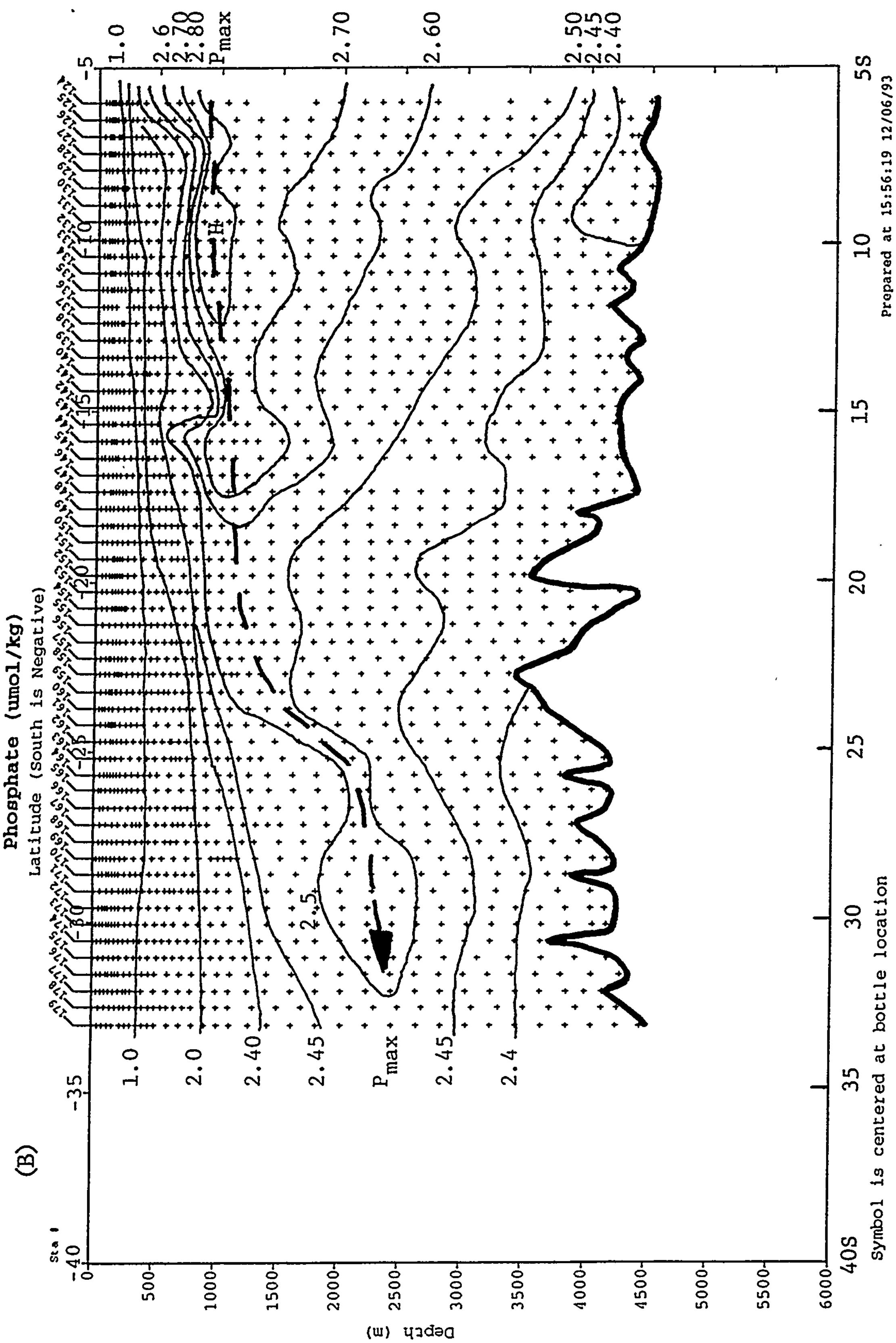

(B)
Phosphate (umol/kg)
Latitude (South is Negative)
Depth (m)
Symbol is centered at bottle location
Prepared at 15:56:37 12/06/93

Fig. 24 - Distribution of phosphate dissolved in seawater along the WOCE P-17C (135°W) section: (A) the upper 1000 meters, and (B) the entire depth range. Dashed curves indicate trends of phosphate maxima.

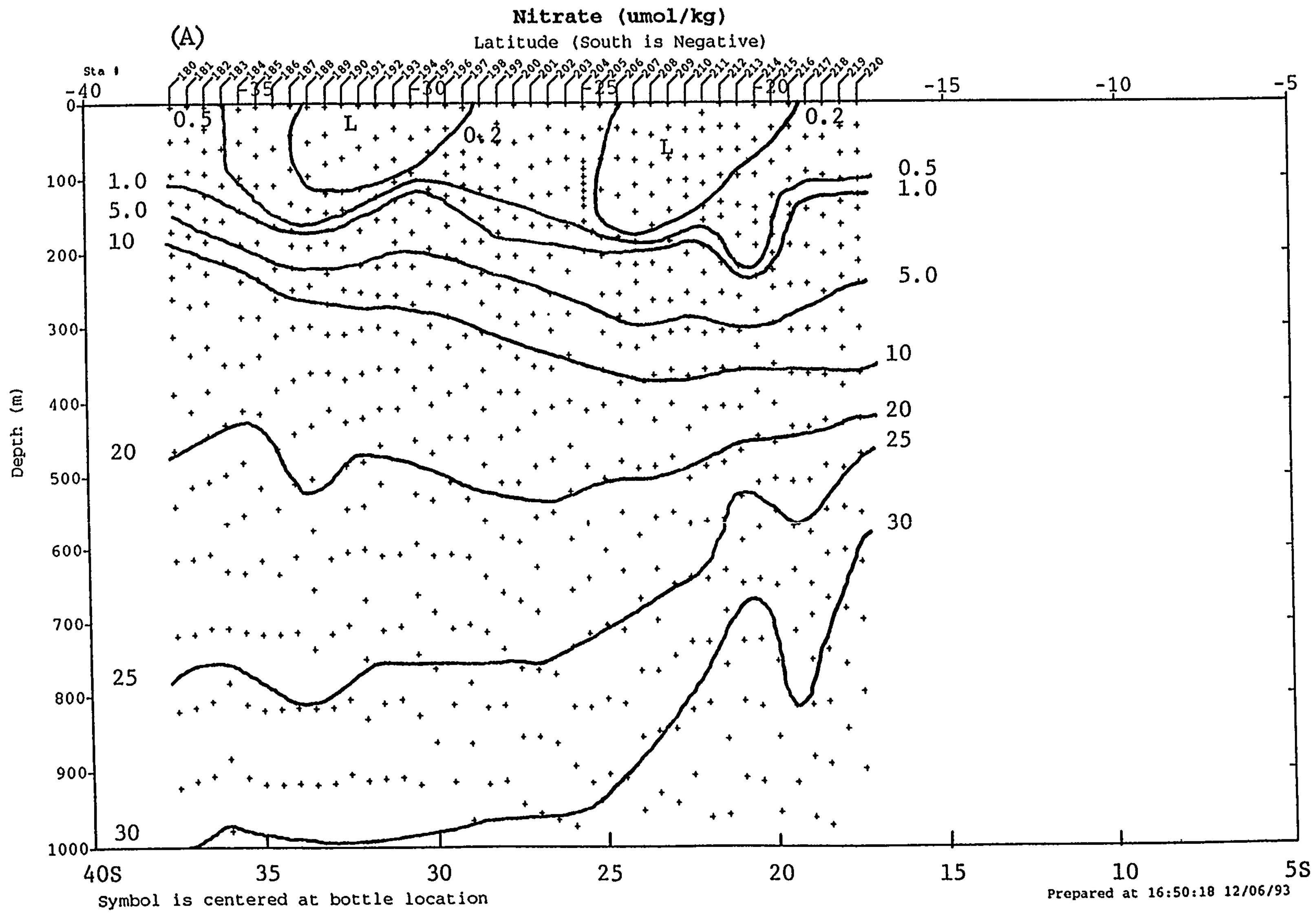
(A)

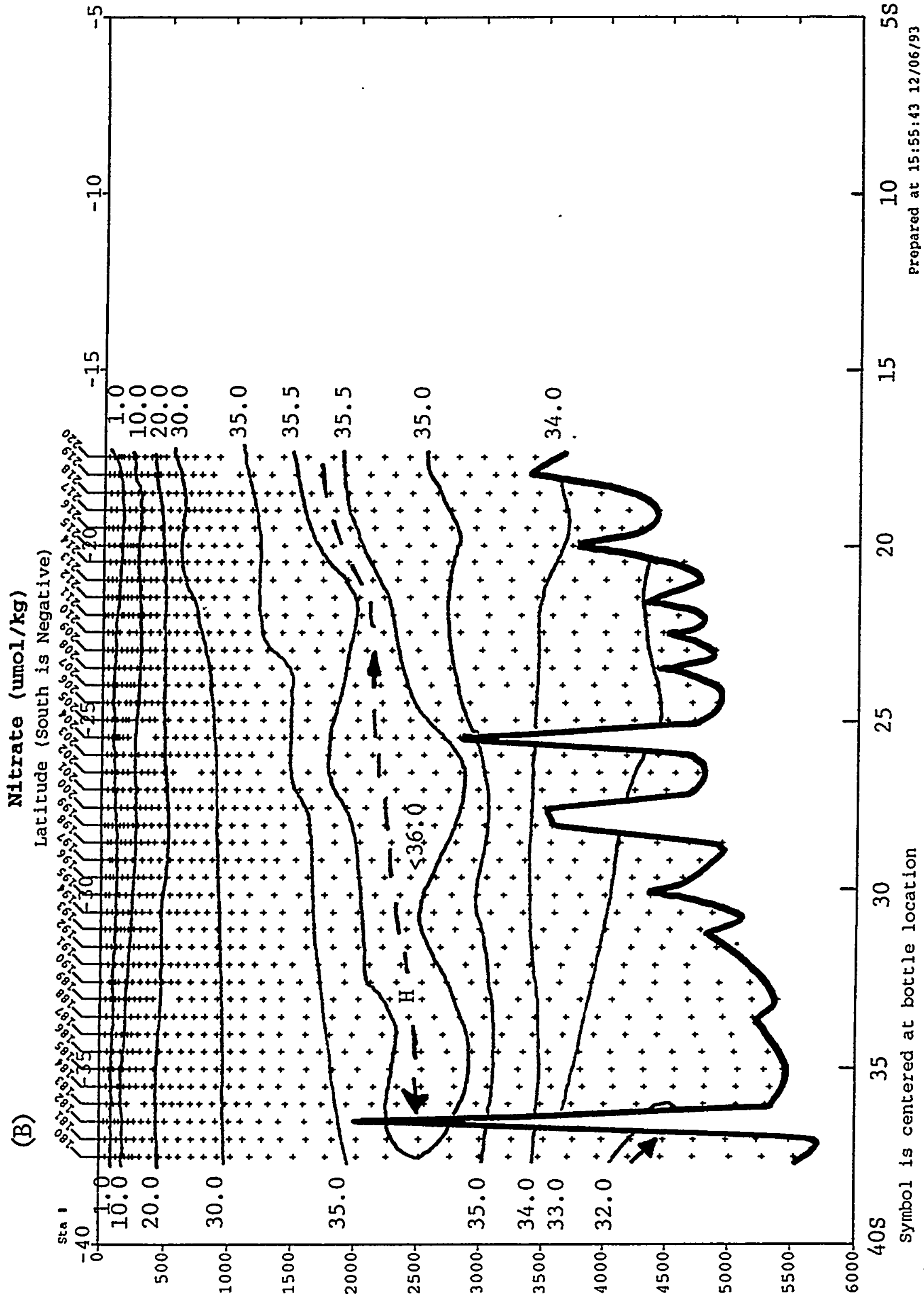




(B)
Phosphate (umol/kg)
Latitude (South is Negative)
Depth (m)
Sta #
P max
Symbol is centered at bottle location
Prepared at 15:56:19 12/06/93

Fig. 25 - Distribution of nitrate dissolved in seawater along the WOCE P-16C (150°W) section: (A) the upper 1000 meters, and (B) the entire depth range. Dashed curves indicate trends of nitrate maxima.




(B)
Nitrate (umol/kg)
Latitude (South is Negative)
Depth (m)
Sta #
40S
35
30
25
20
15
10
5S
Symbol is centered at bottle location
Prepared at 15:55:43 12/06/93
1.0
10.0
20.0
30.0
35.0
35.5
34.0
33.0
32.0
<36.0
H

nearly coincided with that for the pCO_2 maximum layer, but was located a few hundred meters below the deeper oxygen minimum layer.

Figs. 22-A & B show the distribution along 135°W. In the upper 1000 meters, two AOU maximum layers and a minimum layer can be seen due mainly to the more intensified influence of the low oxygen waters of the eastern tropical Pacific over-riding and under-cutting the high oxygen southern water centered around 600 meters. The deeper AOU maximum layer started at a depth of about 500 meters near the northern end of the section and deepened to about 2800 meters near the southern end, where the magnitude was similar to that observed along the 150°W meridian.

Phosphate

Figs. 23-A & B show the distribution of phosphate dissolved in seawater along 150°W down to 1000 meters and to the sea floor respectively. Phosphate in surface layers of the subtropical ocean was nearly depleted, less than 0.2 μmol/kg. It increased with depth to the phosphate maximum layer located at a depth of 2500 meters in the southern end of the section at 37.5°S, and 1600 meters at the northern end at 17.5°S. Since the maximum values for phosphate were similar along this layer at about 2.5 μmol/kg, the direction of its source could not be identified. The position of the phosphate maximum was several hundred meters below that for the oxygen minimum layer north of about 23°S, but coincided with it south of the latitude. Below the maximum layer, phosphate decreased gradually to 2.2 μmol/kg at the southern end and to 2.3 μmol/kg at the northern end. Figs. 24-A & B show the distribution along 135°W. In the northern half of this section between 6°S and 23°S, the phosphate maximum layer was found at about 1200 meters. South of about 25°S, it was observed much deeper at about 2300 meters. Along the layer, the phosphate concentration decreased southward from 2.88 μmol/kg at the northern end to 2.5 μmol/kg at the southern end of the section, indicating a northern origin of this signal.

Nitrate

Figs. 25-A & B show the distribution of nitrate dissolved in seawater along 150°W down to 1000 meters and to the sea floor respectively. The nitrate concentration in surface waters was generally less than 0.5 μmol/kg and was often less than 0.2 μmol/kg. It increased to a nitrate maximum layer, which was located at 2500 meters near the southern end and at

1700 meters near the northern end of the section. The highest nitrate concentration as high as 36.0 µmol/kg was found in this layer at about 26°S, and the value decreased north and south of this latitude as observed for the total CO_2 concentration (Fig. 13-B) and alkalinity (Fig. 17-B). This suggests that a tongue of the North Pacific water was cut across by this section. The concentration decreased with depth to the lowest value of 32.0 µmol/kg in the bottom water in the southern end of the section. The low values for the concentrations of total CO_2, phosphate and nitrate and the high values for oxygen found in bottom waters in the southern end are indicative of their southern high-latitude origin.

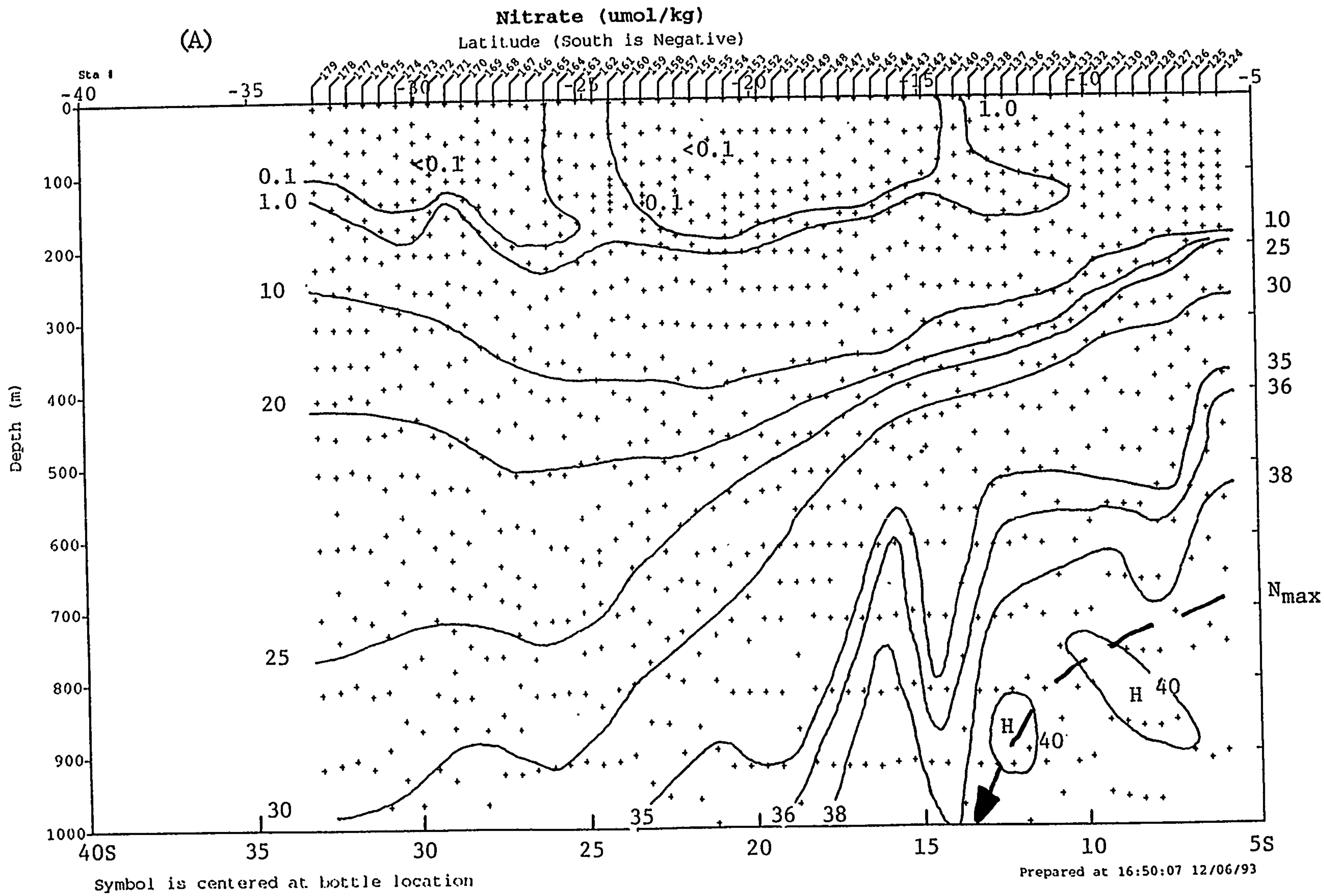
Figs. 26-A & B show the distribution along 135°W. Nitrate maximum layer may be traced from about 800 meters at the northern end and to 2300 meters at the southern end of the section. Values as high as 40 µmol/kg were observed near the northern end. The meridional change of the maximum nitrate layer depth along 135°W differed substantially from that along 150°W due mainly to the stronger influence of the eastern tropical waters with low-oxygen and high-nutrient concentrations.

Silicate

Figs. 27-A & B show that the distribution of silicate dissolved in seawater along 150°W down to 1000 meters and to the sea floor respectively. The silicate concentration in surface waters was less than 2.0 µmol/kg, and it increased with depth to the silicate maximum layer which was located at about 3000 meters. In this layer, silicate values as high as 133.3 µmol/kg were observed near 28°S. The maximum value tended to fall north and south of this latitude similar to the trends observed for the total CO_2 concentration (Fig. 13-B), alkalinity (Fig. 17-B) and nitrate (Fig. 25-B). This suggests that a tongue of the North Pacific water was crossed by this section. Below this maximum layer, a silica minimum layer was found between 4000 and 4300 meters deep in the areas south of 30°S. This silicate minimum layer is considered to represent the Antarctic Circumpolar Deep Water, which is characterized by high-salinity and low-silicate values reflecting the contribution of the NADW, and intrude under the silicate maximum layer of the northern origin. Reid (1986) observed along 170°W a deep silicate minimum layer which was associated with a salinity maximum (with a maximum value of 34.74 PSU) and interpreted that these features were due to the influence of the high-salinity, low-silicate North Atlantic Deep Water (NADW). However, the salinity data obtained during this expedition along 150°W did not show a maximum in association of the

Fig. 26 - Distribution of nitrate dissolved in seawater along the WOCE P-17C (135°W) section: (A) the upper 1000 meters, and (B) the entire depth range. Dashed curves indicate trends of nitrate maxima.

(A)



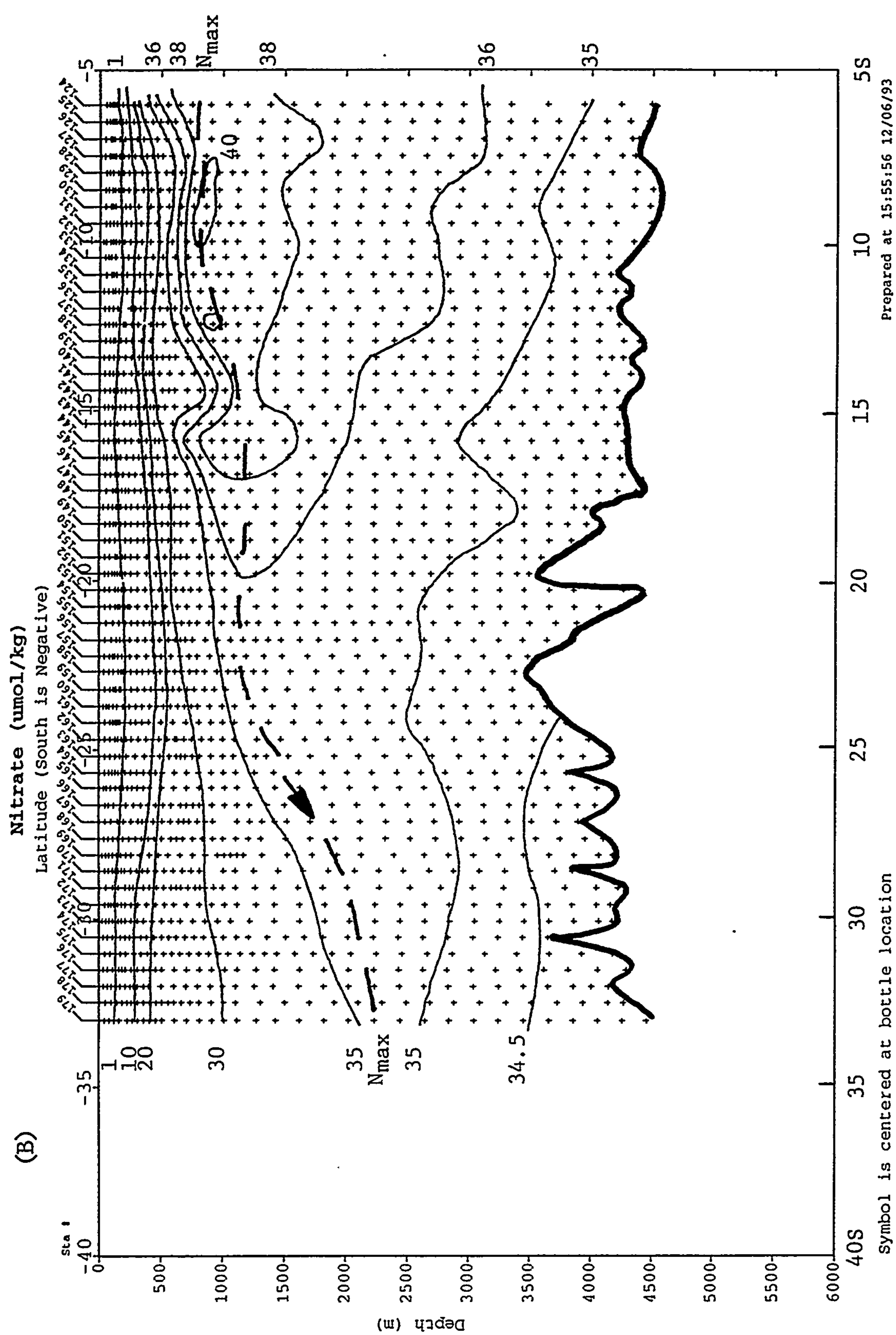
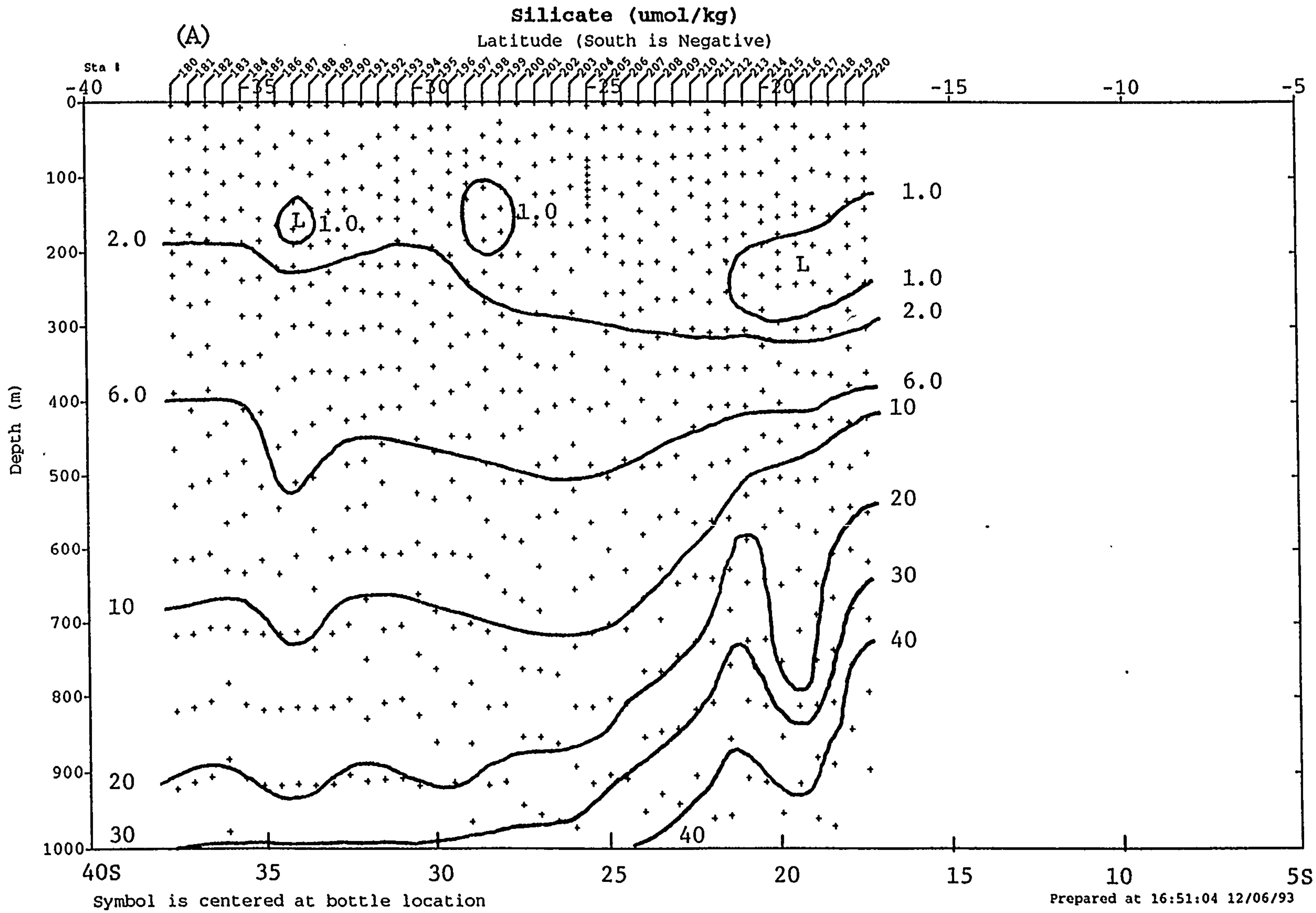

(B)
Nitrate (umol/kg)
Latitude (South is Negative)
Depth (m)
Sta #
Nmax
Symbol is centered at bottle location
Prepared at 15:55:56 12/06/93

Fig. 27 - Distribution of silicate dissolved in seawater along the WOCE P-16C (150°W) section: (A) the upper 1000 meters, and (B) the entire depth range. Dashed curves indicate trends of silicate maxima or minima.



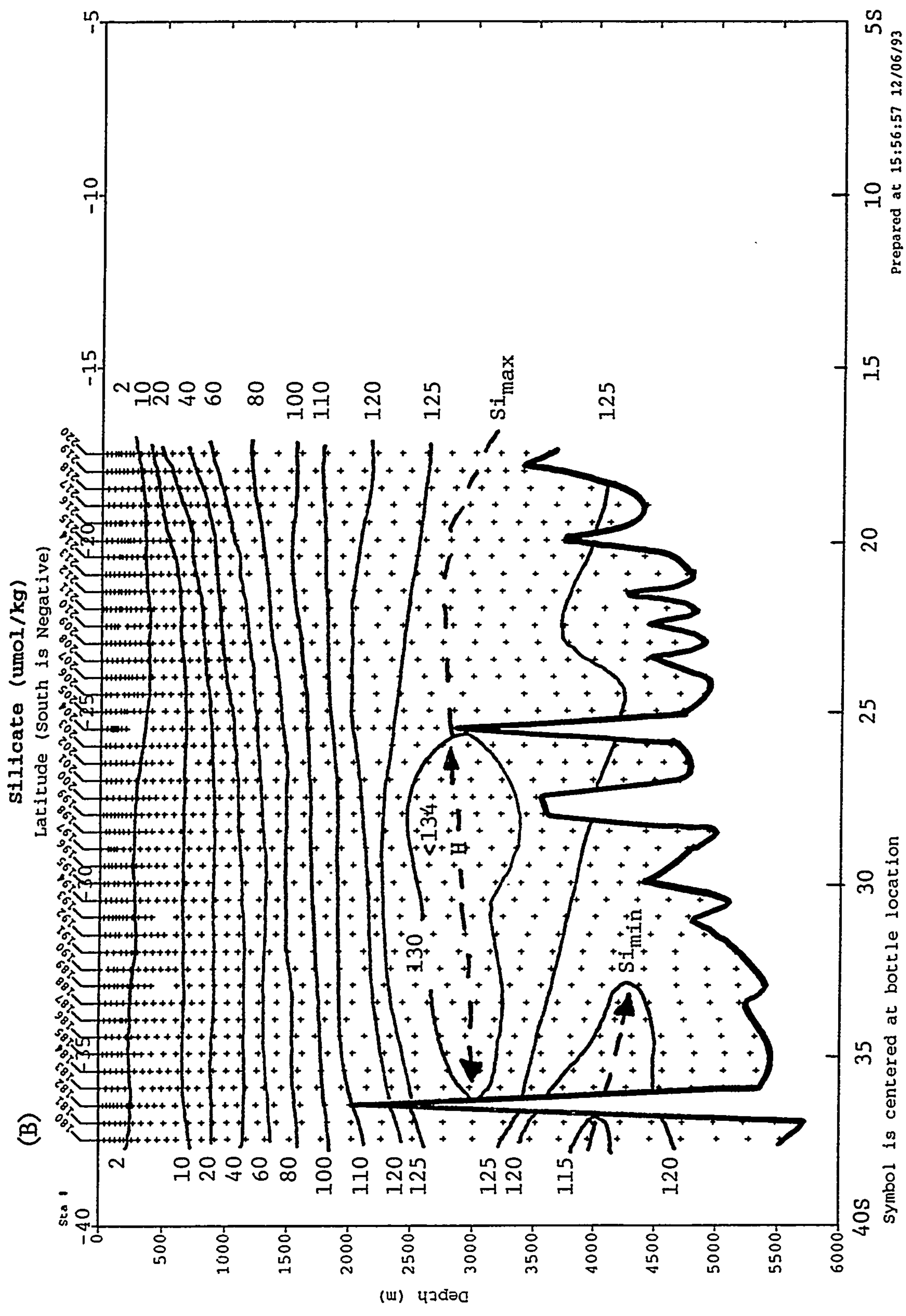
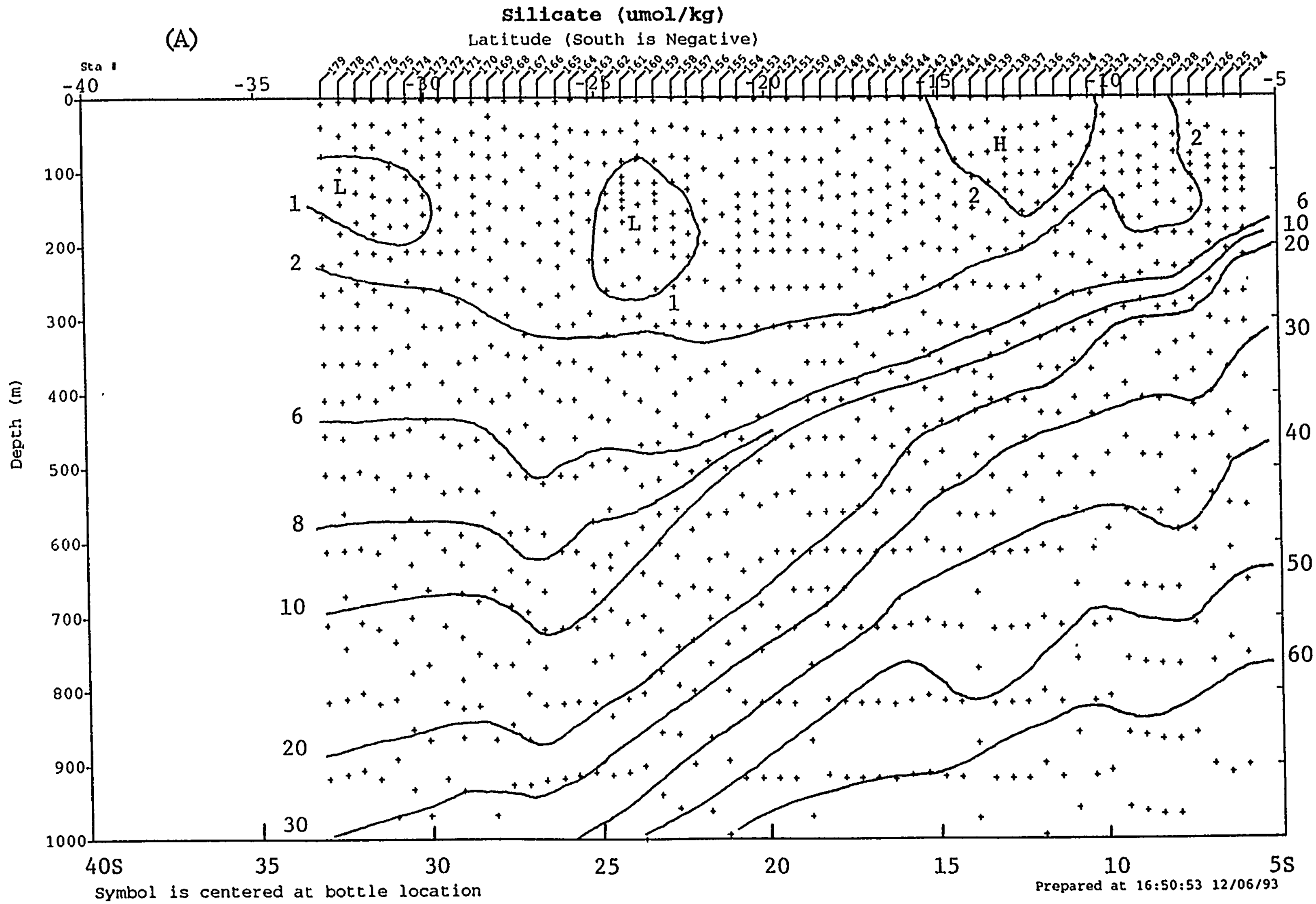
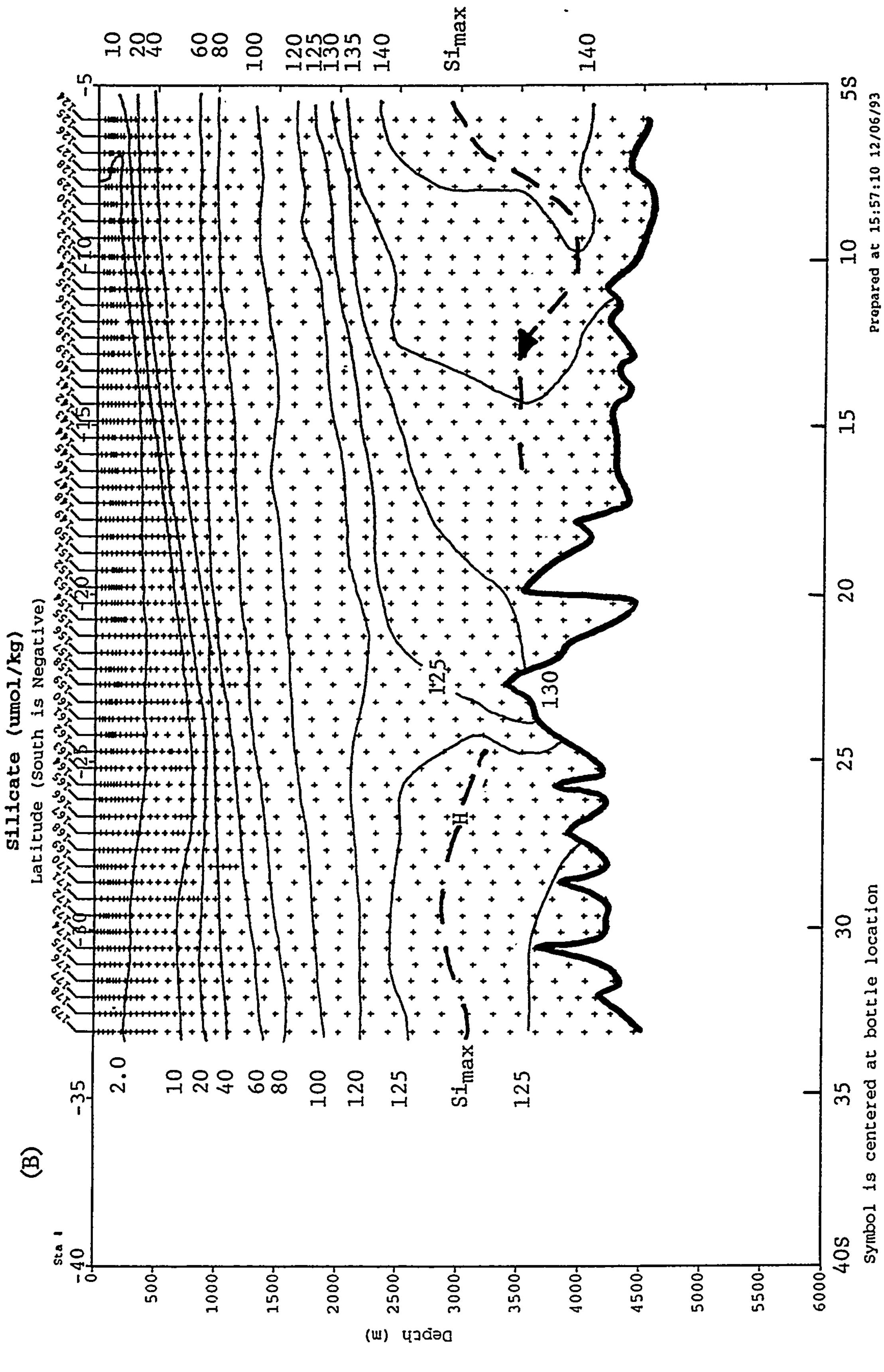

Silicate (umol/kg)
Latitude (South is Negative)
(B)
Sta #
Depth (m)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
-40
-35
-30
-25
-20
-15
-10
-5
40S
35
30
25
20
15
10
5S
2
10
20
40
60
80
100
110
120
125
130
<134
115
Si_max
Si_min
Symbol is centered at bottle location
Prepared at 15:56:57 12/06/93

Fig. 28 - Distribution of silicate dissolved in seawater along the WOCE P-17C (135^{o}W) section: (A) the upper 1000 meters, and (B) the entire depth range. Dashed curves indicate trends of silicate maxima with water depth.




(B)
Silicate (umol/kg)
Latitude (South is Negative)
Sta #
-40
-35
-30
-25
-20
-15
-10
-5
40S
35
30
25
20
15
10
5S
Depth (m)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
2.0
10
20
40
60
80
100
120
125
130
135
140
Simax
H
Symbol is centered at bottle location
Prepared at 15:57:10 12/06/93

silicate minimum presumably due to that the section did not extend beyond 37.5°S. Figs. 28-A and -B show the distribution along 135°W. North of about 16°S, a silicate maximum layer representing the North Pacific water was observed between 3000 and 4000 meters deep. Although this layer could not be clearly defined between 16°S and 25°S, it became clear south of 25°S, where the meridional trend of the maximum layer was too weak to be identified. The silicate minimum layer observed near the southern end of the 150°W section could not be seen in this section since this section was not extended beyond 33.5°S.

III-c) Distribution of Property Maxima and Minima:

The maxima and minima in the property distributions observed along the WOCE P-16C (150°W) and P-17C (135°W) sections (Figs. 7 through 28) are summarized in Figs. 29-A and -B. Two isopycnals of 27.00 sigma-θ and 36.90 sigma-2 are also indicated in both panels for the references using dashed curves. The sea floor topography is indicated with the heavy curves closest to the bottom of each panel.

In the upper 1000 meters, the following four features were observed along both the 150°W and 135°W sections; from the shallowest to the deepest, an oxygen minimum trend (Omin) between 200 and 400 meters, an alkalinity minimum trend (Amin) between 500 and 600 meters, an oxygen maximum trend (Omax) at about 600 meters and a salinity minimum trend (Smin) between 700 and 1000 meters. The arrows are drawn to indicate the direction, towards which the intensity of a maximum or minimum tends to be subdued and hence indicate the direction away from the source area for each trend. Accordingly, the shallow oxygen minimum trend propagated southward from tropical areas, whereas the deeper three features were originated in the Southern Ocean and propagated equatorward. The salinity minimum represents the Antarctic Intermediate Water (AAIW) with a sigma-θ density of about 27.10. In addition to these common features, several additional trends are observed in the 135°W section north of 17.5°S. These are an oxygen minimum trend (Omin) between 400 and 700 meters, and a pCO_2 maximum trend (Pco_2 max), a phosphate maximum trend (Pmax) and a nitrate maximum trend (Nmax), all which nearly coincide each other between 500 and 1000 meters. These features propagated southward from tropical areas, presumably from the eastern tropical Pacific. These features are missing from the 150°W section mainly because the section did not extend beyond north of 17.5°S.

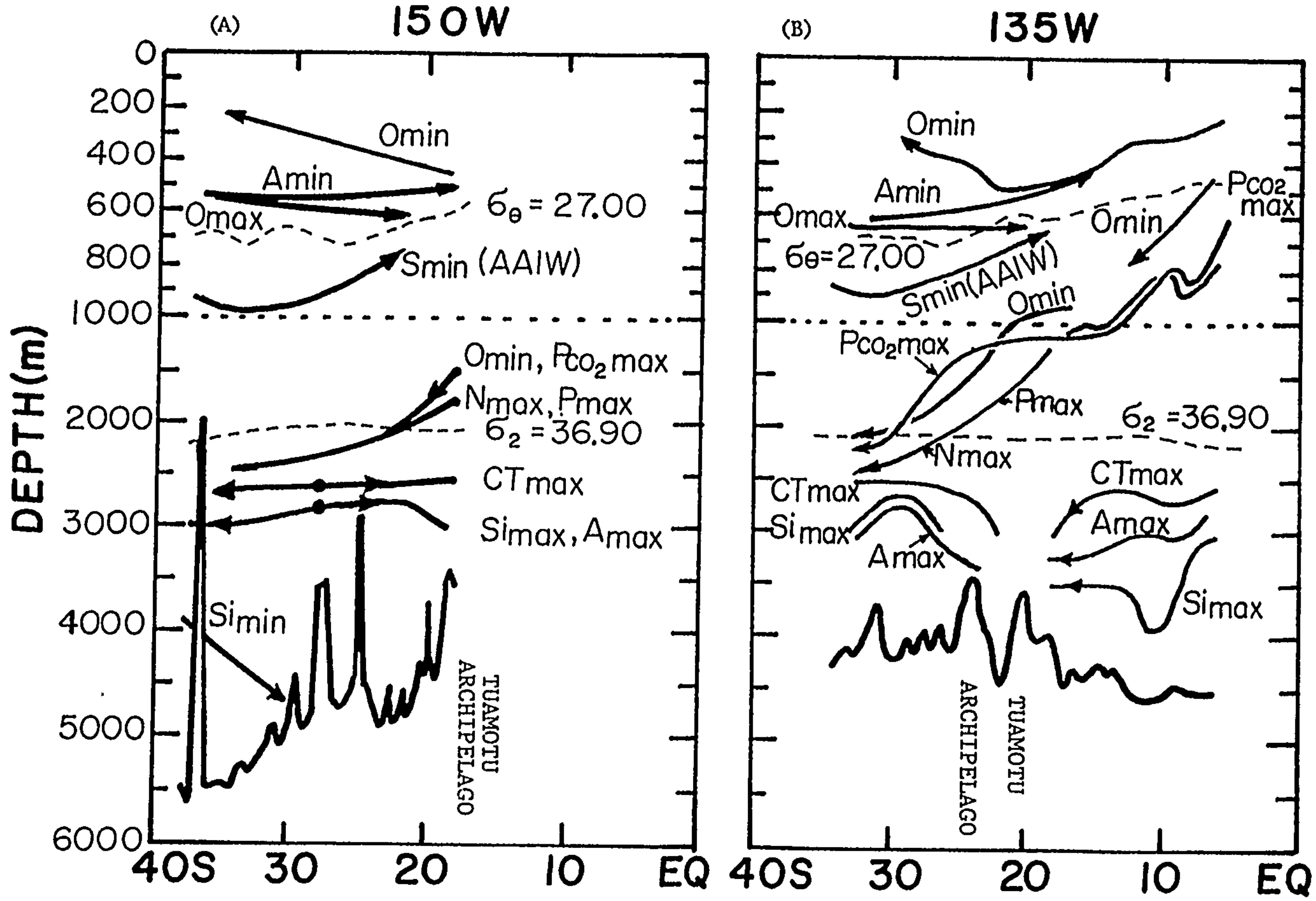


Fig. 29 - Summary of the property maxima and minima observed along (A) the 150°W (P-16C) and (B) 135°W (P-17C) sections. The heavy curves indicate the property maxima or minima along water columns. The arrows indicate the direction toward which the intensity of a maximum or minimum is reduced and hence the direction away from the source. The heavy curves without arrows indicate that no increasing or decreasing trend was observed in maximum or minimum values. Filled circles on the heavy curves indicate the maximum position along a maximum curve. The dashed curves indicate isopycnals.

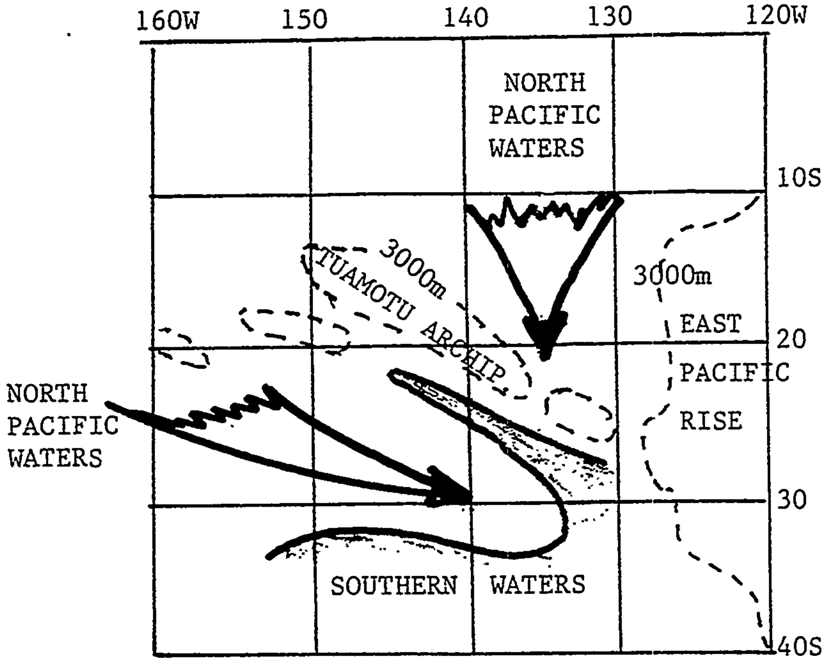
Between 1000 and 2500 meters, the following four features were observed; an oxygen minimum trend (Omin), a pCO_2 maximum trend (Pco_2max), a phosphate maximum trend (Pmax) and a nitrate maximum trend (Nmax). All these trends appear to propagate southward from the tropical Pacific. Although they appear to coincide in the 150°W section while they are separated in the 135°W section, it is not certain whether the differences are real or due to the artifacts of sample distributions and imperfections of the measurements.

Below about 2500 meters to the sea floor, the following trends were observed; a total CO_2 maximum trend (CTmax) between 2500 and 3000 meters, a total alkalinity maximum trend (Amax) centered around 3000 meters, a silicate maximum trend (Si max) between 3000 and 4000 meters and a silicate minimum trend (Si min) below 4000 meters south of about 32°S in the 150°W section. Since the direction of meridional changes for the maxima in the alkalinity and the concentrations of total CO_2 and silicate in the southern half of the 135°W section was not obvious, no arrow was attached to these maximum trend lines. The depth profiles observed during the GEOSECS Program in the North Pacific Ocean (Takahashi et al., 1981-a; Takahashi et al., 1981-b) indicate a maximum concentration in total CO_2 at depths between 1500 and 2000 meters, and that for the alkalinity and silicate both at depths between 2000 and 3000 meters. This suggests that these maxima observed in the 150°W and 135°W sections represent deep waters transported southward from the North Pacific Ocean. Along the 150°W section, the total CO_2, alkalinity and silicate values in the maximum layers decreased away from 28°S (shown with the filled dots). This suggests that a tongue of the North Pacific water was flowing across the section and surrounded by the southern waters which had lower values for these properties. Since a well defined tongue was not observed further east along 135°W, it is deduced that the tongue of the North Pacific water came from the northwest rather than directly from the north. This is because the topographic high of the Tuamotu Archipelago lies from 15°S, 152°W to 22°S, 138°W and blocks the southward flow of the North Pacific waters along 150°W, but does not impede it along 135°W. Along the 135°W section, the maximum values in the total CO_2, alkalinity and silicate maximum layers decreased southward from 6°S to 18°S, suggesting a more or less southward flow of the North Pacific waters between 2500 and 3500 meters. Thus, north of the Tuamotu Archipelago, strong and clear signals for the North Pacific waters were present. On the other hand, south of the Archipelago, the maximum values for these properties were found to be nearly constant south of 22°S. This feature may correspond to the more strongly defined maximum layer observed in the 150°W section. Based upon the property distributions, regional circulation patterns of the waters between 2500 and 3500 meters have been deduced and compared with the geostrophic flow at 2000/3500 db estimated by Reid (1986) in Fig. 30. An eastward flow of the North Pacific waters between 20°S and 30°S is a dominant feature in this area, and is well reflected in the flow patterns estimated on the basis of the property distributions. Thus, Reid's geostrophic flow patterns are consistent with the distribution of the properties observed during this work.

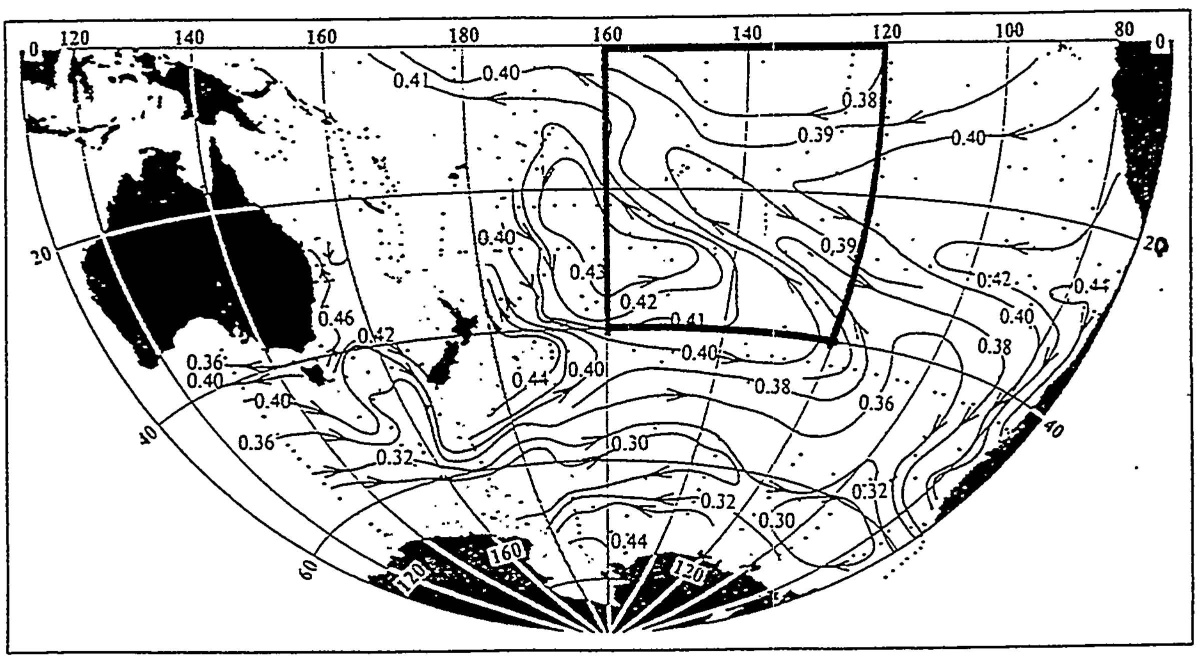
Below about 4000 meters to the sea floor along 150°W, the southern waters which are represented by a silicate minimum layer appear to flow northward. These waters were not observed along the 135°W section presumably because the section did not extend far enough south beyond 33°S and the ocean was no deeper than 4200 meters. As discussed earlier, this silicate minimum represents the effect of NADW which was transported to the South Pacific via the circumpolar currents (Reid, 1986).

Fig. 30 - Flow patterns of water in a depth range between 3000 and 3500 meters. (A) Those deduced on the basis of the distribution of chemical properties observed during this work. The 3000 meter isobaths are indicated with dashed curves. (B) The 2000/3500 db geostrophic flow estimated by Reid (1986). Our study area shown in (A) is outlined with heavy lines in (B).

(A)



(B)



VI. PROPERTY-PROPERTY RELATIONSHIPS

In Figs. 31 through 39 presented in this section, the data for the upper 100 meters representing surface mixed layer waters are indicated with open circles; those between 100 and 800 meters are indicated with the "x" symbols; and those below 800 meters are indicated with the "+" symbols.

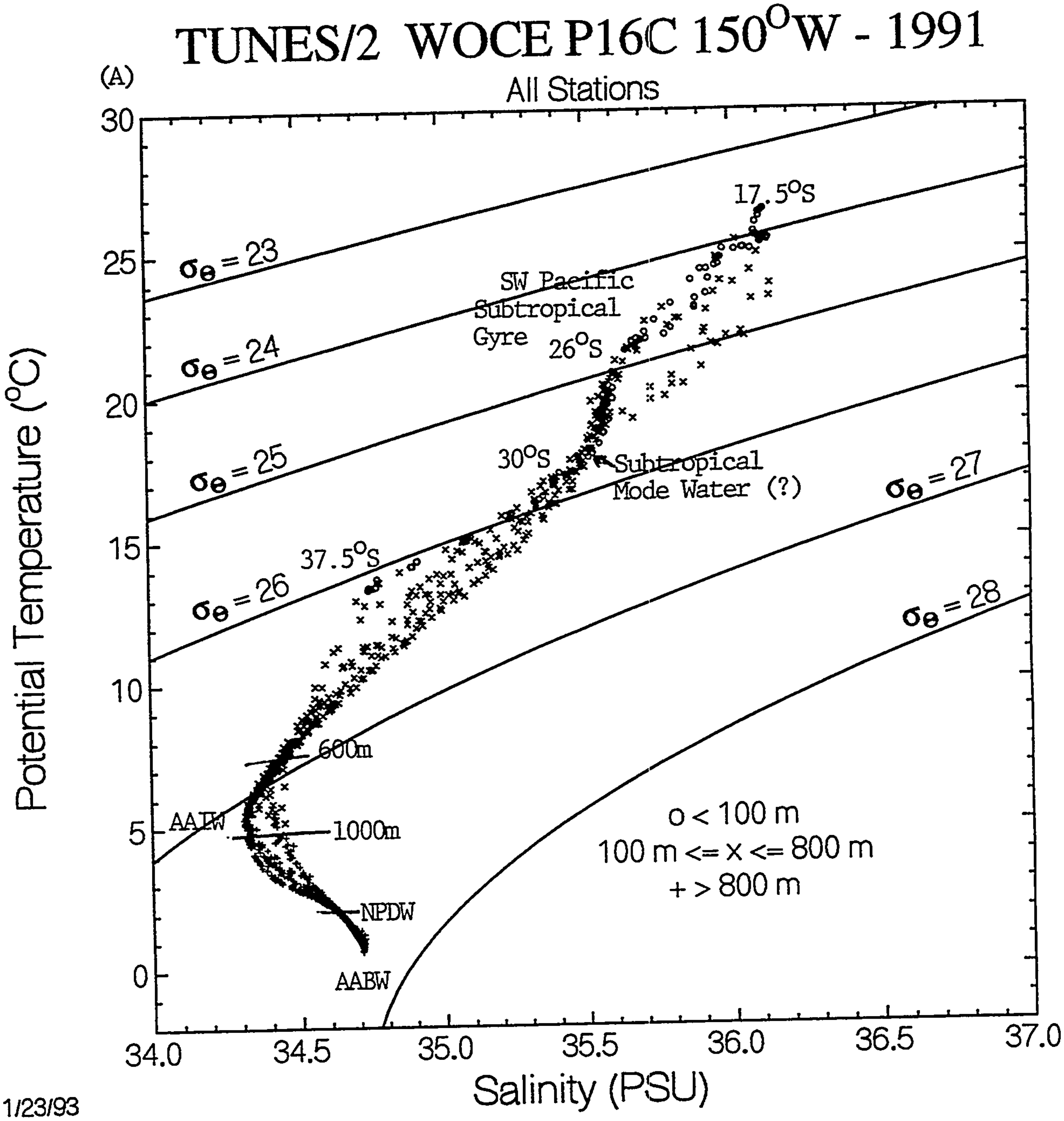
VI-a) θ-S Relationships:

Figs. 31-A & B show the θ-S relationships observed along 150°W (P-16C Section) and 135°W (P-17C Section) respectively. The latitudes shown refer only to the surface data indicated with open circles. The meridional distribution of the mixed layer temperature is shown in Fig. 32 and indicates that the temperature decreased almost linearly with latitude from 25°C at 19°S to 13°C at 37.5°S. The sigma-θ potential density ranging between 23 and 28 are indicated with the solid curves, and selected water depths are indicated with the dashed curves.

Near Surface Layers:

Along 150°W (Fig. 31-A), the surface mixed layer data (open circles) indicate three meridional regimes. Between 17.5°S and 26°S, the density increased from 23.7 to 24.8 as both the temperature and salinity decreased linearly with increasing latitude. Between 26°S and 30°S, the density increased more rapidly from 24.8 to 25.7 due to a small decrease in the salinity from 35.64 to 35.53 PSU accompanied with a linear decrease in temperature with latitude. The small change in salinity may be a result of excess evaporation over the subtropical gyre. Between 32°S and 37.5°S, where the southernmost observation was made along this section, the density was nearly constant and only increased from 25.9 to 26.1 while the temperature decreased from 17°C to 13°C and the salinity from 35.45 to 34.73 PSU. Since the 135°W section sampled waters further north and east, Fig. 31-B shows considerably different features for temperatures above 22°C (or locations north of about 26°S). From 6°S to 16°S, the surface water temperature decreased slowly from 28°C to 27°C (Fig. 32), while the salinity increased rapidly from 35.1 to 36.7 PSU resulting in a rapid southward increase in density of surface waters. This appears to represent a mixing regime for the warm and fresher South Equatorial Current water with the high-salinity subtropical gyre waters. From 16°S to

Fig. 31 - The θ-S relationships observed (A) along the 150°W (P-16C) and (B) the 135°W (P-17C) sections. The open circles, "x" and "+" symbols indicate respectively the data down to 100 meters, between 100 and 800 meters and below 800 meters. The potential density at surface is indicated with the solid curves.



11/23/93

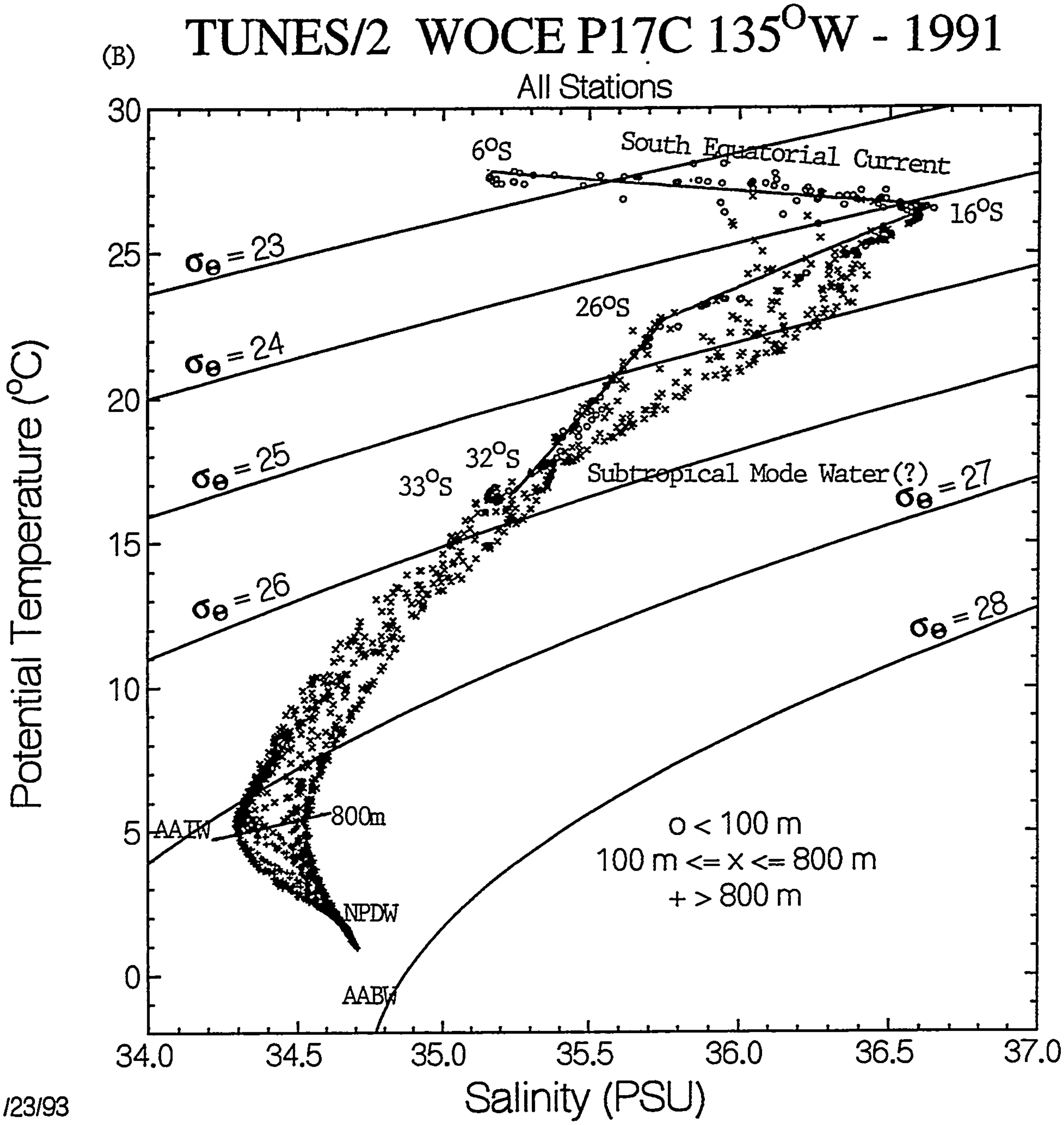
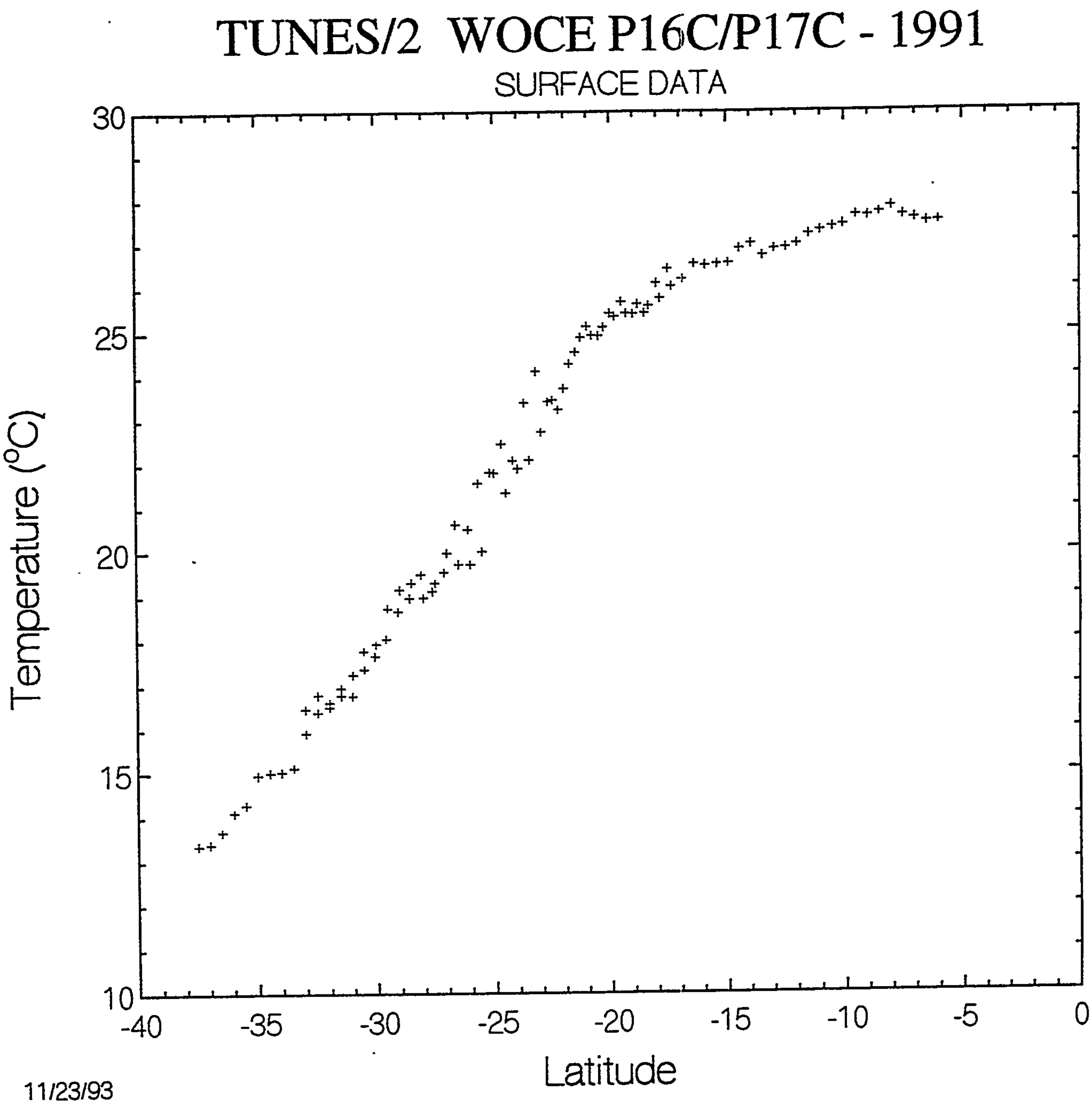

(B)
TUNES/2 WOCE P17C 135°W - 1991
All Stations
Potential Temperature (°C)
Salinity (PSU)
6°S
South Equatorial Current
16°S
26°S
32°S
33°S
Subtropical Mode Water(?)
σθ = 23
σθ = 24
σθ = 25
σθ = 26
σθ = 27
σθ = 28
AAIW
800m
NPDW
AABW
o < 100 m
100 m <= x <= 800 m
+ > 800 m
11/23/93

Fig. 32 - The mixed layer temperature as a function of latitude, observed during this study.



26°S, the surface water salinity decreased southward from 36.7 to 35.75 PSU, while its temperature decreased linearly with latitude (Fig. 32). As a result, the density of surface waters increased slightly from about 24.2 to 24.6. The salinities in this latitudinal range along 135°W were much greater than those observed in the same latitudes along 150°W. This suggests that the high salinity waters centered around 16°S were transported from east to west. From 26°S to 33°S (the southern end of this section), the surface water density increased rapidly from 24.6 to 25.8 due mainly to cooling while the salinity decreased from 35.5 to 35.3 PSU.

Main Thermocline:

Main thermocline waters below the surface mixed layer down to about 600 meters deep are represented by a broadly linear θ-S relationship, which corresponds to a water type categorized as the "Eastern South Pacific Central Water" by Sverdrup et al. (1942). Data for both surface and subsurface water appear to converge to 18°C and 35.52 PSU along 150°W (Fig. 31-A) and to 17.5°C and 35.4 PSU along 135°W (Fig. 31-B). Above and below these points, the data points tend to diverge. This indicates that, north of 30°S, waters with this temperature and salinity and hence with a constant density of about 25.8 were present at every station. Figs. 7-A and 9-A show that, along 150°W, the 17.5°C isothermal and 35.5 PSU isohaline curves are located nearly at the same locations (i. e. at the sea surface at about 30°S and 300 meters between 17.5°S and 25°S). Similar distribution of temperature and salinity was found along 135°W, although a 35.4 isohaline curve was not shown in Fig. 10-B. Therefore, these convergent points appear to indicate the formation and spreading of a subtropical Mode Water in the central South Pacific Ocean. No distinctive feature in the distribution of CO_2, oxygen and nutrients was observed at this temperature and salinity range. The sigma-θ potential density for this water mass is much smaller than 27.0 ± 0.1 observed along the 28°S and 43°S sections in the South Pacific by McCartney (1982) in his Fig. 7 for the subantarctic Mode Water. Although the Eighteen Degree Water in the North Atlantic, a subtropical Mode Water described by Worthington (1959 and 1972), has a similar temperature as this water, it has a density of about 26.5, which is also greater than that for the subtropical water described above.

Intermediate Water Regime:

The salinity minimum water centered at a depth of about 800 meters represents the Antarctic Intermediate Water (AAIW). It has a sigma-θ density of about 27.1 with a temperature of about 5°C and a salinity ranging between 34.3 and 34.6. The salinity increases northward along both sections, but no significant difference was observed between the 150°W and 135°W sections.

Deep and Abyssal Water Regimes:

Figs. 33-A & B show detailed views of the θ-S relationships in the deep and abyssal regimes for the 150°W and 135°W sections respectively. The North Pacific Deep Water is indicated by a minor inflexion point on the θ-S plots located at about 2.0°C and 34.63 PSU. The inflexion point may be obscured depending on the temperature and salinity values of the AAIW overlying and mixing with the North Pacific Deep Water, but it is clearly seen in Fig. 33-A. This water mass, which represents a southward return flow from the North Pacific of the Southern Ocean abyssal water flowing northward into the North Pacific basin, dominates the depth range between about 2500 meters and 3500 meters along these sections. Because of its long travel time, this water has accumulated CO_2 and silicate especially during its circulation through the North Pacific, and hence is characterized by maximum concentrations of total CO_2, silicate and alkalinity as shown in Fig. 29.

Along 150°W, the Circumpolar Deep Water (CPDW) is seen at a temperature of about 1.3°C and a salinity of 34.71 PSU. Since the 135°W section did not extend beyond 33°S, it is not clearly seen. As shown in Fig. 27-B, this water has lower silicate concentrations. This is attributed to the mixing of NADW which has higher salinity and low silicate concentrations (Reid, 1986). The densest water observed in the abyssal depths along these sections has a potential temperature of 0.6°C and a salinity of 34.71 PSU and represents AABW.

VI-b) Relationship between the CO_2 Properties:

Figs. 34-A & B show the relationships between the natural logarithm of pCO_2 at 20°C and that of the total CO_2 concentration normalized to 35.00 salinity along 150°W and 135°W respectively. Major water masses and other oceanographic features are indicated by letters. Three iso-alkalinity curves computed using the LDEO algorithm (Peng et al., 1989) are indicated by the solid curves.

salinity and temperature, the constant Revelle factor trend cannot be due simply to the mixing between surface water and AAIW. An additional study is being made to understand the oceanographic implications of the constant Revelle factor trend.

Intermediate and Deep Waters:

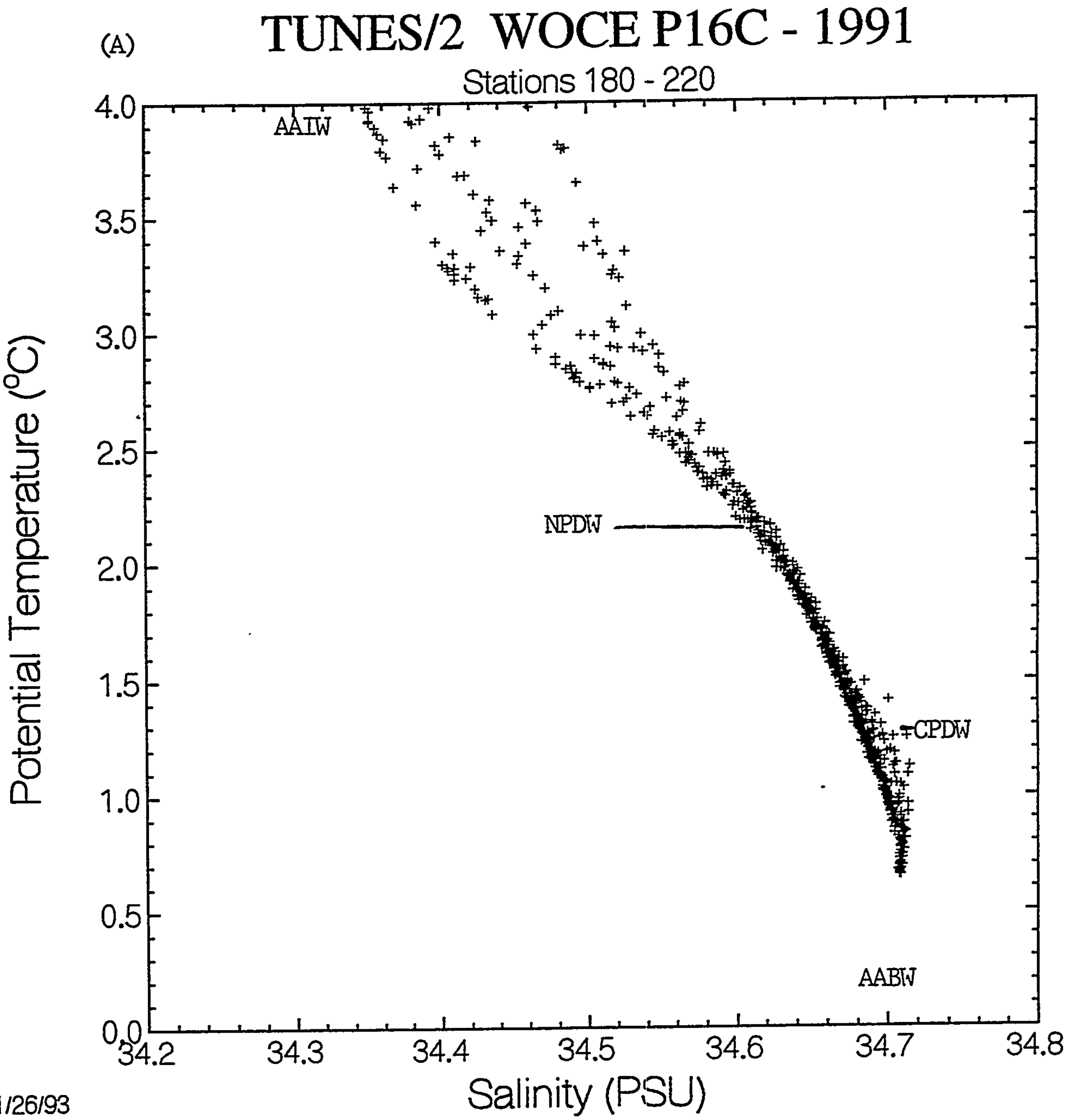
Below AAIW, the relationships become more complicated because of the presence of a number of different water masses which have different chemical characteristics. Along 135°W (Fig. 34-B), the Lower Oxygen Minimum water, which has pCO_2 and TCO_2 values as high as 1650 μatm and 2300 μmol/kg respectively, is observed at 6°S in a depth range between 400 and 500 meters, whereas, south of 20°S, it is found below AAIW at depths between 1000 and 2500 meters (Figs. 29-A & B). The chemical characteristics of the Lower Oxygen-Minimum water found north of the Tuamotu Archipelago (23°S along 135°W) differ in the magnitude in pCO_2; in the areas south of the Archipelago, it has a pCO_2 value of about 1200 μatm (Figs. 34-A & B), whereas in the areas north of it, it has about 1600 μatm (Fig. 34-B). These waters are marked in Figs. 34-A & B as "Lower Omin (S)" and "Lower Omin (N)" respectively. This chemical difference suggests different circulation and mixing histories for these waters. The waters located south of the Archipelago were likely to have mixed with a greater proportion of the southern waters.

Between 2500 and 3000 meters, the North Pacific Deep Water (NPDW) is found. This water is characterized by the maximum concentrations in silicate, total CO_2 and alkalinity as discussed earlier. Two distinct types of the NPDW are identified in Fig. 34-A & B; NPDW (S), which is found south of the Tuamotu Archipelago and is represented by a sharp point in the 150°W section (Fig. 34-A) at the maximum total CO_2 concentration (extreme right); and NPDW (N), which is observed north of the Archipelago and is represented by the maximum total CO_2 concentration in the 135°W section (Fig. 34-B). These chemical differences represent differences in the circulation, mixing and biogeochemical history of the waters.

Below the NPDW, the observed trend indicates mixing with the AADW. The point marked AABW in each of Figs. 34-A & B represents a set of values observed at 67°S and 139.6°W along the WOCE S-4 section: $\theta = 0.6°C$, Sal = 34.705 PSU, $TCO_2 = 2262$ and 2280 μmol/kg (respectively at the observed salinity and 35.00 salinity), $pCO_2 = 1127$ μatm at 20°C, $SiO_3 = 127.1$ μmol/kg.

Fig. 33 - The θ-S relationships between 0.0 and 4.0°C observed (A) along the 150°W (P-16C) and (B) 135°W (P-17C) sections. The North Pacific Deep Water, Circumpolar Deep Water and Antarctic Bottom Water are indicated.

(A)



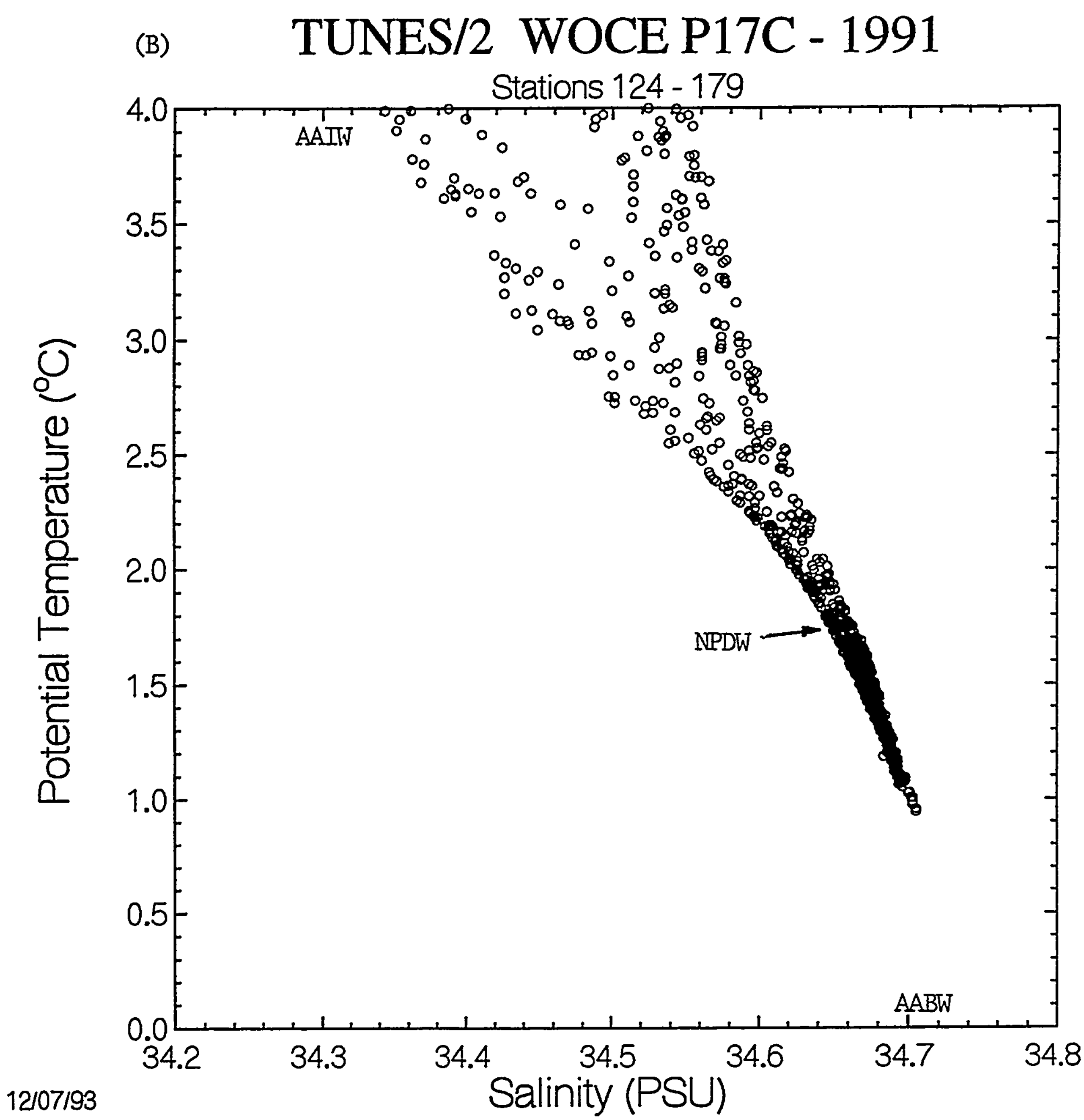
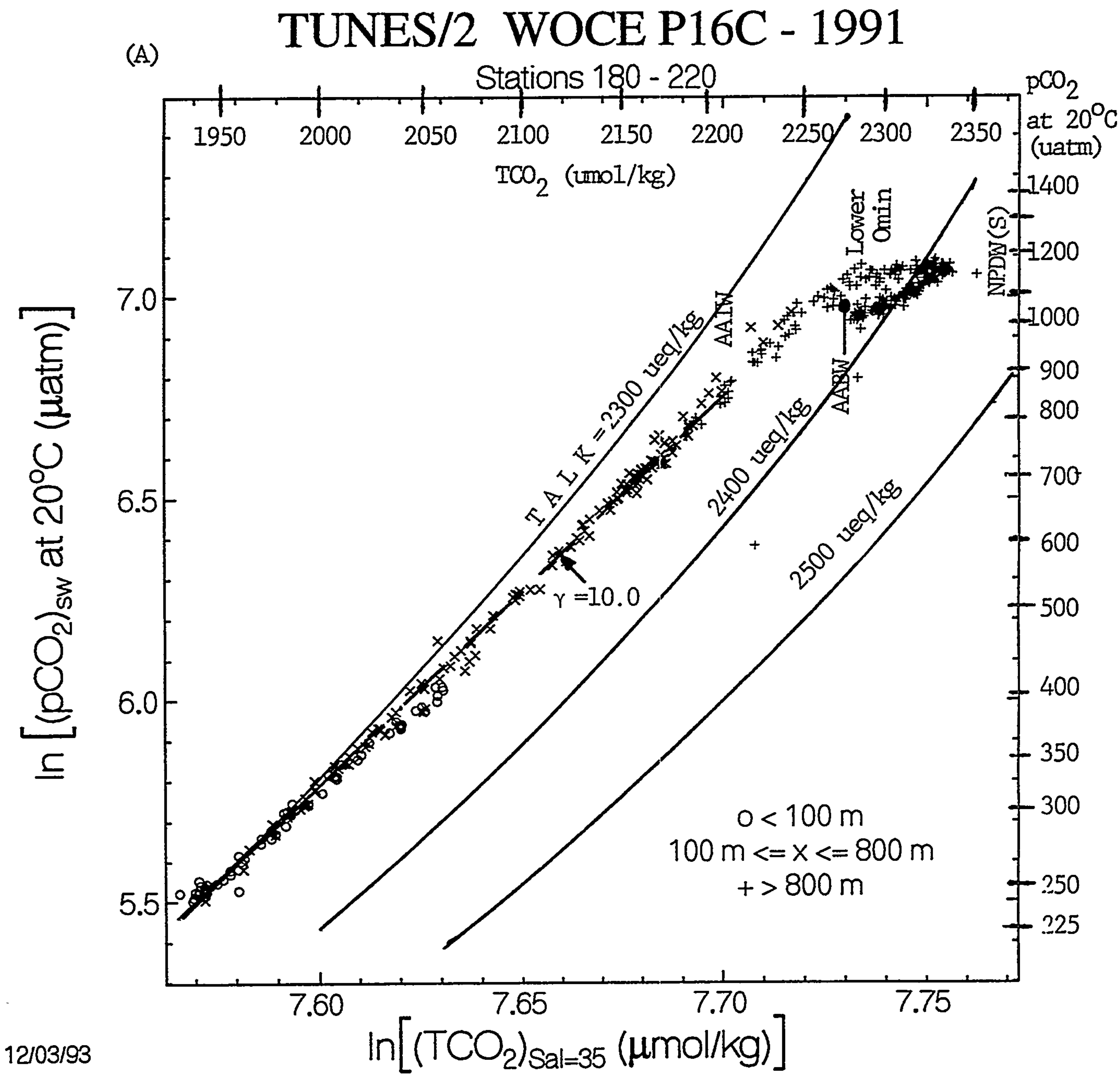
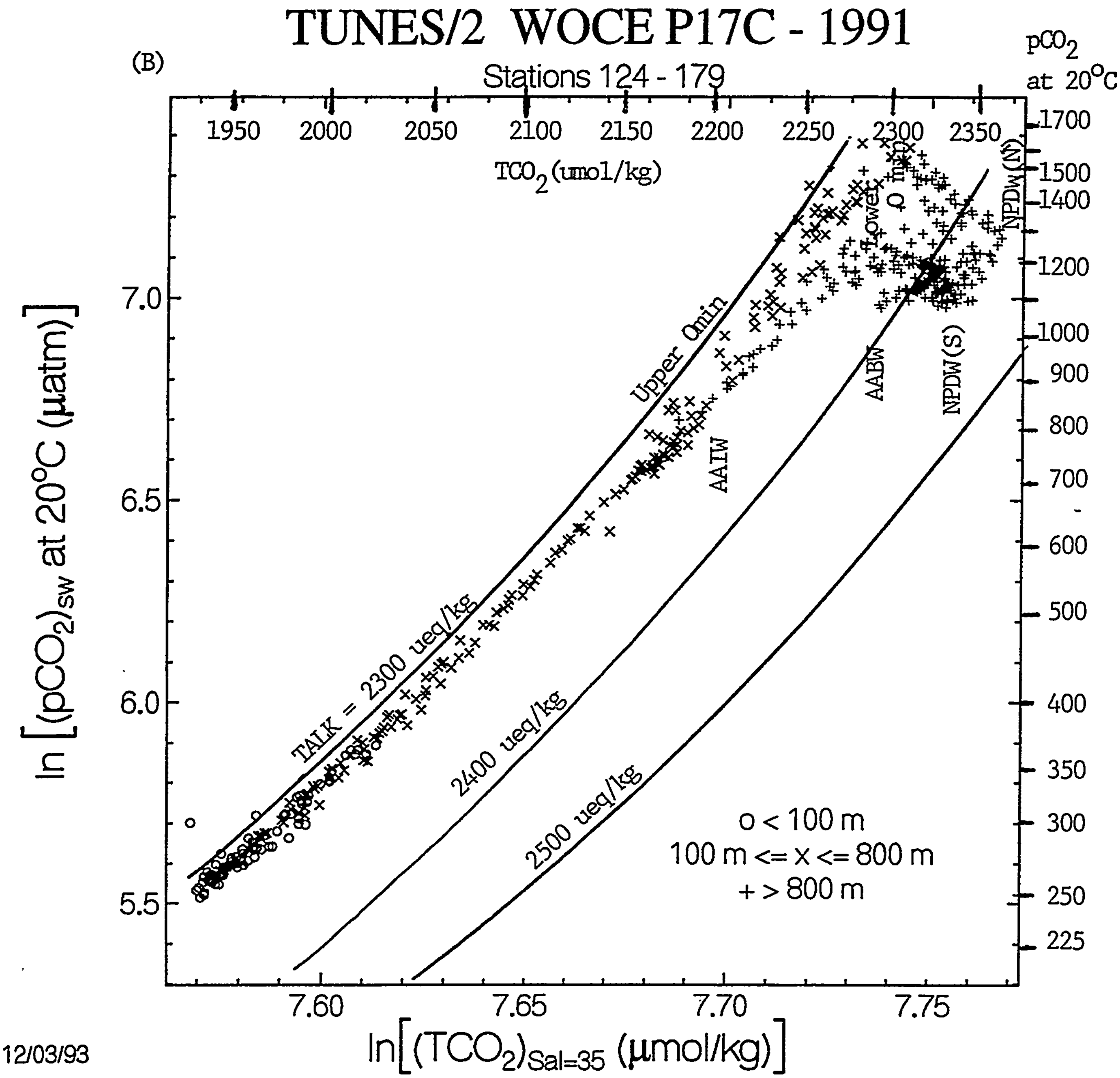

(B)
TUNES/2 WOCE P17C - 1991
Stations 124 - 179
AAIW
NPDW
AABW
Potential Temperature (°C)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
34.2
34.3
34.4
34.5
34.6
34.7
34.8
Salinity (PSU)
12/07/93

Fig. 34 - The relationships between the natural logarithm of pCO_2 at 20°C and that of the total CO_2 concentration in seawater normalized to a salinity of 35 PSU, observed along the 150°W (P-16C) and (B) 135°W (P-17C) sections. The three solid curves indicate respectively iso-alkalinity lines for 2300, 2400 and 2500 μeq/kg. The dashed line indicates a constant Revelle factor of 10.0.





TUNES/2 WOCE P17C - 1991
(B)
Stations 124 - 179
pCO2
at 20°C
1950
2000
2050
2100
2150
2200
2250
2300
2350
TCO2 (umol/kg)
1700
1500
1400
1200
1000
900
800
700
600
500
400
350
300
250
225
7.0
6.5
6.0
5.5
7.60
7.65
7.70
7.75
ln[(pCO2)sw at 20°C (μatm)]
ln[(TCO2)Sal=35 (μmol/kg)]
Upper Omin
Lower Ω min
NPDW(N)
AAIW
AABW
NPDW(S)
TALK = 2300 ueq/kg
2400 ueq/kg
2500 ueq/kg
o < 100 m
100 m <= x <= 800 m
+ > 800 m

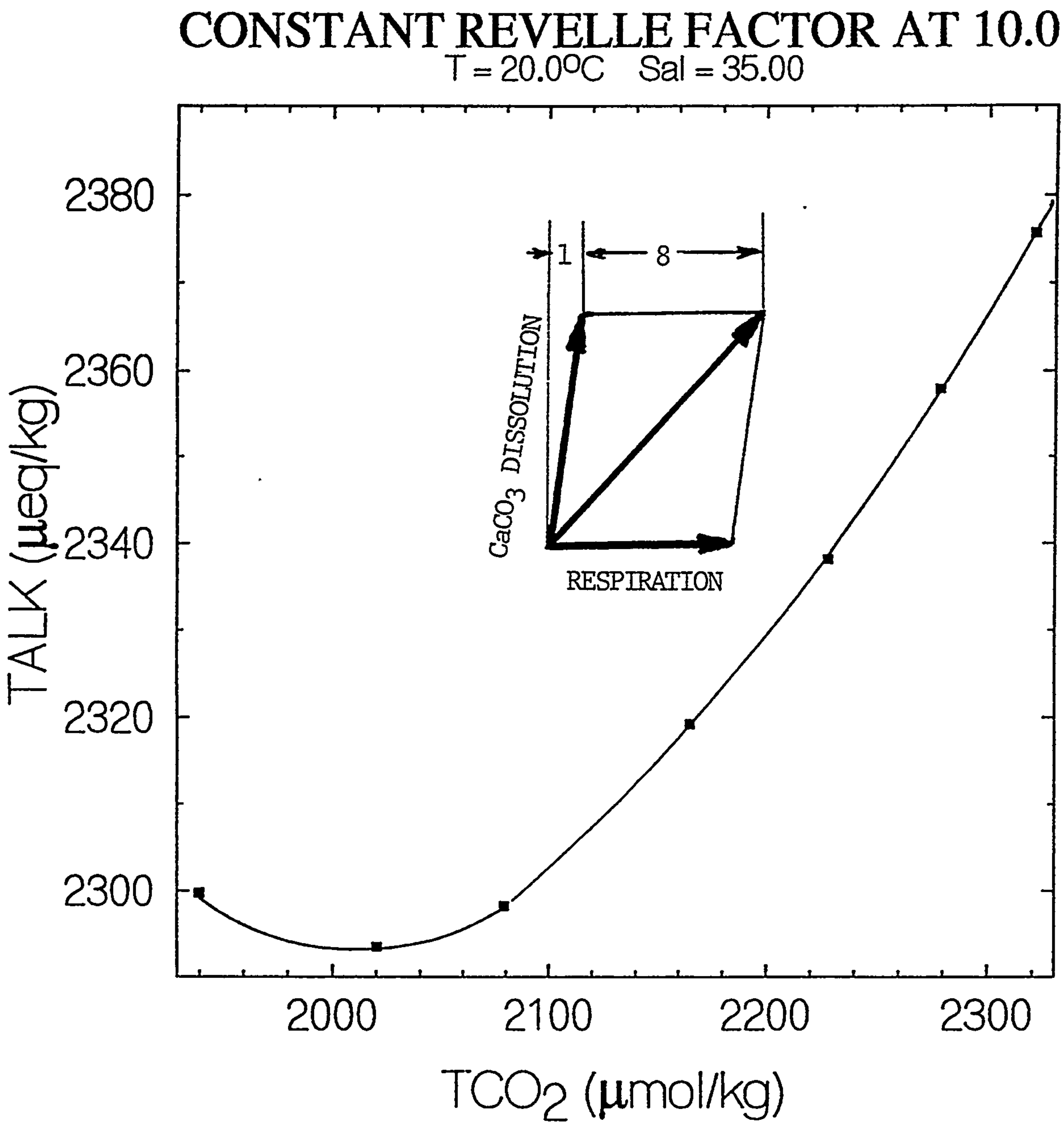
12/03/93

Upper Layer and Main Thermocline Waters:

A linear relationship with a slope of 10.0 is found for the data from the upper 800 meters south of about 20°S in both sections. The linear trend observed in surface waters (defined by the open circles) is indistinguishable from that observed in subsurface waters (defined by the "x" symbols). However, north of 20°S, the Upper Oxygen-Minimum/AOU-Maximum water (300 - 500 meters) and the Lower Oxygen-Minimum/AOU-Maximum water (400 meters and deeper) (see Figs. 20-A & B and 22-A & B) which have very high pCO_2 values between 800 and 1650 μatm (see a group of "x" symbols located in the uppermost sector) fall above the Revelle factor 10 trend. These waters appear to have originated in the eastern tropical Pacific and have been subjected to different biogeochemical processes than those in the waters from the Southern Ocean. These differences may be manifested in the different slopes.

Since the Revelle factor is defined as $(\delta \ln pCO_2/\delta \ln TCO_2)$, the linear trend observed south of 20°S corresponds to a constant Revelle factor of 10 from the surface mixed layer down to the AAIW. Since the pCO_2 values represent those at a constant temperature of 20°C and the total CO_2 concentration at a constant salinity of 35 PSU, a constant Revelle factor of 10 defines a specific relationship between the total alkalinity and total CO_2 concentration. The relationship computed using the thermodynamic relationships in carbonate chemistry (Peng. et al, 1987) is presented in Fig. 35. It shows that, in the surface water regime where the salinity normalized total CO_2 concentration values range between 1950 and 2050 μmol/kg, the total alkalinity is nearly constant. In the deeper waters where the total CO_2 concentration range between 2100 and 2200 μmol/kg, the curve has a $\Delta TALK/\Delta TCO_2$ slope of 26/100 μeq/μmol. As illustrated in Fig. 35, this slope corresponds to a 1 to 8 ratio (or 11% to 89%) for the calcium carbonate dissolution to the respiratory production of CO_2 by the oxidation of organic carbon. This implies that calcium carbonate is dissolved in the upper 800 meters. Since seawaters are supersaturated with respect to calcite in the upper oceans down to 2000 meters in the South Pacific (Broecker and Takahashi, 1978), the increase in alkalinity cannot be attributed to the dissolution of sinking biogenic calcite, but may be due to the dissolution of sinking biogenic aragonite. Alternatively, the increase in the alkalinity and total CO_2 may be attributed to the northward spreading of polar waters high in these quantities. On the other hand, since neither the total CO_2 concentration nor the alkalinity are linearly related to

Fig. 35 - The relationship between the total alkalinity and total CO_2 concentration for a constant Revelle factor of 10 at 20°C and 35 PSU. The arrows indicate respectively (clockwise from the near vertical one) the effect of the dissolution of $CaCO_3$, the mean trend in the study area and the effect of respiration (i. e. the oxidation of organic carbon).



VI-c) CO_2-Oxygen Relationships:

Figs. 36-A & B show the relationships between the concentrations of total CO_2 and oxygen dissolved in seawater observed along the 150°W (P-16C) and 135°W (P-17C) sections respectively. A vector representing the Redfield -O_2/C respiration ratio of 175/106 observed in thermocline waters (Takahashi et al., 1985) is indicated by an arrow. A point representing AABW observed in the southernmost Drake Passage area (Chipman et al., 1992) is indicated in each diagram.

The surface waters of the subtropical gyre (see the open circles for the data between 16°S and 37.5°S) are closely saturated with atmospheric oxygen, whereas those north of 16°S (see Fig. 36-B), which represent the South Equatorial Current, are supersaturated due to the photosynthetic production of oxygen in the nutrient rich water. The variation of CO_2 and oxygen in the subsurface waters is strongly affected by the water masses and the respiration which occurred in the water column. The chemical characteristics for AAIW, Lower Oxygen-Minimum Water, North Pacific Deep Waters and AABW are clearly identifiable and indicated in these plots. Points for waters originated in the Southern Oceans are located on the right hand side of the plots, whereas those for tropical and North Pacific tend to be located on the left side of the plots. A linear trend is observed along a depth of 800 meter and another between the North Pacific Waters and AABW. Although these trends are parallel to the respiration vector, they could also indicate a mixing line between two water masses. Therefore, without further analysis of the associated data, these trends cannot be simply attributed to respiration.

VI-d) Relationships between Alkalinity and Silicate:

Fig. 37-A & B indicate the relationships between the potential alkalinity and silicate. The potential alkalinity (total alkalinity + nitrate) is used to include the contribution of nitrate to the total alkalinity (Brewer and Goldman, 1976). A simple linear relationship is observed between the AAIW located at about 800 meters and the North Pacific Deep Water (located between 2500 and 3500 meters) over a very wide range of silicate values ranging between 15 and 140 µmol/kg. This linear relationship suggests (1) that both the alkalinity and silicate concentrations are governed by mixing between the two water masses, and (2) that the dissolution rates of calcium carbonate and silicic tests of organisms are similar. However, as

shown in Figs. 38-A & B, the potential alkalinity changes linearly with salinity between AAIW and NPDW, indicating that changes in the alkalinity is due mainly to mixing between two water masses. This supports the first of the above explanations.

AABW is represented by a point located significantly below the linear trend, and waters below about 3500 meters are represented by a downward hook seen at the extreme right. The observed trend appears to represent mixing between the North Pacific Deep Water located south of the Tuamotu Archipelago and the AABW. The solid circle in each figure indicates the AABW values (θ = 0.6 °C, Salinity = 34.705 PSU, total alkalinity = 2368 ueq/kg, nitrate = 31.7 μmol/kg, potential alkalinity at 35.00 salinity = 2420 μeq/kg, and silicate = 127.1 μmol/kg) observed along the WOCE S-4 section at 67°S and 139.6°W.

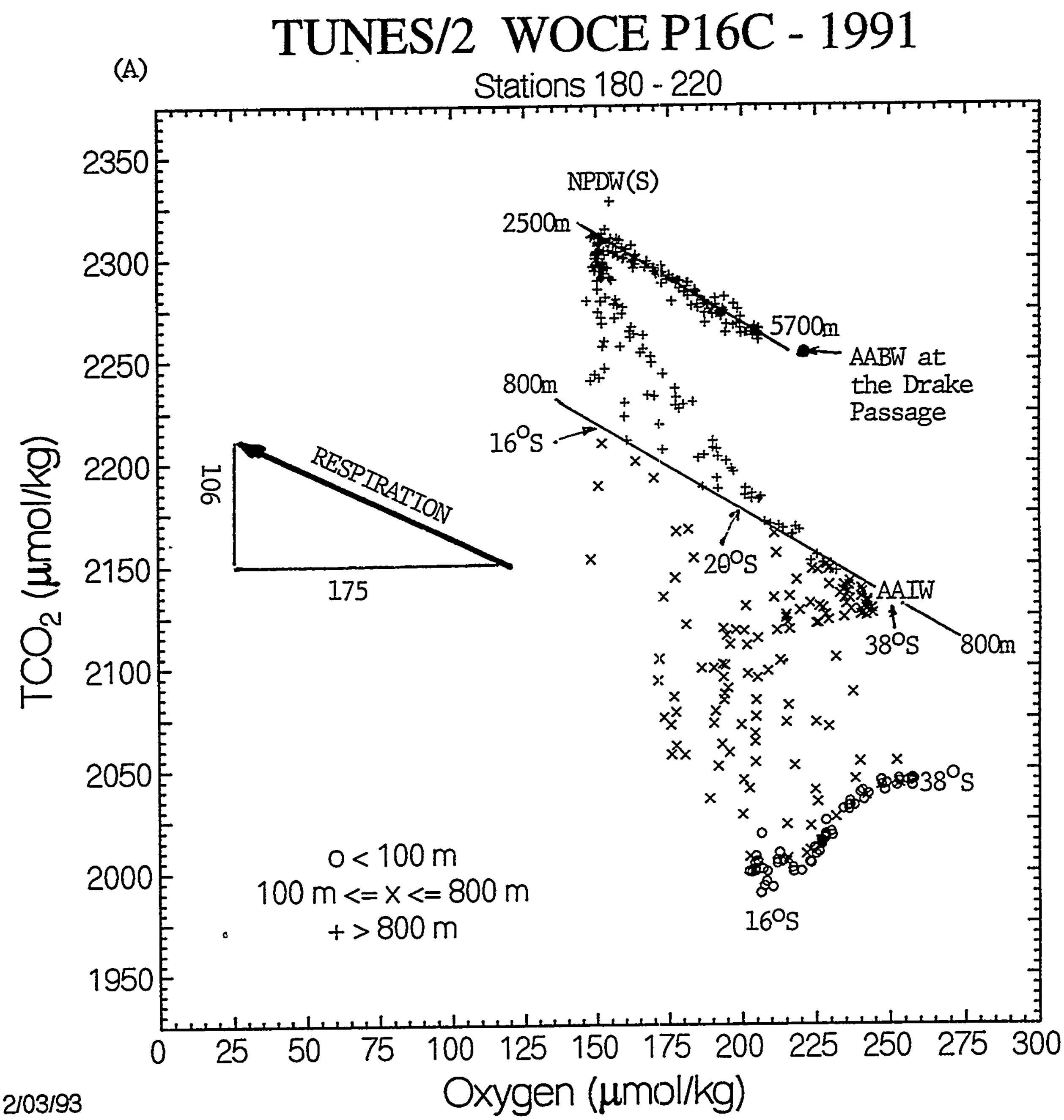
VI-e) Relationships between Phosphate and Nitrate:

The phosphate-nitrate relationships observed along the 150°W and 135°W sections provide insight into the biogeochemical processes occurring in the oceans.

Four approximately linear segments are observed in the phosphate and nitrate plots (Figs. 39-A & B): 1) the surface water segment where nitrate is nearly zero, 2) the main thermocline segment (nitrate concentrations up to 25 μmol/kg), where the N/P ratio is 16.6 and is consistent with the classic Redfield value, 3) the deep water regime (nitrate concentrations between 25 and 35 μmol/kg) where the N/P ratio is about 13.5, and 4) the North Pacific Deep Water and Lower Oxygen-Minimum water regimes (nitrate concentrations above 35 μmol/kg), where the N/P ratio is about 12.3. In addition, a number of data points are located significantly below these trend lines, especially in the 135°W section (Fig. 39-B). Since the deviations far exceed the precision of measurements, they are significant. Those data points which fall below the trend lines are from the Lower Oxygen-Minimum Water of tropical origin and having oxygen values smaller than 160 μmol/kg. Since the magnitude of the deviation and the number of deviating data points increase significantly from west (150°W) to east (135°W), it is concluded that the Lower Oxygen-Minimum Water originated in the eastern tropical Pacific. The observed deviations are due most likely to denitrification processes which occurred in the low oxygen waters of the eastern tropical Pacific. Similar deviations of nitrate from the Redfield N/P ratio have been observed in the low oxygen waters of the Persian Gulf in the Indian Ocean (Takahashi et al, 1985). The observed differences in the slopes of the trend lines may be due to differences in the preformed concentrations of

Fig. 36 - The relationships between the total CO_2 concentration and oxygen in seawater observed along (A) the 150°W (P-16C) and (B) 135°W (P-17C) sections. The arrow indicates the Redfield ratio for the respiration of $-O_2/CO_2 = 175/106$.

(A)



12/03/93

(B)

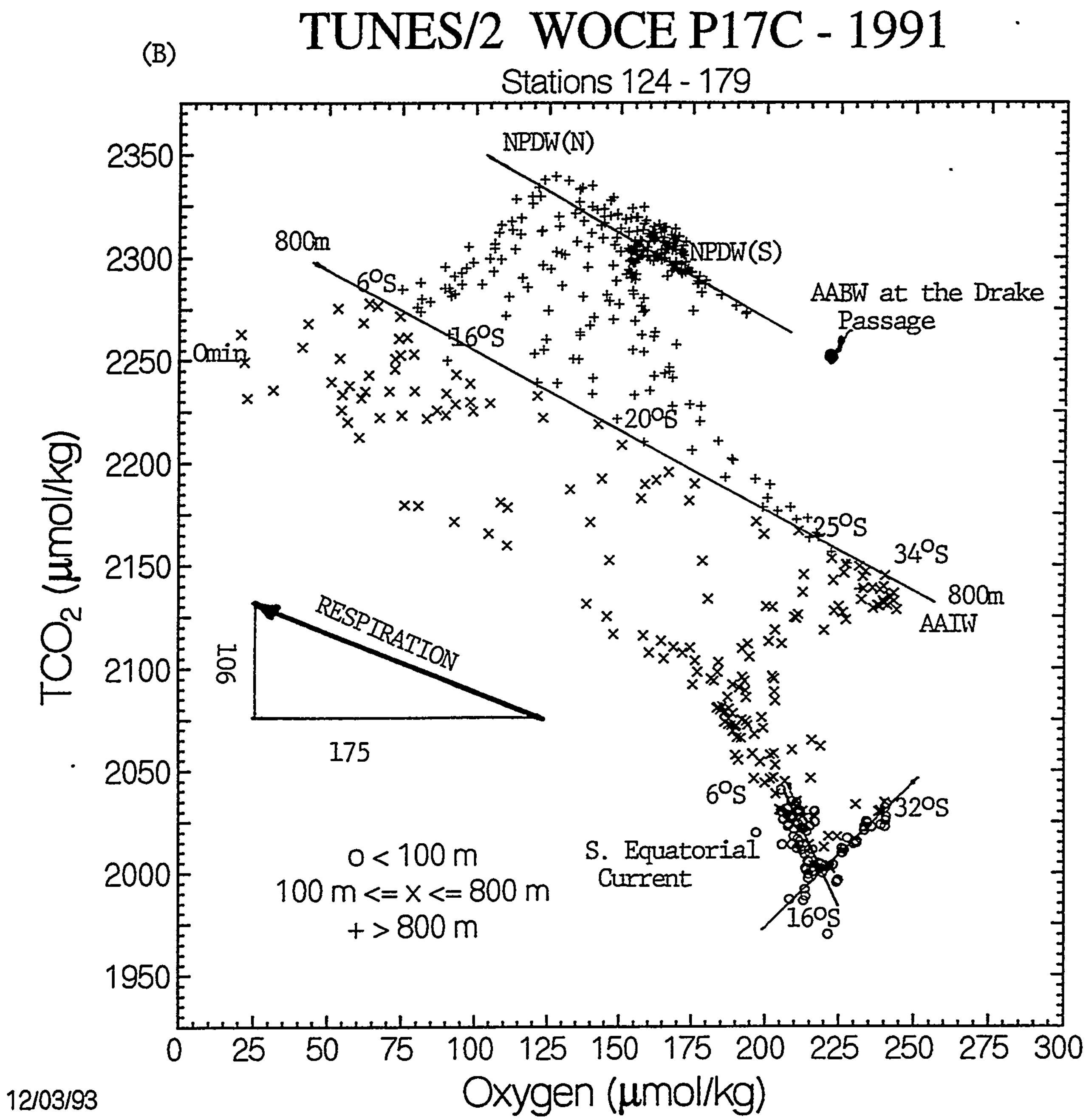
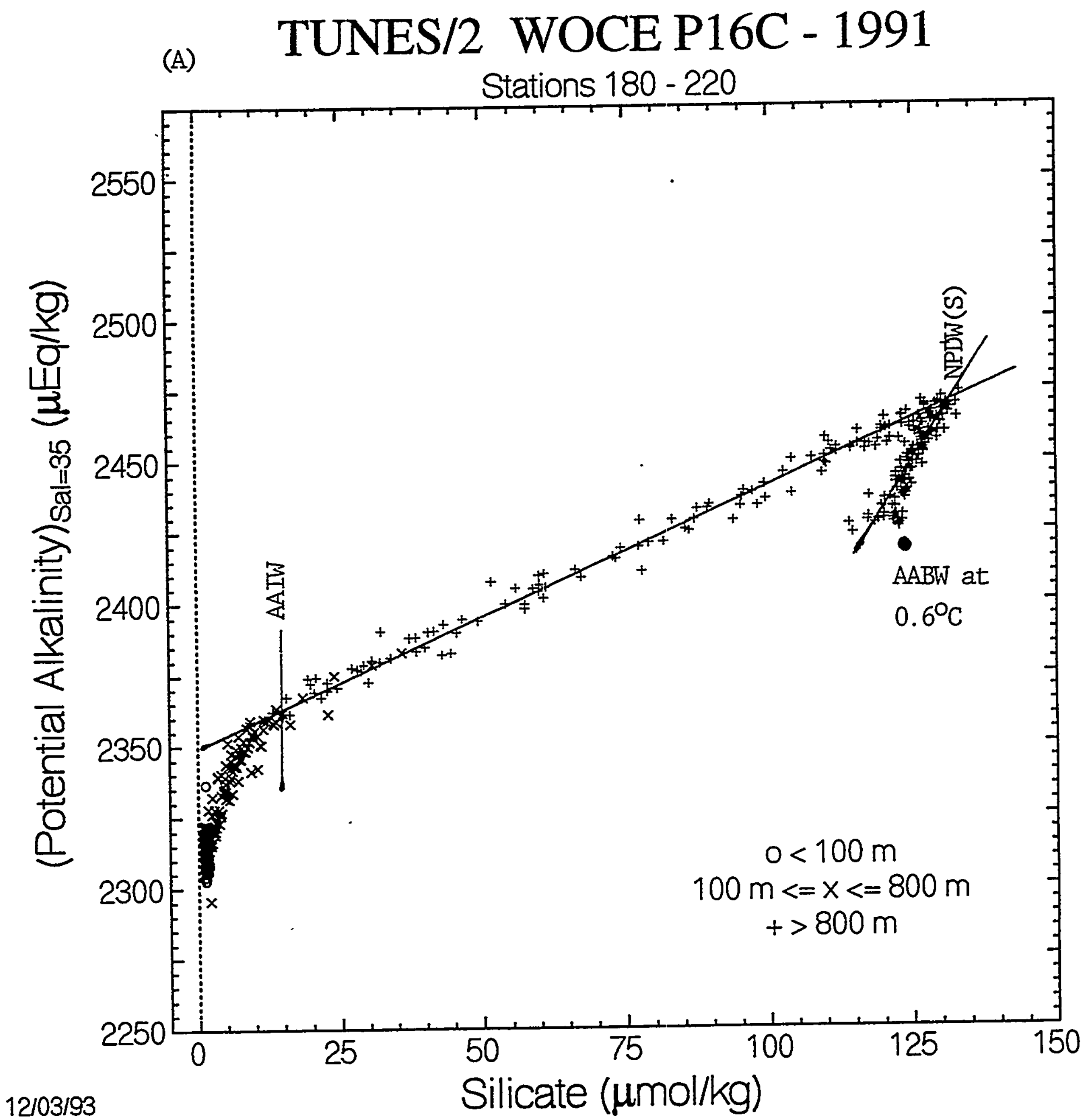

TUNES/2 WOCE P17C - 1991
Stations 124 - 179
NPDW(N)
NPDW(S)
800m
6°S
16°S
20°S
25°S
34°S
800m
AAIW
0min
AABW at the Drake Passage
RESPIRATION
106
175
6°S
32°S
S. Equatorial Current
16°S
o < 100 m
100 m <= x <= 800 m
+ > 800 m
TCO2 (µmol/kg)
Oxygen (µmol/kg)
2350
2300
2250
2200
2150
2100
2050
2000
1950
0
25
50
75
100
125
150
175
200
225
250
275
300
12/03/93

Fig. 37 - The relationships between the potential alkalinity (= (total alkalinity) + (nitrate)) and dissolved silicate in seawater along (A) the 150°W (P-16C) and (B) 135°W (P-17C) sections. The observations made at 67°S and 140°W for the AABW with a potential temperature of 0.6°C are indicated with the solid circles.

(A)



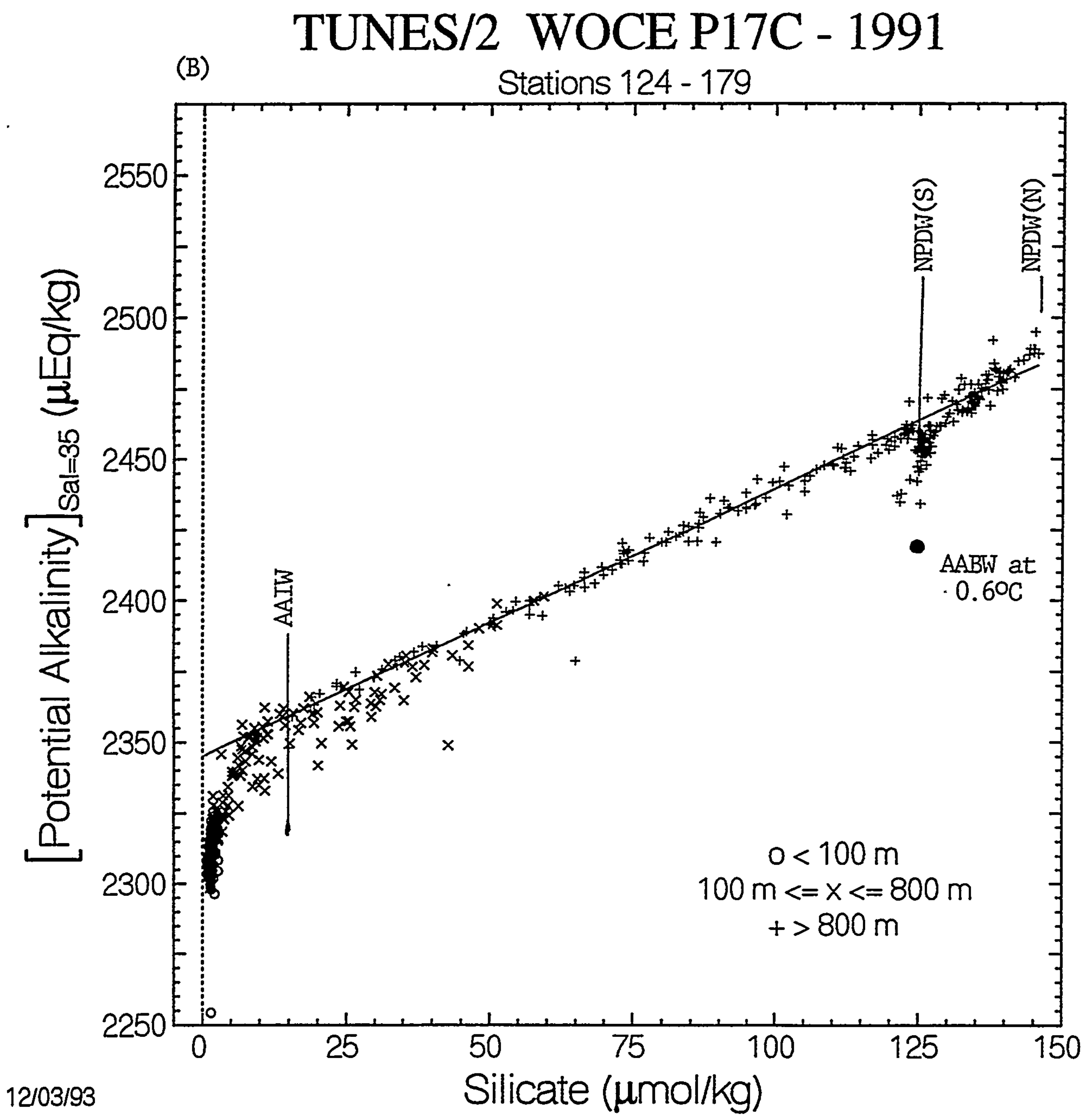
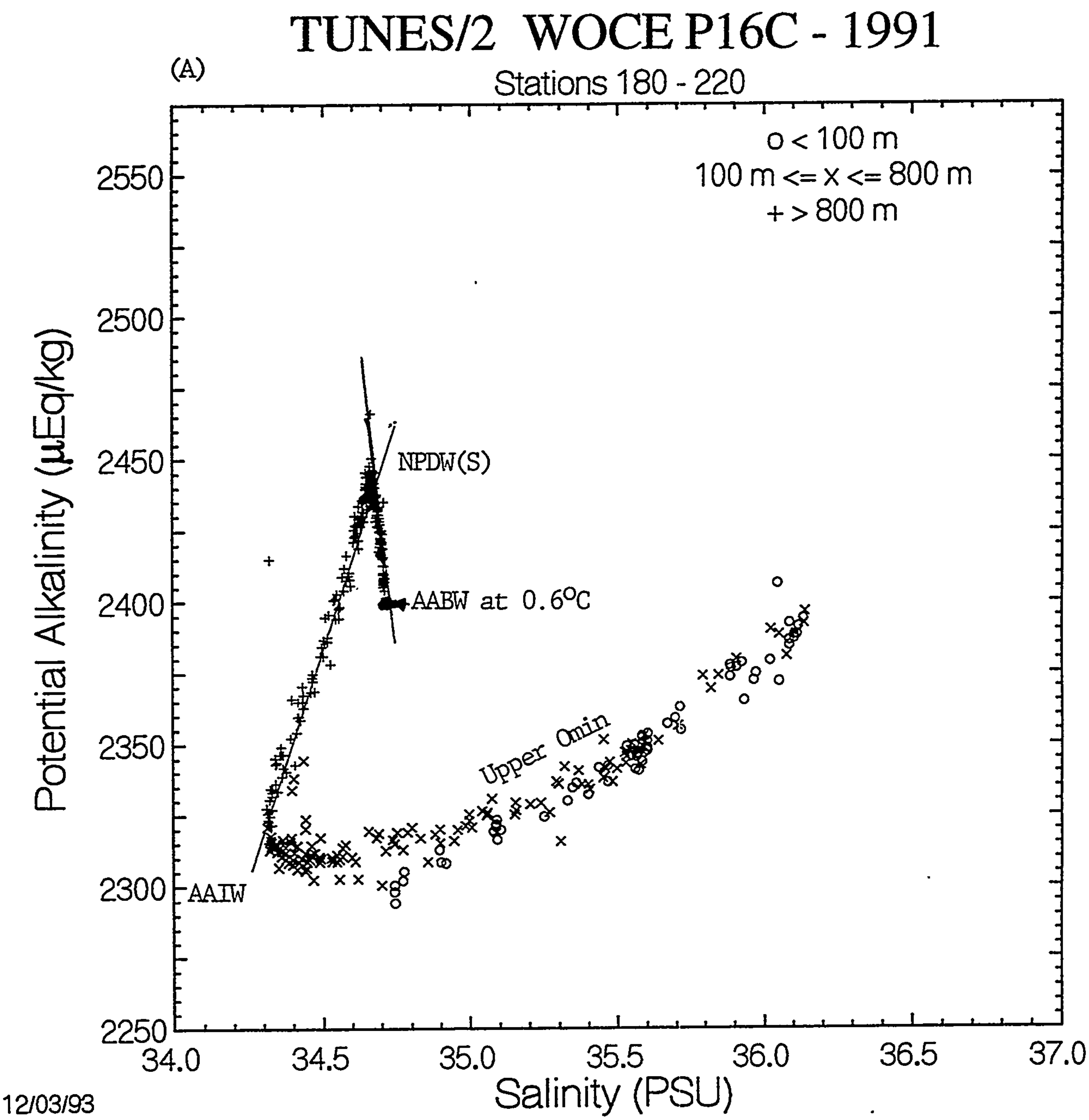

TUNES/2 WOCE P17C - 1991
(B)
Stations 124 - 179
[Potential Alkalinity]Sal=35 (µEq/kg)
2250
2300
2350
2400
2450
2500
2550
0
25
50
75
100
125
150
Silicate (µmol/kg)
AAIW
NPDW(S)
NPDW(N)
AABW at
0.6°C
o < 100 m
100 m <= x <= 800 m
+ > 800 m
12/03/93

Fig. 38 - The relationships between the potential alkalinity and salinity observed along (A) the 150°W (P-16C) and (B) 135°W (P-17C) sections. In the 135°W section, the North Pacific Deep Water located north of the Tuamotu Archipelago, which has been named NPDW(N), is clearly distinguished from that located south of the Archipelago, NPDW(S).



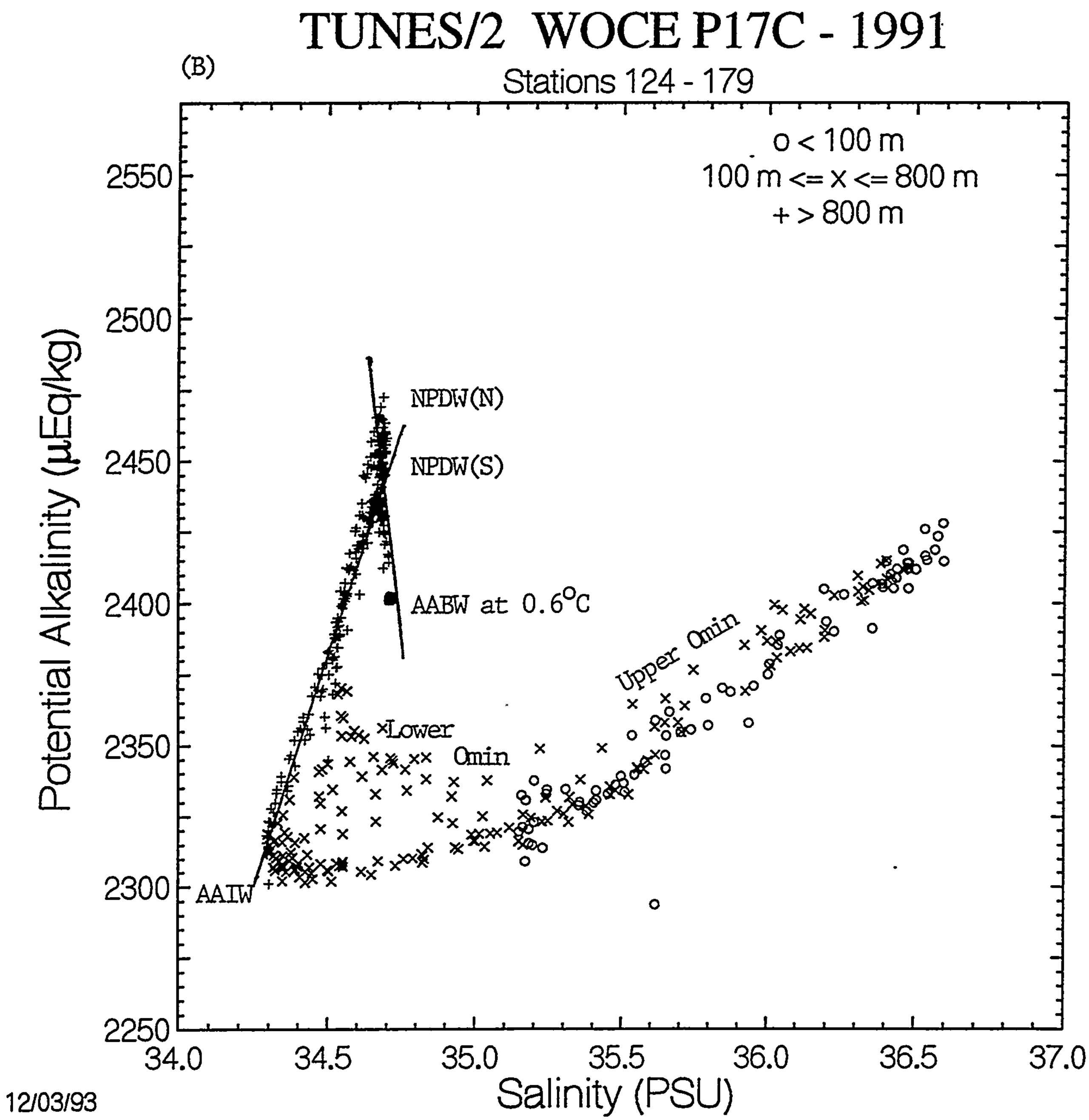
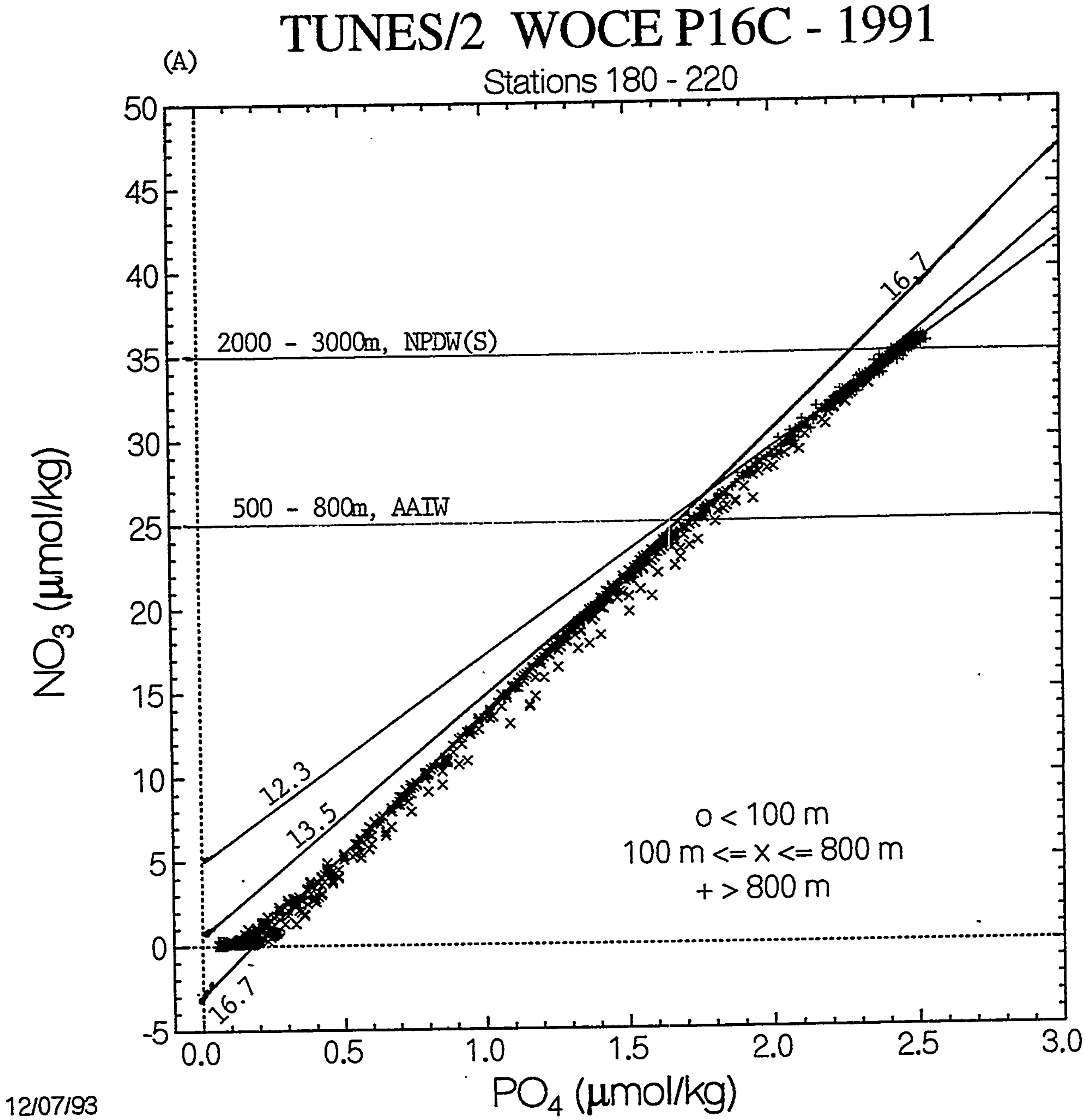
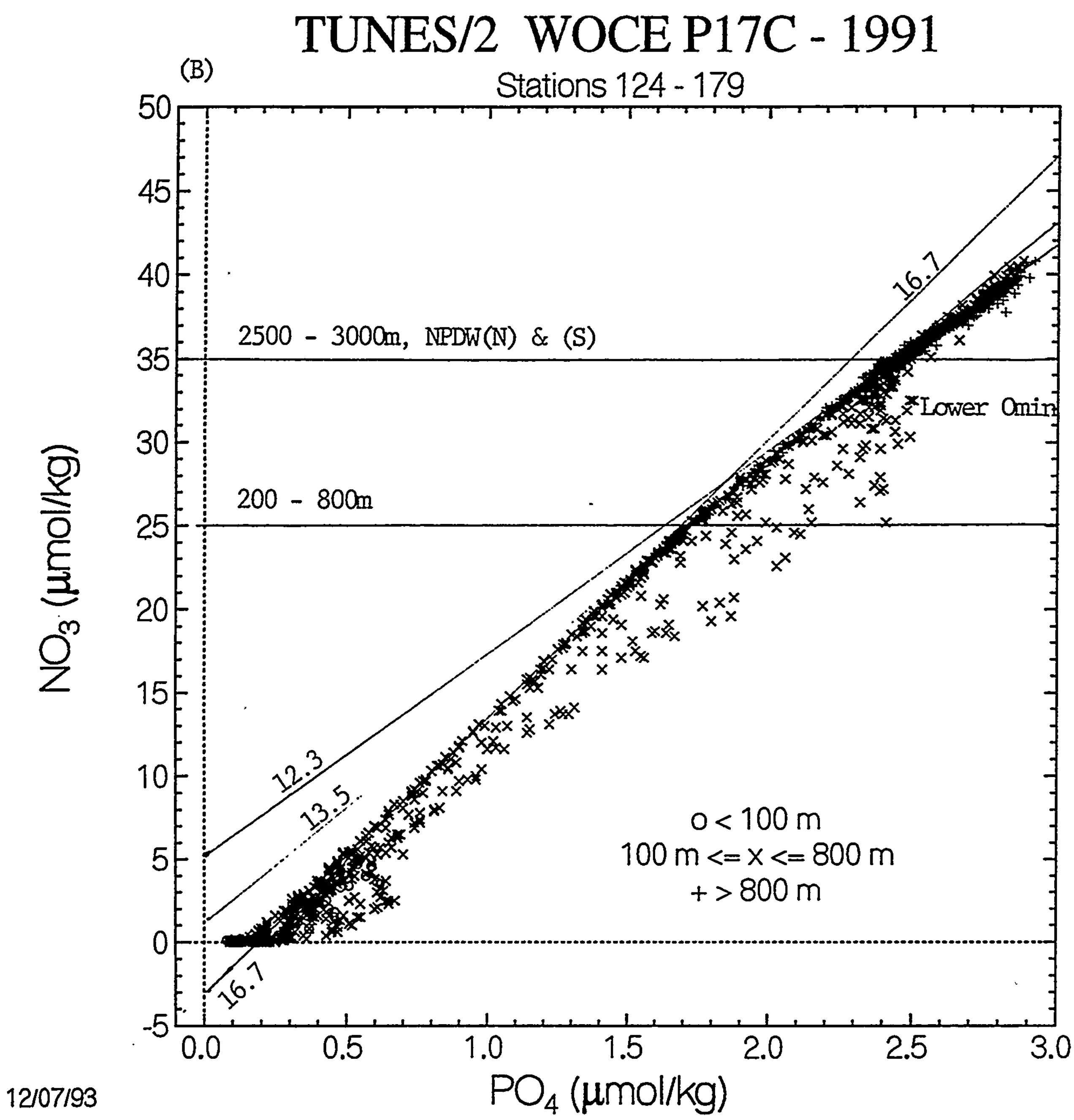

TUNES/2 WOCE P17C - 1991
(B)
Stations 124 - 179
o < 100 m
100 m <= x <= 800 m
+ > 800 m
NPDW(N)
NPDW(S)
AABW at 0.6°C
Upper Omin
Lower
Omin
AAIW
Potential Alkalinity (µEq/kg)
2550
2500
2450
2400
2350
2300
2250
34.0
34.5
35.0
35.5
36.0
36.5
37.0
Salinity (PSU)
12/03/93

Fig. 39 - The relationships between the concentrations of nitrate and phosphate in seawater observed along (A) the 150°W (P-16C) and (B) 135°W (P-17C) sections. The data points located below the linear trends are from the low-oxygen waters from the eastern tropical Pacific.




TUNES/2 WOCE P17C - 1991
(B)
Stations 124 - 179
2500 - 3000m, NPDW(N) & (S)
200 - 800m
Lower Omin
16.7
12.3
13.5
16.7
o < 100 m
100 m <= x <= 800 m
+ > 800 m
NO3 (µmol/kg)
PO4 (µmol/kg)
12/07/93

phosphate and nitrate in the source waters and/or to differences in the remineralization rate of organic debris with varying N/P ratios.

V. SUMMARY AND CONCLUSIONS

1) Measurements for the total CO_2 concentration and pCO_2 in discrete water samples were made along the WOCE P-16C (150°W) and P-17C (135°W) sections in the South Pacific Ocean during the TUNES/2 Expedition. During the 40-day expedition, July 16 through August 25, 1991, the total CO_2 concentration in 1000 seawater samples and the pCO_2 in 940 samples were determined. Using these data, the alkalinity values in 900 water samples were computed. The results are listed along with the hydrographic data in two tables; one for the surface waters and the other for the water columns.

2) During the expedition, 156 coulometric measurements were made for the Certified Reference Solutions (Batch #6) supplied by Andrew Drickson of SIO. Our shipboard measurements yielded a mean value of 2303.2±1.5 μmol/kg, which compares with 2304.6±1.6 μmol/kg (N = 9) determined manometrically by the staff of C. D. Keeling, SIO. Although our values are smaller than the Keeling value by 1.4 μmol/kg, these mean values overlap within one standard deviation. The total CO_2 values listed in this report are based upon our pure CO_2 gas calibration and are not corrected for this difference.

3) The total CO_2 concentration in surface waters increased southward from about 1990 μmol/kg at 6°S to 2050 μmol/kg at 37.5°S. The pCO_2 in the surface water decreased southward from about 410 μatm at 6°S to 290 μatm at 27°S and then increased to 310 μatm at 37.5°S. The mean atmospheric CO_2 concentration in dry air during the expedition was 351.3±1.0 ppm. These data indicate that the tropical waters located north of about 12°S were sources for atmospheric CO_2, whereas the waters located south of this latitude to 37.5°S, the southern extreme of this study, were strong sinks for atmospheric CO_2, with negative ΔpCO_2 values ranging between -40 and -50 μatm.

4) The distribution of the following properties has been presented along the 135°W and 150°W sections; potential temperature, salinity, potential density, the total CO_2 concentration, pCO_2 at 20°C, the alkalinity, the concentration of dissolved oxygen, apparent oxygen utilization, and

the concentrations of phosphate, nitrate and silicate. The positions of the maxima and minima in these properties and their relationships with respective water masses have been identified. The North Pacific Deep Water (NPDW) located north of the Tuamotu Archipelago has been found to have different chemical characteristics in the total CO_2, alkalinity, silicate and oxygen from that located south of the Archipelago. This has been attributed to differences in circulation paths caused by the presence of the high topographic barrier for deep water circulation. The distribution of these chemical properties as well as the other chemical properties in deep waters has been found to be broadly consistent with the geostrophic circulation patterns proposed by Reid (1986).

5) Property-property relationships have been analyzed. The θ-S relationships (Figs. 31 through 33) show the South Equatorial Current water, South Pacific subtropical gyre waters, Eastern South Pacific Central Waters, AAIW, NPDW, AABW. The θ-S trend observed at each station along 135°W and 150°W passes through a common point at sigma-θ density of 25.7 with a temperature of 17.5-18.0°C and salinity of 35.4-35.55 PSU. The waters having this density are found along the base of the seasonal thermocline, and appear to indicate a subtropical Mode Water.

In the upper 1000 meters of water columns located south of about 20°S, the Revelle factor is found to be uniformly 10.0. An alkalinity/total CO_2 concentration relationship has been calculated for a constant Revelle factor in seawater and shows that the CO_2 increase in seawater is due by 8 parts to the oxidation of organic debris and 1 part to the dissolution of calcareous tests.

The N/P ratios observed in the low-oxygen waters are found to be much lower than the general trend observed for well oxygenated waters. This may be attributed to denitrification which occurred in the low oxygen environments in the eastern tropical Pacific.

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IIV. DATA TABLES

IIV-a) Surface Water Data

The following quantities are given in this table. The salinity, temperature, the concentrations of oxygen, phosphate, nitrate and silicates were measured by the staff of ODF/SIO.

Station No.	=	The WOCE station number.
Date	=	Sampling date given in MM/DD/YY.
Lat	=	Latitude in degrees and minutes.
Long	=	Longitude in degrees and minutes.
InSitu Temp	=	The in situ temperature of water in °C.
Sal	=	Salinity in PSU (o/oo).
Seawater pCO2 20 Deg	=	pCO_2 (µatm) in seawater measured at 20.0°C.
Seawater pCO2 inSitu	=	pCO2 (µatm) in seawater corrected to the in situ temperature.
Atmosphere VCO2	=	Mole fraction concentration (ppm) of CO_2 in dry air. Throughout the expedition, the value is taken to be 351.3 ppm which represents the mean of 20 measurements made during this expedition.
Atmosphere pCO2	=	Partial pressure of CO_2 (µatm) in the atmosphere saturated with water vapor at the seawater temperature.
Delta pCO2 sw-air	=	Difference between the pCO_2 in seawater and that in the overlying atmosphere (µatm). Positive values indicate that the seawater is supersaturated with respect to atmospheric CO_2, and negative values indicate that the seawater is undersaturated.
TCO2	=	The total CO_2 concentration in seawater (µmol/kg).
Oxy, PO4, NO3, SiO3	=	The concentrations (µmol/kg) of dissolved oxygen, phosphate, nitrate and silicate in seawater.
Alkalinity Total	=	Total alkalinity (µeq/kg) computed using the total CO_2 concentration and pCO_2 data.
Alkalinity Pot.	=	Potential alkalinity (µeq/kg), [Total alkalinity] + [Nitrate].

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WOCE Line P17 Expedition TUNES/2 WOCE P17C/P16C 1991

Mean VCO2 of Dry Air = 351.3

Pot. Alkalinity = Total Alkalinity + (PO4 x 15.5)

pCO2 of air calculated from VCO2 of dry air at 100% relative humidity using the mean for this leg.

Sta No.	Date MM/DD/YY	Lat DD-MM	Long DDD-MM	InSitu Temp Deg C	Sal o/oo	Seawater pCO2 (uatm) InSitu	Seawater pCO2 (uatm) 20 Deg	Atmosphere VCO2 ppm	Atmosphere pCO2 uatm	Delta pCO2 sw-air uatm	TCO2 - -	Oxy - -	PO4 uM/kg	NO3 - -	SiO3 - -	Alkalinity uEQ/kg Total	Alkalinity uEQ/kg Pot.
124	7/21/91	6- 0S	135- 0W	27.48	35.172	409	298		339	70	1997	215	0.54	4.7	2.7	2326	2334
125	7/22/91	6-30S	135- 0W	27.46	35.241	414	302		339	76	2001	214	0.55	5.0	2.5	2328	2336
126	7/22/91	6-60S	135- 0W	27.55	35.183	401	292		339	63		211	0.49	4.1	2.4		
127	7/22/91	7-30S	135- 0W	27.62	35.160	401	290		339	62	1989	213	0.48	4.2	2.3	2323	2330
128	7/23/91	7-60S	135- 0W	27.82	35.243	393	282		338	54	1989	214	0.47	3.9	2.0	2331	2338
129	7/23/91	8-30S	134-59W	27.69	35.343	387	280		338	49	1987	209	0.45	3.7	1.8	2331	2338
130	7/23/91	9- 0S	135- 0W	27.61	35.636	371	269		339	33	1996	224	0.45	3.5	1.9	2355	2362
131	7/23/91	9-30S	135- 0W	27.63	35.600	378	274		338	39	1998	220	0.45	3.5	1.5	2354	2361
132	7/24/91	10- 2S	134-58W	27.42	35.827	370	270		339	31	2002	216	0.43	3.3	1.5	2363	2370
133	7/24/91	10-29S	134-54W	27.37	35.990	358	263		339	20	2007	215	0.41	2.8	2.0	2383	2389
134	7/25/91	10-59S	134-48W	27.29	36.117						2015	212	0.38	2.3	1.9		
135	7/25/91	11-28S	134-42W	27.20	36.100	354	261		339	16	2001	211	0.38	2.1	2.0		
136	7/25/91	11-58S	134-36W	26.99	35.918						1990	213	0.36	1.9	1.4		
137	7/26/91	12-27S	134-30W	26.91	36.311	350	261		339	11	2023	211	0.32	1.2	2.0	2406	2411
138	7/26/91	12-56S	134-24W	26.88	36.296	343	257		339	4	2018	212	0.33	1.2	1.8	2402	2407
139	7/26/91	13-26S	134-17W	26.73	36.407						2022	214	0.29	0.6	1.7		
140	7/26/91	13-55S	134-11W	27.00	36.438	338	250		339	-1	2020	214	0.26	0.4	2.2	2414	2418
141	7/27/91	14-25S	134- 5W	26.89	36.474	329	248		339	-10	2023	215	0.23	0.1	2.4	2419	2422
142	7/27/91	14-54S	133-59W	26.56	36.532						2023	213	0.23	0.1	1.6		
143	7/28/91	15-23S	133-53W	26.54	36.605	328	248		339	-11		210	0.23	0.1	1.4		
144	7/28/91	15-53S	133-47W	26.51	36.553	338	256		339	-2	2027	209	0.23	0.1	1.5	2417	2420
145	7/28/91	16-22S	133-40W	26.54	36.535	334	253		339	-5	2024	210	0.22	0.1	1.5	2416	2420
146	7/28/91	16-52S	133-34W	26.20	36.596	344	265		340	5	2033	211	0.23	0.1	1.4	2415	2418
147	7/29/91	17-21S	133-28W	26.04	36.576	334	259		340	-6	2034	211	0.21	0.1	1.6	2423	2427
148	7/29/91	17-50S	133-22W	25.77	36.479	330	259		340	-10	2027	209	0.20	0.1	1.5	2413	2416
149	7/29/91	18-20S	133-15W	25.60	36.503	333	263		340	-7	2030	212	0.19	0.0	1.4	2412	2415
150	7/29/91	18-49S	133- 9W	25.63	36.476	345	270		340	5	2030	213	0.19	0.1	1.4	2405	2408
151	7/30/91	19-19S	133- 3W	25.42	36.475	329	262		340	-11	2031		0.18	0.1	1.5	2414	2417
152	7/30/91	19-48S	132-57W	25.35	36.439	329	262		340	-11	2028	216	0.19	0.1	1.9	2410	2413
153	7/30/91	20-17S	132-50W	25.11	36.404	329	264		340	-12	2030	215	0.18	0.0	1.6	2410	2413
154	7/31/91	20-47S	132-44W	24.93	36.358	341	277		340	1	2026	206	0.19	0.1	1.9	2391	2394
155	7/31/91	21-16S	132-37W	24.89	36.394	329	268		340	-11	2030	206	0.19	0.0	1.2	2406	2408
156	7/31/91	21-46S	132-31W	24.29	36.226	328	274		341	-13	2024	208	0.17	0.1	1.4	2390	2393
157	8/ 1/91	22-15S	132-25W	23.25	35.891							213	0.13	0.0	1.5		
158	8/ 1/91	22-42S	132-17W	23.43	35.951	318	275		341	-24	2011	214	0.14	0.1	1.5	2371	2373
159	8/ 1/91	23-14S	132-26W	24.12	36.203	320	269		341	-20	2023	208	0.17	0.1	1.3	2393	2396
160	8/ 1/91	23-43S	132-33W	23.41	36.007	313	271		341	-28	2012	212	0.15	0.1	1.2	2377	2379
161	8/ 2/91	24-12S	132-40W	22.09	35.701	307	281		342	-36	2005	218	0.10	0.0	1.3	2355	2356
162	8/ 2/91	24-41S	132-48W	22.47	35.799	310	280		342	-32	2005	215	0.12	0.1	1.6	2357	2359
163	8/ 2/91	25-11S	132-55W	21.81	35.699							218	0.11	0.1	1.5		

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WOCE Line P17 Expedition TUNES/2 WOCE P17C/P16C 1991

Mean VCO2 of Dry Air = 351.3

Pot. Alkalinity = Total Alkalinity + (PO4 x 15.5)

pCO2 of air calculated from VCO2 of dry air at 100% relative humidity using the mean for this leg.

Sta No.	Date MM/DD/YY	Lat DD-MM	Long DDD-MM	InSitu Temp Deg C	Sal o/oo	Seawater pCO2 (uatm) InSitu	Seawater pCO2 (uatm) 20 Deg	Atmosphere VCO2 ppm	Atmosphere pCO2 uatm	Delta pCO2 sw-air uatm	TCO2 - -	Oxy - -	PO4 uM/kg	NO3 - -	SiO3 - -	Alkalinity uEQ/kg Total	Alkalinity uEQ/kg Pot.
164	8/ 2/91	25-40S	133- 3W	21.57	35.654	304	284		342	-39	2002	219	0.11	0.1	1.5	2347	2349
165	8/ 3/91	26- 7S	133- 5W	20.52	35.576	312	299		343	-31	1970	223	0.10	0.1	1.5	2294	2295
166	8/ 3/91	26-38S	133-18W	20.63	35.581	298	290		343	-45	2004	223	0.11	0.0	1.2	2344	2346
167	8/ 4/91	27- 7S	133-26W	19.55	35.507	300	306		343	-44	2010	226	0.09	0.0	1.7	2337	2338
168	8/ 4/91	27-37S	133-32W	19.12	35.502	309	320		344	-34	2017	227	0.10	0.1	1.4	2334	2335
169	8/ 4/91	28- 6S	133-41W	19.50	35.534	299	305		343	-44	2011	227	0.08	0.1	1.5	2340	2341
170	8/ 5/91	28-35S	133-49W	18.96	35.449	302	316		344	-42	2014	230	0.09	0.1	1.4	2333	2334
171	8/ 5/91	29- 4S	133-56W	18.66	35.412	297	315		344	-46	2015	231	0.09	0.1	1.7	2334	2335
172	8/ 5/91	29-34S	134- 4W	18.05	35.397	304	329		344	-40	2021	234	0.10	0.0	1.5	2330	2331
173	8/ 6/91	30- 3S	134-12W	17.67	35.353	300	331		344	-44	2023	236	0.11	0.1	1.2	2330	2332
174	8/ 6/91	30-32S	134-20W	17.78	35.380	309	340		344	-35	2025	234	0.11	0.1	1.1	2327	2329
175	8/ 6/91	31- 1S	134-28W	16.78	35.170	311	354		345	-34	2026	240	0.13	0.1	0.7	2315	2317
176	8/ 7/91	31-30S	134-36W	16.78	35.167	313	358		345	-32	2023	241	0.12	0.0	1.4	2309	2311
177	8/ 7/91	32- 0S	134-43W	16.63	35.190							243	0.12	0.1	1.1		
178	8/ 7/91	32-29S	134-51W	16.80	35.229	309	353		345	-36	2024	239	0.12	0.1	1.3	2314	2316
179	8/ 8/91	33- 1S	135- 1W	16.48	35.197	307	357		345	-38	2030	241	0.13	0.1	1.1	2319	2321

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Mean VCO2 of Dry Air = 351.3 Pot. Alkalinity = Total Alkalinity + (PO4 x 15.5)

pCO2 of air calculated from VCO2 of dry air at 100% relative humidity using the mean for this leg.

Sta No.	Date MM/DD/YY	Lat DD-MM	Long DDD-MM	InSitu Temp Deg C	Sal o/oo	Seawater pCO2 (uatm) InSitu	Seawater pCO2 (uatm) 20 Deg	Atmosphere VCO2 ppm	Atmosphere pCO2 uatm	Delta pCO2 sw-air uatm	TCO2	Oxy	PO4 uM/kg	NO3	SiO3	Alkalinity uEQ/kg Total	Alkalinity uEQ/kg Pot.
180	8/12/91	37-30S	150-30W	13.38	34.745	314	415		346	-32	2044	257	0.25	0.9	1.5	2296	2300
181	8/12/91	36-60S	150-30W	13.41	34.771	309	408		346	-37	2044	257	0.26	0.8	1.4	2301	2305
182	8/13/91	36-30S	150-30W	13.69	34.776	308	402		346	-38	2044	256	0.25	0.6	1.9	2305	2309
183	8/13/91	36- 0S	150-30W	14.12	34.901	309	397		346	-36	2044	253	0.21	0.5	1.6	2308	2311
184	8/13/91	35-30S	150-30W	14.30	34.918	309	393		346	-37	2042	252	0.20	0.3	1.3	2308	2311
185	8/14/91	35- 0S	150-30W	14.96	35.080	306	379		345	-39	2043	249	0.17	0.1	1.3	2319	2322
186	8/14/91	34-30S	150-30W	15.02	35.092	310	383		345	-35	2042	247	0.18	0.2	1.7	2316	2319
187	8/14/91	34- 0S	150-30W	15.04	35.090	306	378		345	-39	2044	247	0.20	0.3	1.3	2322	2325
188	8/15/91	33-30S	150-30W	15.13	35.104	303	372		345	-43	2039	248	0.17	0.1	1.5	2320	2322
189	8/16/91	32-60S	150-30W	15.93	35.248	306	363		345	-39	2038	243	0.15	0.1	1.8	2324	2327
190	8/16/91	32-30S	150-30W	16.40	35.346	303	352		345	-42	2039	241	0.13	0.1	1.4	2335	2337
191	8/16/91	32- 0S	150-30W	16.52	35.359	301	349		345	-44	2038	240	0.13	0.1	1.3	2336	2338
192	8/16/91	31-30S	150-30W	16.96	35.397	303	344		345	-42	2032	238	0.14	0.2	1.6	2332	2334
193	8/17/91	30-60S	150-31W	17.25	35.436	295	332		345	-49	2032	237	0.11	0.1	1.6	2342	2343
194	8/17/91	30-30S	150-30W	17.38	35.468	300	335		344	-45	2032	236	0.10	0.1	1.7	2339	2341
195	8/17/91	30- 0S	150-31W	17.94	35.524	295	321		344	-50	2030	234	0.08	0.1	1.6	2349	2350
196	8/18/91	29-30S	150-30W	18.73	35.572	296	312		344	-48	2017	230	0.07	0.1	1.2	2341	2342
197	8/18/91	28-60S	150-30W	19.16	35.564	293	304		344	-50	2016	228	0.07	0.1	1.7	2346	2347
198	8/18/91	28-30S	150-30W	19.31	35.587	297	306		344	-46	2017	228	0.08	0.2	1.2	2345	2346
199	8/19/91	27-60S	150-30W	18.97	35.568	295	308		344	-49	2019	230	0.07	0.1	1.8	2347	2348
200	8/19/91	27-30S	150-30W	19.31	35.571	295	304		344	-48	2017	228	0.08	0.0	1.2	2347	2348
201	8/19/91	27- 0S	150-30W	19.99	35.578	288	286		343	-56	2008	226	0.08	0.1	1.0	2353	2354
202	8/20/91	26-30S	150-30W	19.73	35.584	294	297		343	-50	2012	226	0.07	0.3	1.4	2347	2348
203	8/20/91	25-60S	150-30W	19.73	35.585	292	296		343	-51	2015	227	0.07	0.1	1.5	2352	2353
204	8/20/91	25-30S	150-30W	20.02	35.591	293	290		343	-51	2011	225	0.08	0.1	1.5	2353	2355
205	8/20/91	25- 0S	150-30W	21.80	35.690	294	271		342	-49	2000	218	0.10	0.1	1.6	2359	2360
206	8/21/91	24-30S	150-30W	21.35	35.636	294	278		343	-49	2002	222	0.08	0.2	1.4	2354	2355
207	8/21/91	24- 0S	150-30W	21.90	35.700	299	275		342	-43	2000	218	0.09	0.2	1.6	2355	2356
208	8/21/91	23-30S	150-30W	22.09	35.700	295	269		342	-47	2002	217	0.08	0.1	1.5	2363	2364
209	8/21/91	23- 0S	150-30W	22.73	35.843	303	265		342	-39	2009	214	0.12	0.1	1.4	2377	2379
210	8/22/91	22-30S	150-30W	23.47	35.906	302	261		341	-40	2005	212	0.13	0.1	1.7	2377	2379
211	8/22/91	22- 1S	150-30W	23.73	35.910	306	258		341	-35	1992	210	0.13	0.1	0.9	2365	2367
212	8/23/91	21-30S	150-30W	24.56	35.960	309	255		341	-31	1995	209	0.15	0.1	1.5	2372	2374
213	8/23/91	21- 0S	150-30W	25.13	36.049	311	251		340	-29	2004	206	0.16	0.1	1.3	2389	2391
214	8/23/91	20-30S	150-30W	24.91	35.993	317	256		340	-24	2001	208	0.15	0.1	0.9	2379	2381
215	8/24/91	20- 0S	150-30W	25.42	36.111	319	253		340	-21	2005	205	0.17	0.1	1.0	2388	2391
216	8/24/91	19-30S	150-30W	25.69	36.085	319	251		340	-21	2001	205	0.18	0.2	1.4	2385	2388
217	8/24/91	19- 0S	150-30W	25.41	36.105	320	254		340	-20	2004	205	0.17	0.1	1.4	2387	2390
218	8/24/91	18-30S	150-30W	25.44	36.131	316	251		340	-24	2007	205	0.17	0.1	1.2	2394	2397
219	8/25/91	18- 0S	150-30W	26.11	36.096	321	247		340	-18	1999	204	0.19	0.1	1.1	2388	2391
220	8/25/91	17-30S	150-30W	26.43	36.113	322	245		339	-17	2000	202	0.19	0.2	1.2	2391	2394

IIV-b) Hydrographic and CO_2 Chemistry Data

The following hydrographic and CO_2 chemistry data are listed in this table for each station. The station number, positions, date of station occupation and the sea floor depth (m) are listed in each heading. The temperature, salinity and the concentrations of dissolved oxygen, phosphate, nitrate and silicate were measured by the staff of ODF/SIO.

Bot No.	=	Niskin bottle number of each sample.
Depth m	=	Depth (meters) of sample computed from the measured pressure.
Temp deg C	=	Temperature of water (°C).
Pot Temp deg C	=	Potential temperature of water (°C) computed for the sea surface.
Salinity o/oo	=	Measured salinity (PSU).
Sigma Theta	=	Potential density (ppt) of seawater at sea surface.
Oxy, PO4, NO3, SiO3	=	Measured concentrations (μmol/kg) of dissolved oxygen, phosphate, nitrate and silicate in seawater.
AOU	=	Apparent oxygen utilization (μmol/kg) computed for the potential temperature.
TCO2 Obs and S=35	=	The total CO_2 concentration (μmol/kg) dissolved in seawater observed and normalized to a salinity of 35.00 PSU.
pCO2 @20 and @Theta	=	pCO_2 in seawater (μatm) observed at 20.0°C and that corrected to the potential temperature.
Total Alk. Calc	=	Total alkalinity (μeq/kg) computed using the measured total CO_2 concentration and pCO_2 at 20.0°C.
(PALK)s	=	Potential alkalinity (=[total alkalinity]+[nitrate]) normalized to a salinity of 35.00 PSU.

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(TCO2)s=35 = TCO2 obs X (35 / Sal)　　(PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C　Station 124　Latitude 6-00.3S　Longitude 135-00.2W　Date 7/21/91　Bottom Depth 4562

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	(PALK)s (uEq/kg)
101	1	27.	27.	35.	22.	21x	-1x	0.	4.	2.	1997	1988	298	409	2326	2319
102	53	27.	27.	35.	22.	21x	-1x	0.	4.	2.	1999	1989	313	428	2316	2308
103	78	27.	27.	35.	22.	21x	-1x	0.	4.	2.	2002	1991	298	407	2333	2324
104	97	27.	27.	35.	22.	20x	-1x	0.	4.	2.	2014	1987	318	434	2332	2305
105	113	25.	25.	35.	23.	19x	x	0.	3.	2.	2046	1990	305	391	2387	2325
106	128	24.	24.	36.	24.	18x	2x	0.	2.	2.	2079	2020	359	430	2384	2318
107	154	20.	20.	35.	25.	15x	6x	0.	7.	2.	2116	2072	455	458	2369	2327
108	180	16.	16.	35.	25.	7x	16x	1.	18.	8.	2180	2166	782	663	2330	2334
109	214	12.	12.	34.	26.	2x	23x	2.	28.	20.	2232	2236	1276	938	2309	2342
110	264	11.	11.	34.	26.	3x	23x	2.	31.	26.	2236	2246	1330	921	2307	2349
111	305	10.	10.	34.	26.	2x	24x	2.	33.	29.	2249	2263	1420	960	2312	2359
112	379	9.	9.	34.	26.	2x	25x	2.	36.	35.	2263	2282	1603	1023	2309	2365
113	451	8.	8.	34.	26.	4x	24x		36.	36.	2257	2279	1448	889		
114	552	7.	7.	34.	27.	4x	24x	2.	38.	43.	2268	2294	1604	944	2315	2381
115	651	6.	6.	34.	27.	5x	24x	2.	39.	51.	2276	2304	1536	869	2329	2399
116	750	5.	5.	34.	27.	6x	23x	2.	39.	59.	2277	2307	1537	842	2330	2401
117	901	4.	4.	34.	27.	8x	22x	2.	39.	73.	2288	2318	1470	775	2349	2420
118	1046	4.	4.	34.	27.	8x	22x	2.	38.	86.	2296	2326	1440	738	2361	2431
119	1191	3.	3.	34.	27.	9x	22x	2.	38.	96.	2305	2334	1418	711	2374	2443
120	1380	3.	3.	34.	27.	10x	21x		38.	107.	2312	2340	1355	665		
121	1566	2.	2.	34.	27.	11x	21x		37.	116.	2318	2344	1360	656		
122	1762	2.	2.	34.	27.	11x	21x	2.	37.	126.	2328	2354	1348	641	2407	2472
123	1964	2.	2.	34.	27.	11x	21x	2.	37.	131.	2330	2354	1325	623	2411	2475
124	2160	2.	1.	34.	27.	12x	21x	2.	37.	138.	2334	2358	1298	606	2419	2482
125	2307	2.	1.	34.	27.	12x	21x	2.	37.	142.	2338	2361	1300	603	2423	2485
126	2458	1.	1.	34.	27.	12x	20x	2.	37.	144.	2339	2362	1274	588	2428	2489
127	2605	1.	1.	34.	27.	13x	20x	2.	36.	145.	2337	2360	1252	576	2429	2489
128	2754	1.	1.	34.	27.	13x	20x	2.	36.	145.	2333	2355	1224	562	2428	2488
129	2952	1.	1.	34.	27.	14x	19x		36.	146.	2335	2357	1203	550		
130	3144	1.	1.	34.	27.	14x	19x		35.	144.	2329	2351	1153	525		
131	3342	1.	1.	34.	27.	15x	18x	2.	35.	144.	2324	2345	1138	516	2429	2487
133	3640	1.	1.	34.	27.	15x	18x	2.	35.	145.	2324	2345	1091	493	2437	2495
132	3640	1.	1.	34.	27.											
134	3936	1.	1.	34.	27.	16x	17x	2.	35.	143.	2316	2336	1085	488	2428	2485
135	4238	1.	1.	34.	27.	17x	16x	2.	34.	138.	2306	2326	1077	483	2418	2474
136	4489	1.	1.	34.	27.	17x	16x	2.	34.	137.	2307	2328	1084	486	2419	2475

WOCE Line P17C　Station 125　Latitude 6-29.9S　Longitude 135-00.0W　Date 7/22/91　Bottom Depth 4475

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	(PALK)s (uEq/kg)
101	0	27.	27.	35.	22.	21x	-1x	0.	5.	2.	2001	1988	302	414	2328	2317
102	51	27.	27.	35.	22.	21x	-1x	0.	5.	2.						
103	77	27.	27.	35.	22.	21x	-1x	0.	5.	2.						
104	97	27.	27.	35.	22.	21x	-1x	0.	5.	2.						
105	113	26.	26.	35.	23.	19x	x	0.	3.	1.						
106	128	24.	24.	36.	24.	18x	2x	0.	2.	1.						
107	154	20.	20.	35.	25.	16x	6x	0.	7.	1.						
108	179	16.	16.	35.	25.	7x	16x	1.	18.	8.						
109	206	13.	13.	34.	26.	x	25x	2.	25.	22.						
110	266	11.	11.	34.	26.	2x	24x	2.	31.	25.						
111	306	11.	11.	34.	26.	2x	24x	2.	32.	27.						
112	366	10.	10.	34.	26.	1x	25x	2.	35.	32.						
113	428	9.	9.	34.	26.	3x	24x	2.	36.	34.						
114	489	8.	8.	34.	26.	4x	24x	2.	37.	37.						
115	549	7.	7.	34.	27.	6x	22x	2.	36.	39.						
116	609	7.	7.	34.	27.	7x	22x	2.	37.	42.						
117	729	6.	6.	34.	27.	7x	23x	2.	39.	54.						
118	911	4.	4.	34.	27.	8x	22x	2.	39.	71.						
119	1112	4.	4.	34.	27.	9x	22x	2.	39.	90.						
120	1314	3.	3.	34.	27.	10x	21x	2.	38.	102.						
121	1515	3.	2.	34.	27.	10x	21x	2.	38.	112.						
122	1719	2.	2.	34	27.	10x	22x	2.	38.	126.						
123	1921	2.	2.	34.	27.	11x	21x	2.	37.	133.						
124	2125	2.	1.	34.	27.	12x	21x	2.	37.	136.						
125	2328	1.	1.	34.	27.	12x	20x	2.	37.	141.						
126	2532	1.	1.	34.	27.	13x	20x	2.	36.	142.						
127	2736	1.	1.	34.	27.	13x	19x	2.	36.	144.						
128	2939	1.	1.	34.	27.	14x	19x	2.	36.	143.						
129	3138	1.	1.	34.	27.	14x	18x	2.	35.	146.						
130	3335	1.	1.	34.	27.	15x	18x	2.	35.	144.						
131	3530	1.	1.	34.	27.	15x	18x	2.	35.	144.						
132	3726	1.	1.	34.	27.	16x	17x	2.	35.	142.						
133	3921	1.	1.	34.	27.	16x	17x	2.	34.	139.						
134	4117	1.	1.	34.	27.	17x	16x	2.	34.	138.						
135	4313	1.	1.	34.	27.	17x	16x	2.	34.	137.						
136	4464	1.	1.	34.	27.	17x	16x	2.	34.	137.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C Station 126 Latitude 6-59.9S Longitude 135-00.2W Date 7/22/91 Bottom Depth 4393

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	0	27.	27.	35.	22.	21x	-1x	0.	4.	2.			292	401		
102	42	27.	27.	35.	22.	21x	-1x	0.	4.	2.						
103	82	27.	27.	35.	23.	20x	-x	0.	4.	2.						
104	96	26.	26.	35.	23.	19x	x	0.	3.	2.						
105	116	25.	25.	36.	24.	18x	2x	0.	2.	2.						
106	136	20.	20.	35.	25.											
107	155	19.	19.	35.	25.	14x	8x	0.	10.	3.						
108	175	18.	18.	35.	25.	13x	10x	1.	11.	4.						
109	199	15.	15.	35.	25.	9x	15x	1.	17.	8.						
110	249	12.	12.	34.	26.	1x	24x	2.	29.	21.						
111	299	11.	11.	34.	26.	3x	23x	2.	31.	25.						
112	348	10.	10.	34.	26.	3x	23x	2.	33.	28.						
113	399	9.	9.	34.	26.	3x	24x	2.	34.	31.						
114	458	8.	8.	34.	26.	5x	23x	2.	35.	33.						
115	536	8.	8.	34.	26.	6x	22x	2.	35.	36.						
116	636	7.	6.	34.	27.	7x	21x	2.	37.	43.						
117	759	5.	5.	34.	27.	7x	22x	2.	39.	54.						
118	900	4.	4.	34.	27.	8x	22x	2.	39.	69.						
119	1094	4.	3.	34.	27.	10x	21x	2.	38.	88.						
120	1291	3.	3.	34.	27.	10x	21x	2.	38.	103.						
121	1494	2.	2.	34.	27.	10x	21x	2.	38.	115.						
122	1699	2.	2.	34.	27.	10x	22x	2.	38.	126.						
123	1899	2.	2.	34.	27.	11x	21x	2.	38.	133.						
124	2100	2.	2.	34.	27.	12x	21x	2.	37.	136.						
125	2306	1.	1.	34.	27.	12x	20x	2.	37.	140.						
126	2509	1.	1.	34.	27.	13x	20x	2.	37.	143.						
127	2712	1.	1.	34.	27.	13x	20x	2.	36.	145.						
128	2914	1.	1.	34.	27.	14x	19x	2.	36.	144.						
129	3115	1.	1.	34.	27.	15x	18x	2.	36.	143.						
130	3319	1.	1.	34.	27.	15x	18x	2.	35.	145.						
131	3524	1.	1.	34.	27.	15x	18x	2.	35.	145.						
132	3725	1.	1.	34.	27.	15x	18x	2.	35.	145.						
133	3927	1.	1.	34.	27.	16x	17x	2.	35.	143.						
134	4129	1.	1.	34.	27.	17x	17x	2.	34.	138.						
135	4325	1.	1.	34.	27.	17x	16x	2.	34.	138.						
136	4381	1.	1.	34.	27.			2.	34.	137.						

WOCE Line P17C Station 127 Latitude 7-30.2S Longitude 135-00.1W Date 7/22/91 Bottom Depth 4400

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	10	27.	27.	35.	22.	21x	-1x	0.	4.	2.	1986	1977	293	405	2317	2311
102	38	27.	27.	35.	22.	21x	-1x	0.	4.	2.	1992	1983	288	397	2328	2322
103	78	28.	28.	35.	23.	20x	-1x	0.	3.	1.	2014	1966	282	397	2367	2314
104	93	26.	26.	35.	23.	19x	x	0.	3.	2.	2020	1967	304	404	2354	2296
105	107	25.	25.	36.	24.	19x	1x	0.	2.	1.	2058	1997	312	392	2395	2328
106	126	24.	24.	36.	24.	18x	2x	0.	2.	1.	2074	2010	340	411	2392	2320
107	154	22.	22.	36.	24.	17x	4x	0.	5.	1.	2108	2048	396	436	2394	2331
108	185	18.	18.	35.	25.	13x	9x	0.	10.	3.	2132	2099	525	498	2354	2329
109	226	14.	14.	35.	26.	8x	17x	1.	19.	9.	2179	2177	831	654	2319	2335
110	275	11.	11.	34.	26.	5x	21x	2.	27.	19.	2226	2236	1141	806	2319	2357
111	326	10.	10.	34.	26.	6x	20x	2.	30.	25.	2222	2237	1166	771	2311	2357
112	371	9.	9.	34.	26.	5x	22x	2.	32.	29.	2238	2256	1301	837	2312	2364
113	416	9.	9.	34.	26.	5x	22x	2.	34.	32.	2251	2272	1345	845	2322	2377
114	462	8.	8.	34.	26.	6x	22x	2.	34.	33.	2243	2265	1357	837	2311	2369
115	508	8.	8.	34.	26.	7x	21x	2.	34.	35.	2246	2270	1329	801	2318	2378
116	584	7.	7.	34.	27.	7x	21x	2.	36.	40.	2253	2279	1388	812	2319	2383
117	709	6.	6.	34.	27.	7x	22x	2.	38.	51.	2261	2291	1452	808	2322	2391
118	857	5.	5.	34.	27.	7x	23x	2.	40.	66.	2285	2316	1558	830	2337	2410
119	1105	4.	3.	34.	27.	9x	22x	2.	39.	87.	2295	2325	1451	736	2359	2430
120	1298	3.	3.	34.	27.	10x	21x	2.	38.	101.	2307	2335	1384	684	2379	2447
121	1494	2.	2.	34.	27.	10x	21x	2.	38.	114.	2316	2343	1397	677	2388	2455
122	1690	2.	2.	34.	27.	11x	21x	2.	38.	122.	2319	2345	1350	644	2397	2462
123	1881	2.	2.	34.	27.	11x	21x	2.	37.	129.	2326	2351	1322	623	2408	2472
124	2067	2.	2.	34.	27.	12x	21x	2.	37.	135.	2330	2354	1305	611	2414	2477
125	2255	2.	1.	34.	27.	13x	20x	2.	36.	134.	2321	2345	1250	580	2411	2473
126	2448	1.	1.	34.	27.	13x	20x	2.	36.	140.	2327	2349	1227	566	2421	2481
127	2649	1.	1.	34.	27.	13x	20x	2.	36.	144.	2334	2356	1220	560	2429	2489
128	2843	1.	1.	34.	27.	14x	19x	2.	36.	145.						
129	3036	1.	1.	34.	27.	14x	19x	2.	36.	144.	2328	2349	1173	535	2429	2488
130	3241	1.	1.	34.	27.	15x	18x	2.	35.	140.						
131	3434	1.	1.	34.	27.	15x	18x	2.	35.	141.	2316	2337	1133	513	2422	2479
132	3628	1.	1.	34.	27.	16x	17x	2.	35.	142.						
133	3835	1.	1.	34.	27.	16x	17x	2.	35.	140.	2314	2335	1095	493	2425	2482
134	4030	1.	1.	34.	27.	16x	17x	2.	34.	139.	2310	2331	1093	492	2421	2477
135	4247	1.	1.	34.	27.	17x	16x	2.	34.	137.	2303	2323	1090	490	2413	2469
136	4352	1.	1.	34.	27.	17x	16x	2.	34.	136.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C Station 128 Latitude 7-59.9S Longitude 135-00.0W Date 7/23/91 Bottom Depth 4525

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	0	27.	27.	35.	22.	21x	-1x	0.	3.	2.	1989	1975	282	393	2331	2318
102	52	27.	27.	35.	22.	21x	-1x	0.	3.	1.						
103	75	28.	28.	35.	23.	20x	-1x	0.	3.	1.						
104	102	26.	26.	36.	23.	20x	-x	0.	2.	2.						
105	143	22.	22.	36.	24.	17x	3x	0.	3.	1.						
106	184	19.	18.	35.	25.	15x	6x	0.	8.	2.						
107	230	13.	13.	34.	26.	6x	18x	1.	20.	12.						
108	282	11.	11.	34.	26.	3x	23x	2.	29.	23.						
109	332	10.	10.	34.	26.	4x	22x	2.	32.	28.						
110	382	9.	9.	34.	26.	5x	22x	2.	33.	30.						
111	459	8.	8.	34.	26.	6x	21x	2.	34.	33.						
112	533	7.	7.	34.	27.	6x	23x	2.	37.	39.						
113	584	7.	7.	34.	27.	6x	23x	2.	38.	42.						
114	661	6.	6.	34.	27.	7x	22x	2.	38.	48.						
115	764	5.	5.	34.	27.	7x	23x	2.	40.	57.						
116	866	5.	4.	34.	27.	8x	22x	2.	40.	68.						
117	966	4.	4.	34.	27.	8x	22x	2.	39.	76.						
118	1069	4.	4.	34.	27.	9x	21x	2.	38.	86.						
119	1170	3.	3.	34.	27.	10x	21x	2.	38.	93.						
120	1322	3.	3.	34.	27.	10x	21x	2.	38.	103.						
121	1523	2.	2.	34.	27.	11x	21x	2.	38.	114.						
122	1724	2.	2.	34.	27.	12x	20x	2.	37.	120.						
123	1927	2.	2.	34.	27.	12x	20x	2.	37.	127.						
124	2131	2.	1.	34.	27.	13x	20x	2.	36.	130.						
125	2337	1.	1.	34.	27.			2.	36.	135.						
126	2539	1.	1.	34.	27.	13x	19x	2.	36.	141.						
127	2739	1.	1.	34.	27.	13x	19x	2.	36.	144.						
128	2941	1.	1.	34.	27.	14x	19x	2.	36.	144.						
129	3145	1.	1.	34.	27.	15x	18x	2.	35.	142.						
130	3350	1.	1.	34.	27.	15x	18x	2.	35.	141.						
131	3554	1.	1.	34.	27.	15x	18x	2.	35.	141.						
132	3757	1.	1.	34.	27.	16x	17x	2.	35.	141.						
133	3958	1.	1.	34.	27.	16x	17x	2.	34.	140.						
134	4162	1.	1.	34.	27.	17x	17x	2.	34.	138.						
135	4366	1.	1.	34.	27.	17x	16x	2.	34.	137.						
136	4506	1.	1.	34.	27.	17x	16x	2.	34.	137.						

WOCE Line P17C Station 129 Latitude 8-30.4S Longitude 134-59.3W Date 7/23/91 Bottom Depth 4449

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
201	0	27.	27.	35.	22.	20x	-1x	0.	3.	1.	1987	1970	280	387	2331	2314
202	43	27.	27.	35.	22.	20x	-1x	0.	3.	1.						
203	67	27.	27.	36.	23.	20x	-1x	0.	1.	1.						
204	97	26.	26.	36.	23.	19x	x	0.	2.	1.						
205	118	24.	24.	36.	24.	18x	1x	0.	2.	1.						
206	144	22.	22.	36.	24.	17x	3x	0.	3.	2.						
207	184	19.	19.	35.	25.	16x	5x	0.	6.	2.						
208	226	16.	16.	35.	25.	11x	12x	1.	13.	5.						
209	266	12.	12.	34.	26.											
210	286	11.	11.	34.	26.	2x	24x	2.	29.	23.						
211	347	10.	9.	34.	26.	5x	22x	2.	32.	27.						
212	408	9.	9.	34.	26.	6x	21x	2.	33.	30.						
213	485	8.	8.	34.	26.	6x	21x	2.	34.	35.						
237	560	7.	7.	34.	27.	6x	22x	2.	36.	38.						
215	662	6.	6.	34.	27.	7x	22x	2.	38.	46.						
216	763	5.	5.	34.	27.	7x	22x	2.	39.	58.						
217	865	5.	4.	34.	27.	9x	21x	2.	39.	67.						
218	966	4.	4.	34.	27.	9x	21x	2.	39.	78.						
219	1119	3.	3.	34.	27.	10x	21x	2.	38.	88.						
220	1322	3.	3.	34.	27.	11x	21x	2.	38.	102.						
221	1524	2.	2.	34.	27.	11x	21x	2.	38.	113.						
222	1729	2.	2.	34.	27.	12x	20x	2.	37.	121.						
223	1931	2.	2.	34.	27.	12x	20x	2.	37.	127.						
224	2135	2.	1.	34.	27.	13x	20x	2.	37.	132.						
225	2336	1.	1.	34.	27.	13x	19x	2.	36.	137.						
226	2538	1.	1.	34.	27.	14x	19x	2.	36.	139.						
227	2740	1.	1.	34.	27.	14x	19x	2.	36.	142.						
228	2942	1.	1.	34.	27.	15x	18x	2.	35.	139.						
229	3144	1.	1.	34.	27.											
230	3347	1.	1.	34.	27.	15x	18x	2.	35.	140.						
231	3548	1.	1.	34.	27.	16x	17x	2.	35.	138.						
232	3745	1.	1.	34.	27.	16x	17x	2.	35.	142.						
233	3945	1.	1.	34.	27.	16x	17x	2.	34.	141.						
234	4146	1.	1.	34.	27.											
235	4352	1.	1.	34.	27.	17x	16x	2.	34.	138.						
236	4497	1.	1.	34.	27.	17x	17x	2.	34.	138.						

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Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)
WOCE Line P17C Station 130 Latitude 9-00.0S Longitude 135-00.1W Date 7/23/91 Bottom Depth 4494

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	TCO2 Obs	TCO2 S=35	pCO2 @ 20	pCO2 @ Theta	Total Alk. Calc	(PALK)s
						uM/kg							uAtm		uEq/kg	
101	0	27.	27.	35.	22.	22x	-2x	0.	3.	1.	1996	1961	269	371	2355	2318
102	41	27.	27.	35.	23.	22x	-2x	0.	3.	1.						
103	82	25.	25.	36.	23.	21x	-1x	0.	1.	1.						
104	102	24.	24.	36.	24.	20x	x	0.	1.	1.						
105	122	23.	23.	36.	24.	19x	2x	0.	2.	1.						
106	163	20.	20.	35.	25.	18x	4x	0.	6.	1.						
107	203	17.	17.	35.	25.	15x	8x	0.	9.	3.						
108	239	14.	14.	35.	26.	8x	16x	1.	18.	10.						
109	275	12.	12.	34.	26.	2x	23x	2.	27.	20.						
110	307	11.	11.	34.	26.	2x	24x	2.	30.	24.						
111	357	10.	10.	34.	26.											
112	406	9.	9.	34.	26.	5x	22x	2.	32.	29.						
113	483	8.	8.	34.	26.	6x	22x	2.	34.	33.						
137	559	7.	7.	34.	27.	7x	21x	2.	35.	38.						
115	659	6.	6.	34.	27.	7x	22x	2.	37.	47.						
116	761	5.	5.	34.	27.	8x	22x	2.	38.	55.						
117	860	5.	5.	34.	27.	8x	22x	2.	39.	65.						
118	962	4.	4.	34.	27.	9x	21x	2.	39.	75.						
119	1116	3.	3.	34.	27.	10x	21x	2.	38.	89.						
120	1312	3.	3.	34.	27.	11x	21x	2.	38.	102.						
121	1514	2.	2.	34.	27.	11x	20x	2.	37.	111.						
122	1714	2.	2.	34.	27.	12x	20x	2.	37.	121.						
123	1915	2.	2.	34.	27.	12x	20x	2.	37.	126.						
124	2113	2.	1.	34.	27.	13x	20x	2.	36.	131.						
125	2304	1.	1.	34.	27.	13x	19x	2.	36.	136.						
126	2501	1.	1.	34.	27.	14x	19x	2.	36.	138.						
127	2706	1.	1.	34.	27.	14x	19x	2.	36.	140.						
128	2914	1.	1.	34.	27.	15x	18x	2.	35.	137.						
129	3118	1.	1.	34.	27.	15x	18x	2.	35.	139.						
130	3323	1.	1.	34.	27.	16x	17x	2.	35.	139.						
131	3529	1.	1.	34.	27.	16x	17x	2.	35.	139.						
132	3734	1.	1.	34.	27.	16x	17x	2.	35.	140.						
133	3935	1.	1.	34.	27.	16x	17x	2.	34.	140.						
134	4137	1.	1.	34.	27.	17x	17x	2.	34.	139.						
135	4342	1.	1.	34.	27.	17x	17x	2.	34.	139.						
136	4472	1.	1.	34.	27.	17x	17x	2.	34.	138.						

WOCE Line P17C Station 131 Latitude 9-30.1S Longitude 135-00.0W Date 7/23/91 Bottom Depth 4527

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	TCO2 Obs	TCO2 S=35	pCO2 @ 20	pCO2 @ Theta	Total Alk. Calc	(PALK)s
						uM/kg							uAtm		uEq/kg	
101	0	27.	27.	35.	22.	22x	-2x	0.	3.	1.	1996	1966	275	380	2350	2318
102	48	27.	27.	35.	23.	21x	-1x	0.	3.	1.	2000	1963	272	375	2358	2318
103	78	27.	27.	36.	23.	21x	-1x	0.	2.	1.	2016	1958	268	366	2386	2320
104	103	24.	24.	36.	24.	20x	-x	0.	1.	1.	2060	1990	310	380	2401	2321
105	134	23.	23.	36.	24.			0.	1.	1.	2082	2007	334	392	2408	2323
106	164	21.	21.	36.	25.	18x	3x	0.	4.	1.	2098	2033	379	410	2394	2323
107	205	19.	19.	35.	25.	16x	6x	0.	7.	2.	2113	2075	467	449	2359	2323
108	246	13.	13.	34.	26.	10x	15x	1.	17.	10.	2166	2171	777	591	2315	2337
109	286	11.	11.	34.	26.	5x	21x	2.	27.	20.	2220	2235	1183	816	2307	2350
110	327	10.	9.	34.	26.	6x	21x	2.	31.	26.	2232	2250	1240	812	2313	2362
111	387	9.	9.	34.	26.	6x	21x	2.	33.	30.	2235	2255	1307	826	2308	2363
112	459	8.	8.	34.	26.			2.	34.	33.						
113	558	7.	7.	34.	27.	7x	22x	2.	36.	40.	2251	2278	1390	810	2317	2382
137	657	6.	6.	34.	27.	6x	23x	2.	39.	48.	2269	2298	1550	874	2320	2390
115	756	5.	5.	34.	27.	6x	24x	2.	40.	57.	2278	2309	1586	866	2327	2400
116	857	5.	5.	34.	27.	8x	22x	2.	39.	66.	2280	2311	1499	795	2338	2410
117	956	4.	4.	34.	27.	9x	22x	2.	39.	77.	2282	2313	1448	750	2346	2417
118	1056	4.	4.	34.	27.	10x	21x	2.	38.	83.	2287	2317	1394	709	2357	2427
119	1154	3.	3.	34.	27.	10x	21x	2.	38.	90.	2294	2323	1371	689	2366	2435
120	1302	3.	3.	34.	27.	10x	21x	2.	38.	99.	2299	2328	1360	673	2374	2442
121	1503	2.	2.	34.	27.	11x	21x	2.	37.	110.	2311	2339	1353	656	2388	2454
122	1705	2.	2.	34.	27.	12x	20x	2.	37.	116.	2313	2339	1314	628	2394	2458
123	1898	2.	2.	34.	27.	12x	20x	2.	37.	123.	2315	2340	1227	579	2407	2470
124	2093	2.	1.	34.	27.	13x	19x	2.	36.	129.	2321	2345	1250	583	2411	2473
125	2286	1.	1.	34.	27.	13x	19x	2.	36.	134.	2323	2346	1229	569	2416	2477
126	2478	1.	1.	34.	27.	14x	19x	2.	36.	137.	2325	2347	1207	556	2421	2480
127	2667	1.	1.	34.	27.	14x	19x	2.	35.	138.	2324	2346	1183	544	2423	2482
128	2852	1.	1.	34.	27.	14x	18x	2.	35.	137.	2321	2343			2434	2492
129	3041	1.	1.	34.	27.	15x	18x	2.	35.	138.	2320	2341	1137	519	2424	2482
130	3228	1.	1.	34.	27.	15x	18x	2.	35.	138.	2318	2339	1109	504	2427	2484
131	3414	1.	1.	34.	27.	16x	17x	2.	35.	139.	2315	2336	1108	502	2424	2481
132	3603	1.	1.	34.	27.	16x	17x	2.	34.	139.	2313	2334	1097	496	2424	2481
133	3796	1.	1.	34.	27.	16x	17x	2.	34.	140.	2314	2335	1096	495	2425	2481
134	3989	1.	1.	34.	27.	16x	17x	2.	34.	140.	2311	2331	1088	490	2422	2479
135	4193	1.	1.	34.	27.	17x	17x	2.	34.	139.	2308	2328	1088	489	2419	2475
136	4480	1.	1.	34.	27.	17x	17x	2.	34.	138.	2310	2330	1072	482	2424	2480

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Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
(TCO2)s=35 = TCO2 obs X (35 / Sal)   (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C   Station 132   Latitude 10-02.4S   Longitude 134-57.6W   Date 7/24/91   Bottom Depth 4450

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs	TCO2 S=35	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
201	0	27.	27.	35.	23.	21x	-2x	0.	3.	1.	2002	1958	270	370	2363	2314
202	26	27.	27.	35.	23.	21x	-1x	0.	3.	1.						
203	50	27.	27.	35.	23.	21x	-1x	0.	3.	1.						
204	85	27.	27.	36.	23.	21x	-2x	0.	2.	1.						
205	105	26.	26.	36.	23.	20x	x	0.	1.	2.						
206	125	24.	24.	36.	24.	19x	1x	0.	1.	1.						
207	150	22.	22.	36.	24.	18x	3x	0.	3.	1.						
208	191	19.	19.	35.	25.	17x	4x	0.	6.	1.						
209	243	15.	15.	35.	26.	12x	11x	1.	13.	6.						
210	290	11.	11.	34.	26.	6x	20x	2.	24.	16.						
211	335	9.	9.	34.	26.	5x	22x	2.	30.	24.						
212	405	8.	8.	34.	26.	7x	20x	2.	32.	29.						
213	482	7.	7.	34.	27.	8x	20x	2.	34.	35.						
237	583	6.	6.	34.	27.	8x	21x	2.	36.	42.						
215	705	5.	5.	34.	27.	8x	21x	2.	38.	52.						
216	807	5.	5.	34.	27.	8x	22x	2.	39.	62.						
217	907	4.	4.	34.	27.	9x	21x	2.	38.	69.						
218	1009	4.	4.	34.	27.	9x	21x	2.	38.	78.						
219	1110	4.	3.	34.	27.	10x	21x	2.	38.	85.						
220	1314	3.	3.	34.	27.	11x	21x	2.	38.	98.						
221	1517	2.	2.	34.	27.	11x	20x	2.	37.	111.						
222	1718	2.	2.	34.	27.	12x	20x	2.	37.	120.						
223	1919	2.	2.	34.	27.	12x	20x	2.	37.	126.						
224	2121	2.	1.	34.	27.	13x	19x	2.	36.	130.						
225	2321	1.	1.	34.	27.	13x	19x	2.	36.	133.						
226	2529	1.	1.	34.	27.	14x	19x	2.	36.	136.						
227	2728	1.	1.	34.	27.	14x	18x	2.	35.	137.						
228	2927	1.	1.	34.	27.	15x	18x	2.	35.	136.						
229	3127	1.	1.	34.	27.	16x	17x	2.	35.	137.						
230	3329	1.	1.	34.	27.	16x	17x	2.	34.	136.						
231	3530	1.	1.	34.	27.	16x	17x	2.	34.	137.						
232	3730	1.	1.	34.	27.	16x	17x	2.	34.	138.						
233	3931	1.	1.	34.	27.	16x	17x	2.	34.	139.						
234	4134	1.	1.	34.	27.	16x	17x	2.	34.	139.						
235	4339	1.	1.	34.	27.	16x	17x	2.	34.	139.						
236	4442	1.	1.	34.	27.	17x	17x	2.	34.	139.						

WOCE Line P17C   Station 133   Latitude 10-29.0S   Longitude 134-53.9W   Date 7/24/91   Bottom Depth 4320

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs	TCO2 S=35	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	0	27.	27.	35.	23.	21x	-1x	0.	2.	2.	2006	1953				
102	42	27.	27.	36.	23.	21x	-1x	0.	2.	2.	2009	1951	263	358	2383	2317
103	68	27.	27.	36.	23.	21x	-1x	0.	2.	2.	2012	1951				
104	92	26.	26.	36.	23.	20x	-x	0.	1.	1.	2040	1973	282	375	2403	2326
105	123	24.	24.	36.	24.	18x	2x	0.	1.	1.	2075	2001				
106	153	22.	22.	36.	25.						2196	2126				
107	183	20.	20.	35.	25.	17x	4x	0.	5.	2.	2104	2050	410	424	2380	2324
108	225	17.	17.	35.	25.	14x	8x	0.	9.	4.	2117	2094				
109	267	13.	13.	34.	26.	9x	16x	1.	18.	10.	2172	2179	846	636	2306	2333
110	307	11.	11.	34.	26.	6x	20x	2.	25.	17.	2213	2230				
111	368	9.	9.	34.	26.	5x	22x	2.	31.	25.	2234	2255	1353	874	2302	2356
112	428	8.	8.	34.	26.	8x	20x	2.	32.	30.	2226	2250				
113	509	7.	7.	34.	27.	9x	20x	2.	34.	37.	2234	2261	1284	751	2310	2373
137	609	6.	6.	34.	27.	7x	22x	2.	37.	46.	2253	2283	1423	803	2316	2384
115	711	5.	5.	34.	27.	7x	23x	2.	39.	56.	2272	2303				
116	813	5.	5.	34.	27.	8x	22x	2.	39.	63.	2276	2307	1513	810	2332	2404
117	914	4.	4.	34.	27.	9x	22x	2.	39.	73.	2285	2316				
118	914	4.	4.	34.	27.	9x	22x	2.	39.	73.	2284	2315	1472	766	2345	2417
119	1016	4.	4.	34.	27.	9x	22x	2.	39.	81.	2291	2322	1469	753	2353	2424
120	1168	3.	3.	34.	27.	9x	22x	2.	39.	91.	2298	2327	1446	726	2363	2433
121	1319	3.	3.	34.	27.	10x	21x	2.	38.	101.	2305	2333				
122	1511	2.	2.	34.	27.	11x	21x	2.	38.	111.	2313	2341	1381	668	2387	2454
123	1704	2.	2.	34.	27.	12x	20x	2.	37.	120.	2313	2339	1321	628	2393	2458
124	1908	2.	2.	34.	27.	12x	20x	2.	37.	126.	2320	2344				
125	2108	2.	1.	34.	27.	13x	19x	2.	36.	129.	2318	2341				
126	2308	1.	1.	34.	27.	14x	19x	2.	36.	132.	2323	2346	1225	566	2417	2477
127	2516	1.	1.	34.	27.	14x	19x	2.	36.	135.	2320	2342	1203	554	2416	2475
128	2719	1.	1.	34.	27.	14x	18x	2.	36.	136.	2321	2342				
129	2920	1.	1.	34.	27.	15x	18x	2.	35.	136.	2319	2341	1154	528	2422	2480
130	3121	1.	1.	34.	27.	15x	18x	2.	35.	136.	2313	2335				
131	3323	1.	1.	34.	27.	16x	17x	2.	35.	136.	2312	2333	1121	509	2418	2476
132	3526	1.	1.	34.	27.	16x	17x	2.	35.	136.	2312	2333	1113	504	2420	2477
133	3728	1.	1.	34.	27.	16x	17x	2.	35.	137.	2309	2330				
134	3930	1.	1.	34.	27.	16x	17x	2.	34.	139.	2311	2331	1094	492	2421	2478
135	4137	1.	1.	34.	27.	16x	17x	2.	34.	139.	2314	2334	1091	490	2425	2481
136	4310	1.	1.	34.	27.	16x	17x	2.	34.	138.	2303	2324				

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Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)
WOCE Line P17C Station 134 Latitude 10-59.2S Longitude 134-48.1W Date 7/25/91 Bottom Depth 4167

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	---TCO2---- Obs	S=35	-----pCO2---- @ 20	@ Theta	Total Alk. Calc (PALK)s
						---uM/kg---							-----uAtm----		---uEq/kg---
101	2	27.	27.	36.	23.	21x	-1x	0.	2.	1.	2015	1953			
102	52	27.	27.	36.	23.	21x	-2x	0.	2.	1.					
103	93	27.	27.	36.	23.	20x	-1x	0.	1.	1.					
104	111	25.	25.	36.	24.	20x	x	0.	1.	1.					
105	133	24.	24.	36.	24.	18x	2x	0.	0.	1.					
106	172	21.	21.	36.	25.	18x	3x	0.	4.	1.					
107	214	19.	19.	35.	25.	17x	5x	0.	6.	1.					
108	266	15.	15.	35.	25.	12x	12x	1.	14.	6.					
109	316	11.	11.	34.	26.	5x	20x	2.	24.	16.					
110	357	10.	10.	34.	26.	4x	23x	2.	31.	24.					
111	406	8.	8.	34.	26.	5x	22x	2.	33.	29.					
112	487	7.	7.	34.	27.	7x	21x	2.	35.	36.					
113	557	6.	6.	34.	27.	7x	22x	2.	37.	42.					
137	656	6.	6.	34.	27.	6x	23x	2.	39.	49.					
115	756	5.	5.	34.	27.	7x	23x	2.	40.	59.					
117	856	4.	4.	34.	27.	7x	23x	2.	40.	67.					
116	856	4.	4.	34.	27.	7x	23x	2.	40.	67.					
118	957	4.	4.	34.	27.	8x	22x	2.	39.	75.					
119	1058	4.	4.	34.	27.	9x	22x	2.	39.	83.					
120	1209	3.	3.	34.	27.	9x	22x	2.	39.	94.					
121	1411	3.	3.	34.	27.	10x	21x	2.	38.	107.					
122	1613	2.	2.	34.	27.	11x	21x	2.	38.	116.					
123	1814	2.	2.	34.	27.	12x	20x	2.	37.	123.					
124	2015	2.	2.	34.	27.	13x	20x	2.	36.	126.					
125	2216	1.	1.	34.	27.	14x	19x	2.	36.	130.					
126	2367	1.	1.	34.	27.	14x	19x	2.	35.	132.					
127	2518	1.	1.	34.	27.	14x	19x	2.	35.	134.					
128	2670	1.	1.	34.	27.	14x	18x	2.	35.	135.					
129	2822	1.	1.	34.	27.	15x	18x	2.	35.	135.					
130	3025	1.	1.	34.	27.	15x	18x	2.	35.	135.					
131	3226	1.	1.	34.	27.	16x	17x	2.	34.	135.					
132	3426	1.	1.	34.	27.	16x	17x	2.	34.	136.					
133	3627	1.	1.	34.	27.	16x	17x	2.	34.	135.					
134	3827	1.	1.	34.	27.	16x	17x	2.	34.	134.					
135	4028	1.	1.	34.	27.	16x	17x	2.	34.	133.					
136	4154	1.	1.	34.	27.	16x	17x	2.	34.	133.					

WOCE Line P17C Station 135 Latitude 11-28.2S Longitude 134-41.9W Date 7/25/91 Bottom Depth 4319

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	---TCO2---- Obs	S=35	-----pCO2---- @ 20	@ Theta	Total Alk. Calc (PALK)s
						---uM/kg---							-----uAtm----		---uEq/kg---
101	0	27.	27.	36.	23.						2001	1943	261	354	
102	31	27.	27.	36.	23.	21x	-1x	0.	2.	2.					
103	66	27.	27.	36.	23.	21x	-1x	0.	1.	1.					
104	101	24.	24.	36.	24.	19x	1x	0.	0.	1.					
105	122	23.	23.	36.	24.	19x	1x	0.	1.	2.					
106	153	22.	21.	36.	25.	18x	3x	0.	4.	1.					
107	182	20.	20.	35.	25.	17x	5x	0.	5.	1.					
108	213	17.	17.	35.	25.	15x	8x	0.	9.	3.					
109	265	13.	13.	34.	26.	8x	17x	1.	19.	11.					
110	315	11.	11.	34.	26.	3x	23x	2.	27.	21.					
111	315	11.	11.	34.	26.	3x	23x	2.	27.	21.					
112	367	9.	9.	34.	26.	4x	23x	2.	31.	25.					
113	427	8.	8.	34.	26.	6x	22x	2.	33.	30.					
137	509	7.	7.	34.	27.	7x	21x	2.	35.	36.					
115	611	6.	6.	34.	27.	6x	23x	2.	38.	45.					
116	711	5.	5.	34.	27.	6x	23x	2.	40.	53.					
117	814	5.	5.	34.	27.	7x	23x	2.	40.	59.					
118	915	4.	4.	34.	27.	7x	23x	2.	40.	71.					
119	1017	4.	4.	34.	27.	8x	23x	2.	40.	79.					
120	1220	3.	3.	34.	27.	9x	22x	2.	39.	92.					
121	1423	3.	2.	34.	27.	10x	21x	2.	38.	106.					
122	1624	2.	2.	34.	27.	11x	21x	2.	37.	115.					
123	1828	2.	2.	34.	27.	12x	20x	2.	37.	120.					
124	2032	2.	2.	34.	27.	13x	19x	2.	36.	126.					
125	2236	2.	1.	34.	27.	14x	19x	2.	36.	128.					
126	2439	1.	1.	34.	27.	14x	19x	2.	35.	132.					
127	2643	1.	1.	34.	27.	14x	18x	2.	35.	135.					
128	2845	1.	1.	34.	27.	15x	18x	2.	35.	135.					
129	3049	1.	1.	34.	27.	15x	18x	2.	35.	135.					
130	3252	1.	1.	34.	27.	16x	17x	2.	35.	135.					
131	3455	1.	1.	34.	27.	16x	17x	2.	34.	135.					
132	3658	1.	1.	34.	27.	16x	17x	2.	34.	135.					
133	3859	1.	1.	34.	27.	16x	17x	2.	34.	134.					
134	4055	1.	1.	34.	27.	16x	17x	2.	34.	133.					
135	4192	1.	1.	34.	27.	17x	16x	2.	34.	133.					
136	4277	1.	1.	34.	27.	17x	16x	2.	34.	132.					

Lamont-Doherty Earth Observatory of Columbia University
Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C Station 136 Latitude 11-58.2S Longitude 134-35.8W Date 7/25/91 Bottom Depth 4140

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	0	26.	26.	35.	23.						1990	1956				
102	38	27.	27.	36.	23.	21x	-1x	0.	1.	1.						
103	73	27.	27.	36.	23.	21x	-1x	0.	1.	1.						
104	103	27.	26.	36.	23.	21x	-1x	0.	1.	1.						
105	144	23.	23.	36.	24.	18x	2x	0.	2.	2.						
106	195	19.	19.	35.	25.											
107	245	15.	15.	35.	25.	12x	12x	1.	13.	6.						
108	285	12.	12.	34.	26.	8x	17x	1.	20.	12.						
109	326	10.	10.	34.	26.	5x	22x	2.	27.	20.						
110	365	9.	9.	34.	26.	4x	23x	2.	30.	23.						
111	426	8.	8.	34.	26.	6x	21x	2.	32.	29.						
112	486	8.	8.	34.	26.	8x	20x	2.	33.	32.						
113	545	7.	7.	34.	27.	7x	21x	2.	35.	36.						
137	605	6.	6.	34.	27.	7x	22x	2.	37.	41.						
115	701	6.	6.	34.	27.	7x	23x	2.	39.	49.						
116	799	5.	5.	34.	27.	8x	22x	2.	39.	56.						
117	897	4.	4.	34.	27.	7x	23x	2.	40.	67.						
118	995	4.	4.	34.	27.	8x	23x	2.	40.	76.						
119	1095	4.	3.	34.	27.	9x	21x	2.	38.	83.						
120	1195	3.	3.	34.	27.	10x	21x	2.	38.	90.						
121	1295	3.	3.	34.	27.	10x	22x	2.	39.	96.						
122	1494	3.	2.	34.	27.	11x	21x	2.	38.	107.						
123	1693	2.	2.	34.	27.	12x	20x	2.	37.	113.						
124	1892	2.	2.	34.	27.	13x	19x	2.	36.	118.						
125	2091	2.	1.	34.	27.	14x	19x	2.	36.	126.						
126	2287	1.	1.	34.	27.	14x	19x	2.	36.	131.						
127	2481	1.	1.	34.	27.	14x	19x	2.	36.	133.						
128	2678	1.	1.	34.	27.	14x	19x	2.	35.	136.						
129	2874	1.	1.	34.	27.	15x	18x	2.	35.	136.						
130	3071	1.	1.	34.	27.	15x	18x	2.	35.	136.						
131	3270	1.	1.	34.	27.	15x	17x	2.	35.	136.						
132	3468	1.	1.	34.	27.	16x	17x	2.	35.	135.						
133	3668	1.	1.	34.	27.	16x	17x	2.	34.	134.						
134	3870	1.	1.	34.	27.	16x	17x	2.	34.	133.						
135	4000	1.	1.	34.	27.	17x	17x	2.	34.	133.						
136	4147	1.	1.	34.	27.	17x	16x	2.	34.	132.						

WOCE Line P17C Station 137 Latitude 12-26.9S Longitude 134-30.0W Date 7/26/91 Bottom Depth 4237

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	1	26.	26.	36.	23.	21x	-1x	0.	1.	2.	2021	1951				
102	42	26.	26.	36.	23.	21x	-1x	0.	1.	2.	2024	1948	261	350	2406	2317
103	73	26.	26.	36.	23.	20x	-x	0.	1.	2.	2028	1952				
104	104	26.	26.	36.	23.	20x	-x	0.	0.	2.	2039	1960	271	361	2414	2322
105	130	24.	24.	36.	24.	19x	1x	0.	0.	2.	2066	1987	306	371	2413	2322
106	155	23.	23.	36.	24.	18x	2x	0.	1.	1.	2080	2002				
107	186	21.	21.	36.	25.	18x	3x	0.	3.	1.	2095	2028	375	405	2393	2320
108	205	21.	20.	35.	25.	17x	4x	0.	4.	1.	2098	2043				
109	257	17.	17.	35.	25.	16x	7x	0.	8.	2.	2108	2082	488	446	2341	2321
110	307	13.	13.	34.	26.	11x	14x	1.	17.	10.	2160	2172				
111	358	10.	10.	34.	26.											
112	409	9.	9.	34.	26.	5x	23x	2.	32.	26.	2240	2265				
113	460	8.	8.	34.	26.	7x	21x	2.	33.	30.	2235	2260	1336	816	2305	2365
137	511	7.	7.	34.	27.	7x	21x	2.	34.	34.	2235	2262				
115	612	6.	6.	34.	27.	7x	22x	2.	37.	42.	2223	2252	1446	825	2281	2349
116	713	6.	6.	34.	27.	7x	22x	2.	39.	49.	2261	2291				
117	815	5.	5.	34.	27.	8x	22x	2.	40.	58.	2274	2306	1531	823	2328	2401
118	917	4.	4.	34.	27.	8x	22x	2.	40.	66.	2279	2311				
119	1018	4.	4.	34.	27.	9x	22x	2.	39.	72.	2282	2313	1476	765	2342	2414
120	1119	4.	4.	34.	27.	9x	22x	2.	39.	79.	2287	2318	1466	749	2349	2421
121	1272	3.	3.	34.	27.	11x	20x	2.	37.	88.	2286	2316				
122	1425	3.	2.	34.	27.	12x	20x	2.	37.	100.	2296	2325	1322	643	2375	2442
123	1626	2.	2.	34.	27.	12x	20x	2.	37.	110.	2303	2329				
124	1831	2.	2.	34.	27.	13x	19x	2.	36.	117.	2308	2333	1272	600	2393	2457
125	2033	2.	1.	34.	27.	14x	19x	2.	36.	125.	2312	2336				
126	2236	1.	1.	34.	27.	14x	19x	2.	36.	130.	2315	2338				
127	2439	1.	1.	34.	27.	14x	19x	2.	36.	135.	2317	2339	1201	553	2413	2472
128	2643	1.	1.	34.	27.	14x	19x	2.	36.	137.	2320	2342				
129	2847	1.	1.	34.	27.	15x	18x	2.	35.	136.	2318	2340	1164	532	2420	2478
130	3052	1.	1.	34.	27.	15x	18x	2.	35.	136.	2313	2334				
131	3253	1.	1.	34.	27.	16x	17x	2.	35.	135.	2311	2332	1128	513	2417	2474
132	3455	1.	1.	34.	27.	16x	17x	2.	35.	135.	2310	2331				
133	3659	1.	1.	34.	27.	16x	17x	2.	34.	135.	2307	2328	1112	503	2414	2471
134	3862	1.	1.	34.	27.	16x	17x		34.	135.	2309	2329				
135	4064	1.	1.	34.	27.	17x	16x		34.	133.	2301	2322				
136	4222	1.	1.	34.	27.	17x	16x		34.	133.	2298	2318	1099	495		

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Project/Expedition is TUNES/2 WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C Station 138 Latitude 12-55.9S Longitude 134-23.8W Date 7/26/91 Bottom Depth 4414

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	2	26.	26.	36.	23.	21x	-1x	0.	1.	1.	2018	1948	257	343	2402	2320
102	45	26.	26.	36.	23.	21x	-1x	0.	1.	1.						
103	85	26.	26.	36.	23.	20x	-x	0.	0.	1.						
104	106	25.	25.	36.	24.	19x	x	0.	0.	1.						
105	126	24.	24.	36.	24.	19x	1x	0.	0.	1.						
106	167	22.	22.	36.	24.	18x	2x	0.	2.	1.						
107	207	20.	20.	35.	25.	17x	4x	0.	4.	1.						
108	258	17.	17.	35.	25.	16x	6x	0.	7.	2.						
109	334	11.	11.	34.	26.	6x	19x	2.	23.	16.						
110	410	9.	9.	34.	26.	4x	23x	2.	32.	26.						
111	460	8.	8.	34.	26.											
112	532	7.	7.	34.	26.	9x	19x	2.	33.	32.						
113	613	6.	6.	34.	27.	11x	18x	2.	33.	38.						
137	714	5.	5.	34.	27.	10x	19x	2.	35.	47.						
115	816	5.	5.	34.	27.	11x	19x	2.	36.	55.						
116	917	4.	4.	34.	27.	11x	19x	2.	36.	63.						
117	1018	4.	4.	34.	27.	11x	19x	2.	37.	72.						
118	1121	3.	3.	34.	27.	11x	20x	2.	37.	82.						
119	1272	3.	3.	34.	27.	11x	20x	2.	37.	91.						
120	1423	3.	3.	34.	27.	11x	20x	2.	37.	100.						
121	1626	2.	2.	34.	27.	12x	20x	2.	37.	108.						
122	1828	2.	2.	34.	27.	13x	19x	2.	36.	118.						
123	2032	2.	1.	34.	27.	14x	19x	2.	36.	124.						
124	2233	1.	1.	34.	27.	14x	19x	2.	36.	130.						
125	2387	1.	1.	34.	27.	14x	19x	2.	36.	133.						
126	2539	1.	1.	34.	27.	14x	19x	2.	35.	136.						
127	2691	1.	1.	34.	27.	14x	18x	2.	35.	136.						
128	2842	1.	1.	34.	27.	15x	18x	2.	35.	136.						
129	3044	1.	1.	34.	27.	15x	18x	2.	35.	136.						
130	3248	1.	1.	34.	27.	15x	17x	2.	35.	136.						
131	3450	1.	1.	34.	27.	16x	17x	2.	35.	136.						
132	3653	1.	1.	34.	27.	16x	17x	2.	34.	136.						
133	3855	1.	1.	34.	27.	16x	17x	2.	34.	135.						
134	4058	1.	1.	34.	27.	17x	16x	2.	34.	133.						
135	4260	1.	1.	34.	27.	17x	16x	2.	34.	132.						
136	4387	1.	1.	34.	27.	17x	16x	2.	34.	131.						

WOCE Line P17C Station 139 Latitude 13-26.0S Longitude 134-16.8W Date 7/26/91 Bottom Depth 4294

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	2	26.	26.	36.	23.	21x	-1x	0.	0.	1.	2022	1947				
102	34	26.	26.	36.	23.	21x	-1x	0.	0.	1.						
103	75	26.	26.	36.	23.	21x	-1x	0.	0.	1.						
104	116	26.	26.	36.	23.	21x	-1x	0.	0.	1.						
105	156	23.	23.	36.	24.	18x	2x	0.	1.	1.						
106	206	21.	21.	36.	25.	18x	3x	0.	3.	1.						
107	257	17.	17.	35.	25.	17x	6x	0.	6.	2.						
108	318	13.	13.	34.	26.	11x	14x	1.	17.	9.						
109	350	12.	11.	34.	26.	7x	19x	2.	22.	15.						
110	379	11.	11.	34.	26.	5x	21x	2.	26.	19.						
111	409	9.	9.	34.	26.			2.	29.	21.						
112	460	8.	8.	34.	26.	9x	19x	2.	31.	27.						
113	512	7.	7.	34.	27.	11x	17x	2.	31.	32.						
137	563	6.	6.	34.	27.	12x	17x	2.	32.	36.						
115	614	6.	6.	34.	27.	12x	17x	2.	33.	39.						
116	716	5.	5.	34.	27.	12x	18x	2.	34.	46.						
117	817	5.	5.	34.	27.	12x	18x	2.	35.	54.						
118	918	4.	4.	34.	27.	11x	19x	2.	36.	63.						
119	1020	4.	4.	34.	27.	12x	19x	2.	36.	70.						
120	1223	3.	3.	34.	27.	11x	20x	2.	37.	85.						
121	1425	3.	3.	34.	27.	12x	20x	2.	37.	98.						
122	1627	2.	2.	34.	27.	13x	19x	2.	37.	107.						
123	1831	2.	2.	34.	27.	13x	19x	2.	36.	117.						
124	2036	2.	1.	34.	27.	14x	19x	2.	36.	123.						
125	2238	1.	1.	34.	27.	14x	18x	2.	35.	128.						
126	2441	1.	1.	34.	27.	14x	18x	2.	35.	132.						
127	2644	1.	1.	34.	27.	15x	18x	2.	35.	133.						
128	2847	1.	1.	34.	27.	15x	18x	2.	35.	134.						
129	3050	1.	1.	34.	27.	15x	17x	2.	35.	135.						
130	3254	1.	1.	34.	27.	16x	17x	2.	35.	136.						
131	3457	1.	1.	34.	27.	16x	17x	2.	34.	136.						
132	3660	1.	1.	34.	27.	16x	17x	2.	34.	135.						
133	3861	1.	1.	34.	27.	16x	17x	2.	34.	134.						
134	4064	1.	1.	34.	27.	17x	16x	2.	34.	133.						
135	4164	1.	1.	34.	27.	17x	16x	2.	34.	133.						
136	4256	1.	1.	34.	27.	17x	16x	2.	34.	133.						

Lamont-Doherty Earth Observatory of Columbia University
Project/Expedition is TUNES/2 WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C Station 140 Latitude 13-55.2S Longitude 134-11.1W Date 7/26/91 Bottom Depth 4423

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	2	27.	27.	36.	23.	21x	-1x	0.	0.	2.	2020	1942	250	338	2414	2322
102	42	26.	26.	36.	23.	21x	-1x	0.	0.	2.						
103	79	26.	26.	36.	23.	21x	-1x	0.	0.	1.						
104	109	25.	25.	36.	24.	20x	-x	0.	0.	1.						
105	150	23.	23.	36.	24.	18x	2x	0.	1.	2.						
106	190	22.	22.	36.	25.	18x	2x	0.	3.	1.						
107	252	19.	18.	35.	25.	17x	5x	0.	5.	1.						
108	312	14.	14.	34.	26.	13x	11x	1.	13.	6.						
109	372	10.	10.	34.	26.	8x	19x	2.	26.	17.						
110	403	9.	9.	34.	26.	7x	20x	2.	29.	21.						
111	424	8.	8.	34.	26.	7x	20x	2.	30.	24.						
112	484	7.	7.	34.	26.	10x	18x	2.	31.	28.						
113	565	6.	6.	34.	27.	12x	17x	2.	32.	35.						
137	667	5.	5.	34.	27.	12x	18x	2.	34.	44.						
115	769	5.	5.	34.	27.	12x	18x	2.	35.	51.						
116	870	4.	4.	34.	27.	12x	19x	2.	36.	60.						
117	971	4.	4.	34.	27.	11x	19x	2.	36.	69.						
118	1072	4.	3.	34.	27.	11x	19x	2.	37.	76.						
119	1224	3.	3.	34.	27.	11x	20x	2.	37.	87.						
120	1428	3.	2.	34.	27.	12x	20x	2.	37.	100.						
121	1629	2.	2.	34.	27.	13x	19x	2.	36.	108.						
122	1832	2.	2.	34.	27.	13x	19x	2.	36.	117.						
123	2036	2.	1.	34.	27.	14x	18x	2.	35.	123.						
124	2239	1.	1.	34.	27.	14x	18x	2.	35.	127.						
125	2391	1.	1.	34.	27.	14x	18x	2.	35.	130.						
126	2544	1.	1.	34.	27.	15x	18x	2.	35.	132.						
127	2697	1.	1.	34.	27.	15x	18x	2.	35.	132.						
128	2849	1.	1.	34.	27.	15x	18x	2.	35.	132.						
129	3052	1.	1.	34.	27.	15x	17x	2.	35.	135.						
130	3254	1.	1.	34.	27.	16x	17x	2.	34.	135.						
131	3457	1.	1.	34.	27.	16x	17x	2.	34.	136.						
132	3660	1.	1.	34.	27.	16x	17x	2.	34.	135.						
133	3862	1.	1.	34.	27.	16x	17x	2.	34.	134.						
134	4116	1.	1.	34.	27.	17x	16x	2.	34.	134.						
135	4319	1.	1.	34.	27.	17x	16x	2.	34.	132.						
136	4400	1.	1.	34.	27.	17x	16x	2.	34.	132.						

WOCE Line P17C Station 141 Latitude 14-25.1S Longitude 134-05.0W Date 7/27/91 Bottom Depth 4245

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	3	27.	27.	36.	23.	21x	-2x	0.	0.	2.	2025	1942				
102	43	26.	26.	36.	23.	21x	-1x	0.	0.	2.	2022	1941	248	329	2419	2322
103	85	26.	26.	36.	23.	20x	-1x	0.	0.	2.	2035	1949	257	340	2426	2324
104	115	24.	24.	36.	24.	20x	x	0.	1.	1.	2058	1980				
105	146	23.	23.	36.	24.	19x	1x	0.	1.	1.	2072	1995	325	377	2403	2316
106	177	22.	22.	36.	25.	18x	2x	0.	3.	1.	2086	2014				
107	207	21.	21.	36.	25.	18x	3x	0.	4.	1.	2094	2036	387	404	2383	2320
108	258	18.	18.	35.	25.	17x	5x	0.	5.	2.	2092	2060				
109	309	14.	14.	34.	26.	14x	10x	1.	12.	6.	2125	2130	620	482	2310	2328
110	370	10.	10.	34.	26.	10x	16x	1.	23.	14.	2181	2208				
111	435	8.	8.	34.	26.	8x	20x	2.	31.	25.	2222	2251	1287	792	2296	2357
112	512	7.	7.	34.	27.	9x	19x	2.	33.	31.	2225	2256	1273	742	2301	2367
113	563	6.	6.	34.	27.	10x	19x	2.	34.	35.	2229	2261				
137	611	6.	6.	34.	27.	12x	17x	2.	33.	38.	2222	2254	1171	657	2310	2377
115	713	5.	5.	34.	27.	12x	18x	2.	34.	45.	2233	2266				
116	815	5.	5.	34.	27.	12x	18x	2.	35.	50.	2239	2272	1241	663	2321	2391
117	916	4.	4.	34.	27.	12x	19x	2.	36.	61.	2253	2286				
118	1018	4.	4.	34.	27.	11x	20x	2.	37.	72.	2272	2304	1371	705	2342	2413
119	1120	3.	3.	34.	27.	11x	20x	2.	38.	81.	2281	2312				
120	1272	3.	3.	34.	27.	11x	20x	2.	37.	91.	2290	2320	1360	673	2364	2433
121	1423	3.	2.	34.	27.	12x	19x	2.	37.	99.	2295	2323				
122	1628	2.	2.	34.	27.	13x	19x	2.	36.	110.	2302	2328	1298	620	2383	2448
123	1831	2.	2.	34.	27.	13x	19x	2.	36.	117.	2305	2330				
124	2033	2.	1.	34.	27.	14x	19x	2.	36.	124.	2309	2333				
125	2235	1.	1.	34.	27.	14x	18x	2.	35.	126.	2309	2332				
126	2436	1.	1.	34.	27.	15x	18x	2.	35.	130.	2314	2336	1185	546	2411	2471
127	2637	1.	1.	34.	27.	15x	18x	2.	35.	132.	2312	2334				
128	2841	1.	1.	34.	27.	15x	18x	2.	35.	133.	2308	2330	1152	526	2410	2468
129	3044	1.	1.	34.	27.	16x	17x	2.	35.	133.	2310	2332	1135	517	2415	2472
130	3248	1.	1.	34.	27.	16x	17x	2.	35.	134.	2310	2331				
131	3450	1.	1.	34.	27.	16x	17x	2.	34.	135.	2308	2329	1115	505	2415	2472
132	3652	1.	1.	34.	27.	16x	17x	2.	34.	134.	2305	2326	1113	504	2412	2469
133	3856	1.	1.	34.	27.	16x	17x	2.	34.	133.	2305	2326				
135	4058	1.	1.	34.	27.	17x	16x	2.	34.	133.	2304	2325				
134	4058	1.	1.	34.	27.	17x	16x	2.	34.	132.	2302	2322	1099	496	2411	2467
136	4209	1.	1.	34.	27.	17x	16x	2.	34.	133.	2302	2323	1099	496	2411	2467

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)
WOCE Line P17C Station 142 Latitude 14-53.9S Longitude 133-59.0W Date 7/27/91 Bottom Depth 4270

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	---TCO2---- Obs	S=35	-----pCO2---- @ 20	@ Theta	Total Alk. Calc (PALK)s
						---uM/kg---							-----uAtm----		---uEq/kg---
113	1	26.	26.	36.	23.	21x	-1x	0.	0.	1.	2023	1941			
137	43	26.	26.	36.	24.	21x	-1x	0.	0.	1.					
115	73	26.	26.	36.	24.	21x	-1x	0.	0.	1.					
116	104	26.	26.	36.	24.	20x	-x	0.	0.	1.					
117	134	24.	24.	36.	24.	20x	x	0.	0.	1.					
118	165	23.	23.	36.	24.	19x	1x	0.	1.	1.					
119	206	21.	21.	36.	25.	18x	3x	0.	3.	1.					
120	256	18.	18.	35.	25.	17x	6x	0.	6.	1.					
121	306	14.	14.	35.	26.	13x	11x	1.	13.	7.					
122	358	11.	11.	34.	26.	10x	16x	1.	20.	11.					
123	409	9.	9.	34.	26.	8x	19x	2.	28.	19.					
124	438	9.	8.	34.	26.	7x	21x	2.	31.	23.					
125	479	8.	8.	34.	26.	8x	20x	2.	32.	26.					
126	531	7.	7.	34.	26.	10x	18x	2.	32.	30.					
127	611	6.	6.	34.	27.	10x	19x	2.	34.	36.					
128	712	5.	5.	34.	27.	10x	20x	2.	36.	46.					
129	813	5.	5.	34.	27.	10x	20x	2.	37.	56.					
130	915	4.	4.	34.	27.	10x	21x	2.	38.	66.					
131	1016	4.	4.	34.	27.	10x	21x	2.	39.	74.					
132	1117	3.	3.	34.	27.	10x	21x	2.	39.	83.					
133	1320	3.	3.	34.	27.	11x	21x	2.	38.	97.					
134	1522	2.	2.	34.	27.	12x	20x	2.	37.	106.					
135	1726	2.	2.	34.	27.	13x	19x	2.	37.	114.					
136	1930	2.	2.	34.	27.			2.	36.	120.					
101	2134	1.	1.	34.	27.	14x	18x	2.	35.	125.					
102	2336	1.	1.	34.	27.	15x	18x	2.	35.	128.					
103	2539	1.	1.	34.	27.	15x	18x	2.	35.	130.					
104	2744	1.	1.	34.	27.	15x	18x	2.	35.	132.					
105	2947	1.	1.	34.	27.	15x	17x	2.	35.	134.					
106	3150	1.	1.	34.	27.	16x	17x	2.	35.	135.					
107	3348	1.	1.	34.	27.	16x	17x	2.	35.	136.					
108	3544	1.	1.	34.	27.	16x	17x	2.	35.	136.					
109	3744	1.	1.	34.	27.	16x	17x	2.	34.	135.					
110	3949	1.	1.	34.	27.	16x	17x	2.	34.	135.					
111	4099	1.	1.	34.	27.	17x	16x	2.	34.	134.					
112	4230	1.	1.	34.	27.	17x	16x	2.	34.	134.					

WOCE Line P17C Station 143 Latitude 15-22.9S Longitude 133-52.9W Date 7/28/91 Bottom Depth 4258

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	---TCO2---- Obs	S=35	-----pCO2---- @ 20	@ Theta	Total Alk. Calc (PALK)s
						---uM/kg---							-----uAtm----		---uEq/kg---
301	3	26.	26.	36.	24.	20x	-1x	0.	0.	1.			248	328	
302	47	26.	26.	36.	24.	21x	-1x	0.	0.	1.					
303	87	26.	26.	36.	24.	20x	-1x	0.	0.	1.					
304	121	25.	25.	36.	24.	20x	x	0.	0.	1.					
305	143	23.	23.	36.	24.	19x	1x	0.	0.	1.					
306	172	22.	22.	36.	25.										
307	199	21.	21.	36.	25.	18x	2x	0.	2.	1.					
308	245	19.	19.	35.	25.	18x	4x	0.	3.	1.					
309	293	16.	16.	35.	25.	17x	7x	0.	7.	2.					
310	343	12.	12.	34.	26.	13x	12x	1.	16.	8.					
311	394	10.	10.	34.	26.	9x	18x	2.	24.	16.					
312	445	8.	8.	34.	26.	8x	20x	2.	31.	24.					
313	494	7.	7.	34.	26.	8x	20x	2.	33.	26.					
337	598	6.	6.	34.	27.	10x	19x	2.	34.	36.					
315	705	5.	5.	34.	27.	10x	20x	2.	36.	46.					
316	806	5.	5.	34.	27.	10x	20x	2.	37.	54.					
317	911	4.	4.	34.	27.	9x	21x	2.	38.	64.					
318	1015	4.	4.	34.	27.	9x	22x	2.	39.	73.					
319	1117	3.	3.	34.	27.	9x	22x	2.	39.	83.					
320	1219	3.	3.	34.	27.	10x	22x	2.	39.	90.					
321	1424	3.	3.	34.	27.	11x	21x	2.	38.	101.					
322	1629	2.	2.	34.	27.	12x	20x	2.	37.	109.					
323	1833	2.	2.	34.	27.	13x	19x	2.	36.	116.					
324	2034	2.	1.	34.	27.	14x	18x	2.	35.	120.					
325	2230	1.	1.	34.	27.	15x	18x	2.	35.	123.					
326	2430	1.	1.	34.	27.	15x	18x	2.	35.	127.					
327	2633	1.	1.	34.	27.	15x	18x	2.	35.	129.					
328	2833	1.	1.	34.	27.	15x	18x	2.	35.	130.					
329	3033	1.	1.	34.	27.	15x	17x	2.	34.	132.					
330	3234	1.	1.	34.	27.	16x	17x	2.	34.	133.					
331	3434	1.	1.	34.	27.	16x	17x	2.	34.	133.					
332	3632	1.	1.	34.	27.	16x	17x	2.	34.	132.					
333	3833	1.	1.	34.	27.	16x	17x	2.	34.	132.					
335	4036	1.	1.	34.	27.	17x	17x	2.	34.	132.					
334	4037	1.	1.	34.	27.	17x	17x	2.	34.	132.					
336	4211	1.	1.	34.	27.	17x	16x	2.	34.	131.					

Lamont-Doherty Earth Observatory of Columbia University
Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C Station 144 Latitude 15-52.9S Longitude 133-47.1W Date 7/28/91 Bottom Depth 4260

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	3	26.	26.	36.	24.	21x	-1x	0.	0.	1.	2028	1942	258	340	2415	2313
102	34	26.	26.	36.	24.	20x	-x	0.	0.	1.	2027	1940	255	335	2419	2315
103	74	26.	26.	36.	24.	20x	-x	0.	0.	1.	2031	1943	251	330	2428	2322
104	115	25.	25.	36.	24.	20x	-x	0.	0.	1.	2045	1963	281	354	2412	2315
105	135	23.	23.	36.	24.	19x	1x	0.	0.	1.	2054	1980	299	353	2404	2317
106	156	23.	23.	36.	24.	18x	2x	0.	1.	1.	2078	2002	333	380	2404	2318
107	206	21.	21.	36.	25.	18x	3x	0.	3.	1.	2081	2016	367	393	2381	2309
108	258	18.	18.	35.	25.	18x	4x	0.	4.	1.	2081	2045	406	386	2352	2316
109	319	14.	14.	35.	26.	16x	8x	0.	9.	3.	2105	2103	537	433	2315	2323
110	380	10.	10.	34.	26.	11x	16x	1.	23.	13.	2179	2207	999	664	2286	2339
111	450	7.	7.	34.	26.	9x	19x	2.	32.	23.	2223	2257	1367	820	2288	2356
112	481	7.	7.	34.	26.	9x	20x	2.	33.	26.	2229	2262	1349	791	2296	2365
113	531	6.	6.	34.	27.	9x	19x	2.	34.	30.	2230	2264	1350	772	2297	2368
137	611	6.	6.	34.	27.	9x	20x	2.	36.	36.	2239	2273	1379	770	2305	2377
115	711	5.	5.	34.	27.	9x	21x	2.	37.	46.	2243	2277	1433	781	2304	2377
116	813	5.	5.	34.	27.	9x	21x	2.	38.	56.	2263	2296	1477	787	2321	2395
117	913	4.	4.	34.	27.	9x	22x	2.	39.	64.	2250	2282	1499	786	2306	2379
118	1012	4.	4.	34.	27.	8x	22x	2.	39.	74.	2285	2317	1525	786	2341	2414
119	1112	3.	3.	34.	27.	9x	22x	2.	39.	83.	2293	2324	1494	756	2352	2424
120	1210	3.	3.	34.	27.	9x	22x	2.	39.	90.	2298	2328	1475	737	2360	2431
121	1307	3.	3.	34.	27.	10x	21x	2.	38.	96.	2300	2329	1450	716	2365	2434
122	1502	2.	2.	34.	27.	11x	21x	2.	38.	105.	2304	2332	1400	679	2375	2442
123	1699	2.	2.	34.	27.	12x	20x	2.	36.	112.	2302	2329	1313	626	2382	2447
124	1900	2.	2.	34.	27.	14x	19x	2.	36.	118.						
125	2099	1.	1.	34.	27.	14x	18x	2.	35.	124.	2306	2329	1208	561	2400	2460
126	2299	1.	1.	34.	27.	15x	18x	2.	35.	126.						
127	2499	1.	1.	34.	27.	15x	18x	2.	35.	128.	2305	2327	1174	540	2403	2462
128	2701	1.	1.	34.	27.	15x	18x	2.	35.	132.	2319	2341	1163	532	2421	2479
129	2902	1.	1.	34.	27.	15x	18x	2.	34.	133.						
130	3104	1.	1.	34.	27.	16x	17x	2.	34.	134.	2310	2331	1142	520	2413	2471
131	3307	1.	1.	34.	27.	16x	17x	2.	34.	134.	2308	2330	1133	515	2413	2470
132	3511	1.	1.	34.	27.	16x	17x	2.	34.	134.						
133	3712	1.	1.	34.	27.	16x	17x	2.	34.	134.	2305	2326	1119	507	2411	2467
134	3918	1.	1.	34.	27.	16x	17x	2.	34.	134.	2304	2324	1115	504	2410	2467
135	4122	1.	1.	34.	27.	16x	17x	2.	34.	134.						
136	4267	1.	1.	34.	27.	16x	17x	2.	34.	134.	2307	2327	1118	505	2413	2469

WOCE Line P17C Station 145 Latitude 16-22.0S Longitude 133-39.8W Date 7/28/91 Bottom Depth 4252

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	2	26.	26.	36.	24.	21x	-1x	0.	0.	1.	2024	1939	253	334	2416	2315
102	35	26.	26.	36.	24.	20x	-x	0.	0.	1.						
103	60	26.	26.	36.	24.	21x	-1x	0.	0.	1.						
104	96	26.	26.	36.	24.	20x	-x	0.	0.	1.						
105	121	24.	24.	36.	24.	19x	1x	0.	0.	1.						
106	147	23.	23.	36.	24.	19x	1x	0.	0.	1.						
107	167	22.	22.	36.	24.	18x	2x	0.	2.	1.						
108	218	20.	20.	36.	25.	18x	3x	0.	3.	1.						
109	270	18.	18.	35.	25.	18x	4x	0.	4.	1.						
110	320	15.	15.	35.	25.	17x	7x	0.	9.	3.						
111	372	11.	11.	34.	26.	13x	13x	1.	18.	8.						
112	422	9.	9.	34.	26.	9x	18x	2.	27.	17.						
113	472	7.	7.	34.	26.	9x	19x	2.	32.	23.						
137	533	6.	6.	34.	27.	10x	19x	2.	34.	27.						
115	613	6.	6.	34.	27.	10x	19x	2.	35.	35.						
116	715	5.	5.	34.	27.	9x	20x	2.	37.	44.						
117	818	5.	5.	34.	27.	9x	21x	2.	38.	56.						
118	919	4.	4.	34.	27.	8x	22x	2.	39.	65.						
119	1020	4.	4.	34.	27.	8x	22x	2.	39.	75.						
120	1122	3.	3.	34.	27.	9x	22x	2.	39.	82.						
121	1325	3.	3.	34.	27.	10x	22x	2.	38.	95.						
122	1529	2.	2.	34.	27.	11x	21x	2.	37.	105.						
123	1732	2.	2.	34.	27.	13x	19x	2.	36.	111.						
124	1935	2.	1.	34.	27.	14x	19x	2.	36.	120.						
125	2138	1.	1.	34.	27.	14x	18x	2.	35.	123.						
126	2341	1.	1.	34.	27.	15x	18x	2.	35.	125.						
127	2544	1.	1.	34.	27.	15x	18x	2.	34.	126.						
128	2747	1.	1.	34.	27.	15x	17x	2.	34.	128.						
129	2949	1.	1.	34.	27.	15x	17x	2.	34.	130.						
130	3151	1.	1.	34.	27.	16x	17x	2.	34.	131.						
131	3350	1.	1.	34.	27.	16x	17x	2.	34.	132.						
132	3550	1.	1.	34.	27.	16x	17x	2.	34.	133.						
133	3752	1.	1.	34.	27.	16x	17x	2.	34.	133.						
134	3956	1.	1.	34.	27.	17x	16x	2.	34.	132.						
135	4110	1.	1.	34.	27.	17x	16x	2.	34.	131.						
136	4235	1.	1.	34.	27.	17x	16x	2.	34.	132.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C Station 146 Latitude 16-52.0S Longitude 133-33.9W Date 7/28/91 Bottom Depth 4293

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy uM/kg	AOU uM/kg	PO4 uM/kg	NO3 uM/kg	SiO3 uM/kg	TCO2 Obs	TCO2 S=35	pCO2 @ 20 uAtm	pCO2 @ Theta uAtm	Total Alk. Calc uEq/kg	(PALK)s uEq/kg
101	3	26.	26.	36.	24.	21x	-1x	0.	0.	1.	2033	1944	265	344	2415	2309
102	44	26.	26.	36.	24.	21x	-1x	0.	0.	1.						
103	86	26.	26.	36.	24.	21x	-1x	0.	0.	1.						
104	126	26.	26.	36.	24.	20x	-x	0.	0.	1.						
105	157	24.	24.	36.	24.	19x	1x	0.	0.	1.						
106	187	22.	22.	36.	24.	19x	2x	0.	1.	1.						
107	239	20.	20.	35.	25.	18x	3x	0.	2.	1.						
108	289	18.	17.	35.	25.	18x	5x	0.	5.	1.						
109	350	13.	13.	34.	26.	15x	10x	1.	12.	5.						
110	410	9.	9.	34.	26.	11x	16x	1.	24.	14.						
111	461	8.	8.	34.	26.	10x	18x	2.	29.	18.						
112	512	7.	7.	34.	26.	13x	16x	2.	30.	19.						
113	562	6.	6.	34.	27.	14x	16x	2.	32.	23.						
137	614	6.	6.	34.	27.	12x	17x	2.	34.	30.						
115	715	5.	5.	34.	27.	10x	19x	2.	36.	45.						
116	816	5.	5.	34.	27.	9x	21x	2.	38.	55.						
117	917	4.	4.	34.	27.	9x	21x	2.	38.	65.						
118	1019	4.	4.	34.	27.	8x	22x	2.	39.	73.						
119	1118	4.	3.	34.	27.	9x	22x	2.	39.	82.						
120	1219	3.	3.	34.	27.	9x	22x	2.	39.	89.						
121	1419	3.	3.	34.	27.	10x	21x	2.	38.	101.						
122	1622	2.	2.	34.	27.	12x	20x	2.	37.	108.						
123	1828	2.	2.	34.	27.	14x	19x	2.	35.	113.						
124	2033	2.	1.	34.	27.	14x	18x		35.	120.						
125	2236	1.	1.	34.	27.	14x	18x		35.	124.						
126	2388	1.	1.	34.	27.	15x	18x		34.	126.						
127	2542	1.	1.	34.	27.	15x	18x		34.	127.						
128	2694	1.	1.	34.	27.	15x	18x		34.	129.						
129	2846	1.	1.	34.	27.	15x	18x		34.	131.						
130	3051	1.	1.	34.	27.	16x	17x		34.	131.						
131	3253	1.	1.	34.	27.	16x	17x		34.	134.						
132	3457	1.	1.	34.	27.	16x	17x		34.	135.						
133	3659	1.	1.	34.	27.	16x	17x		34.	134.						
134	3862	1.	1.	34.	27.	17x	17x		34.	133.						
135	4063	1.	1.	34.	27.	17x	16x	2.	34.	132.						
136	4257	1.	1.	34.	27.	17x	16x	2.	34.	131.						

WOCE Line P17C Station 147 Latitude 17-20.9S Longitude 133-28.0W Date 7/29/91 Bottom Depth 4404

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy uM/kg	AOU uM/kg	PO4 uM/kg	NO3 uM/kg	SiO3 uM/kg	TCO2 Obs	TCO2 S=35	pCO2 @ 20 uAtm	pCO2 @ Theta uAtm	Total Alk. Calc uEq/kg	(PALK)s uEq/kg
101	3	26.	26.	36.	24.	21x	-1x	0.	0.	1.	2034	1947	258	334	2423	2319
102	55	25.	25.	36.	24.	21x	-1x	0.	0.	1.						
103	106	25.	25.	36.	24.	21x	-x	0.	0.	1.						
104	131	25.	25.	36.	24.	20x	-x	0.	0.	1.						
105	156	23.	23.	36.	24.	19x	1x	0.	0.	1.						
106	181	23.	23.	36.	24.	19x	2x	0.	1.	1.						
107	208	22.	22.	36.	25.	18x	2x	0.	2.	1.						
108	234	21.	21.	36.	25.	18x	3x	0.	2.	1.						
109	283	18.	18.	35.	25.	18x	4x	0.	3.	1.						
110	335	15.	15.	35.	25.	17x	6x	0.	7.	2.						
111	386	11.	11.	34.	26.	15x	11x	1.	17.	7.						
112	436	9.	9.	34.	26.	14x	14x	1.	24.	13.						
113	492	7.	7.	34.	26.	12x	16x	2.	30.	19.						
137	553	6.	6.	34.	27.	15x	14x	2.	30.	20.						
115	613	5.	5.	34.	27.	14x	15x	2.	32.	27.						
116	715	5.	5.	34.	27.	12x	18x	2.	34.	43.						
117	817	5.	5.	34.	27.	12x	18x	2.	35.	54.						
118	918	4.	4.	34.	27.	11x	19x	2.	36.	62.						
119	1070	4.	4.	34.	27.	11x	19x	2.	37.	74.						
120	1222	3.	3.	34.	27.	12x	19x	2.	37.	83.						
121	1426	3.	2.	34.	27.	13x	18x	2.	36.	94.						
122	1630	2.	2.	34.	27.	13x	19x	2.	36.	106.						
123	1832	2.	2.	34.	27.	14x	19x	2.	36.	115.						
124	2034	2.	1.	34.	27.	14x	18x	2.	35.	120.						
125	2237	1.	1.	34.	27.	14x	18x	2.	35.	125.						
126	2440	1.	1.	34.	27.	15x	18x	2.	35.	127.						
127	2643	1.	1.	34.	27.	15x	18x	2.	35.	128.						
128	2846	1.	1.	34.	27.	15x	17x	2.	35.	130.						
129	3050	1.	1.	34.	27.	15x	17x	2.	35.	131.						
130	3253	1.	1.	34.	27.	15x	17x	2.	34.	134.						
131	3455	1.	1.	34.	27.	16x	17x	2.	34.	134.						
132	3658	1.	1.	34.	27.	16x	17x	2.	34.	134.						
133	3860	1.	1.	34.	27.	16x	17x	2.	34.	134.						
134	4063	1.	1.	34.	27.	17x	16x	2.	34.	132.						
135	4216	1.	1.	34.	27.	17x	16x	2.	34.	132.						
136	4367	1.	1.	34.	27.	17x	16x	2.	34.	132.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C Station 148 Latitude 17-50.0S Longitude 133-22.0W Date 7/29/91 Bottom Depth 3970

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	(PALK)s (uEq/kg)
101	2	25.	25.	36.	24.	20x	-x	0.	0.	1.	2028	1945	259	330	2414	2316
102	32	25.	25.	36.	24.	20x	-x	0.	0.	1.	2027	1945	259	330	2412	2314
103	73	25.	25.	36.	24.	20x	-x	0.	0.	1.	2028	1946	260	332	2412	2315
104	104	25.	25.	36.	24.	21x	-x	0.	0.	1.	2033	1950	266	338	2412	2314
105	134	24.	24.	36.	24.	20x	x	0.	0.	1.	2046	1971	291	350	2401	2313
106	175	22.	22.	36.	25.	18x	2x	0.	1.	1.	2072	2004	342	377	2389	2311
107	216	21.	21.	36.	25.	18x	3x	0.	2.	1.	2078	2019	365	383	2378	2312
108	257	19.	19.	35.	25.	18x	4x	0.	3.	1.	2080	2038	391	382	2361	2316
109	308	16.	16.	35.	25.	18x	5x	0.	5.	2.	2081	2067	450	388	2326	2316
110	358	13.	13.	34.	26.	16x	8x	1.	11.	4.	2110	2120	588	446	2302	2324
111	409	10.	10.	34.	26.	14x	12x	1.	20.	9.	2153	2180	830	550	2287	2337
112	460	8.	8.	34.	26.	13x	15x	2.	27.	15.	2187	2223	1078	658	2284	2350
113	511	7.	7.	34.	26.	14x	15x	2.	30.	17.	2193	2231	1106	644	2286	2357
137	561	6.	6.	34.	27.	15x	14x	2.	30.	20.	2190	2230	1076	604	2287	2361
115	612	5.	5.	34.	27.	16x	14x	2.	31.	23.	2192	2233	1087	596	2288	2363
116	662	5.	5.	34.	27.	15x	15x	2.	33.	30.	2209	2249	1153	623	2297	2374
117	714	5.	5.	34.	27.	14x	16x	2.	34.	35.	2219	2258	1190	637	2304	2380
118	815	4.	4.	34.	27.	12x	18x	2.	36.	50.	2239	2275	1264	665	2318	2392
119	917	4.	4.	34.	27.	12x	19x	2.	36.	61.	2255	2289	1284	667	2333	2405
120	1018	4.	4.	34.	27.	12x	19x	2.	36.	69.	2260	2293	1288	660	2339	2409
121	1118	3.	3.	34.	27.	12x	19x	2.	36.	77.	2275	2306	1304	657	2353	2422
122	1269	3.	3.	34.	27.	13x	19x	2.	36.	88.	2287	2317	1287	636	2368	2436
123	1421	3.	2.	34.	27.	13x	18x	2.	36.	94.	2281	2310	1258	611	2365	2432
124	1623	2.	2.	34.	27.	13x	19x	2.	36.	107.	2296	2322	1257	599	2382	2446
125	1825	2.	2.	34.	27.	14x	18x	2.	35.	113.	2296	2322	1212	570	2388	2451
126	2028	2.	1.	34.	27.	15x	18x	2.	35.	119.	2303	2327	1206	561	2396	2457
127	2231	1.	1.	34.	27.	15x	18x	2.	35.	123.	2304	2327	1182	547	2401	2461
128	2434	1.	1.	34.	27.	15x	18x	2.	35.	127.	2304	2326	1180	544	2401	2460
129	2637	1.	1.	34.	27.	15x	18x	2.	35.	129.	2308	2330	1171	538	2407	2465
130	2840	1.	1.	34.	27.	15x	18x	2.	35.	131.	2308	2329	1153	528	2409	2467
131	3043	1.	1.	34.	27.	16x	17x	2.	35.	132.	2307	2329	1147	524	2410	2468
132	3246	1.	1.	34.	27.	16x	17x	2.	35.	134.	2312	2334	1140	519	2416	2474
133	3450	1.	1.	34.	27.	16x	17x	2.	35.	135.	2309	2330	1129	513	2414	2471
134	3652	1.	1.	34.	27.	16x	17x	2.	34.	135.	2308	2329	1119	507	2414	2471
135	3856	1.	1.	34.	27.	16x	17x	2.	34.	134.	2305	2326	1116	504	2412	2468
136	3951	1.	1.	34.	27.				34.		2304	2325	1109	500		

WOCE Line P17C Station 149 Latitude 18-19.8S Longitude 133-15.0W Date 7/29/91 Bottom Depth 4107

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	(PALK)s (uEq/kg)
101	1	25.	25.	36.	24.	21x	-1x	0.	0.	1.	2030	1946	263	333	2412	2313
102	44	25.	25.	36.	24.	21x	-1x	0.	0.	1.						
103	85	25.	25.	36.	24.	21x	-x	0.	0.	1.						
104	116	25.	25.	36.	24.	21x	-x	0.	0.	1.						
105	136	24.	24.	36.	24.	20x	x	0.	0.	1.						
106	172	22.	22.	36.	24.	19x	1x	0.	0.	1.						
107	207	21.	21.	36.	25.	18x	2x	0.	2.	1.						
108	257	18.	18.	35.	25.	18x	4x	0.	3.	1.						
109	308	16.	16.	35.	25.	18x	5x	0.	5.	1.						
110	359	13.	12.	34.	26.	17x	8x	1.	12.	4.						
111	409	10.	10.	34.	26.	15x	11x	1.	19.	9.						
112	460	8.	8.	34.	26.	15x	13x	1.	25.	12.						
113	511	6.	6.	34.	26.	17x	12x	1.	28.	14.						
137	560	6.	6.	34.	27.	19x	11x	1.	28.	15.						
115	611	5.	5.	34.	27.	18x	12x	2.	29.	19.						
116	662	5.	5.	34.	27.	16x	14x	2.	32.	26.						
117	711	5.	5.	34.	27.	14x	16x	2.	34.	33.						
118	812	4.	4.	34.	27.	12x	18x	2.	36.	50.						
119	913	4.	4.	34.	27.	12x	19x	2.	36.	63.						
120	1014	4.	4.	34.	27.	12x	19x	2.	37.	72.						
121	1216	3.	3.	34.	27.	12x	19x	2.	37.	85.						
122	1418	3.	2.	34.	27.	13x	18x	2.	36.	95.						
123	1620	2.	2.	34.	27.	14x	18x	2.	35.	104.						
124	1823	2.	2.	34.	27.	14x	18x	2.	35.	112.						
125	2026	2.	1.	34.	27.	15x	18x	2.	35.	118.						
126	2227	1.	1.	34.	27.	15x	18x	2.	35.	122.						
127	2431	1.	1.	34.	27.	15x	18x	2.	35.	125.						
128	2634	1.	1.	34.	27.	15x	18x	2.	35.	128.						
129	2838	1.	1.	34.	27.	15x	17x	2.	35.	130.						
130	3043	1.	1.	34.	27.	15x	17x	2.	34.	131.						
131	3247	1.	1.	34.	27.	16x	17x	2.	35.	134.						
132	3452	1.	1.	34.	27.	16x	17x	2.	35.	136.						
133	3656	1.	1.	34.	27.	16x	17x	2.	34.	135.						
134	3808	1.	1.	34.	27.	16x	17x	2.	34.	134.						
135	3961	1.	1.	34.	27.	17x	17x	2.	34.	134.						
138	4083	1.	1.	34.	27.	17x	16x	2.	34.	133.						

(TCO2)s=35 = TCO2 obs X (35 / Sal)   (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C Station 150 Latitude 18-48.9S Longitude 133-09.0W Date 7/29/91 Bottom Depth 3884

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	1	25.	25.	36.	24.	21x	-1x	0.	0.	1.	2030	1948	269	345	2405	2308
102	44	25.	25.	36.	24.	21x	-1x	0.	0.	1.						
103	84	25.	25.	36.	24.	21x	-1x	0.	0.	1.						
104	125	25.	25.	36.	24.	21x	-x	0.	0.	0.						
105	166	23.	23.	36.	24.	20x	x	0.	0.	1.						
106	207	21.	21.	36.	25.	19x	2x	0.	2.	1.						
107	258	19.	19.	35.	25.	19x	3x	0.	3.	1.						
108	309	16.	16.	35.	25.	18x	5x	0.	5.	2.						
109	359	13.	13.	34.	26.	17x	8x	1.	11.	4.						
110	410	10.	10.	34.	26.	16x	11x	1.	19.	9.						
111	461	8.	8.	34.	26.	15x	13x	1.	25.	13.						
112	511	6.	6.	34.	26.	17x	12x	1.	27.	14.						
113	563	6.	6.	34.	27.	20x	9x	1.	27.	13.						
137	613	5.	5.	34.	27.	19x	10x	1.	28.	18.						
115	664	5.	5.	34.	27.	16x	13x	2.	31.	25.						
116	765	5.	4.	34.	27.	13x	17x	2.	35.	43.						
117	867	4.	4.	34.	27.	12x	19x	2.	36.	59.						
118	969	4.	4.	34.	27.	12x	19x	2.	36.	68.						
119	1071	3.	3.	34.	27.	12x	19x	2.	36.	76.						
120	1223	3.	3.	34.	27.	12x	19x	2.	36.	84.						
121	1425	3.	2.	34.	27.	13x	18x	2.	36.	90.						
122	1629	2.	2.	34.	27.	14x	18x	2.	35.	103.						
123	1832	2.	2.	34.	27.	15x	18x	2.	35.	110.						
124	2035	2.	1.	34.	27.	15x	18x	2.	35.	117.						
125	2237	1.	1.	34.	27.	15x	17x	2.	35.	121.						
126	2390	1.	1.	34.	27.	15x	18x	2.	35.	125.						
127	2541	1.	1.	34.	27.	15x	18x	2.	35.	126.						
128	2693	1.	1.	34.	27.	15x	18x	2.	35.	129.						
129	2845	1.	1.	34.	27.	15x	18x	2.	35.	131.						
130	3049	1.	1.	34.	27.	16x	17x	2.	34.	130.						
131	3252	1.	1.	34.	27.	16x	17x	2.	34.	130.						
133	3454	1.	1.	34.	27.	16x	17x	2.	34.	132.						
132	3454	1.	1.	34.	27.	16x	17x	2.	34.	132.						
135	3657	1.	1.	34.	27.	16x	17x	2.	34.	133.						
134	3658	1.	1.	34.	27.											
138	3840	1.	1.	34.	27.	16x	17x	2.	34.	133.						

WOCE Line P17C Station 151 Latitude 19-18.7S Longitude 133-03.1W Date 7/30/91 Bottom Depth 3629

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	3	25.	25.	36.	24.			0.	0.	1.	2031	1949	262	329	2414	2317
102	44	25.	25.	36.	24.			0.	0.	1.						
103	85	25.	25.	36.	24.	21x	-1x	0.	0.	1.						
104	127	25.	25.	36.	24.	21x	-1x	0.	0.	1.						
105	146	23.	23.	36.	24.	21x	x	0.	0.	1.						
106	166	23.	23.	36.	24.	20x	x	0.	0.	1.						
107	187	22.	22.	36.	24.	19x	2x	0.	0.	1.						
108	207	21.	21.	36.	25.	19x	2x	0.	1.	1.						
109	258	19.	19.	35.	25.	18x	3x	0.	2.	1.						
110	310	17.	17.	35.	25.	18x	4x	0.	3.	2.						
111	386	13.	13.	34.	26.	16x	9x	1.	13.	5.						
112	472	8.	8.	34.	26.	14x	14x	1.	25.	13.						
113	533	7.	7.	34.	26.	16x	12x	1.	27.	15.						
137	613	6.	6.	34.	27.	19x	10x	1.	28.	16.						
115	664	5.	5.	34.	27.	18x	12x	2.	30.	21.						
116	715	5.	5.	34.	27.	16x	14x	2.	33.	29.						
117	817	4.	4.	34.	27.	13x	17x	2.	35.	48.						
118	918	4.	4.	34.	27.	12x	18x	2.	36.	60.						
119	1019	4.	4.	34.	27.	12x	19x	2.	36.	69.						
120	1121	3.	3.	34.	27.	13x	18x	2.	36.	76.						
121	1274	3.	3.	34.	27.	14x	18x	2.	35.	87.						
122	1426	2.	2.	34.	27.	14x	18x	2.	35.	98.						
123	1629	2.	2.	34.	27.	15x	18x	2.	35.	108.						
124	1833	2.	2.	34.	27.	15x	17x	2.	35.	112.						
125	2035	2.	1.	34.	27.	15x	17x	2.	35.	117.						
126	2239	1.	1.	34.	27.	15x	17x	2.	35.	121.						
127	2441	1.	1.	34.	27.	15x	17x	2.	34.	123.						
128	2644	1.	1.	34.	27.	16x	17x	2.	34.	126.						
129	2847	1.	1.	34.	27.	16x	17x	2.	34.	126.						
130	3050	1.	1.	34.	27.	16x	17x	2.	34.	127.						
131	3050	1.	1.	34.	27.	16x	17x	2.	34.	128.						
132	3253	1.	1.	34.	27.	16x	17x	2.	34.	128.						
133	3253	1.	1.	34.	27.	16x	17x	2.	34.	129.						
135	3456	1.	1.	34.	27.	16x	17x	2.	34.	130.						
134	3456	1.	1.	34.	27.	16x	17x	2.	34.	130.						
138	3593	1.	1.	34.	27.	16x	17x	2.	34.	130.						

Lamont-Doherty Earth Observatory of Columbia University
Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C Station 152 Latitude 19-47.9S Longitude 132-57.0W Date 7/30/91 Bottom Depth 3414

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	2	25.	25.	36.	24.	21x	-1x	0.	0.	1.	2030	1950	263	330	2412	2317
102	44	25.	25.	36.	24.	21x	-1x	0.	0.	1.	2027	1947	262	328	2409	2314
103	75	25.	25.	36.	24.	21x	-1x	0.	0.	1.	2025	1946	263	329	2405	2311
104	105	25.	25.	36.	24.	21x	-1x	0.	0.	1.	2028	1949	263	329	2409	2315
105	126	25.	25.	36.	24.	21x	-x	0.	0.	1.	2030	1952	266	332	2408	2315
106	146	23.	23.	36.	24.	21x	-x	0.	0.	1.	2035	1968	289	342	2388	2309
107	167	23.	23.	36.	24.	20x	x	0.	0.	1.	2047	1984	309	355	2384	2311
108	187	22.	22.	36.	24.	19x	1x	0.	0.	1.	2058	1997	327	362	2383	2312
109	208	21.	21.	36.	25.	19x	2x	0.	1.	1.	2066	2008	347	370	2377	2311
110	258	19.	19.	35.	25.	19x	3x	0.	3.	1.	2075	2037	391	376	2355	2315
111	310	16.	16.	35.	25.	18x	5x	0.	4.	1.	2073	2054	430	377	2327	2311
112	386	12.	12.	34.	26.	17x	8x	1.	13.	4.	2110	2123	602	441	2297	2324
113	461	9.	9.	34.	26.	14x	14x	1.	23.	12.	2171	2204	957	608	2284	2343
137	537	7.	7.	34.	26.	15x	13x	2.	28.	16.	2183	2222	1043	603	2284	2354
115	613	6.	6.	34.	27.	17x	12x	2.	30.	19.	2182	2223	1020	565	2286	2360
116	714	5.	5.	34.	27.	16x	13x	2.	31.	24.	2196	2237	1071	579	2294	2370
117	816	4.	4.	34.	27.	14x	16x	2.	34.	40.	2221	2261	1178	620	2308	2384
118	917	4.	4.	34.	27.	14x	17x	2.	35.	54.	2242	2278	1219	632	2326	2400
119	1019	4.	4.	34.	27.	13x	18x	2.	35.	66.	2251	2284	1240	633	2333	2405
120	1119	3.	3.	34.	27.	13x	18x	2.	36.	74.	2264	2296	1244	626	2348	2418
121	1272	3.	3.	34.	27.	14x	18x	2.	36.	86.	2271	2302	1231	605	2358	2426
122	1425	2.	2.	34.	27.	14x	18x	2.	35.	94.	2282	2311	1215	588	2372	2438
123	1628	2.	2.	34.	27.	14x	18x	2.	35.	106.	2289	2315	1206	572	2380	2444
124	1832	2.	2.	34.	27.	15x	18x	2.	35.	113.						
125	2034	2.	1.	34.	27.	15x	18x	2.	35.	119.	2298	2322	1182	550	2394	2455
126	2238	1.	1.	34.	27.	15x	17x	2.	35.	123.	2300	2323	1172	542	2398	2457
127	2391	1.	1.	34.	27.	15x	17x	2.	35.	124.						
128	2543	1.	1.	34.	27.	15x	17x	2.	35.	126.	2303	2325	1162	534	2403	2462
129	2694	1.	1.	34.	27.	16x	17x	2.	34.	128.						
130	2847	1.	1.	34.	27.	16x	17x	2.	34.	127.	2302	2323				
131	2847	1.	1.	34.	27.	16x	17x	2.	34.	127.						
133	3049	1.	1.	34.	27.	16x	17x	2.	34.	129.						
132	3049	1.	1.	34.	27.	16x	17x	2.	34.	128.	2304	2325	1155	527	2404	2462
134	3252	1.	1.	34.	27.	16x	17x	2.	34.	129.	2302	2324	1135	517	2406	2463
135	3395	1.	1.	34.	27.	16x	17x	2.	34.	130.						
138	3494	1.	1.	34.	27.	16x	17x	2.	34.	131.	2304	2325	1144	520	2406	2463

WOCE Line P17C Station 153 Latitude 20-17.0S Longitude 132-50.0W Date 7/30/91 Bottom Depth 4430

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
201	3	25.	25.	36.	24.	21x	-1x	0.	0.	1.	2030	1951	264	329	2410	2316
202	44	25.	25.	36.	24.	21x	-x	0.	0.	1.						
203	85	25.	25.	36.	24.	21x	-x	0.	0.	1.						
204	131	24.	24.	36.	24.	20x	-x	0.	0.	1.						
205	157	23.	23.	36.	24.	20x	1x	0.	0.	1.						
206	181	22.	22.	36.	24.	19x	2x	0.	0.	1.						
207	208	21.	21.	36.	25.	18x	3x	0.	1.	1.						
208	259	19.	18.	35.	25.	18x	4x	0.	3.	1.						
209	310	16.	16.	35.	25.	18x	5x	0.	5.	1.						
210	371	14.	14.	34.	26.	18x	6x	0.	9.	3.						
211	432	10.	10.	34.	26.	17x	9x	1.	16.	6.						
212	492	8.	8.	34.	26.	17x	11x	1.	24.	11.						
213	552	6.	6.	34.	26.	18x	11x	1.	27.	14.						
237	624	6.	6.	34.	27.	19x	10x	1.	28.	16.						
215	684	5.	5.	34.	27.	17x	12x	2.	30.	21.						
216	745	5.	5.	34.	27.	16x	14x	2.	32.	28.						
217	816	5.	5.	34.	27.	13x	17x	2.	34.	38.						
218	917	4.	4.	34.	27.	13x	17x	2.	35.	53.						
219	1019	4.	4.	34.	27.	13x	18x	2.	35.	64.						
220	1222	3.	3.	34.	27.	14x	18x	2.	35.	82.						
221	1426	2.	2.	34.	27.	14x	18x	2.	35.	97.						
222	1629	2.	2.	34.	27.	14x	18x	2.	35.	105.						
223	1832	2.	2.	34.	27.	15x	18x	2.	35.	114.						
224	2035	2.	1.	34.	27.	15x	18x	2.	35.	118.						
225	2237	1.	1.	34.	27.	15x	17x	2.	34.	122.						
226	2440	1.	1.	34.	27.	15x	17x	2.	34.	125.						
227	2643	1.	1.	34.	27.	16x	17x	2.	34.	125.						
228	2846	1.	1.	34.	27.	16x	17x	2.	34.	125.						
229	3050	1.	1.	34.	27.	16x	17x	2.	34.	127.						
230	3253	1.	1.	34.	27.	16x	17x	2.	34.	127.						
231	3456	1.	1.	34.	27.	16x	17x	2.	34.	128.						
232	3659	1.	1.	34.	27.	16x	17x	2.	34.	129.						
233	3862	1.	1.	34.	27.	16x	17x	2.	34.	129.						
234	4065	1.	1.	34.	27.											
235	4267	1.	1.	34.	27.	16x	17x	2.	34.	129.						
238	4414	1.	1.	34.	27.	16x	17x	2.	34.	129.						

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Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)
WOCE Line P17C Station 154 Latitude 20-47.2S Longitude 132-44.0W Date 7/31/91 Bottom Depth 4250

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	2	24.	24.	36.	24.	20x	-x	0.	0.	1.	2026	1951	277	341	2391	2302
102	45	24.	24.	36.	24.	20x	-x	0.	0.	1.						
103	86	24.	24.	36.	24.	20x	-x	0.	0.	1.						
104	131	24.	24.	36.	24.	20x	-x	0.	0.	1.						
105	148	24.	24.	36.	24.	20x	x	0.	0.	1.						
106	167	22.	22.	35.	24.	20x	1x	0.	0.	1.						
107	187	21.	21.	35.	24.	19x	1x	0.	0.	1.						
108	207	21.	21.	35.	25.	19x	2x	0.	1.	1.						
109	228	20.	20.	35.	25.	18x	3x	0.	2.	1.						
110	248	20.	20.	35.	25.	18x	3x	0.	2.	1.						
111	310	17.	17.	35.	25.	19x	4x	0.	4.	2.						
112	387	13.	13.	34.	26.	18x	7x	0.	10.	3.						
113	462	9.	9.	34.	26.	17x	10x	1.	20.	8.						
137	538	7.	7.	34.	26.	17x	11x	1.	26.	12.						
115	639	5.	5.	34.	27.	19x	10x	1.	28.	16.						
116	716	5.	5.	34.	27.	18x	12x	2.	30.	23.						
117	816	4.	4.	34.	27.	15x	15x	2.	34.	38.						
118	917	4.	4.	34.	27.	13x	17x	2.	35.	53.						
119	1019	4.	4.	34.	27.	13x	18x	2.	36.	68.						
120	1121	3.	3.	34.	27.	13x	18x	2.	36.	77.						
121	1273	3.	3.	34.	27.	14x	18x	2.	36.	86.						
122	1424	2.	2.	34.	27.	14x	18x	2.	35.	95.						
123	1628	2.	2.	34.	27.	14x	18x	2.	35.	105.						
124	1830	2.	2.	34.	27.	15x	18x	2.	35.	112.						
125	2034	2.	1.	34.	27.	15x	18x	2.	35.	119.						
126	2237	1.	1.	34.	27.	15x	18x	2.	35.	123.						
127	2440	1.	1.	34.	27.	15x	17x	2.	35.	125.						
128	2642	1.	1.	34.	27.	15x	17x	2.	35.	126.						
129	2847	1.	1.	34.	27.	16x	17x	2.	35.	128.						
130	3049	1.	1.	34.	27.	16x	17x	2.	34.	128.						
131	3254	1.	1.	34.	27.	16x	17x	2.	34.	129.						
132	3458	1.	1.	34.	27.	16x	17x	2.	34.	131.						
133	3660	1.	1.	34.	27.	16x	17x	2.	34.	132.						
134	3864	1.	1.	34.	27.	16x	17x	2.	34.	132.						
135	4067	1.	1.	34.	27.	16x	17x	2.	34.	132.						
138	4270	1.	1.	34.	27.											

WOCE Line P17C Station 155 Latitude 21-15.8S Longitude 132-37.1W Date 7/31/91 Bottom Depth 3959

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	2	24.	24.	36.	24.	20x	-x	0.	0.	1.	2030	1952	268	329	2406	2313
102	55	24.	24.	36.	24.	20x	-x	0.	0.	1.	2030	1953	267	329	2407	2315
103	106	24.	24.	36.	24.	20x	-x	0.	0.	1.	2031	1953	268	329	2407	2315
104	158	24.	24.	36.	24.	20x	x	0.	0.	1.	2031	1957	273	334	2401	2313
105	208	21.	21.	35.	25.	19x	2x	0.	1.	1.	2055	2002	339	360	2368	2308
106	259	19.	19.	35.	25.	18x	3x	0.	2.	1.	2069	2029	379	372	2356	2312
107	310	17.	17.	35.	25.	19x	4x	0.	4.	1.	2071	2050	415	368	2334	2314
108	361	15.	15.	35.	25.	18x	5x	0.	6.	2.						
109	409	12.	12.	34.	26.	18x	7x	0.	12.	3.	2103	2114	570	418	2300	2324
110	456	9.	9.	34.	26.	18x	9x	1.	18.	6.	2134	2162	723	470	2290	2338
111	502	8.	8.	34.	26.	17x	10x	1.	23.	9.	2152	2188	849	517	2282	2344
112	561	6.	6.	34.	26.	19x	10x	1.	25.	12.						
113	617	6.	6.	34.	27.	20x	10x	1.	27.	14.	2165	2208	927	514	2283	2356
137	674	5.	5.	34.	27.	19x	10x	2.	28.	17.	2171	2214	941	513	2287	2362
115	736	5.	5.	34.	27.	17x	13x	2.	31.	25.	2190	2233	1049	562	2291	2368
116	799	5.	4.	34.	27.	15x	15x	2.	33.	33.	2210	2251	1143	605	2301	2377
117	894	4.	4.	34.	27.	14x	17x	2.	35.	49.	2234	2271	1225	636	2317	2391
118	994	4.	4.	34.	27.	13x	18x	2.	36.	63.	2251	2285	1260	644	2331	2403
119	1094	3.	3.	34.	27.	13x	18x	2.	35.	73.	2262	2295	1240	624	2347	2417
120	1198	3.	3.	34.	27.	14x	18x	2.	35.	80.	2267	2299	1241	615	2352	2421
121	1291	3.	3.	34.	27.	14x	18x	2.	35.	86.						
122	1445	2.	2.	34.	27.	14x	18x	2.	35.	96.	2279	2308	1220	587	2368	2434
123	1605	2.	2.	34.	27.	15x	17x	2.	35.	102.						
124	1758	2.	2.	34.	27.	15x	17x	2.	35.	108.	2292	2318	1198	564	2385	2448
125	1913	2.	2.	34.	27.	15x	18x	2.	35.	114.						
126	2070	2.	1.	34.	27.	15x	17x	2.	35.	117.	2297	2321	1196	556	2392	2452
127	2215	1.	1.	34.	27.	15x	18x	2.	35.	120.						
128	2359	1.	1.	34.	27.	15x	17x	2.	35.	121.	2301	2324	1183	547	2398	2457
129	2510	1.	1.	34.	27.	15x	17x	2.	35.	124.						
130	2714	1.	1.	34.	27.	15x	17x	2.	35.	126.	2304	2326				
131	2911	1.	1.	34.	27.	16x	17x	2.	34.	126.						
132	3108	1.	1.	34.	27.	16x	17x	2.	34.	127.	2302	2324	1161	530	2402	2459
133	3301	1.	1.	34.	27.	16x	17x	2.	34.	128.						
134	3500	1.	1.	34.	27.	16x	17x	2.	34.	130.	2304	2325	1127	512	2409	2466
135	3711	1.	1.	34.	27.	16x	17x	2.	34.	131.						
138	3886	1.	1.	34.	27.	16x	17x	2.	34.	131.	2307	2328	1125	510	2413	2470

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Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)
WOCE Line P17C Station 156 Latitude 21-46.0S Longitude 132-31.1W Date 7/31/91 Bottom Depth 3837

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	2	24.	24.	36.	24.	20x	-x	0.	0.	1.	2024	1955	274	328	2390	2309
102	49	24.	24.	36.	24.	20x	-x	0.	0.	1.						
103	96	24.	24.	36.	24.	20x	x	0.	0.	1.						
104	140	23.	23.	36.	24.	20x	x	0.	0.	1.						
105	165	22.	22.	35.	24.	19x	2x	0.	0.	1.						
106	197	21.	21.	35.	25.	19x	2x	0.	1.	1.						
107	248	19.	19.	35.	25.	18x	3x	0.	2.	1.						
108	309	17.	17.	35.	25.	19x	4x	0.	4.	1.						
109	371	14.	14.	35.	26.	18x	6x	0.	8.	2.						
110	431	11.	11.	34.	26.	18x	8x	1.	15.	5.						
111	492	8.	8.	34.	26.	18x	10x	1.	20.	9.						
112	564	6.	6.	34.	26.	19x	10x	1.	26.	12.						
113	623	6.	6.	34.	27.	19x	10x	1.	27.	15.						
137	664	5.	5.	34.	27.	19x	10x	2.	28.	17.						
115	702	5.	5.	34.	27.	18x	11x	2.	30.	20.						
116	762	5.	5.	34.	27.	17x	13x	2.	31.	27.						
117	863	4.	4.	34.	27.	15x	16x	2.	34.	44.						
118	962	4.	4.	34.	27.	13x	17x	2.	35.	58.						
119	1065	4.	3.	34.	27.	13x	18x	2.	35.	68.						
120	1168	3.	3.	34.	27.	13x	18x	2.	35.	76.						
121	1270	3.	3.	34.	27.	14x	18x	2.	35.	83.						
122	1372	2.	2.	34.	27.	14x	17x	2.	35.	89.						
123	1475	2.	2.	34.	27.	14x	17x	2.	35.	95.						
124	1627	2.	2.	34.	27.	15x	18x	2.	35.	102.						
125	1782	2.	2.	34.	27.	15x	18x	2.	35.	108.						
126	1932	2.	2.	34.	27.	15x	18x	2.	35.	113.						
127	2084	2.	1.	34.	27.	15x	18x	2.	35.	117.						
128	2238	1.	1.	34.	27.	15x	18x	2.	35.	120.						
129	2438	1.	1.	34.	27.	15x	18x	2.	35.	123.						
130	2638	1.	1.	34.	27.	15x	17x	2.	34.	124.						
131	2838	1.	1.	34.	27.	16x	17x	2.	34.	125.						
132	3040	1.	1.	34.	27.	16x	17x	2.	34.	127.						
133	3244	1.	1.	34.	27.	16x	17x	2.	34.	127.						
134	3441	1.	1.	34.	27.	16x	17x	2.	34.	128.						
135	3642	1.	1.	34.	27.	16x	17x	2.	34.	130.						
138	3816	1.	1.	34.	27.	16x	17x	2.	34.	131.						

WOCE Line P17C Station 157 Latitude 22-15.3S Longitude 132-25.1W Date 8/ 1/91 Bottom Depth 3512

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	7	23.	23.	35.	24.	21x	-x	0.	0.	1.						
102	43	23.	23.	35.	24.	21x	-x	0.	0.	1.						
103	83	23.	23.	35.	24.	21x	-x	0.	0.	1.						
104	106	22.	22.	35.	24.	21x	-x	0.	0.	1.						
105	124	22.	22.	35.	24.	21x	-x	0.	0.	1.						
106	153	22.	22.	35.	24.	21x	x	0.	0.	1.						
107	184	21.	21.	35.	24.	20x	1x	0.	0.	1.						
108	215	20.	20.	35.	25.	20x	2x	0.	0.	1.						
109	246	19.	19.	35.	25.	19x	3x	0.	2.	1.						
110	306	17.	17.	35.	25.	18x	4x	0.	4.	1.						
111	381	13.	13.	34.	26.	18x	7x	0.	10.	3.						
112	456	9.	9.	34.	26.	18x	9x	1.	19.	7.						
113	506	7.	7.	34.	26.	18x	10x	1.	24.	10.						
137	584	6.	6.	34.	26.	19x	10x	1.	26.	13.						
115	660	5.	5.	34.	27.	20x	10x	1.	28.	16.						
116	731	5.	5.	34.	27.	18x	11x	2.	30.	21.						
117	800	5.	5.	34.	27.	16x	14x	2.	32.	29.						
118	899	4.	4.	34.	27.	14x	16x	2.	34.	47.						
119	1001	4.	4.	34.	27.	13x	17x	2.	35.	59.						
120	1093	4.	3.	34.	27.	13x	18x	2.	35.	67.						
121	1191	3.	3.	34.	27.	13x	18x	2.	35.	76.						
122	1336	3.	3.	34.	27.	14x	18x	2.	35.	84.						
123	1483	2.	2.	34.	27.	15x	17x	2.	35.	95.						
124	1690	2.	2.	34.	27.	15x	17x	2.	35.	105.						
125	1892	2.	2.	34.	27.	15x	18x	2.	35.	113.						
126	2099	1.	1.	34.	27.	15x	17x	2.	35.	118.						
127	2304	1.	1.	34.	27.	15x	17x	2.	35.	121.						
128	2503	1.	1.	34.	27.	15x	17x	2.	34.	122.						
129	2706	1.	1.	34.	27.	16x	17x	2.	34.	124.						
131	2917	1.	1.	34.	27.	16x	17x	2.	34.	123.						
130	2917	1.	1.	34.	27.	16x	17x	2.	34.	124.						
132	3121	1.	1.	34.	27.	16x	17x	2.	34.	124.						
133	3122	1.	1.	34.	27.	16x	17x	2.	34.	124.						
135	3327	1.	1.	34.	27.	16x	17x	2.	34.	124.						
134	3329	1.	1.	34.	27.	16x	17x	2.	34.	124.						
138	3483	1.	1.	34.	27.	16x	17x	2.	34.	125.						

Project/Expedition is TUNES/2   WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal)   (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C   Station 158   Latitude 22-42.5S   Longitude 132-17.1W   Date 8/ 1/91   Bottom Depth 3398

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	2	23.	23.	35.	24.	21x	-x	0.	0.	1.	2011	1958	275	318	2371	2308
102	39	23.	23.	35.	24.	21x	-x	0.	0.	1.						
103	80	23.	23.	35.	24.	21x	-x	0.	0.	1.						
104	114	23.	23.	35.	24.	21x	-x	0.	0.	1.						
105	156	23.	23.	35.	24.	21x	-x	0.	0.	1.						
106	176	22.	22.	35.	24.	21x	x	0.	0.	1.						
107	196	22.	22.	35.	24.	20x	1x	0.	0.	1.						
108	215	20.	20.	35.	25.	19x	3x	0.	1.	1.						
109	256	19.	18.	35.	25.	19x	3x	0.	2.	1.						
110	305	16.	16.	35.	25.	19x	4x	0.	4.	1.						
111	352	14.	14.	35.	26.	19x	6x	0.	8.	2.						
112	401	12.	12.	34.	26.	18x	7x	1.	12.	4.						
113	444	10.	10.	34.	26.	18x	9x	1.	17.	6.						
137	496	8.	8.	34.	26.	17x	10x	1.	22.	9.						
115	556	6.	6.	34.	26.	21x	8x	1.	24.	9.						
116	619	6.	6.	34.	26.	19x	10x	1.	27.	14.						
117	672	5.	5.	34.	27.	19x	11x	2.	29.	17.						
118	741	5.	5.	34.	27.	18x	11x	2.	30.	21.						
119	792	5.	5.	34.	27.	17x	13x	2.	32.	28.						
120	858	4.	4.	34.	27.	16x	15x	2.	33.	36.						
121	958	4.	4.	34.	27.	14x	16x	2.	34.	51.						
122	1049	4.	4.	34.	27.	14x	17x	2.	35.	62.						
123	1108	4.	3.	34.	27.	13x	18x	2.	35.	69.						
124	1157	3.	3.	34.	27.	14x	17x	2.	35.	71.						
125	1254	3.	3.	34.	27.	14x	17x	2.	35.	79.						
126	1350	3.	3.	34.	27.	14x	17x	2.	35.	86.						
127	1552	2.	2.	34.	27.	15x	17x	2.	35.	98.						
128	1759	2.	2.	34.	27.	15x	17x	2.	35.	109.						
129	1966	2.	1.	34.	27.	15x	18x	2.	35.	117.						
130	2171	1.	1.	34.	27.	15x	17x	2.	35.	121.						
131	2381	1.	1.	34.	27.	15x	17x	2.	35.	123.						
132	2586	1.	1.	34.	27.	16x	17x	2.	34.	125.						
133	2791	1.	1.	34.	27.	16x	17x	2.	34.	125.						
134	3000	1.	1.	34.	27.	16x	17x	2.	34.	126.						
135	3193	1.	1.	34.	27.	16x	17x	2.	34.	126.						
138	3374	1.	1.	34.	27.	17x	16x	2.	34.	126.						

WOCE Line P17C   Station 159   Latitude 23-14.0S   Longitude 132-26.1W   Date 8/ 1/91   Bottom Depth 3619

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	4	24.	24.	36.	24.	20x	x	0.	0.	1.	2023	1956	269	320	2393	2314
102	45	24.	24.	36.	24.	20x	-x	0.	0.	1.						
103	86	24.	24.	36.	24.	20x	x	0.	0.	1.						
104	115	24.	24.	36.	24.	20x	x	0.	0.	1.						
105	129	22.	22.	35.	24.	19x	1x	0.	0.	1.						
106	140	22.	22.	36.	24.	19x	1x	0.	0.	1.						
107	162	22.	22.	36.	24.	19x	2x	0.	1.	1.						
108	177	21.	21.	35.	25.	19x	2x	0.	1.	1.						
109	208	20.	20.	35.	25.	19x	3x	0.	1.	1.						
110	259	17.	17.	35.	25.	19x	4x	0.	3.	1.						
111	309	16.	15.	35.	25.	19x	5x	0.	5.	1.						
112	367	13.	13.	34.	26.	18x	6x	0.	10.	2.						
113	424	10.	10.	34.	26.	19x	7x	1.	15.	4.						
137	467	9.	9.	34.	26.	19x	8x	1.	18.	6.						
115	517	7.	7.	34.	26.	20x	8x	1.	21.	7.						
116	563	6.	6.	34.	26.	21x	7x	1.	23.	9.						
117	602	6.	6.	34.	26.	22x	7x	1.	24.	10.						
118	655	6.	5.	34.	27.	22x	7x	1.	25.	12.						
119	718	5.	5.	34.	27.	21x	8x	1.	27.	15.						
120	773	5.	5.	34.	27.	20x	10x	2.	29.	21.						
121	856	4.	4.	34.	27.	18x	12x	2.	31.	30.						
122	939	4.	4.	34.	27.	16x	14x	2.	33.	42.						
123	1028	3.	3.	34.	27.	15x	16x	2.	35.	57.						
124	1189	3.	3.	34.	27.	14x	17x	2.	35.	76.						
125	1343	2.	2.	34.	27.	14x	17x	2.	35.	88.						
126	1529	2.	2.	34.	27.	15x	17x	2.	35.	100.						
127	1732	2.	2.	34.	27.	15x	18x	2.	35.	108.						
128	1941	2.	1.	34.	27.	15x	17x	2.	35.	115.						
129	2125	1.	1.	34.	27.	15x	17x	2.	35.	119.						
130	2321	1.	1.	34.	27.	15x	17x	2.	35.	121.						
131	2517	1.	1.	34.	27.	16x	17x	2.	35.	123.						
132	2707	1.	1.	34.	27.	16x	17x	2.	34.	124.						
133	2895	1.	1.	34.	27.	16x	17x	2.	34.	125.						
134	3121	1.	1.	34.	27.	16x	17x	2.	34.	125.						
135	3358	1.	1.	34.	27.	17x	16x	2.	34.	125.						
138	3581	1.	1.	34.	27.	17x	16x	2.	34.	125.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C Station 160 Latitude 23-43.3S Longitude 132-33.0W Date 8/ 1/91 Bottom Depth 3664

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	4	23.	23.	36.	24.	21x	-x	0.	0.	1.	2011	1955	271	313	2375	2309
102	35	23.	23.	36.	24.	21x	-x	0.	0.	1.	2014	1957	271	313	2379	2312
103	60	23.	23.	35.	24.	21x	-x	0.	0.	1.	2009	1960	273	313	2369	2311
104	80	22.	22.	35.	24.	21x	-x	0.	0.	1.	2002	1961	277	308	2355	2307
105	115	22.	22.	35.	24.	21x	-x	0.	0.	0.	2004	1964	279	308	2355	2308
106	144	21.	21.	35.	24.	21x	x	0.	0.	0.	2014	1979	301	317	2347	2306
107	195	19.	19.	35.	25.	20x	2x	0.	1.	0.	2044	2012	353	343	2341	2306
108	244	17.	17.	35.	25.	19x	3x	0.	2.	0.	2058	2032	391	358	2333	2305
109	296	15.	15.	35.	26.	19x	5x	0.	5.	1.	2074	2058	443	371	2322	2309
110	348	13.	13.	34.	26.	18x	6x	0.	9.	2.	2092	2092	520	397	2307	2317
111	410	11.	11.	34.	26.	19x	7x	1.	14.	4.	2112	2128	620	425	2293	2326
112	470	8.	8.	34.	26.	20x	8x	1.	19.	5.	2130	2160	715	446	2286	2339
113	525	7.	7.	34.	26.	21x	7x	1.	22.	7.	2137	2174	770	455	2281	2343
137	581	6.	6.	34.	26.	22x	7x	1.	24.	9.	2143	2183	789	448	2284	2352
115	641	6.	6.	34.	27.	22x	7x	1.	25.	11.	2146	2189	818	453	2282	2353
116	699	5.	5.	34.	27.	22x	8x	1.	26.	13.	2153	2197	840	458	2285	2359
117	750	5.	5.	34.	27.	21x	9x	1.	28.	18.	2167	2211	894	479	2290	2366
118	803	5.	4.	34.	27.	19x	11x	2.	30.	23.	2178	2222	954	506	2293	2370
119	901	4.	4.	34.	27.	17x	13x	2.	33.	36.	2206	2248	1084	560	2304	2382
120	1000	3.	3.	34.	27.	15x	16x	2.	35.	54.	2233	2272	1185	599	2321	2396
121	1100	3.	3.	34.	27.	14x	17x	2.	35.	66.						
122	1251	3.	2.	34.	27.	14x	17x	2.	35.	84.	2270	2301	1221	594	2358	2426
123	1406	2.	2.	34.	27.	15x	17x	2.	35.	94.	2278	2306	1213	581	2367	2433
124	1586	2.	2.	34.	27.	15x	17x	2.	35.	104.						
125	1790	2.	2.	34.	27.	15x	18x	2.	35.	111.	2294	2319	1194	560	2388	2450
126	1990	2.	1.	34.	27.	15x	18x	2.	35.	116.						
127	2182	1.	1.	34.	27.	15x	17x	2.	35.	120.	2300	2323	1177	545	2397	2456
128	2388	1.	1.	34.	27.	15x	17x	2.	35.	122.	2301	2324	1163	536	2400	2459
129	2584	1.	1.	34.	27.	16x	17x	2.	34.	123.	2301	2323	1156	531	2401	2459
130	2780	1.	1.	34.	27.	16x	17x	2.	34.	124.						
131	2980	1.	1.	34.	27.	16x	17x	2.	34.	124.	2298	2320	1144	522	2400	2457
132	3179	1.	1.	34.	27.	16x	16x	2.	34.	125.	2297	2318	1131	515	2400	2457
134	3372	1.	1.	34.	27.	17x	16x	2.	34.	124.	2293	2315	1127	512	2397	2454
133	3373	1.	1.	34.	27.	17x	16x	2.	34.	124.						
135	3519	1.	1.	34.	27.	17x	16x	2.	34.	125.						
138	3642	1.	1.	34.	27.	17x	16x	2.	34.	124.	2293	2314	1116	507	2398	2455

WOCE Line P17C Station 161 Latitude 24-12.1S Longitude 132-40.1W Date 8/ 2/91 Bottom Depth 3777

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
101	4	22.	22.	35.	24.	21x	-x	0.	0.	1.	2005	1965	281	307	2355	2308
102	45	22.	22.	35.	24.	21x	-x	0.	0.	1.						
103	86	22.	22.	35.	24.	21x	-x	0.	0.	1.						
104	107	22.	22.	35.	24.	21x	-x	0.	0.	1.						
105	116	22.	22.	35.	24.	21x	-x	0.	0.	1.						
106	128	21.	21.	35.	24.	21x	x	0.	0.	1.						
107	138	20.	20.	35.	25.	20x	1x	0.	0.	1.						
108	148	20.	20.	35.	25.	20x	2x	0.	0.	1.						
109	168	19.	19.	35.	25.	20x	2x	0.	0.	1.						
110	206	18.	18.	35.	25.	20x	3x	0.	1.	1.						
111	254	17.	17.	35.	25.	19x	4x	0.	3.	1.						
112	299	15.	15.	35.	25.	19x	4x	0.	5.	1.						
113	347	13.	13.	35.	26.	19x	6x	0.	9.	2.						
137	400	11.	11.	34.	26.	19x	7x	1.	14.	4.						
115	502	8.	8.	34.	26.	20x	8x	1.	21.	7.						
116	602	6.	6.	34.	27.	22x	8x	1.	23.	9.						
117	708	5.	5.	34.	27.	22x	7x	1.	26.	13.						
118	811	5.	4.	34.	27.	20x	10x	2.	29.	21.						
119	910	4.	4.	34.	27.	17x	13x	2.	32.	36.						
120	1003	4.	3.	34.	27.	15x	16x	2.	34.	51.						
121	1098	3.	3.	34.	27.	15x	16x	2.	35.	63.						
122	1235	3.	3.	34.	27.	14x	17x	2.	36.	77.						
123	1375	2.	2.	34.	27.	14x	17x	2.	35.	89.						
124	1580	2.	2.	34.	27.	15x	17x	2.	35.	101.						
125	1792	2.	2.	34.	27.	15x	17x	2.	35.	110.						
126	1987	2.	1.	34.	27.	15x	18x	2.	35.	118.						
127	2179	1.	1.	34.	27.	15x	17x	2.	35.	122.						
128	2375	1.	1.	34.	27.	15x	17x	2.	35.	123.						
129	2592	1.	1.	34.	27.	16x	17x	2.	35.	124.						
130	2794	1.	1.	34.	27.	16x	17x	2.	34.	126.						
131	3003	1.	1.	34.	27.	16x	16x	2.	34.	126.						
132	3210	1.	1.	34.	27.	17x	16x	2.	34.	126.						
133	3412	1.	1.	34.	27.	17x	16x	2.	34.	126.						
134	3611	1.	1.	34.	27.	17x	16x	2.	34.	125.						
135	3611	1.	1.	34.	27.	17x	16x	2.	34.	125.						
138	3800	1.	1.	34.	27.	17x	16x	2.	34.	126.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C Station 162 Latitude 24-41.3S Longitude 132-48.0W Date 8/ 2/91 Bottom Depth 4047

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	---TCO2---- Obs	S=35	-----pCO2---- @ 20	@ Theta	Total Alk. Calc	(PALK)s
						---	---	---	uM/kg	---	---	---	-----uAtm----		---uEq/kg---	
101	2	22.	22.	35.	24.	21x	-x	0.	0.	1.	2005	1960	280	310	2357	2305
102	47	22.	22.	35.	24.	21x	-x	0.	0.	1.						
103	89	22.	22.	35.	24.	21x	-x	0.	0.	1.						
104	129	22.	22.	35.	24.	21x	x	0.	0.	1.						
105	149	21.	21.	35.	25.	19x	2x	0.	0.	1.						
106	180	19.	19.	35.	25.	19x	2x	0.	1.	1.						
107	220	18.	18.	35.	25.	19x	3x	0.	2.	1.						
108	261	17.	17.	35.	25.	20x	3x	0.	2.	1.						
109	321	15.	15.	35.	26.	19x	4x	0.	5.	1.						
110	382	13.	13.	34.	26.	19x	6x	0.	10.	3.						
111	436	10.	10.	34.	26.	19x	8x	1.	16.	5.						
112	490	8.	8.	34.	26.	19x	8x	1.	21.	7.						
113	557	7.	7.	34.	26.	20x	8x	1.	23.	9.						
137	617	6.	6.	34.	26.	21x	8x	1.	25.	11.						
115	634	6.	6.	34.	26.	22x	8x	1.	25.	11.						
116	649	6.	6.	34.	27.											
117	691	5.	5.	34.	27.	22x	8x	1.	26.	13.						
118	752	5.	5.	34.	27.	21x	9x	1.	27.	16.						
119	834	4.	4.	34.	27.	20x	10x	2.	29.	23.						
120	913	4.	4.	34.	27.	18x	13x	2.	32.	33.						
121	1003	4.	4.	34.	27.	16x	15x	2.	34.	47.						
122	1098	3.	3.	34.	27.	15x	16x	2.	35.	60.						
123	1282	3.	3.	34.	27.	14x	17x	2.	35.	80.						
124	1473	2.	2.	34.	27.	15x	17x	2.	35.	94.						
125	1671	2.	2.	34.	27.	15x	17x	2.	35.	105.						
126	1858	2.	2.	34.	27.	15x	17x	2.	35.	114.						
127	2042	2.	1.	34.	27.	15x	18x	2.	35.	119.						
128	2244	1.	1.	34.	27.	15x	18x	2.	35.	123.						
129	2463	1.	1.	34.	27.	15x	17x	2.	35.	124.						
130	2663	1.	1.	34.	27.	16x	17x	2.	34.	125.						
131	2884	1.	1.	34.	27.	16x	17x	2.	34.	126.						
132	3096	1.	1.	34.	27.	16x	16x	2.	34.	126.						
133	3304	1.	1.	34.	27.	17x	16x	2.	34.	126.						
134	3534	1.	1.	34.	27.	17x	16x	2.	34.	126.						
135	3751	1.	1.	34.	27.	17x	16x	2.	34.	126.						
138	3981	1.	1.	34.	27.	17x	16x	2.	34.	125.						

WOCE Line P17C Station 163 Latitude 25-10.9S Longitude 132-55.2W Date 8/ 2/91 Bottom Depth 4178

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	---TCO2---- Obs	S=35	-----pCO2---- @ 20	@ Theta	Total Alk. Calc	(PALK)s
						---	---	---	uM/kg	---	---	---	-----uAtm----		---uEq/kg---	
101	2	21.	21.	35.	24.			0.	0.	1.						
102	47	21.	21.	35.	24.	21x	-x	0.	0.	1.						
103	88	21.	21.	35.	24.	21x	x	0.	0.	1.						
104	128	21.	21.	35.	24.	21x	x	0.	0.	1.						
105	165	19.	19.	35.	25.	20x	1x	0.	0.	1.						
106	220	18.	17.	35.	25.	19x	3x	0.	1.	1.						
107	292	15.	15.	35.	25.	19x	4x	0.	4.	1.						
108	367	13.	12.	34.	26.	19x	6x	0.	10.	3.						
109	431	10.	10.	34.	26.			1.	15.	4.						
110	497	8.	8.	34.	26.			1.	20.	6.						
111	573	6.	6.	34.	26.	22x	7x	1.	23.	9.						
112	631	6.	6.	34.	26.	23x	7x	1.	24.	10.						
113	666	5.	5.	34.	27.	23x	7x	1.	25.	11.						
137	703	5.	5.	34.	27.	23x	7x	1.	25.	12.						
115	760	5.	5.	34.	27.	22x	8x	1.	27.	16.						
116	816	5.	4.	34.	27.	20x	10x	2.	29.	22.						
117	909	4.	4.	34.	27.	18x	12x	2.	32.	33.						
118	1002	4.	3.	34.	27.	16x	15x	2.	34.	48.						
119	1091	3.	3.	34.	27.	15x	16x	2.	35.	61.						
120	1178	3.	3.	34.	27.	14x	17x	2.	35.	70.						
121	1270	3.	3.	34.	27.	14x	17x	2.	35.	80.						
122	1357	2.	2.	34.	27.	14x	17x	2.	35.	86.						
123	1534	2.	2.	34.	27.	15x	17x	2.	35.	96.						
124	1715	2.	2.	34.	27.	15x	17x	2.	35.	107.						
125	1910	2.	1.	34.	27.	15x	18x	2.	35.	115.						
126	2108	1.	1.	34.	27.	15x	18x	2.	35.	120.						
127	2320	1.	1.	34.	27.	15x	17x	2.	35.	123.						
128	2513	1.	1.	34.	27.	15x	17x	2.	35.	124.						
129	2704	1.	1.	34.	27.	16x	17x	2.	34.	125.						
130	2925	1.	1.	34.	27.			2.	34.	125.						
131	3124	1.	1.	34.	27.			2.	34.	126.						
132	3300	1.	1.	34.	27.	17x	16x	2.	34.	126.						
133	3521	1.	1.	34.	27.	17x	16x	2.	34.	125.						
134	3757	1.	1.	34.	27.	17x	16x	2.	34.	126.						
135	3938	1.	1.	34.	27.			2.	34.	125.						
138	4150	1.	1.	34.	27.	17x	16x	2.	33.	125.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C Station 164 Latitude 25-40.4S Longitude 133-02.7W Date 8/ 2/91 Bottom Depth 3845

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	3	21.	21.	35.	24.	21x	-x	0.	0.	1.	2004	1967	281	300	2353	2310
102	44	21.	21.	35.	24.	22x	-x	0.	0.	1.	2000	1963	288	307	2342	2299
103	80	21.	21.	35.	24.	21x	-x	0.	0.	1.	2002	1965	285	304	2346	2304
104	105	20.	20.	35.	24.	22x	-x	0.	0.	1.	2003	1970	288	297	2345	2306
105	130	20.	20.	35.	25.	22x	-x	0.	0.	1.	2002	1970	290	299	2341	2304
106	155	20.	20.	35.	25.	22x	x	0.	0.	1.	2003	1972	292	297	2342	2305
107	181	19.	19.	35.	25.	22x	x	0.	0.	1.	2013	1983	314	313	2333	2298
168	207	19.	19.	35.	25.	22x	x	0.	0.	1.	2018	1991	320	312	2334	2303
169	256	17.	17.	35.	25.	20x	3x	0.	1.	1.	2053	2031	389	351	2327	2304
170	307	15.	15.	35.	25.	19x	4x	0.	5.	1.	2072	2059	446	374	2318	2308
111	357	13.	13.	35.	26.	19x	6x	0.	9.	2.	2091	2090	508	391	2310	2318
112	408	11.	11.	34.	26.	19x	7x	1.	13.	4.	2110	2124	604	423	2296	2326
113	460	9.	9.	34.	26.	20x	8x	1.	18.	6.	2130	2159	704	447	2290	2340
137	513	8.	7.	34.	26.	21x	7x	1.	21.	7.	2145	2181	747	449	2296	2356
115	613	6.	6.	34.	26.	23x	6x	1.	23.	9.	2139	2179	767	432	2284	2352
116	714	5.	5.	34.	27.	23x	7x	1.	24.	11.	2144	2187	785	430	2287	2357
117	814	5.	5.	34.	27.	21x	9x	1.	28.	19.	2164	2208	891	475	2287	2363
118	913	4.	4.	34.	27.	18x	12x	2.	31.	31.	2193	2236	1027	535	2298	2376
119	1011	4.	4.	34.	27.	16x	15x	2.	34.	45.	2222	2262	1155	590	2312	2389
120	1108	3.	3.	34.	27.	16x	16x	2.	34.	56.	2235	2273	1172	586	2325	2400
121	1259	3.	3.	34.	27.	15x	17x	2.	35.	73.	2255	2289	1214	594	2342	2413
122	1418	2.	2.	34.	27.	15x	17x	2.	35.	86.	2270	2300	1202	579	2359	2427
123	1621	2.	2.	34.	27.	15x	17x	2.	35.	102.	2284	2311	1197	566	2376	2440
124	1817	2.	2.	34.	27.	15x	17x	2.	35.	112.	2293	2318	1197	561	2386	2449
125	2016	2.	1.	34.	27.	15x	18x	2.	35.	119.	2299	2324				
126	2215	1.	1.	34.	27.	15x	17x	2.	35.	122.	2303	2326	1190	550	2398	2459
127	2415	1.	1.	34.	27.	15x	17x	2.	35.	124.	2303	2326	1176	541	2400	2460
128	2614	1.	1.	34.	27.	16x	17x	2.	35.	125.	2301	2323	1160	532	2401	2459
129	2814	1.	1.	34.	27.	16x	17x	2.	34.	125.	2300	2321	1147	524	2401	2459
130	3018	1.	1.	34.	27.	16x	16x	2.	34.	125.	2295	2316	1138	519	2397	2454
131	3217	1.	1.	34.	27.	17x	16x	2.	34.	125.	2297	2318	1126	512	2401	2458
133	3417	1.	1.	34.	27.	17x	16x	2.	34.	125.	2294	2315	1123	509	2398	2455
132	3418	1.	1.	34.	27.	17x	16x	2.	34.	125.	2295	2316	1119	507	2400	2456
134	3622	1.	1.	34.	27.	17x	16x	2.	34.	125.	2293	2314	1115	505	2398	2454
135	3622	1.	1.	34.	27.			2.	34.	125.	2292	2313	1117	506	2397	2453
138	3803	1.	1.	34.	27.	17x	16x	2.	34.	125.	2274	2295	1112	503	2378	2434

WOCE Line P17C Station 165 Latitude 26-06.6S Longitude 133-05.3W Date 8/ 3/91 Bottom Depth 4187

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
213	5	20.	20.	35.	24.	22x	-x	0.	0.	1.	1970	1936	299	312	2294	2254
237	39	20.	20.	35.	25.	22x	-x	0.	0.	1.						
215	60	19.	19.	35.	25.	22x	-x	0.	0.	1.						
216	95	19.	19.	35.	25.	22x	x	0.	0.	1.						
217	135	19.	19.	35.	25.	22x	-x	0.	0.	1.						
218	166	19.	19.	35.	25.	22x	x	0.	0.	1.						
219	197	18.	18.	35.	25.	21x	2x	0.	0.	1.						
220	228	17.	17.	35.	25.	20x	3x	0.	2.	1.						
221	268	16.	16.	35.	25.	19x	4x	0.	4.	1.						
222	309	15.	15.	35.	26.	19x	5x	0.	6.	1.						
223	359	12.	12.	34.	26.	19x	6x	0.	10.	3.						
224	410	10.	10.	34.	26.	19x	8x	1.	16.	5.						
225	511	7.	7.	34.	26.	21x	7x	1.	22.	7.						
226	612	6.	6.	34.	26.	23x	6x	1.	23.	9.						
227	715	5.	5.	34.	27.	23x	7x	1.	25.	12.						
228	817	5.	5.	34.	27.	21x	9x	1.	28.	19.						
229	917	4.	4.	34.	27.	19x	11x	2.	31.	28.						
230	1020	4.	3.	34.	27.	17x	14x	2.	33.	43.						
231	1120	3.	3.	34.	27.	16x	16x	2.	34.	58.						
232	1274	3.	3.	34.	27.	15x	16x	2.	35.	73.						
233	1426	2.	2.	34.	27.	15x	17x	2.	35.	89.						
235	1627	2.	2.	34.	27.											
234	1627	2.	2.	34.	27.	15x	17x	2.	35.	101.						
238	1830	2.	2.	34.	27.	15x	17x	2.	35.	111.						
261	2034	2.	1.	34.	27.	15x	18x	2.	35.	118.						
202	2238	1.	1.	34.	27.	15x	18x	2.	35.	123.						
203	2438	1.	1.	34.	27.	15x	17x	2.	35.	124.						
204	2640	1.	1.	34.	27.	16x	17x	2.	34.	125.						
205	2839	1.	1.	34.	27.	16x	17x	2.	34.	126.						
206	3037	1.	1.	34.	27.	16x	17x	2.	34.	126.						
207	3234	1.	1.	34.	27.	17x	16x	2.	34.	126.						
268	3438	1.	1.	34.	27.	17x	16x	2.	34.	125.						
269	3646	1.	1.	34.	27.	17x	16x	2.	34.	125.						
270	3849	1.	1.	34.	27.	17x	16x	2.	33.	125.						
211	4053	1.	1.	34.	27.	17x	16x	2.	33.	125.						
212	4170	1.	1.	34.	27.	17x	16x	2.	33.	125.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C Station 166 Latitude 26-37.9S Longitude 133-18.0W Date 8/ 3/91 Bottom Depth 4028

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
261	8	20.	20.	35.	25.	22x	-x	0.	0.	1.	2004	1971	290	298	2344	2306
202	52	20.	20.	35.	25.	22x	x	0.	0.	1.						
203	78	19.	19.	35.	25.	22x	-x	0.	0.	1.						
204	118	19.	19.	35.	25.	22x	x	0.	0.	1.						
205	169	19.	19.	35.	25.	21x	1x	0.	0.	1.						
206	220	17.	17.	35.	25.	20x	3x	0.	2.	0.						
207	280	15.	15.	35.	26.	19x	4x	0.	5.	1.						
268	338	13.	13.	35.	26.	19x	6x	0.	8.	2.						
269	397	11.	11.	34.	26.	19x	7x	1.	13.	3.						
270	461	8.	8.	34.	26.	20x	7x	1.	18.	5.						
211	522	7.	7.	34.	26.	23x	6x	1.	21.	6.						
212	589	6.	6.	34.	26.	24x	5x	1.	22.	7.						
213	666	6.	6.	34.	27.	24x	6x	1.	23.	9.						
237	717	5.	5.	34.	27.	23x	6x	1.	24.	11.						
215	768	5.	5.	34.	27.	23x	7x	1.	25.	13.						
216	819	5.	5.	34.	27.	22x	8x	1.	27.	17.						
217	920	4.	4.	34.	27.	19x	11x	2.	30.	28.						
218	1022	4.	4.	34.	27.	17x	13x	2.	33.	40.						
219	1121	3.	3.	34.	27.	16x	15x	2.	34.	54.						
220	1218	3.	3.	34.	27.	15x	16x	2.	35.	67.						
221	1362	2.	2.	34.	27.	15x	17x	2.	35.	80.						
222	1504	2.	2.	34.	27.	15x	17x	2.	35.	91.						
223	1697	2.	2.	34.	27.	15x	17x	2.	35.	103.						
224	1894	2.	2.	34.	27.	15x	17x	2.	35.	113.						
225	2095	2.	1.	34.	27.	15x	18x	2.	35.	119.						
226	2297	1.	1.	34.	27.	15x	18x	2.	35.	123.						
227	2503	1.	1.	34.	27.	15x	17x	2.	35.	124.						
228	2712	1.	1.	34.	27.	16x	17x	2.	35.	125.						
229	2918	1.	1.	34.	27.	16x	17x	2.	34.	125.						
230	3125	1.	1.	34.	27.	17x	16x	2.	34.	125.						
231	3332	1.	1.	34.	27.	17x	16x	2.	34.	125.						
232	3535	1.	1.	34.	27.	17x	16x	2.	34.	125.						
233	3738	1.	1.	34.	27.	17x	16x	2.	33.	125.						
235	3892	1.	1.	34.	27.	17x	16x	2.	33.	125.						
234	3892	1.	1.	34.	27.	17x	16x	2.	33.							
238	4034	1.	1.	34.	27.	17x	16x	2.	33.	125.						

WOCE Line P17C Station 167 Latitude 27-07.1S Longitude 133-26.1W Date 8/ 4/91 Bottom Depth 3758

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	4	19.	19.	35.	25.	22x	x	0.	0.	1.	2010	1981	305	300	2337	2303
102	51	19.	19.	35.	25.	22x	x	0.	0.	1.	2010	1981	305	299	2337	2303
103	97	19.	19.	35.	25.	22x	x	0.	0.	1.	2012	1984	306	299	2339	2306
104	148	19.	19.	35.	25.	22x	x	0.	0.	1.	2018	1992	321	311	2333	2302
105	197	17.	17.	35.	25.	21x	2x	0.	0.	1.	2046	2027	374	336	2329	2308
106	259	16.	16.	35.	25.	19x	4x	0.	4.	1.	2068	2050	428	365	2322	2306
107	320	14.	14.	35.	26.	19x	5x	0.	7.	2.	2086	2079	488	386	2313	2313
168	351	13.	13.	35.	26.	19x	6x	0.	9.	2.	2094	2094	526	397	2307	2316
169	381	11.	11.	34.	26.	19x	7x	0.	13.	3.	2106	2116	584	412	2298	2323
170	442	9.	9.	34.	26.	20x	7x	1.	17.	4.	2119	2142	661	428	2288	2331
111	513	7.	7.	34.	26.	22x	6x	1.	20.	6.	2130	2165	715	426	2287	2345
112	583	7.	6.	34.	26.	23x	5x	1.	21.	7.	2130	2168	724	417	2284	2347
113	653	6.	6.	34.	26.	24x	6x	1.	23.	9.	2133	2173	743	418	2283	2350
137	693	6.	6.	34.	27.	23x	6x	1.	23.	9.	2138	2179	759	423	2286	2354
115	733	6.	5.	34.	27.	23x	6x	1.	24.	11.	2139	2181	776	428	2283	2353
116	803	5.	5.	34.	27.	22x	7x	1.	26.	15.	2151	2195	827	446	2285	2359
117	865	5.	5.	34.	27.	21x	9x	1.	28.	20.	2166	2210	882	468	2292	2367
118	926	4.	4.	34.	27.	20x	10x	2.	30.	27.	2176	2220	949	495	2292	2369
119	1018	4.	4.	34.	27.											
120	1120	3.	3.	34.	27.	16x	15x	2.	34.	52.	2228	2266	1139	570	2321	2396
121	1222	3.	3.	34.	27.	16x	16x	2.	34.	64.	2242	2278	1174	579	2333	2405
122	1322	3.	2.	34.	27.	15x	16x	2.	35.	76.	2254	2287	1189	578	2344	2414
123	1422	2.	2.	34.	27.	15x	17x	2.	35.	84.	2263	2293	1193	575	2353	2421
124	1523	2.	2.	34.	27.	15x	17x	2.	35.	93.	2274	2303	1192	569	2366	2432
125	1716	2.	2.	34.	27.	15x	17x	2.	35.	105.	2282	2309	1192	562	2375	2438
126	1902	2.	2.	34.	27.	15x	17x	2.	35.	113.	2290	2315	1193	558	2384	2446
127	2120	2.	1.	34.	27.	15x	18x	2.	35.	120.	2299	2322	1190	552	2394	2455
128	2327	1.	1.	34.	27.	15x	18x	2.	35.	124.	2298	2321	1185	547	2394	2453
129	2526	1.	1.	34.	27.	15x	17x	2.	35.	125.	2301	2324	1179	542	2398	2457
130	2722	1.	1.	34.	27.	16x	17x	2.	35.	126.	2299	2321	1168	535	2397	2456
131	2926	1.	1.	34.	27.	16x	17x	2.	34.	127.	2300	2322	1154	527	2401	2458
132	3124	1.	1.	34.	27.	16x	17x	2.	34.	126.	2296	2318	1145	521	2397	2454
133	3320	1.	1.	34.	27.	17x	16x	2.	34.	126.	2293	2314	1137	516	2395	2451
134	3516	1.	1.	34.	27.	17x	16x	2.	33.	125.	2293	2314	1118	506	2398	2454
135	3720	1.	1.	34.	27.	17x	16x	2.	33.	125.	2288	2309	1112	503	2394	2449
138	3895	1.	1.	34.	27.	17x	16x	2.	33.	125.	2287	2308	1120	506	2391	2447

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C Station 168 Latitude 27-37.1S Longitude 133-32.4W Date 8/ 4/91 Bottom Depth 4130

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	---TCO2---- Obs	S=35	-----pCO2---- @ 20	@ Theta	Total Alk. Calc	(PALK)s
						------------------	------------------	------------------uM/kg	------------------	------------------	------------------	------------------	-----uAtm----		---uEq/kg---	
161	4	19.	19.	35.	25.	22x	x	0.	0.	1.	2017	1988	319	309	2334	2300
102	41	19.	18.	35.	25.	22x	x	0.	0.	1.						
103	77	18.	18.	35.	25.	21x	1x	0.	0.	1.						
104	113	18.	18.	35.	25.	21x	2x	0.	0.	1.						
105	148	17.	17.	35.	25.	20x	2x	0.	1.	1.						
106	194	16.	16.	35.	25.	20x	3x	0.	2.	1.						
107	244	15.	15.	35.	26.	19x	4x	0.	5.	1.						
168	294	14.	14.	35.	26.	19x	5x	0.	8.	2.						
169	348	12.	12.	34.	26.	19x	6x	0.	11.	3.						
170	402	10.	10.	34.	26.	19x	7x	1.	16.	5.						
111	451	8.	8.	34.	26.	21x	7x	1.	19.	5.						
112	510	7.	7.	34.	26.	23x	6x	1.	20.	6.						
113	588	6.	6.	34.	26.	24x	5x	1.	22.	7.						
137	637	6.	6.	34.	26.	24x	5x	1.	22.	9.						
115	685	6.	6.	34.	27.	23x	6x	1.	24.	10.						
116	764	5.	5.	34.	27.	23x	7x	1.	25.	13.						
117	845	5.	5.	34.	27.	22x	8x	1.	27.	18.						
118	926	4.	4.	34.	27.	20x	10x	2.	29.	25.						
119	1008	4.	4.	34.	27.	18x	13x	2.	32.	37.						
120	1110	3.	3.	34.	27.	17x	14x	2.	33.	50.						
121	1211	3.	3.	34.	27.	16x	15x	2.	34.	63.						
122	1314	3.	2.	34.	27.	16x	16x	2.	34.	72.						
123	1514	2.	2.	34.	27.	15x	17x	2.	34.	91.						
124	1717	2.	2.	34.	27.	15x	17x	2.	35.	105.						
125	1919	2.	1.	34.	27.	15x	18x	2.	35.	115.						
126	2121	1.	1.	34.	27.	15x	18x	2.	35.	120.						
127	2323	1.	1.	34.	27.	15x	18x	2.	35.	123.						
128	2524	1.	1.	34.	27.	15x	17x	2.	35.	126.						
129	2732	1.	1.	34.	27.	16x	17x	2.	34.	127.						
130	2940	1.	1.	34.	27.	16x	17x	2.	34.	127.						
131	3145	1.	1.	34.	27.	16x	17x	2.	34.	126.						
132	3349	1.	1.	34.	27.	17x	16x	2.	34.	126.						
133	3551	1.	1.	34.	27.	17x	16x	2.	33.	125.						
134	3751	1.	1.	34.	27.	17x	16x	2.	33.	125.						
135	3954	1.	1.	34.	27.	17x	16x	2.	33.	124.						
138	4105	1.	1.	34.	27.	17x	16x	2.	33.	125.						

WOCE Line P17C Station 169 Latitude 28-05.8S Longitude 133-40.9W Date 8/ 4/91 Bottom Depth 4230

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	---TCO2---- Obs	S=35	-----pCO2---- @ 20	@ Theta	Total Alk. Calc	(PALK)s
						------------------	------------------	------------------uM/kg	------------------	------------------	------------------	------------------	-----uAtm----		---uEq/kg---	
161	3	19.	19.	35.	25.	22x	-x	0.	0.	1.	2011	1981	304	299	2340	2304
102	25	19.	19.	35.	25.	22x	-x	0.	0.	1.						
103	54	18.	18.	35.	25.	23x	-x	0.	0.	1.						
104	80	18.	18.	35.	25.	23x	-x	0.	0.	1.						
105	106	18.	18.	35.	25.	22x	x	0.	0.	1.						
106	142	17.	17.	35.	25.	21x	2x	0.	0.	1.						
107	176	16.	16.	35.	25.	20x	3x	0.	2.	1.						
168	218	15.	15.	35.	25.	19x	4x	0.	4.	1.						
169	259	14.	14.	35.	26.	19x	5x	0.	7.	1.						
170	335	12.	12.	34.	26.	19x	6x	0.	12.	3.						
111	410	9.	9.	34.	26.	20x	7x	1.	17.	5.						
112	486	7.	7.	34.	26.	22x	6x	1.	20.	6.						
113	561	6.	6.	34.	26.	23x	6x	1.	22.	7.						
137	663	6.	6.	34.	27.	23x	6x	1.	24.	10.						
115	765	5.	5.	34.	27.	22x	8x	1.	26.	15.						
116	865	4.	4.	34.	27.	21x	10x	2.	29.	23.						
117	967	4.	4.	34.	27.	19x	11x	2.	31.	33.						
118	1018	4.	4.	34.	27.	18x	12x	2.	32.	37.						
119	1069	3.	3.	34.	27.	17x	13x	2.	33.	45.						
120	1120	3.	3.	34.	27.	17x	14x	2.	33.	52.						
121	1172	3.	3.	34.	27.	17x	15x	2.	34.	60.						
122	1324	2.	2.	34.	27.	16x	16x	2.	34.	76.						
123	1527	2.	2.	34.	27.	15x	17x	2.	34.	92.						
124	1730	2.	2.	34.	27.	15x	17x	2.	35.	106.						
125	1931	2.	1.	34.	27.	15x	18x	2.	35.	115.						
126	2129	1.	1.	34.	27.	15x	18x	2.	35.	120.						
127	2391	1.	1.	34.	27.	15x	18x	2.	35.	124.						
128	2643	1.	1.	34.	27.	15x	17x	2.	35.	126.						
129	2841	1.	1.	34.	27.	16x	17x	2.	34.	127.						
130	3041	1.	1.	34.	27.	16x	17x	2.	34.	127.						
131	3246	1.	1.	34.	27.	16x	17x	2.	34.	126.						
132	3452	1.	1.	34.	27.	17x	16x	2.	34.	126.						
133	3659	1.	1.	34.	27.	17x	16x	2.	33.	125.						
134	3863	1.	1.	34.	27.	17x	16x	2.	33.	124.						
135	4066	1.	1.	34.	27.	17x	16x	2.	33.	124.						
138	4182	1.	1.	34.	27.	18x	16x	2.	33.	124.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C Station 170 Latitude 28-34.9S Longitude 133-49.0W Date 8/ 5/91 Bottom Depth 3885

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	6	18.	18.	35.	25.	23x	-x	0.	0.	1.	2014	1989	316	302	2333	2303
102	47	18.	18.	35.	25.	23x	-x	0.	0.	1.						
103	76	18.	18.	35.	25.	23x	-x	0.	0.	1.						
104	107	18.	18.	35.	25.	23x	x	0.	0.	1.						
105	132	18.	18.	35.	25.	22x	1x	0.	0.	1.						
106	155	17.	17.	35.	25.	20x	2x	0.	1.	1.						
107	180	16.	16.	35.	25.	20x	3x	0.	2.	1.						
168	204	16.	16.	35.	25.	19x	4x	0.	3.	1.						
169	252	14.	14.	35.	26.	19x	5x	0.	6.	1.						
170	304	13.	13.	34.	26.	19x	6x	0.	9.	2.						
111	351	11.	11.	34.	26.	19x	7x	1.	13.	3.						
112	394	9.	9.	34.	26.	20x	7x	1.	17.	5.						
113	462	7.	7.	34.	26.	22x	6x	1.	20.	6.						
137	531	6.	6.	34.	26.	23x	5x	1.	21.	7.						
115	604	6.	6.	34.	26.	23x	6x	1.	23.	9.						
116	679	5.	5.	34.	27.	23x	6x	1.	24.	11.						
117	749	5.	5.	34.	27.	23x	7x	1.	25.	13.						
118	820	5.	5.	34.	27.	22x	8x	1.	27.	18.						
119	916	4.	4.	34.	27.											
120	1011	4.	4.	34.	27.	18x	13x	2.	32.	38.						
121	1105	3.	3.	34.	27.	17x	14x	2.	33.	50.						
122	1256	3.	3.	34.	27.	16x	15x	2.	34.	67.						
123	1453	2.	2.	34.	27.	16x	16x	2.	34.	86.						
124	1657	2.	2.	34.	27.	15x	17x	2.	35.	101.						
125	1862	2.	2.	34.	27.	15x	17x	2.	35.	111.						
126	2076	2.	1.	34.	27.	15x	18x	2.	35.	118.						
127	2272	1.	1.	34.	27.	15x	18x	2.	35.	123.						
128	2469	1.	1.	34.	27.	15x	18x	2.	35.	125.						
129	2680	1.	1.	34.	27.	16x	17x	2.	35.	127.						
130	2883	1.	1.	34.	27.	16x	17x	2.	34.	126.						
131	3089	1.	1.	34.	27.	16x	17x	2.	34.	126.						
132	3297	1.	1.	34.	27.	17x	16x	2.	34.	126.						
134	3507	1.	1.	34.	27.	17x	16x	2.	34.	125.						
133	3508	1.	1.	34.	27.	17x	16x	2.	34.	125.						
135	3708	1.	1.	34.	27.	17x	16x	2.	33.	125.						
138	3850	1.	1.	34.	27.	17x	16x	2.	33.	124.						

WOCE Line P17C Station 171 Latitude 29-04.1S Longitude 133-55.9W Date 8/ 5/91 Bottom Depth 4206

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	3	18.	18.	35.	25.	23x	-x	0.	0.	1.	2015	1991	315	297	2334	2307
102	56	18.	18.	35.	25.	23x	-x	0.	0.	1.	2016	1992	320	302	2331	2304
103	107	18.	18.	35.	25.	23x	x	0.	0.	1.	2017	1994	327	307	2326	2300
104	157	16.	16.	35.	25.	20x	3x	0.	2.	1.	2058	2040	411	358	2320	2302
105	207	15.	15.	35.	25.	20x	4x	0.	4.	1.	2071	2056	440	368	2319	2307
106	246	14.	14.	35.	26.	19x	4x	0.	6.	1.	2076	2067	470	378	2310	2306
107	276	13.	13.	35.	26.	19x	6x	0.	8.	2.	2089	2086	504	389	2310	2315
168	307	12.	12.	34.	26.	19x	6x	0.	11.	3.	2096	2100	540	398	2303	2319
169	358	10.	10.	34.	26.	20x	7x	1.	15.	4.	2113	2135	639	425	2289	2328
170	409	8.	8.	34.	26.	21x	7x	1.	19.	5.	2126	2156	698	433	2287	2339
111	470	7.	7.	34.	26.	22x	6x	1.	20.	7.	2127	2162	725	429	2281	2340
112	529	7.	7.	34.	26.	23x	5x	1.	21.	7.	2129	2167	719	415	2285	2347
113	590	6.	6.	34.	26.	24x	5x	1.	22.	8.	2131	2171	739	418	2283	2348
137	629	6.	6.	34.	26.	24x	5x	1.	23.	9.	2134	2175	742	416	2285	2352
115	668	6.	6.	34.	27.	24x	6x	1.	24.	10.	2140	2181	763	423	2286	2355
116	727	5.	5.	34.	27.	23x	7x	1.	25.	13.	2147	2190	794	433	2288	2360
117	784	5.	5.	34.	27.	22x	8x	1.	26.	15.	2150	2194	820	442	2286	2360
118	823	5.	5.	34.	27.	21x	9x	1.	28.	18.	2164	2208	877	467	2290	2366
119	862	4.	4.	34.	27.	21x	10x	2.	29.	23.	2172	2217	907	479	2294	2371
120	934	4.	4.	34.	27.	20x	11x	2.	30.	29.	2183	2226	967	502	2296	2373
121	1004	4.	4.	34.	27.	18x	12x	2.	32.	38.	2201	2243	1028	525	2307	2384
122	1109	3.	3.	34.	27.	17x	14x	2.	33.	50.	2220	2260	1096	549	2318	2394
123	1266	3.	3.	34.	27.	16x	15x	2.	34.	66.	2242	2277	1141	559	2336	2408
124	1417	2.	2.	34.	27.	16x	16x	2.	34.	82.	2262	2293	1171	564	2355	2423
125	1614	2.	2.	34.	27.	15x	17x	2.	35.	98.	2277	2304	1168	554	2372	2436
126	1816	2.	2.	34.	27.	15x	17x	2.	35.	110.	2291	2316	1186	557	2385	2448
127	2019	2.	1.	34.	27.	15x	18x	2.	35.	117.	2298	2323	1187	553	2394	2455
128	2273	1.	1.	34.	27.	15x	18x	2.	35.	123.	2304	2327	1181	547	2400	2461
129	2526	1.	1.	34.	27.	15x	18x	2.	35.	126.	2305	2328	1179	542	2403	2462
130	2778	1.	1.	34.	27.	15x	17x	2.	35.	128.	2305	2327	1172	537	2403	2462
131	3033	1.	1.	34.	27.	16x	17x	2.	34.	127.	2301	2323	1151	525	2402	2460
132	3287	1.	1.	34.	27.	16x	16x	2.	34.	127.	2298	2319	1136	516	2401	2458
133	3539	1.	1.	34.	27.	17x	16x	2.	34.	126.	2293	2314	1125	509	2397	2453
134	3793	1.	1.	34.	27.	17x	16x	2.	33.	125.	2291	2311	1118	505	2396	2451
135	4049	1.	1.	34.	27.	18x	16x	2.	33.	124.	2289	2309	1091	492	2397	2452
138	4227	1.	1.	34.	27.	17x	16x	2.	33.	125.	2287	2307	1124	507	2390	2446

Lamont-Doherty Earth Observatory of Columbia University
Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C Station 172 Latitude 29-34.0S Longitude 134-04.2W Date 8/ 5/91 Bottom Depth 4183

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs	TCO2 S=35	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
261	3	18.	18.	35.	25.	23x	-x	0.	0.	1.	2021	1998	329	304	2330	2303
202	45	17.	17.	35.	25.	23x	x	0.	0.	1.						
203	76	17.	17.	35.	25.	23x	x	0.	0.	1.						
204	97	17.	17.	35.	25.	23x	x	0.	0.	1.						
205	117	17.	17.	35.	25.	23x	x	0.	0.	1.						
206	148	16.	16.	35.	25.	21x	2x	0.	1.	1.						
207	179	15.	15.	35.	26.	20x	3x	0.	3.	1.						
268	209	14.	14.	35.	26.	20x	4x	0.	4.	1.						
269	260	13.	13.	35.	26.	19x	5x	0.	9.	2.						
270	311	11.	11.	34.	26.	19x	6x	0.	12.	3.						
211	384	9.	9.	34.	26.	20x	7x	1.	17.	5.						
212	458	7.	7.	34.	26.	23x	6x	1.	20.	6.						
213	534	6.	6.	34.	26.	24x	5x	1.	21.	7.						
237	610	6.	6.	34.	26.	24x	5x	1.	22.	9.						
215	712	6.	5.	34.	27.	24x	6x	1.	24.	11.						
216	815	5.	5.	34.	27.	22x	8x	1.	27.	17.						
217	918	4.	4.	34.	27.	20x	10x	2.	30.	27.						
218	1020	4.	4.	34.	27.	18x	12x	2.	32.	39.						
219	1122	3.	3.	34.	27.	17x	14x	2.	33.	51.						
299	1274	3.	3.	34.	27.	16x	15x	2.	34.	68.	2244	2278	1169	571	2335	2406
221	1274	3.	3.	34.	27.	16x	15x	2.	34.	69.	2245	2279	1134	554	2341	2412
222	1425	2.	2.	34.	27.	16x	16x	2.	34.	83.						
223	1628	2.	2.	34.	27.	15x	17x	2.	35.	98.						
224	1832	2.	2.	34.	27.	15x	17x	2.	35.	110.						
225	2036	2.	1.	34.	27.	15x	18x	2.	35.	119.						
226	2240	1.	1.	34.	27.	15x	18x	2.	35.	123.						
227	2443	1.	1.	34.	27.	15x	18x	2.	35.	125.						
228	2645	1.	1.	34.	27.	15x	17x	2.	35.	127.						
229	2848	1.	1.	34.	27.	16x	17x	2.	34.	128.						
230	3050	1.	1.	34.	27.	16x	17x	2.	34.	127.						
231	3252	1.	1.	34.	27.	16x	17x	2.	34.	126.						
232	3450	1.	1.	34.	27.	17x	16x	2.	33.	125.						
233	3648	1.	1.	34.	27.	17x	16x	2.	33.	125.						
234	3846	1.	1.	34.	27.	17x	16x	2.	33.	124.						
235	4048	1.	1.	34.	27.	18x	16x	2.	33.	124.						
238	4164	1.	1.	34.	27.	18x	15x	2.	33.	124.						

WOCE Line P17C Station 173 Latitude 30-02.9S Longitude 134-12.2W Date 8/ 6/91 Bottom Depth 4190

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs	TCO2 S=35	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	3	17.	17.	35.	25.	23x	-x	0.	0.	1.	2023	2002	331	300	2330	2307
102	29	17.	17.	35.	25.	23x	-x	0.	0.	1.						
103	54	17.	17.	35.	25.	23x	-x	0.	0.	1.						
104	80	17.	17.	35.	25.	23x	x	0.	0.	1.						
105	106	17.	17.	35.	25.	23x	x	0.	0.	1.						
106	131	16.	16.	35.	25.	22x	1x	0.	0.	1.						
107	157	16.	16.	35.	25.	21x	2x	0.	2.	1.						
168	182	15.	15.	35.	26.	21x	3x	0.	3.	1.						
169	207	14.	14.	35.	26.	20x	4x	0.	4.	1.						
170	259	13.	13.	35.	26.	19x	5x	0.	8.	2.						
111	309	11.	11.	34.	26.	20x	6x	0.	12.	3.						
112	360	10.	10.	34.	26.	20x	7x	1.	15.	4.						
113	435	8.	8.	34.	26.	21x	7x	1.	19.	6.						
137	511	7.	7.	34.	26.	23x	6x	1.	21.	7.						
115	587	6.	6.	34.	26.	23x	6x	1.	23.	8.						
116	663	6.	6.	34.	27.	23x	6x	1.	24.	10.						
117	764	5.	5.	34.	27.	23x	7x	1.	25.	14.						
118	866	5.	5.	34.	27.	22x	9x	1.	28.	19.						
119	967	4.	4.	34.	27.	20x	11x	2.	30.	30.						
120	1069	4.	3.	34.	27.	18x	13x	2.	32.	41.						
121	1221	3.	3.	34.	27.	17x	15x	2.	33.	59.						
122	1424	2.	2.	34.	27.	16x	16x	2.	34.	80.						
123	1628	2.	2.	34.	27.	15x	17x	2.	34.	97.						
124	1832	2.	2.	34.	27.	15x	17x	2.	35.	109.						
125	2035	2.	1.	34.	27.	15x	18x	2.	35.	117.						
126	2238	1.	1.	34.	27.	15x	18x	2.	35.	122.						
127	2441	1.	1.	34.	27.	15x	18x	2.	35.	125.						
128	2645	1.	1.	34.	27.	15x	17x	2.	34.	127.						
129	2847	1.	1.	34.	27.	16x	17x	2.	34.	127.						
130	3051	1.	1.	34.	27.	16x	17x	2.	34.	127.						
131	3253	1.	1.	34.	27.	16x	17x	2.	34.	127.						
132	3457	1.	1.	34.	27.	17x	16x	2.	33.	126.						
133	3660	1.	1.	34.	27.	17x	16x	2.	33.	125.						
134	3863	1.	1.	34.	27.	18x	16x	2.	33.	124.						
135	4066	1.	1.	34.	27.	18x	15x	2.	33.	124.						
138	4177	1.	1.	34.	27.	18x	15x	2.	33.	123.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C Station 174 Latitude 30-31.9S Longitude 134-20.0W Date 8/ 6/91 Bottom Depth 3711

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	---TCO2---- Obs	S=35	-----pCO2---- @ 20	@ Theta	Total Alk. Calc	(PALK)s
						uM/kg							uAtm		uEq/kg	
161	4	17.	17.	35.	25.	23x	-x	0.	0.	1.	2024	2003				
102	36	17.	17.	35.	25.	23x	x	0.	0.	1.	2025	2003	340	309	2327	2302
103	71	17.	17.	35.	25.	23x	x	0.	0.	1.	2023	2002	332	302	2329	2306
104	106	16.	16.	35.	25.	23x	x	0.	0.	1.	2030	2019	349	306	2325	2312
105	137	16.	16.	35.	25.	23x	x	0.	0.	0.	2031	2021	348	303	2326	2315
106	172	16.	16.	35.	25.	23x	1x	0.	0.	0.	2034	2024	370	319	2314	2304
107	207	14.	14.	35.	26.	21x	3x	0.	3.	1.	2065	2063	439	354	2311	2312
168	248	13.	13.	34.	26.	20x	5x	0.	7.	2.	2084	2085	487	374	2311	2319
169	287	12.	12.	34.	26.	20x	5x	0.	10.	2.	2095	2105	546	394	2299	2321
170	336	10.	10.	34.	26.	20x	6x	1.	14.	3.	2112	2132	616	412	2294	2331
111	387	9.	8.	34.	26.	21x	7x	1.	18.	5.	2124	2152	682	427	2289	2338
112	448	7.	7.	34.	26.	22x	6x	1.	20.	6.	2128	2162	713	426	2285	2342
113	510	7.	7.	34.	26.	23x	5x	1.	21.	6.	2131	2168	721	418	2286	2347
137	569	6.	6.	34.	26.	24x	5x	1.	22.	8.	2133	2172	725	413	2287	2352
115	629	6.	6.	34.	26.	24x	5x	1.	23.	9.	2136	2177	739	415	2288	2355
116	701	6.	5.	34.	27.	24x	6x	1.	24.	10.	2145	2187	761	421	2292	2362
117	775	5.	5.	34.	27.	23x	7x	1.	26.	14.	2149	2193	801	434	2289	2362
118	851	5.	5.	34.	27.	22x	8x	1.	27.	18.	2156	2200	855	456	2286	2361
119	932	4.	4.	34.	27.	20x	10x	2.	29.	26.	2178	2222	924	483	2298	2375
120	1012	4.	4.	34.	27.	19x	11x	2.	31.	34.	2192	2235	988	507	2303	2380
121	1113	3.	3.	34.	27.	18x	13x	2.	33.	45.	2211	2251	1063	535	2312	2388
122	1212	3.	3.	34.	27.	17x	14x	2.	33.	56.	2228	2266	1117	553	2325	2398
124	1363	3.	2.	34.	27.	16x	15x	2.	34.	71.	2247	2280	1151	559	2341	2411
125	1515	2.	2.	34.	27.			2.	34.	86.	2261	2291	1171	560	2355	2421
126	1667	2.	2.	34.	27.	15x	17x	2.	35.	99.	2280	2307				
127	1820	2.	2.	34.	27.	15x	17x	2.	35.	108.	2289	2315				
128	2022	2.	1.	34.	27.	15x	18x	2.	35.	116.	2293	2318	1181	550	2389	2450
129	2225	1.	1.	34.	27.	15x	18x	2.	35.	122.	2303	2327	1183	548	2400	2460
130	2428	1.	1.	34.	27.	15x	18x	2.	35.	125.	2303	2326	1190	549	2399	2459
131	2631	1.	1.	34.	27.	15x	17x	2.	35.	127.	2304	2326	1167	535	2403	2462
132	2834	1.	1.	34.	27.	16x	17x	2.	34.	127.	2298	2320	1169	534	2397	2455
133	3038	1.	1.	34.	27.	16x	17x	2.	34.	127.	2299	2321	1152	525	2400	2457
134	3240	1.	1.	34.	27.	16x	17x	2.	34.	127.	2293	2315	1142	519	2395	2452
135	3443	1.	1.	34.	27.	17x	16x	2.	34.	126.	2292	2313	1128	511	2395	2452
138	3652	1.	1.	34.	27.	17x	16x	2.	33.	124.	2287	2308	1118	505	2392	2447

WOCE Line P17C Station 175 Latitude 31-01.3S Longitude 134-27.9W Date 8/ 6/91 Bottom Depth 4258

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	---TCO2---- Obs	S=35	-----pCO2---- @ 20	@ Theta	Total Alk. Calc	(PALK)s
						uM/kg							uAtm		uEq/kg	
161	3	16.	16.	35.	25.	24x	-x	0.	0.	0.	2026	2015	354	311	2315	2304
102	46	16.	16.	35.	25.	24x	x	0.	0.	0.						
103	92	16.	16.	35.	25.	24x	x	0.	0.	0.						
104	137	16.	16.	35.	25.	23x	x	0.	0.	0.						
105	173	15.	15.	35.	25.	21x	3x	0.	3.	0.						
106	217	13.	13.	34.	26.	20x	4x	0.	6.	1.						
107	280	12.	12.	34.	26.	20x	6x	0.	11.	2.						
168	342	9.	9.	34.	26.	20x	6x	1.	15.	4.						
169	391	8.	8.	34.	26.	21x	6x	1.	18.	4.						
170	455	7.	7.	34.	26.	22x	6x	1.	20.	6.						
111	529	7.	6.	34.	26.	24x	5x	1.	21.	6.						
112	593	6.	6.	34.	26.	24x	5x	1.	22.	8.						
113	658	6.	6.	34.	27.	24x	5x	1.	23.	9.						
137	733	5.	5.	34.	27.	24x	6x	1.	24.	11.						
115	811	5.	5.	34.	27.	23x	7x	1.	26.	15.						
116	891	5.	5.	34.	27.	22x	9x	1.	28.	20.						
117	969	4.	4.	34.	27.	20x	10x	2.	30.	27.						
118	1048	4.	4.	34.	27.	19x	12x	2.	32.	39.						
119	1147	3.	3.	34.	27.	18x	13x	2.	33.	48.						
120	1245	3.	3.	34.	27.	17x	14x	2.	33.	58.						
121	1343	3.	2.	34.	27.	16x	15x	2.	34.	69.						
122	1442	2.	2.	34.	27.	16x	16x	2.	34.	81.						
124	1592	2.	2.	34.	27.	16x	17x	2.	34.	93.						
125	1741	2.	2.	34.	27.	15x	17x	2.	35.	103.						
126	1893	2.	2.	34.	27.	15x	17x	2.	35.	110.						
127	2045	2.	1.	34.	27.	15x	18x	2.	35.	117.						
128	2251	1.	1.	34.	27.			2.	35.	122.						
129	2458	1.	1.	34.	27.	15x	18x	2.	35.	125.						
130	2665	1.	1.	34.	27.	15x	17x	2.	34.	126.						
131	2872	1.	1.	34.	27.	16x	17x	2.	34.	126.						
132	3134	1.	1.	34.	27.	16x	17x	2.	34.	127.						
133	3396	1.	1.	34.	27.	17x	16x	2.	34.	126.						
134	3662	1.	1.	34.	27.	17x	16x	2.	33.	125.						
135	3926	1.	1.	34.	27.	18x	15x	2.	33.	124.						
138	4182	1.	1.	34.	27.	18x	15x	2.	33.	123.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
(TCO2)s=35 = TCO2 obs X (35 / Sal)   (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C   Station 176   Latitude 31-30.0S Longitude 134-36.0W Date 8/ 7/91   Bottom Depth 4290

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy uM/kg	AOU uM/kg	PO4 uM/kg	NO3 uM/kg	SiO3 uM/kg	TCO2 Obs uM/kg	TCO2 S=35 uM/kg	pCO2 @ 20 uAtm	pCO2 @ Theta uAtm	Total Alk. Calc uEq/kg	(PALK)s uEq/kg
161	3	16.	16.	35.	25.	24x	-x	0.	0.	1.	2023	2013	358	313	2309	2298
102	36	16.	16.	35.	25.	24x	-x	0.	0.	1.						
103	66	16.	16.	35.	25.	24x	-x	0.	0.	1.						
104	107	16.	16.	35.	25.	24x	x	0.	0.	0.						
105	132	16.	16.	35.	25.	23x	x	0.	0.	0.						
106	158	16.	16.	35.	25.	23x	x	0.	0.	0.						
107	183	15.	15.	35.	25.	21x	3x	0.	3.	1.						
168	210	14.	14.	35.	26.	20x	4x	0.	4.	1.						
169	259	13.	13.	34.	26.	20x	5x	0.	7.	2.						
170	310	11.	11.	34.	26.	20x	6x	0.	13.	3.						
111	360	9.	9.	34.	26.	21x	6x	1.	16.	4.						
112	409	8.	8.	34.	26.	22x	6x	1.	19.	5.						
113	459	7.	7.	34.	26.	23x	5x	1.	20.	6.						
137	512	7.	7.	34.	26.	24x	5x	1.	20.	6.						
115	614	6.	6.	34.	26.	24x	5x	1.	22.	8.						
116	716	6.	5.	34.	27.	24x	6x	1.	24.	10.						
117	817	5.	5.	34.	27.	23x	7x	1.	25.	14.						
118	918	4.	4.	34.	27.	21x	9x	1.	28.	22.						
119	1020	4.	4.	34.	27.	19x	11x	2.	30.	32.						
120	1122	3.	3.	34.	27.	18x	13x	2.	32.	43.						
121	1273	3.	3.	34.	27.	17x	15x	2.	34.	62.						
122	1425	2.	2.	34.	27.	16x	16x	2.	34.	75.						
123	1627	2.	2.	34.	27.	16x	17x	2.	34.	92.						
124	1827	2.	2.	34.	27.	15x	17x	2.	35.	105.						
125	2029	2.	1.	34.	27.	15x	17x	2.	35.	116.						
126	2229	1.	1.	34.	27.	15x	18x	2.	35.	121.						
127	2429	1.	1.	34.	27.	15x	18x	2.	35.	124.						
128	2633	1.	1.	34.	27.	15x	17x	2.	35.	126.						
129	2830	1.	1.	34.	27.	16x	17x	2.	34.	127.						
130	3025	1.	1.	34.	27.	16x	17x	2.	34.	127.						
131	3223	1.	1.	34.	27.	16x	17x	2.	34.	126.						
132	3419	1.	1.	34.	27.	17x	16x	2.	34.	126.						
133	3619	1.	1.	34.	27.	17x	16x	2.	33.	125.						
134	3816	1.	1.	34.	27.	18x	15x	2.	33.	124.						
135	4059	1.	1.	34.	27.	18x	15x	2.	32.	122.						
138	4293	1.	1.	34.	27.	18x	15x	2.	32.	121.						

WOCE Line P17C   Station 177   Latitude 32-00.2S Longitude 134-42.9W Date 8/ 7/91   Bottom Depth 4156

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy uM/kg	AOU uM/kg	PO4 uM/kg	NO3 uM/kg	SiO3 uM/kg	TCO2 Obs uM/kg	TCO2 S=35 uM/kg	pCO2 @ 20 uAtm	pCO2 @ Theta uAtm	Total Alk. Calc uEq/kg	(PALK)s uEq/kg
161	3	16.	16.	35.	25.	24x	-x	0.	0.	1.						
102	36	16.	16.	35.	25.	24x	-x	0.	0.	1.						
103	67	16.	16.	35.	25.	24x	x	0.	0.	1.						
104	97	16.	16.	35.	25.	24x	x	0.	0.	1.						
105	128	16.	16.	35.	25.	24x	x	0.	0.	0.						
106	168	15.	15.	35.	25.	24x	x	0.	0.	0.						
107	209	15.	15.	35.	25.	22x	2x	0.	2.	1.						
168	251	14.	14.	35.	26.	20x	4x	0.	6.	1.						
169	279	12.	12.	34.	26.	20x	5x	0.	9.	2.						
170	310	11.	11.	34.	26.	20x	6x	0.	11.	2.						
111	358	9.	9.	34.	26.	21x	6x	1.	15.	4.						
112	403	8.	8.	34.	26.	22x	5x	1.	17.	4.						
113	505	7.	7.	34.	26.	23x	5x	1.	21.	6.						
137	608	6.	6.	34.	26.	24x	5x	1.	22.	8.						
115	707	6.	6.	34.	27.	24x	6x	1.	24.	10.						
116	802	5.	5.	34.	27.	23x	7x	1.	26.	14.						
117	906	5.	4.	34.	27.	22x	9x	1.	28.	21.						
118	1005	4.	4.	34.	27.	20x	11x	2.	30.	30.						
119	1107	3.	3.	34.	27.	19x	12x	2.	32.	40.						
120	1260	3.	3.	34.	27.	17x	14x	2.	33.	58.						
121	1413	2.	2.	34.	27.	16x	15x	2.	34.	73.						
122	1617	2.	2.	34.	27.	16x	16x	2.	34.	91.						
123	1823	2.	2.	34.	27.	15x	17x	2.	34.	104.						
124	2029	2.	1.	34.	27.	15x	17x	2.	35.	113.						
125	2232	1.	1.	34.	27.	15x	17x	2.	35.	120.						
126	2437	1.	1.	34.	27.	15x	17x	2.	35.	124.						
127	2640	1.	1.	34.	27.	15x	17x	2.	35.	125.						
128	2841	1.	1.	34.	27.	16x	17x	2.	34.	126.						
129	3043	1.	1.	34.	27.	16x	17x	2.	34.	126.						
130	3245	1.	1.	34.	27.	16x	17x	2.	34.	126.						
131	3450	1.	1.	34.	27.	17x	16x	2.	34.	125.						
132	3653	1.	1.	34.	27.	17x	16x	2.	33.	124.						
133	3857	1.	1.	34.	27.	18x	15x	2.	33.	123.						
134	3857	1.	1.	34.	27.	18x	15x	2.	33.	123.						
135	4008	1.	1.	34.	27.	18x	15x	2.	33.	122.						
138	4147	1.	1.	34.	27.	18x	15x	2.	32.	122.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal)   (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P17C Station 178 Latitude 32-28.9S Longitude 134-50.9W Date 8/ 7/91 Bottom Depth 4337

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	5	16.	16.	35.	25.	23x	x	0.	0.	1.	2024	2010	353	309	2314	2299
102	51	16.	16.	35.	25.	23x	x	0.	0.	1.						
103	96	16.	16.	35.	25.	23x	x	0.	0.	1.						
104	143	15.	15.	35.	25.	24x	x	0.	0.	1.						
105	183	15.	15.	35.	25.	21x	2x	0.	2.	1.						
106	224	14.	14.	35.	26.	20x	4x	0.	6.	1.						
107	260	13.	13.	34.	26.	20x	5x	0.	9.	2.						
168	310	11.	11.	34.	26.	20x	6x	0.	12.	3.						
169	360	9.	9.	34.	26.	21x	6x	1.	16.	4.						
170	411	8.	8.	34.	26.	22x	5x	1.	18.	4.						
111	461	7.	7.	34.	26.	24x	5x	1.	19.	5.						
112	512	7.	7.	34.	26.	24x	4x	1.	19.	6.						
113	562	7.	7.	34.	26.	24x	4x	1.	20.	6.						
137	611	6.	6.	34.	26.	24x	4x	1.	21.	7.						
115	672	6.	6.	34.	26.	24x	5x	1.	22.	9.						
116	742	6.	6.	34.	27.	24x	6x	1.	24.	11.						
117	811	5.	5.	34.	27.	23x	7x	1.	25.	14.						
118	912	5.	5.	34.	27.	22x	9x	1.	27.	20.						
119	1011	4.	4.	34.	27.	20x	10x	2.	29.	29.						
120	1109	4.	3.	34.	27.	19x	12x	2.	31.	38.						
121	1309	3.	3.	34.	27.	17x	15x	2.	34.	63.						
122	1508	2.	2.	34.	27.	16x	16x	2.	34.	82.						
123	1708	2.	2.	34.	27.	15x	17x	2.	34.	99.						
124	1908	2.	2.	34.	27.	15x	17x	2.	35.	109.						
125	2104	2.	1.	34.	27.	15x	17x	2.	35.	116.						
126	2299	1.	1.	34.	27.	15x	17x	2.	35.	121.						
127	2494	1.	1.	34.	27.	15x	17x	2.	35.	124.						
128	2687	1.	1.	34.	27.	16x	17x	2.	34.	125.						
129	2887	1.	1.	34.	27.	16x	17x	2.	34.	125.						
130	3095	1.	1.	34.	27.	16x	17x	2.	34.	125.						
131	3308	1.	1.	34.	27.	17x	16x	2.	34.	126.						
132	3518	1.	1.	34.	27.	17x	16x	2.	34.	125.						
133	3728	1.	1.	34.	27.	17x	16x	2.	33.	124.						
134	3939	1.	1.	34.	27.	18x	15x	2.	33.	122.						
135	4142	1.	0.	34.	27.	19x	15x	2.	32.	122.						
138	4270	1.	0.	34.	27.	19x	15x	2.	32.	121.						

WOCE Line P17C Station 179 Latitude 33-00.6S Longitude 135-01.3W Date 8/ 8/91 Bottom Depth 4493

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
261	8	16.	16.	35.	25.	24x	x	0.	0.	1.	2032	2020	355	306	2323	2310
202	40	16.	16.	35.	25.	24x	-x	0.	0.	1.	2027	2016	358	309	2315	2302
203	79	16.	16.	35.	25.	24x	x	0.	0.	1.	2034	2025	362	307	2319	2310
204	120	16.	16.	35.	25.	24x	x	0.	0.	1.	2035	2026	369	312	2316	2307
205	161	15.	15.	35.	25.	21x	2x	0.	2.	1.	2062	2057	422	346	2317	2314
206	189	14.	14.	35.	26.						2044	2041	381	303		
207	227	13.	13.	34.	26.	20x	5x	0.	8.	2.	2089	2092	513	385	2305	2317
268	267	12.	12.	34.	26.	20x	6x	0.	11.	2.	2096	2107	553	397	2298	2320
269	309	10.	10.	34.	26.	21x	6x	1.	14.	3.	2125	2145	615	411	2309	2346
270	360	8.	8.	34.	26.	22x	6x	1.	17.	4.	2118	2148	674	420	2284	2334
211	409	7.	7.	34.	26.	22x	6x	1.	19.	5.	2124	2157	700	420	2283	2340
212	457	7.	7.	34.	26.	23x	6x	1.	21.	6.	2133	2170	728	425	2287	2349
213	510	6.	6.	34.	26.	24x	5x	1.	21.	7.	2131	2169	709	407	2289	2352
237	613	6.	6.	34.	26.	24x	5x	1.	22.	8.	2128	2169	738	414	2279	2346
215	711	6.	5.	34.	27.	24x	6x	1.	24.	10.	2135	2177	761	420	2282	2351
216	815	5.	5.	34.	27.	23x	7x	1.	26.	15.	2139	2182	810	437	2275	2348
217	918	4.	4.	34.	27.	21x	9x	2.	28.	24.	2173	2217	912	480	2294	2370
218	1015	4.	4.	34.	27.	20x	11x	2.	30.	33.	2190	2232	974	500	2302	2379
219	1117	3.	3.	34.	27.	18x	13x	2.	32.	44.	2202	2242	1059	531	2303	2379
220	1274	3.	3.	34.	27.	17x	14x	2.	33.	59.	2228	2264	1130	553	2322	2395
221	1430	2.	2.	34.	27.	16x	15x	2.	34.	73.	2258	2290	1182	569	2349	2417
222	1624	2.	2.	34.	27.	16x	16x	2.	34.	89.	2264	2292	1182	561	2356	2421
223	1825	2.	2.	34.	27.	15x	17x	2.	34.	102.	2274	2300	1179	555	2368	2430
224	2029	2.	1.	34.	27.	15x	17x	2.	35.	112.	2292	2316	1190	555	2386	2447
225	2231	1.	1.	34.	27.	15x	18x	2.	35.	119.	2298	2321	1185	549	2394	2453
226	2441	1.	1.	34.	27.	15x	17x	2.	35.	123.	2306	2329	1185	546	2403	2462
227	2646	1.	1.	34.	27.	15x	17x	2.	35.	125.	2300	2323	1174	538	2398	2457
228	2844	1.	1.	34.	27.	16x	17x	2.	34.	126.	2301	2323	1162	531	2401	2459
229	3045	1.	1.	34.	27.	16x	17x	2.	34.	126.	2291	2313	1155	526	2390	2448
230	3244	1.	1.	34.	27.	16x	16x	2.	34.	125.	2298	2319	1137	517	2400	2457
231	3450	1.	1.	34.	27.	17x	16x	2.	34.	125.	2294	2315	1132	513	2397	2453
232	3658	1.	1.	34.	27.	17x	16x	2.	33.	124.	2283	2303	1118	505	2387	2442
233	3857	1.	1.	34.	27.	18x	15x	2.	33.	123.	2282	2302	1098	494	2388	2443
234	4059	1.	1.	34.	27.	19x	15x	2.	33.	122.	2277	2296	1089	487	2384	2438
235	4259	1.	0.	34.	27.	19x	14x	2.	32.	121.	2273	2292	1079	482	2381	2435
238	4460	1.	0.	34.	27.	19x	14x	2.	32.	121.	2274	2293	1071	478	2384	2437

Lamont-Doherty Earth Observatory of Columbia University
Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P16C Station 180 Latitude 37-29.9S Longitude 150-30.1W Date 8/12/91 Bottom Depth 5533

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
261	4	13.	13.	34.	26.	25x	-x	0.	0.	1.	2042	2057	417	315	2293	2311
202	49	13.	13.	34.	26.	25x	-x	0.	0.	1.	2045	2060	414	312	2300	2317
203	95	13.	13.	34.	26.	25x	-x	0.	0.	1.	2045	2060	417	314	2297	2315
204	131	12.	12.	34.	26.	25x	x	0.	2.	1.	2054	2071	434	322	2298	2320
205	171	11.	11.	34.	26.	23x	3x	0.	8.	1.	2087	2110	531	366	2294	2328
206	201	9.	9.	34.	26.	23x	4x	0.	12.	2.	2104	2131	599	392	2290	2332
207	231	9.	9.	34.	26.	22x	5x	1.	15.	3.	2121	2148	646	410	2295	2340
268	261	8.	8.	34.	26.	22x	5x	1.	16.	4.	2123	2152	663	411	2292	2340
269	312	8.	8.	34.	26.	24x	4x	1.	17.	4.	2126	2157	675	408	2292	2344
270	389	7.	7.	34.	26.	24x	4x	1.	19.	5.	2125	2158	707	420	2283	2338
211	465	7.	7.	34.	26.	24x	4x	1.	20.	6.	2126	2161	702	412	2286	2343
212	541	7.	7.	34.	26.	24x	5x	1.	21.	7.	2128	2165	714	413	2285	2346
213	616	6.	6.	34.	26.	24x	5x	1.	22.	8.	2133	2171	729	415	2286	2350
237	718	6.	6.	34.	27.	23x	6x	1.	23.	11.	2137	2177	762	426	2283	2350
215	820	5.	5.	34.	27.	22x	7x	1.	25.	15.	2151	2193	805	441	2289	2360
216	922	5.	5.	34.	27.	21x	9x	1.	28.	21.	2167	2210	880	470	2294	2367
217	1023	4.	4.	34.	27.	20x	11x	2.	30.	30.	2182	2225	955	496	2297	2373
218	1175	3.	3.	34.	27.	19x	12x	2.	32.	43.	2203	2244	1045	526	2307	2382
219	1327	3.	3.	34.	27.	18x	14x	2.	33.	57.	2229	2266	1116	547	2325	2398
220	1526	2.	2.	34.	27.	16x	16x	2.	34.	78.	2254	2285	1187	571	2344	2411
221	1778	2.	2.	34.	27.	15x	17x	2.	34.	98.	2278	2304	1184	562	2371	2434
222	2027	2.	2.	34.	27.	15x	18x	2.	35.	109.	2290	2315	1196	562	2384	2445
223	2268	2.	1.	34.	27.	15x	18x	2.	35.	117.	2298	2322	1192	556	2393	2454
224	2520	2.	1.	34.	27.	15x	18x	2.	35.	122.	2303	2326	1203	558	2397	2457
225	2770	1.	1.	34.	27.	15x	18x	2.	35.	127.	2303	2326	1197	552	2398	2457
226	3006	1.	1.	34.	27.	15x	18x	2.	35.	128.	2304	2326	1186	544	2400	2458
227	3241	1.	1.	34.	27.	16x	17x	2.	34.	125.	2296	2316	1155	528	2395	2452
228	3474	1.	1.	34.	27.	17x	16x	2.	33.	117.	2279	2299	1113	507	2383	2437
229	3717	1.	1.	34.	27.	18x	15x	2.	32.	114.	2269	2287	1089	493	2375	2427
230	3956	1.	1.	34.	27.	19x	14x	2.	32.	114.	2264	2283	1073	482	2372	2424
231	4204	1.	0.	34.	27.	20x	14x	2.	32.	117.	2266	2285	1058	472	2377	2428
232	4465	1.	0.	34.	27.	20x	14x	2.	32.	119.	2265	2284	1056	469	2376	2428
233	4721	1.	0.	34.	27.	20x	14x	2.	32.	120.	2265	2284	1046	463	2378	2430
234	5014	1.	0.	34.	27.	20x	13x	2.	32.	122.	2266	2285	1054	465	2378	2430
235	5275	1.	0.	34.	27.	20x	13x	2.	32.	122.	2262	2281	1052	464	2374	2426
238	5527	1.	0.	34.	27.	20x	13x	2.	32.	123.	2263	2282	1048	462	2375	2427

WOCE Line P16C Station 181 Latitude 36-59.9S Longitude 150-29.9W Date 8/12/91 Bottom Depth 5686

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	3	13.	13.	34.	26.	25x	-x	0.	0.	1.	2044	2058	408	309	2301	2317
102	48	13.	13.	34.	26.	25x	-x	0.	0.	1.						
103	89	13.	13.	34.	26.	25x	x	0.	0.	1.						
104	136	12.	12.	34.	26.	24x	1x	0.	2.	1.						
105	176	10.	10.	34.	26.	22x	4x	0.	10.	2.						
106	215	9.	9.	34.	26.	22x	5x	1.	14.	3.						
107	271	8.	8.	34.	26.	22x	5x	1.	17.	4.						
168	337	7.	7.	34.	26.	24x	4x	1.	18.	5.						
169	412	7.	7.	34.	26.	24x	4x	1.	19.	6.						
170	514	7.	7.	34.	26.	24x	5x	1.	20.	7.						
111	614	6.	6.	34.	26.	24x	5x	1.	22.	8.						
112	716	6.	6.	34.	27.	23x	6x	1.	23.	10.						
113	815	5.	5.	34.	27.	22x	7x	1.	25.	15.						
137	913	5.	5.	34.	27.	21x	9x	1.	28.	21.						
115	1018	4.	4.	34.	27.	20x	11x	2.	30.	30.						
116	1117	4.	3.	34.	27.	19x	12x	2.	31.	39.						
117	1266	3.	3.	34.	27.	18x	14x	2.	33.	54.						
118	1419	2.	2.	34.	27.	17x	15x	2.	34.	69.						
119	1625	2.	2.	34.	27.	16x	16x	2.	34.	87.						
120	1826	2.	2.	34.	27.	15x	17x	2.	34.	101.						
121	2026	2.	2.	34.	27.	15x	18x	2.	35.	110.						
122	2273	2.	1.	34.	27.	15x	18x	2.	35.	118.						
123	2520	1.	1.	34.	27.	15x	18x	2.	35.	124.						
124	2769	1.	1.	34.	27.	15x	18x	2.	35.	129.						
125	3007	1.	1.	34.	27.	15x	18x	2.	35.	130.						
126	3259	1.	1.	34.	27.	16x	17x	2.	34.	129.						
127	3518	1.	1.	34.	27.	17x	16x	2.	34.	124.						
128	3756	1.	1.	34.	27.	18x	15x	2.	33.	118.						
129	3989	1.	1.	34.	27.	19x	14x	2.	32.	114.						
130	4224	1.	0.	34.	27.	19x	14x	2.	32.	116.						
131	4483	1.	0.	34.	27.	20x	14x	2.	32.	118.						
132	4729	1.	0.	34.	27.	20x	14x	2.	32.	120.						
133	4985	1.	0.	34.	27.	20x	13x	2.	32.	121.						
134	5228	1.	0.	34.	27.	20x	13x	2.	32.	122.						
135	5485	1.	0.	34.	27.	20x	13x	2.	32.	122.						
138	5683	1.	0.	34.	27.	20x	13x	2.	32.	122.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)
WOCE Line P16C Station 182 Latitude 36-30.0S Longitude 150-30.0W Date 8/13/91 Bottom Depth 5590

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy uM/kg	AOU uM/kg	PO4 uM/kg	NO3 uM/kg	SiO3 uM/kg	TCO2 Obs uM/kg	TCO2 S=35 uM/kg	pCO2 @ 20 uAtm	pCO2 @ Theta uAtm	Total Alk. Calc uEq/kg	Total Alk. (PALK)s uEq/kg
213	4	13.	13.	34.	26.	25x	-x	0.	0.	2.	2044	2057	402	308	2305	2320
237	33	13.	13.	34.	26.	25x	-x	0.	0.	1.						
215	62	13.	13.	34.	26.	25x	-x	0.	0.	1.						
216	93	13.	13.	34.	26.	25x	x	0.	0.	1.						
217	122	13.	13.	34.	26.	25x	x	0.	0.	1.						
218	154	12.	12.	34.	26.	23x	2x	0.	5.	1.						
219	184	11.	11.	34.	26.	23x	3x	0.	8.	2.						
220	226	9.	9.	34.	26.	22x	5x	1.	13.	3.						
221	266	8.	8.	34.	26.	23x	5x	1.	16.	4.						
222	325	8.	8.	34.	26.	24x	4x	1.	17.	5.						
223	385	7.	7.	34.	26.	24x	4x	1.	19.	5.						
224	445	7.	7.	34.	26.	24x	4x	1.	19.	6.						
225	507	7.	7.	34.	26.	24x	4x	1.	20.	7.						
226	607	6.	6.	34.	26.	24x	5x	1.	22.	9.						
227	707	6.	6.	34.	27.	23x	6x	1.	24.	11.						
228	807	5.	5.	34.	27.	22x	7x	1.	26.	15.						
229	906	5.	5.	34.	27.	21x	9x	1.	28.	23.						
230	1006	4.	4.	34.	27.	20x	11x	2.	30.	31.						
231	1101	4.	3.	34.	27.	19x	12x	2.	31.	40.						
232	1251	3.	3.	34.	27.	18x	13x	2.	33.	53.						
233	1403	2.	2.	34.	27.	17x	15x	2.	34.	68.						
234	1610	2.	2.	34.	27.	16x	16x	2.	34.	88.						
235	1814	2.	2.	34.	27.	15x	17x	2.	35.	104.						
238	2017	2.	2.	34.	27.	15x	18x	2.	35.	111.						

WOCE Line P16C Station 183 Latitude 36-00.0S Longitude 150-29.8W Date 8/13/91 Bottom Depth 5293

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy uM/kg	AOU uM/kg	PO4 uM/kg	NO3 uM/kg	SiO3 uM/kg	TCO2 Obs uM/kg	TCO2 S=35 uM/kg	pCO2 @ 20 uAtm	pCO2 @ Theta uAtm	Total Alk. Calc uEq/kg	Total Alk. (PALK)s uEq/kg
161	2	14.	14.	34.	26.	25x	-x	0.	0.	1.	2044	2050	397	309	2308	2315
102	59	14.	14.	34.	26.	25x	-x	0.	0.	1.	2045	2051	393	306	2312	2320
103	108	13.	13.	34.	26.	25x	x	0.	0.	1.	2043	2051	395	306	2308	2318
164	156	13.	13.	34.	26.	22x	2x	0.	4.	1.	2071	2077	452	340	2311	2322
105	211	11.	11.	34.	26.	21x	5x	0.	11.	2.	2103	2117	563	391	2302	2328
106	281	8.	8.	34.	26.											
107	349	8.	7.	34.	26.	23x	5x	1.	18.	5.	2124	2156	678	407	2290	2343
168	430	7.	7.	34.	26.	24x	5x	1.	20.	6.	2126	2160	699	410	2287	2344
169	497	7.	7.	34.	26.	24x	5x	1.	21.	7.	2129	2165	706	409	2288	2348
170	564	6.	6.	34.	26.	24x	5x	1.	21.	8.	2130	2167	717	411	2286	2348
111	630	6.	6.	34.	26.	24x	5x	1.	22.	9.	2134	2173	724	410	2289	2354
112	707	6.	6.	34.	27.	23x	6x	1.	24.	11.	2139	2180	754	420	2288	2356
113	782	5.	5.	34.	27.	22x	7x	1.	25.	15.	2150	2192	797	436	2291	2362
137	883	5.	5.	34.	27.	21x	9x	1.	27.	20.	2164	2207	855	458	2295	2369
115	978	4.	4.	34.	27.	20x	10x	2.	29.	28.	2182	2225	932	486	2301	2377
116	1073	4.	4.	34.	27.	19x	12x	2.	31.	37.	2197	2239	969	494	2312	2388
117	1167	3.	3.	34.	27.	19x	13x	2.	32.	45.	2211	2252	1053	527	2314	2390
118	1317	3.	3.	34.	27.	17x	14x	2.	33.	60.	2232	2269	1117	546	2329	2402
119	1458	2.	2.	34.	27.	16x	15x	2.	34.	73.	2252	2284	1150	555	2347	2415
120	1596	2.	2.	34.	27.	16x	16x	2.	34.	86.	2264	2294	1157	554	2360	2425
121	1742	2.	2.	34.	27.	15x	17x	2.	34.	97.	2280	2307	1169	554	2375	2439
122	1944	2.	2.	34.	27.	15x	17x	2.	35.	110.	2291	2316	1181	555	2387	2448
123	2148	2.	1.	34.	27.	15x	18x	2.	35.	117.	2299	2323	1183	553	2395	2456
124	2352	2.	1.	34.	27.	15x	18x	2.	35.	123.	2308	2331	1184	549	2405	2465
125	2564	1.	1.	34.	27.	15x	18x	2.	35.	128.	2307	2330	1189	549	2404	2463
126	2770	1.	1.	34.	27.	15x	18x	2.	35.	129.	2309	2331	1189	547	2405	2464
127	2979	1.	1.	34.	27.	15x	18x	2.	35.	130.	2307	2329	1168	535	2406	2465
128	3234	1.	1.	34.	27.	16x	17x	2.	34.	129.	2299	2320	1148	523	2400	2457
129	3489	1.	1.	34.	27.	17x	16x	2.	33.	124.	2290	2310	1116	506	2395	2450
130	3748	1.	1.	34.	27.	18x	15x	2.	32.	120.	2276	2295	1092	493	2383	2436
131	4006	1.	1.	34.	27.	19x	14x	2.	32.	117.	2268	2287	1068	479	2377	2430
132	4272	1.	0.	34.	27.	20x	14x	2.	32.	118.	2263	2282	1050	468	2375	2427
133	4542	1.	0.	34.	27.	20x	14x	2.	32.	120.	2264	2283				
134	4806	1.	0.	34.	27.	20x	13x	2.	32.	122.	2265	2284	1056	467	2376	2428
135	5065	1.	0.	34.	27.	20x	13x	2.	32.	123.	2263	2282	1033	456	2378	2430
138	5297	1.	0.	34.	27.	20x	13x	2.	32.	123.	2265	2285	1013	447	2384	2436

Lamont-Doherty Earth Observatory of Columbia University
Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
$(TCO2)s=35$ = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P16C Station 184 Latitude 35-29.8S Longitude 150-29.9W Date 8/13/91 Bottom Depth 5383

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	7	14.	14.	34.	26.	25x	-x	0.	0.	1.	2042	2047	393	309	2308	2314
102	51	14.	14.	34.	26.	25x	-x	0.	0.	1.						
103	98	14.	14.	34.	26.	25x	-x	0.	0.	1.						
164	143	12.	12.	34.	26.	23x	2x	0.	3.	1.						
105	188	11.	11.	34.	26.	22x	4x	0.	10.	2.						
106	237	9.	9.	34.	26.	21x	5x	1.	13.	3.						
107	286	8.	8.	34.	26.	22x	5x	1.	16.	4.						
168	349	8.	8.	34.	26.	23x	5x	1.	18.	5.						
169	411	7.	7.	34.	26.	23x	5x	1.	19.	6.						
170	481	7.	7.	34.	26.	24x	5x	1.	20.	6.						
111	553	7.	7.	34.	26.	24x	5x	1.	21.	7.						
112	633	6.	6.	34.	26.	24x	5x	1.	22.	9.						
113	713	6.	6.	34.	27.	23x	6x	1.	23.	11.						
137	811	5.	5.	34.	27.	22x	7x	1.	26.	15.						
115	908	5.	5.	34.	27.	21x	9x	1.	28.	22.						
116	1009	4.	4.	34.	27.	20x	11x	2.	30.	31.						
117	1110	4.	3.	34.	27.	19x	12x	2.	31.	39.						
118	1256	3.	3.	34.	27.	18x	13x	2.	33.	53.						
119	1403	2.	2.	34.	27.	17x	15x	2.	34.	69.						
120	1591	2.	2.	34.	27.	16x	16x	2.	34.	88.						
121	1777	2.	2.	34.	27.	15x	17x	2.	34.	100.						
122	1968	2.	2.	34.	27.	15x	17x	2.	35.	109.						
123	2159	2.	1.	34.	27.	15x	18x	2.	35.	116.						
124	2346	2.	1.	34.	27.	15x	18x	2.	35.	122.						
125	2539	1.	1.	34.	27.	15x	18x	2.	35.	127.						
126	2802	1.	1.	34.	27.	15x	18x	2.	35.	130.						
127	3065	1.	1.	34.	27.	15x	17x	2.	35.	130.						
128	3323	1.	1.	34.	27.	16x	17x	2.	34.	127.						
129	3580	1.	1.	34.	27.	17x	16x	2.	33.	123.						
130	3832	1.	1.	34.	27.	18x	15x	2.	32.	118.						
131	4080	1.	0.	34.	27.	19x	14x	2.	32.	118.						
132	4329	1.	0.	34.	27.	20x	14x	2.	32.	118.						
133	4565	1.	0.	34.	27.	20x	14x	2.	32.	120.						
134	4814	1.	0.	34.	27.	20x	14x	2.	31.	121.						
135	5065	1.	0.	34.	27.	20x	13x	2.	32.	122.						
138	5332	1.	0.	34.	27.	20x	13x	2.	32.	122.						

WOCE Line P16C Station 185 Latitude 35-00.0S Longitude 150-29.9W Date 8/14/91 Bottom Depth 5470

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	4	14.	14.	35.	26.	24x	-x	0.	0.	1.	2043	2038	379	306	2319	2314
102	33	14.	14.	35.	26.	24x	-x	0.	0.	1.						
103	68	14.	14.	35.	26.	25x	-x	0.	0.	1.						
164	109	14.	14.	35.	26.	24x	-x	0.	0.	1.						
105	155	14.	14.	35.	26.	24x	x	0.	0.	1.						
106	185	12.	12.	34.	26.	22x	3x	0.	5.	1.						
107	234	11.	11.	34.	26.	21x	5x	0.	11.	2.						
168	286	9.	9.	34.	26.	22x	5x	1.	15.	3.						
169	338	8.	8.	34.	26.	22x	6x	1.	17.	4.						
170	415	7.	7.	34.	26.	23x	5x	1.	19.	5.						
111	515	7.	7.	34.	26.	24x	5x	1.	20.	6.						
112	616	6.	6.	34.	26.	24x	5x	1.	22.	8.						
113	716	6.	6.	34.	27.	23x	6x	1.	23.	10.						
137	818	5.	5.	34.	27.	22x	7x	1.	26.	15.						
115	917	5.	5.	34.	27.	21x	9x	1.	28.	22.						
116	1018	4.	4.	34.	27.	20x	11x	2.	30.	30.						
117	1119	4.	3.	34.	27.	19x	12x	2.	31.	39.						
118	1271	3.	3.	34.	27.	18x	14x	2.	33.	55.						
119	1424	2.	2.	34.	27.	17x	15x	2.	34.	71.						
120	1626	2.	2.	34.	27.	16x	16x	2.	34.	90.						
121	1832	2.	2.	34.	27.	15x	17x	2.	35.	104.						
122	2034	2.	2.	34.	27.	15x	18x	2.	35.	113.						
123	2290	2.	1.	34.	27.	15x	18x	2.	35.	121.						
124	2543	1.	1.	34.	27.	15x	18x	2.	35.	127.						
125	2800	1.	1.	34.	27.	15x	18x	2.	35.	130.						
126	3055	1.	1.	34.	27.	15x	18x	2.	35.	131.						
127	3308	1.	1.	34.	27.	16x	17x	2.	34.	127.						
128	3561	1.	1.	34.	27.	17x	16x	2.	33.	123.						
129	3816	1.	1.	34.	27.	18x	15x	2.	32.	120.						
130	4068	1.	0.	34.	27.	19x	14x	2.	32.	119.						
131	4322	1.	0.	34.	27.	20x	14x	2.	32.	120.						
132	4575	1.	0.	34.	27.	20x	14x	2.	32.	121.						
133	4825	1.	0.	34.	27.	20x	14x	2.	32.	122.						
134	5078	1.	0.	34.	27.	20x	13x	2.	32.	122.						
135	5284	1.	0.	34.	27.	20x	13x	2.	32.	122.						
138	5437	1.	0.	34.	27.			2.	32.	123.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)
WOCE Line P16C Station 186 Latitude 34-29.8S Longitude 150-30.3W Date 8/14/91 Bottom Depth 5348

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	2	15.	15.	35.	26.	24x	x	0.	0.	1.	2042	2037	383	310	2316	2310
102	59	15.	15.	35.	26.	24x	x	0.	0.	1.						
103	109	15.	15.	35.	26.	24x	x	0.	0.	1.						
164	164	15.	14.	35.	26.	24x	x	0.	0.	1.						
105	220	13.	13.	34.	26.	21x	4x	0.	7.	1.						
106	261	11.	11.	34.	26.	20x	6x	0.	12.	3.						
107	311	9.	9.	34.	26.	21x	6x	1.	15.	3.						
168	383	8.	8.	34.	26.	23x	5x	1.	18.	4.						
169	462	7.	7.	34.	26.	24x	5x	1.	19.	6.						
170	544	7.	7.	34.	26.	24x	5x	1.	20.	7.						
111	635	6.	6.	34.	26.	24x	5x	1.	22.	8.						
112	716	6.	6.	34.	26.	24x	6x	1.	23.	9.						
113	817	5.	5.	34.	27.	23x	7x	1.	25.	13.						
137	918	5.	5.	34.	27.	21x	9x	1.	27.	19.						
115	1020	4.	4.	34.	27.	20x	10x	2.	29.	27.						
116	1120	4.	4.	34.	27.	19x	12x	2.	31.	38.						
117	1272	3.	3.	34.	27.	18x	14x	2.	33.	54.						
118	1425	2.	2.	34.	27.	17x	15x	2.	34.	68.						
119	1577	2.	2.	34.	27.	16x	16x	2.	34.	83.						
120	1728	2.	2.	34.	27.	15x	17x	2.	35.	98.						
121	1929	2.	2.	34.	27.	15x	17x	2.	35.	108.						
122	2133	2.	1.	34.	27.	15x	18x	2.	35.	117.						
123	2336	1.	1.	34.	27.	15x	18x	2.	35.	123.						
124	2538	1.	1.	34.	27.	15x	18x	2.	35.	127.						
125	2742	1.	1.	34.	27.	15x	18x	2.	35.	130.						
126	2945	1.	1.	34.	27.	15x	18x	2.	35.	131.						
127	3148	1.	1.	34.	27.	16x	17x	2.	35.	130.						
128	3351	1.	1.	34.	27.	16x	17x	2.	34.	127.						
129	3552	1.	1.	34.	27.	17x	16x	2.	33.	123.						
130	3805	1.	1.	34.	27.	18x	15x	2.	32.	120.						
131	4056	1.	0.	34.	27.	19x	14x	2.	32.	120.						
132	4312	1.	0.	34.	27.	19x	14x	2.	32.	120.						
133	4557	1.	0.	34.	27.	20x	14x	2.	32.	121.						
134	4796	1.	0.	34.	27.	20x	14x	2.	32.	121.						
135	5050	1.	0.	34.	27.	20x	13x	2.	32.	122.						
138	5318	1.	0.	34.	27.	20x	13x	2.	32.	123.						

WOCE Line P16C Station 187 Latitude 34-00.1S Longitude 150-30.0W Date 8/14/91 Bottom Depth 5318

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
261	3	15.	15.	35.	26.	24x	x	0.	0.	1.	2044	2039	376	305	2323	2317
202	41	15.	15.	35.	26.	24x	x	0.	0.	1.	2045	2039	380	308	2321	2315
203	87	15.	15.	35.	26.	24x	x	0.	0.	1.	2044	2039	378	306	2322	2316
264	133	15.	15.	35.	26.	24x	x	0.	0.	1.	2042	2037	379	307	2319	2313
205	169	14.	14.	35.	26.	24x	1x	0.	1.	1.	2054	2050	392	312	2324	2321
206	189	13.	13.	34.	26.	22x	2x	0.	3.	1.	2073	2074	445	343	2317	2322
207	219	13.	13.	34.	26.	21x	4x	0.	6.	1.	2081	2084	482	360	2309	2319
268	248	12.	12.	34.	26.	20x	5x	0.	9.	2.	2098	2105	530	382	2309	2326
269	300	10.	10.	34.	26.	21x	6x	1.	14.	3.	2118	2137	606	401	2304	2339
270	370	8.	8.	34.	26.	22x	5x	1.	17.	4.	2121	2149	660	409	2292	2339
211	442	8.	7.	34.	26.	23x	5x	1.	18.	5.	2131	2162	673	405	2299	2351
212	509	7.	7.	34.	26.	24x	5x	1.	19.	5.	2128	2161	687	406	2292	2347
213	610	7.	7.	34.	26.	24x	5x	1.	21.	7.	2131	2168	696	402	2293	2354
237	713	6.	6.	34.	26.	24x	5x	1.	23.	9.	2138	2178	725	409	2293	2359
215	815	5.	5.	34.	27.	23x	7x	1.	25.	13.	2147	2189	775	426	2292	2362
216	916	5.	5.	34.	27.	21x	8x	1.	27.	19.	2167	2210	842	451	2300	2374
217	1013	4.	4.	34.	27.	20x	10x	2.	29.	28.	2183	2226				
218	1111	4.	4.	34.	27.	19x	12x	2.	31.	38.	2201	2243	994	506	2312	2388
219	1258	3.	3.	34.	27.	18x	13x	2.	33.	51.	2230	2269	1071	530	2333	2408
220	1407	3.	2.	34.	27.	17x	15x	2.	34.	66.	2244	2278	1125	547	2341	2412
221	1613	2.	2.	34.	27.	16x	16x	2.	34.	87.	2266	2295	1145	546	2364	2429
222	1807	2.	2.	34.	27.	15x	17x	2.	35.	104.	2290	2316	1159	547	2388	2450
223	1985	2.	2.	34.	27.	15x	18x	2.	35.	112.	2294	2319	1170	548	2391	2453
224	2228	2.	1.	34.	27.	15x	18x	2.	35.	120.	2305	2328	1162	540	2404	2465
225	2482	1.	1.	34.	27.	15x	18x	2.	35.	127.	2310	2333	1178	544	2408	2468
226	2710	1.	1.	34.	27.	15x	18x	2.	35.	131.	2310	2332	1160	533	2410	2470
227	2941	1.	1.	34.	27.	15x	18x	2.	35.	132.	2310	2332	1160	531	2411	2469
228	3181	1.	1.	34.	27.	16x	17x	2.	34.	130.	2306	2328	1134	517	2410	2468
229	3426	1.	1.	34.	27.	17x	16x	2.	34.	127.	2293	2313	1122	509	2397	2453
230	3673	1.	1.	34.	27.	18x	15x	2.	33.	122.	2282	2301	1094	494	2389	2443
231	3924	1.	1.	34.	27.	19x	15x	2.	32.	121.	2273	2292	1065	478	2383	2436
232	4178	1.	0.	34.	27.	19x	14x	2.	32.	119.	2267	2286	1044	466	2381	2433
233	4429	1.	0.	34.	27.	20x	14x	2.	32.	120.	2264	2283	1045	464	2377	2429
234	4741	1.	0.	34.	27.	20x	14x	2.	32.	121.	2262	2281	1043	462	2375	2428
235	5028	1.	0.	34.	27.	20x	13x	2.	32.	122.	2260	2279	1034	457	2374	2427
238	5293	1.	0.	34.	27.	20x	13x	2.	32.	122.	2264	2283	1038	458	2378	2430

(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P16C Station 188 Latitude 33-29.8S Longitude 150-30.3W Date 8/15/91 Bottom Depth 5236

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs	TCO2 S=35	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	(PALK)s (uEq/kg)
161	4	15.	15.	35.	26.	24x	-x	0.	0.	1.	2039	2033	372	303	2320	2313
102	51	15.	15.	35.	26.	24x	-x	0.	0.	1.						
103	96	15.	15.	35.	26.	24x	-x	0.	0.	1.						
164	141	15.	14.	35.	26.	24x	x	0.	0.	1.						
105	192	13.	13.	34.	26.	22x	3x	0.	5.	1.						
106	243	11.	11.	34.	26.	20x	5x	0.	11.	2.						
107	298	10.	10.	34.	26.	21x	6x	1.	14.	3.						
168	360	8.	8.	34.	26.	23x	5x	1.	17.	4.						
169	431	7.	7.	34.	26.	23x	5x	1.	19.	6.						
170	503	7.	7.	34.	26.	24x	5x	1.	20.	6.						
111	574	6.	6.	34.	26.	24x	5x	1.	21.	8.						
112	655	6.	6.	34.	26.	24x	5x	1.	22.	9.						
113	736	6.	6.	34.	27.	23x	6x	1.	24.	11.						
137	816	5.	5.	34.	27.	22x	8x	1.	26.	16.						
115	918	5.	4.	34.	27.	21x	9x	1.	28.	24.						
116	1018	4.	4.	34.	27.	20x	11x	2.	30.	32.						
117	1118	3.	3.	34.	27.	19x	12x	2.	32.	42.						
118	1270	3.	3.	34.	27.	17x	14x	2.	33.	58.						
119	1421	2.	2.	34.	27.	16x	15x	2.	34.	72.						
120	1623	2.	2.	34.	27.	16x	16x	2.	34.	91.						
121	1825	2.	2.	34.	27.	15x	17x	2.	35.	106.						
122	2030	2.	2.	34.	27.	15x	18x	2.	35.	114.						
123	2233	2.	1.	34.	27.	14x	18x	2.	35.	124.						
124	2436	1.	1.	34.	27.	14x	18x	2.	35.	128.						
125	2639	1.	1.	34.	27.	15x	18x	2.	35.	132.						
126	2839	1.	1.	34.	27.	15x	18x	2.	35.	132.						
127	3035	1.	1.	34.	27.	15x	18x	2.	35.	131.						
128	3237	1.	1.	34.	27.	16x	17x	2.	34.	130.						
129	3442	1.	1.	34.	27.	17x	16x	2.	34.	126.						
130	3699	1.	1.	34.	27.	18x	15x	2.	33.	121.						
131	3952	1.	1.	34.	27.	19x	14x	2.	32.	118.						
132	4206	1.	0.	34.	27.	19x	14x	2.	32.	119.						
133	4454	1.	0.	34.	27.	20x	14x	2.	32.	120.						
134	4708	1.	0.	34.	27.	20x	13x	2.	32.	122.						
135	4956	1.	0.	34.	27.	20x	13x	2.	32.	122.						
138	5195	1.	0.	34.	27.	20x	13x	2.	32.	123.						

WOCE Line P16C Station 189 Latitude 32-59.7S Longitude 150-29.5W Date 8/16/91 Bottom Depth 5401

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs	TCO2 S=35	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	(PALK)s (uEq/kg)
361	4	15.	15.	35.	25.	24x	x	0.	0.	1.	2038	2023	363	306	2324	2308
302	41	15.	15.	35.	25.	24x	x	0.	0.	1.						
303	80	15.	15.	35.	25.	24x	x	0.	0.	1.						
364	120	15.	15.	35.	26.	24x	x	0.	0.	1.						
305	146	14.	14.	35.	26.	22x	1x	0.	1.	1.						
306	186	13.	13.	35.	26.	22x	3x	0.	4.	1.						
307	226	12.	12.	34.	26.	21x	5x	0.	8.	2.						
368	268	11.	11.	34.	26.	20x	6x	0.	12.	3.						
369	309	9.	9.	34.	26.	20x	6x	1.	15.	4.						
370	360	8.	8.	34.	26.	22x	6x	1.	18.	5.						
311	410	7.	7.	34.	26.	22x	6x	1.	19.	6.						
312	512	7.	7.	34.	26.	24x	5x									
313	613	6.	6.	34.	26.	24x	5x	1.	22.	9.						
337	715	6.	6.	34.	27.	23x	6x	1.	24.	11.						
315	815	5.	5.	34.	27.	23x	7x	1.	25.	14.						
316	916	5.	5.	34.	27.	21x	9x	1.	28.	21.						
317	1018	4.	4.	34.	27.	20x	10x	2.	30.	29.						
318	1121	3.	3.	34.	27.	19x	12x	2.	32.	41.						
319	1273	3.	3.	34.	27.	17x	14x	2.	34.	59.						
320	1423	2.	2.	34.	27.	16x	15x	2.	34.	74.						
321	1628	2.	2.	34.	27.	15x	17x	2.	35.	92.						
322	1832	2.	2.	34.	27.	15x	17x	2.	35.	106.						
323	2034	2.	2.	34.	27.	15x	18x	2.	35.	115.						
324	2289	1.	1.	34.	27.	14x	18x	2.	35.	124.						
325	2543	1.	1.	34.	27.	15x	18x	2.	35.	129.						
326	2798	1.	1.	34.	27.	15x	18x	2.	35.	131.						
327	3051	1.	1.	34.	27.	15x	18x	2.	35.	131.						
328	3305	1.	1.	34.	27.	16x	17x	2.	34.	127.						
329	3560	1.	1.	34.	27.	17x	16x	2.	33.	122.						
330	3813	1.	1.	34.	27.	18x	15x	2.	32.	120.						
331	4067	1.	0.	34.	27.	19x	14x	2.	32.	120.						
332	4370	1.	0.	34.	27.	20x	14x	2.	32.	119.						
333	4676	1.	0.	34.	27.	20x	14x	2.	32.	121.						
334	4932	1.	0.	34.	27.	20x	13x	2.	32.	122.						
339	5185	1.	0.	34.	27.	20x	13x	2.	32.	122.						
338	5386	1.	0.	34.	27.	20x	13x	2.	32.	122.						

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Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P16C Station 190 Latitude 32-29.9S Longitude 150-30.0W Date 8/16/91 Bottom Depth 5179

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	---TCO2---- Obs	S=35	-----pCO2---- @ 20	@ Theta	Total Alk. Calc	(PALK)s
						---uM/kg---							-----uAtm----		---uEq/kg---	
161	2	16.	16.	35.	25.	24x	x	0.	0.	1.	2039	2019	352	303	2335	2312
102	72	16.	16.	35.	25.	24x	x	0.	0.	1.	2035	2016	351	300	2330	2308
103	117	16.	16.	35.	25.	24x	x	0.	0.	1.	2037	2021	360	305	2326	2308
164	142	15.	15.	35.	25.	23x	x	0.	0.	1.	2045	2031	370	311	2329	2313
105	192	14.	14.	35.	26.	21x	3x	0.	4.	1.	2073	2064	440	350	2321	2315
106	248	12.	12.	35.	26.	20x	5x	0.	9.	3.	2096	2096	521	385	2311	2320
107	309	11.	11.	34.	26.	20x	6x	0.	13.	3.	2110	2121	584	403	2304	2328
168	369	9.	9.	34.	26.	21x	6x	1.	16.	4.	2118	2142	645	411	2293	2335
169	426	8.	8.	34.	26.	22x	6x	1.	19.	6.	2128	2157	689	421	2291	2342
170	485	7.	7.	34.	26.	22x	6x	1.	21.	7.	2131	2165	713	421	2289	2346
111	544	7.	6.	34.	26.	23x	6x	1.	21.	8.	2133	2170	717	414	2290	2352
112	604	6.	6.	34.	26.	23x	6x	1.	22.	9.	2133	2172	729	414	2287	2352
113	703	6.	6.	34.	27.	23x	6x	1.	24.	11.	2140	2181	745	414	2291	2360
137	804	5.	5.	34.	27.	22x	8x	1.	26.	15.	2154	2197	798	435	2295	2367
115	904	5.	5.	34.	27.	21x	9x	1.	28.	22.	2169	2212	866	461	2298	2373
116	1006	4.	4.	34.	27.	20x	11x	2.	30.	32.	2187	2230	950	491	2304	2380
117	1105	3.	3.	34.	27.	19x	12x	2.	32.	43.	2207	2249	1011	510	2317	2393
118	1258	3.	3.	34.	27.	17x	14x	2.	33.	57.	2227	2264	1091	538	2326	2400
119	1411	2.	2.	34.	27.	16x	15x	2.	34.	73.	2249	2282	1125	544	2347	2416
120	1567	2.	2.	34.	27.	16x	16x	2.	34.	85.	2263	2293	1148	549	2359	2426
121	1718	2.	2.	34.	27.	15x	17x	2.	34.	99.	2277	2304	1164	551	2373	2436
122	1925	2.	2.	34.	27.	15x	17x	2.	35.	110.	2296	2321	1162	545	2394	2456
123	2132	2.	1.	34.	27.	15x	18x	2.	35.	119.	2298	2322	1172	545	2396	2457
124	2336	1.	1.	34.	27.	15x	18x	2.	35.	126.	2306	2329	1174	543	2404	2465
125	2537	1.	1.	34.	27.	15x	18x	2.	35.	129.	2311	2333	1168	538	2410	2470
126	2737	1.	1.	34.	27.	15x	18x	2.	35.	131.	2308	2330	1167	535	2407	2466
127	2935	1.	1.	34.	27.	15x	17x	2.	35.	131.	2309	2331	1154	527	2410	2469
128	3128	1.	1.	34.	27.	16x	17x	2.	34.	130.	2300	2321	1136	517	2403	2460
129	3385	1.	1.	34.	27.	17x	16x	2.	34.	126.	2293	2313	1111	503	2399	2455
130	3641	1.	1.	34.	27.	18x	15x	2.	33.	124.	2283	2303	1091	492	2391	2446
131	3897	1.	1.	34.	27.	18x	15x	2.	33.	123.	2277	2297	1068	479	2388	2442
132	4151	1.	0.	34.	27.	19x	14x	2.	32.	122.	2274	2293	1057	472	2386	2439
133	4412	1.	0.	34.	27.	19x	14x	2.	32.	121.	2268	2287	1052	468	2380	2433
134	4670	1.	0.	34.	27.	20x	14x	2.	32.	121.	2264	2283	1047	465	2376	2429
139	4924	1.	0.	34.	27.	20x	13x	2.	32.	122.	2267	2286	1039	460	2381	2433
138	5168	1.	0.	34.	27.	20x	13x	2.	32.	123.	2262	2281	1036	458	2376	2428

WOCE Line P16C Station 191 Latitude 32-00.0S Longitude 150-30.1W Date 8/16/91 Bottom Depth 5170

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	---TCO2---- Obs	S=35	-----pCO2---- @ 20	@ Theta	Total Alk. Calc	(PALK)s
						---uM/kg---							-----uAtm----		---uEq/kg---	
161	3	16.	16.	35.	25.	24x	x	0.	0.	1.	2038	2018	349	301	2336	2313
102	58	16.	16.	35.	25.	24x	x	0.	0.	1.						
103	114	16.	16.	35.	25.	24x	x	0.	0.	1.						
164	169	15.	15.	35.	26.	21x	2x	0.	3.	1.						
105	215	14.	14.	35.	26.	20x	4x	0.	6.	2.						
106	252	13.	13.	35.	26.	20x	5x	0.	8.	2.						
107	302	11.	11.	34.	26.	20x	6x	0.	12.	3.						
168	361	9.	9.	34.	26.	20x	7x	1.	16.	4.						
169	421	8.	8.	34.	26.	22x	6x	1.	18.	5.						
170	480	7.	7.	34.	26.	23x	5x	1.	19.	5.						
111	540	7.	7.	34.	26.	24x	5x	1.	20.	6.						
112	600	7.	6.	34.	26.	23x	6x	1.	21.	8.						
113	669	6.	6.	34.	26.	23x	5x	1.	22.	9.						
137	750	6.	6.	34.	27.	23x	6x	1.	24.	11.						
115	830	5.	5.	34.	27.	22x	8x	1.	26.	15.						
116	912	5.	5.	34.	27.	21x	9x	1.	27.	20.						
117	1002	4.	4.	34.	27.	20x	10x	2.	29.	28.						
118	1102	4.	4.	34.	27.	19x	12x	2.	31.	37.						
119	1202	3.	3.	34.	27.	18x	13x	2.	33.	48.						
120	1356	3.	2.	34.	27.	17x	15x	2.	34.	67.						
121	1508	2.	2.	34.	27.	16x	16x	2.	34.	81.						
122	1711	2.	2.	34.	27.	15x	17x	2.	35.	98.						
123	1916	2.	2.	34.	27.	15x	17x	2.	35.	111.						
124	2120	2.	1.	34.	27.	15x	18x	2.	35.	119.						
125	2373	1.	1.	34.	27.	15x	18x	2.	35.	127.						
126	2627	1.	1.	34.	27.	15x	18x	2.	35.	130.						
127	2884	1.	1.	34.	27.	15x	18x	2.	35.	132.						
128	3141	1.	1.	34.	27.	16x	17x	2.	34.	131.						
129	3397	1.	1.	34.	27.	17x	16x	2.	33.	127.						
130	3652	1.	1.	34.	27.	18x	15x	2.	33.	124.						
131	3907	1.	1.	34.	27.	18x	15x	2.	33.	124.						
132	4161	1.	0.	34.	27.	19x	14x	2.	32.	122.						
133	4410	1.	0.	34.	27.	19x	14x	2.	32.	121.						
134	4665	1.	0.	34.	27.	20x	14x	2.	32.	121.						
139	4921	1.	0.	34.	27.											
138	5157	1.	0.	34.	27.	20x	14x	2.	32.	121.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P16C Station 192 Latitude 31-30.0S Longitude 150-30.2W Date 8/16/91 Bottom Depth 4928

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	3	16.	16.	35.	25.	23x	x	0.	0.	1.	2032	2009	344	303	2332	2306
102	45	16.	16.	35.	25.	23x	x	0.	0.	1.						
103	84	16.	16.	35.	25.	23x	x	0.	0.	1.						
164	124	16.	16.	35.	25.	23x	x	0.	0.	1.						
105	155	16.	16.	35.	25.	22x	1x	0.	1.	1.						
106	184	15.	15.	35.	26.											
107	218	14.	14.	35.	26.	20x	4x	0.	6.	2.						
168	256	13.	13.	35.	26.	19x	5x	0.	8.	2.						
169	299	12.	12.	34.	26.	19x	6x	0.	11.	3.						
170	354	10.	10.	34.	26.	20x	7x	1.	15.	4.						
111	408	9.	9.	34.	26.	21x	6x	1.	17.	4.						
112	458	8.	8.	34.	26.	22x	6x	1.	19.	5.						
113	509	7.	7.	34.	26.	23x	5x	1.	20.	6.						
137	609	6.	6.	34.	26.	24x	5x	1.	21.	7.						
115	710	6.	6.	34.	26.	24x	5x	1.	23.	9.						
116	809	5.	5.	34.	27.	23x	6x	1.	24.	12.						
117	910	5.	5.	34.	27.	22x	8x	1.	27.	18.						
118	1010	4.	4.	34.	27.	20x	10x	2.	29.	27.						
119	1108	4.	4.	34.	27.	19x	12x	2.	31.	37.						
120	1259	3.	3.	34.	27.	18x	14x	2.	33.	55.						
121	1408	2.	2.	34.	27.	16x	15x	2.	34.	72.						
122	1616	2.	2.	34.	27.	16x	16x	2.	34.	91.						
123	1825	2.	2.	34.	27.	15x	17x	2.	35.	106.						
124	2030	2.	2.	34.	27.	15x	18x	2.	35.	115.						
125	2226	2.	1.	34.	27.	15x	18x	2.	35.	122.						
126	2424	1.	1.	34.	27.	15x	18x	2.	35.	127.						
127	2680	1.	1.	34.	27.	15x	18x	2.	35.	130.						
128	2938	1.	1.	34.	27.	15x	18x	2.	35.	130.						
129	3192	1.	1.	34.	27.	16x	17x	2.	34.	129.						
130	3447	1.	1.	34.	27.	17x	16x	2.	33.	126.						
131	3702	1.	1.	34.	27.	18x	15x	2.	33.	124.						
132	3958	1.	1.	34.	27.	18x	15x	2.	33.	123.						
133	4214	1.	0.	34.	27.	19x	15x	2.	32.	122.						
134	4466	1.	0.	34.	27.	19x	14x	2.	32.	122.						
139	4716	1.	0.	34.	27.	20x	14x	2.	32.	121.						
138	4902	1.	0.	34.	27.	20x	14x	2.	32.	121.						

WOCE Line P16C Station 193 Latitude 30-59.8S Longitude 150-30.6W Date 8/17/91 Bottom Depth 4547

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	3	17.	17.	35.	25.	23x	x	0.	0.	1.	2032	2007	332	295	2342	2313
102	33	17.	17.	35.	25.	23x	x	0.	0.	1.						
103	74	17.	17.	35.	25.	23x	x	0.	0.	1.						
164	104	17.	17.	35.	25.	23x	x	0.	0.	1.						
105	129	15.	15.	35.	25.	21x	2x	0.	2.	1.						
106	155	14.	14.	35.	26.	22x	2x	0.	2.	1.						
107	185	14.	14.	35.	26.	21x	3x	0.	4.	1.						
168	215	14.	14.	35.	26.	19x	5x	0.	8.	2.						
169	256	13.	13.	35.	26.	19x	6x	0.	9.	3.						
170	307	11.	11.	34.	26.	19x	6x	0.	13.	4.						
111	356	10.	10.	34.	26.	20x	7x	1.	16.	5.						
112	408	9.	9.	34.	26.	20x	7x	1.	17.	5.						
113	507	7.	7.	34.	26.											
137	607	6.	6.	34.	26.	23x	5x	1.	21.	8.						
115	705	6.	6.	34.	27.	23x	6x	1.	23.	10.						
116	804	5.	5.	34.	27.	23x	7x	1.	25.	13.						
117	908	5.	5.	34.	27.	21x	8x	1.	27.	20.						
118	1012	4.	4.	34.	27.	20x	10x	2.	29.	28.						
119	1112	4.	4.	34.	27.	19x	12x	2.	31.	38.						
121	1263	3.	3.	34.	27.	18x	14x	2.	33.	54.						
120	1412	2.	2.	34.	27.	16x	15x	2.	34.	73.						
122	1611	2.	2.	34.	27.	16x	16x	2.	34.	91.						
123	1810	2.	2.	34.	27.	15x	17x	2.	34.	105.						
124	2009	2.	2.	34.	27.	15x	18x	2.	35.	114.						
125	2210	1.	1.	34.	27.	15x	18x	2.	35.	123.						
126	2409	1.	1.	34.	27.	15x	18x	2.	35.	127.						
127	2605	1.	1.	34.	27.	15x	18x	2.	35.	130.						
128	2797	1.	1.	34.	27.	15x	18x	2.	35.	131.						
129	2997	1.	1.	34.	27.	16x	17x	2.	34.	131.						
130	3248	1.	1.	34.	27.	16x	17x	2.	34.	128.						
131	3503	1.	1.	34.	27.	17x	16x	2.	33.	125.						
132	3760	1.	1.	34.	27.	18x	15x	2.	33.	124.						
133	4012	1.	0.	34.	27.	19x	15x	2.	32.	123.						
134	4266	1.	0.	34.	27.	19x	14x	2.	32.	123.						
139	4524	1.	0.	34.	27.	19x	14x	2.	32.	122.						
138	4772	1.	0.	34.	27.	19x	14x	2.	32.	122.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal)   (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P16C Station 194 Latitude 30-30.2S Longitude 150-30.3W Date 8/17/91 Bottom Depth 4939

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	---TCO2---- Obs	S=35	-----pCO2---- @ 20	@ Theta	Total Alk. Calc	(PALK)s
						-----------------	-----------------	uM/kg	-----------------	-----------------	-----------------	-----------------	-----uAtm----		---uEq/kg---	
361	2	17.	17.	35.	25.	23x	x	0.	0.	1.	2030	2003	335	300	2337	2306
302	46	17.	17.	35.	25.	23x	-x	0.	0.	1.	2034	2007	334	299	2342	2312
303	92	17.	17.	35.	25.	23x	x	0.	0.	1.	2032	2006	333	298	2340	2310
364	132	16.	16.	35.	25.	21x	2x	0.	1.	1.	2052	2029	376	330	2334	2309
305	172	15.	15.	35.	26.	20x	3x	0.	4.	2.	2076	2058	468	389	2311	2296
306	217	14.	14.	35.	26.	20x	4x	0.	6.	2.	2084.	2074	467	366	2320	2316
307	268	12.	12.	34.	26.	20x	5x	0.	9.	2.	2095	2097	517	379	2310	2323
368	319	10.	10.	34.	26.	20x	6x	1.	13.	4.	2114	2127	590	402	2306	2333
369	380	9.	9.	34.	26.	21x	6x	1.	17.	4.	2122	2146	657	415	2293	2337
370	451	8.	7.	34.	26.	22x	6x	1.	19.	5.	2126	2157	679	409	2291	2345
311	523	7.	7.	34.	26.	23x	5x	1.	20.	6.	2128	2163	689	404	2291	2349
312	592	6.	6.	34.	26.	24x	5x	1.	21.	7.	2128	2165	702	403	2288	2350
313	662	6.	6.	34.	26.	24x	5x	1.	22.	9.	2136	2176	724	408	2292	2358
337	743	6.	5.	34.	27.	23x	6x	1.	24.	12.	2141	2183	758	419	2289	2359
315	825	5.	5.	34.	27.	23x	7x	1.	26.	15.	2147	2190	788	429	2289	2362
316	917	5.	5.	34.	27.	21x	9x	1.	27.	20.	2168	2212	852	454	2300	2374
317	1018	4.	4.	34.	27.	20x	11x	2.	30.	30.	2185	2228	931	483	2304	2380
318	1120	3.	3.	34.	27.	19x	12x	2.	32.	41.	2207	2248	1021	516	2314	2390
319	1269	3.	3.	34.	27.	17x	14x	2.	33.	60.	2237	2273	1096	537	2337	2410
320	1419	2.	2.	34.	27.	16x	16x	2.	34.	77.	2256	2287	1144	550	2352	2420
321	1619	2.	2.	34.	27.	15x	17x	2.	34.	95.	2276	2304	1156	549	2373	2437
322	1823	2.	2.	34.	27.	15x	17x	2.	35.	107.	2291	2316	1164	547	2388	2451
323	2025	2.	1.	34.	27.	15x	18x	2.	35.	115.	2297	2322	1175	548	2394	2455
324	2226	1.	1.	34.	27.	15x	18x	2.	35.	123.	2307	2331	1179	546	2405	2465
325	2426	1.	1.	34.	27.	15x	18x	2.	35.	128.	2308	2330	1175	542	2406	2466
326	2626	1.	1.	34.	27.	15x	18x	2.	35.	130.	2308	2330	1164	534	2408	2467
327	2828	1.	1.	34.	27.	15x	18x	2.	35.	131.	2310	2332	1165	533	2410	2468
328	3081	1.	1.	34.	27.	16x	17x	2.	34.	130.	2302	2323	1133	516	2405	2463
329	3338	1.	1.	34.	27.	17x	16x	2.	34.	127.	2293	2314	1122	508	2398	2454
330	3594	1.	1.	34.	27.	18x	15x	2.	33.	126.	2287	2307	1098	494	2394	2449
331	3848	1.	1.	34.	27.	18x	15x	2.	33.	124.	2279	2299	1071	480	2389	2444
332	4098	1.	0.	34.	27.	19x	15x	2.	33.	123.	2277	2297	1069	478	2388	2442
333	4354	1.	0.	34.	27.	19x	14x	2.	32.	123.	2281	2301	1065	475	2393	2446
334	4609	1.	0.	34.	27.	19x	14x	2.	32.	122.	2278	2297	1048	466	2392	2445
339	4864	1.	0.	34.	27.	19x	14x	2.	32.	122.	2275	2294	1047	465	2389	2442
338	5074	1.	0.	34.	27.	20x	14x	2.	32.	122.	2271	2290	1058	470	2383	2436

WOCE Line P16C Station 195 Latitude 30-00.2S Longitude 150-30.7W Date 8/17/91 Bottom Depth 5029

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	---TCO2---- Obs	S=35	-----pCO2---- @ 20	@ Theta	Total Alk. Calc	(PALK)s
						-----------------	-----------------	uM/kg	-----------------	-----------------	-----------------	-----------------	-----uAtm----		---uEq/kg---	
161	1	18.	18.	35.	25.	23x	-x	0.	0.	1.	2030	2000	320	295	2349	2314
102	34	17.	17.	35.	25.	23x	-x	0.	0.	1.						
103	64	17.	17.	35.	25.	23x	x	0.	0.	1.						
164	114	17.	17.	35.	25.	23x	x	0.	0.	1.						
105	143	17.	17.	35.	25.	23x	x	0.	0.	1.						
106	193	15.	15.	35.	26.	21x	2x	0.	2.	1.						
107	240	14.	14.	35.	26.	20x	4x	0.	5.	2.						
168	297	12.	12.	34.	26.	19x	6x	0.	10.	3.						
169	353	10.	10.	34.	26.	20x	7x	1.	14.	4.						
170	403	9.	9.	34.	26.	20x	7x	1.	18.	5.						
111	468	8.	8.	34.	26.	22x	6x	1.	19.	6.						
112	532	7.	7.	34.	26.	23x	5x	1.	20.	7.						
113	609	6.	6.	34.	26.	24x	5x	1.	21.	8.						
137	685	6.	6.	34.	26.	24x	5x	1.	22.	9.						
115	763	6.	6.	34.	27.	23x	6x	1.	24.	11.						
116	861	5.	5.	34.	27.	22x	7x	1.	25.	15.						
117	1010	4.	4.	34.	27.	20x	11x	2.	30.	30.						
118	1157	3.	3.	34.	27.	18x	13x	2.	32.	48.						
119	1354	3.	3.	34.	27.	17x	15x	2.	34.	67.						
120	1553	2.	2.	34.	27.	16x	16x	2.	34.	87.						
121	1752	2.	2.	34.	27.	15x	17x	2.	34.	103.						
122	1958	2.	2.	34.	27.	15x	18x	2.	35.	113.						
124	2160	2.	1.	34.	27.	15x	18x	2.	35.	121.						
123	2162	2.	1.	34.	27.	15x	18x	2.	35.	121.						
125	2356	1.	1.	34.	27.	15x	18x	2.	35.	128.						
126	2557	1.	1.	34.	27.	15x	18x	2.	35.	130.						
127	2766	1.	1.	34.	27.	15x	18x	2.	35.	132.						
128	2973	1.	1.	34.	27.	15x	17x	2.	35.							
129	3182	1.	1.	34.	27.	16x	17x	2.	34.	129.						
130	3389	1.	1.	34.	27.	17x	16x	2.	34.	127.						
131	3593	1.	1.	34.	27.	18x	16x	2.	33.	125.						
132	3802	1.	1.	34.	27.	18x	15x	2.	33.	125.						
133	3803	1.	1.	34.	27.	18x	15x	2.	33.	124.						
134	4005	1.	1.	34.	27.	18x	15x	2.	32.	123.						
139	4207	1.	0.	34.	27.	19x	15x	2.	32.	123.						
138	4367	1.	0.	34.	27.	19x	14x	2.	32.	123.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P16C Station 196 Latitude 29-30.2S Longitude 150-30.2W Date 8/18/91 Bottom Depth 4579

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	3	18.	18.	35.	25.	23x	-x	0.	0.	1.	2017	1985	312	296	2341	2303
102	33	18.	18.	35.	25.	23x	-x	0.	0.	1.						
103	68	18.	18.	35.	25.	23x	-x	0.	0.	1.						
164	93	18.	18.	35.	25.	22x	x	0.	0.	1.						
105	123	17.	17.	35.	25.	21x	2x	0.	1.	1.						
106	163	16.	16.	35.	25.	20x	3x	0.	2.	1.						
107	204	15.	15.	35.	26.	20x	4x	0.	4.	1.						
168	245	14.	14.	35.	26.	19x	5x	0.	7.	2.						
169	285	13.	13.	35.	26.	19x	6x	0.	9.	2.						
170	326	12.	12.	34.	26.	19x	6x	0.	12.	3.						
111	387	10.	10.	34.	26.	20x	7x	1.	16.	4.						
112	447	8.	8.	34.	26.	21x	7x	1.	18.	5.						
113	507	7.	7.	34.	26.	22x	6x	1.	20.	6.						
137	607	6.	6.	34.	26.	23x	6x	1.	22.	8.						
115	708	6.	6.	34.	27.	23x	6x	1.	24.	11.						
116	811	5.	5.	34.	27.	22x	8x	1.	26.	16.						
117	914	5.	5.	34.	27.	21x	9x	1.	28.	23.						
118	1017	4.	4.	34.	27.	19x	11x	2.	30.	33.						
119	1118	4.	3.	34.	27.	18x	13x	2.	32.	46.						
120	1268	3.	3.	34.	27.	17x	15x	2.	33.	62.						
121	1419	2.	2.	34.	27.	16x	16x	2.	34.	78.						
122	1621	2.	2.	34.	27.	15x	17x	2.	34.	93.						
123	1827	2.	2.	34.	27.	15x	17x	2.	35.	107.						
124	2030	2.	2.	34.	27.	15x	18x	2.	35.	116.						
125	2235	1.	1.	34.	27.	14x	18x	2.	35.	123.						
126	2437	1.	1.	34.	27.	14x	18x	2.	35.	127.						
127	2640	1.	1.	34.	27.	15x	18x	2.	35.	129.						
128	2845	1.	1.	34.	27.	15x	18x	2.	35.	131.						
129	3048	1.	1.	34.	27.	16x	17x	2.	35.	130.						
130	3252	1.	1.	34.	27.	16x	17x	2.	34.	128.						
131	3455	1.	1.	34.	27.	17x	16x	2.	34.	127.						
132	3708	1.	1.	34.	27.	18x	15x	2.	33.	125.						
133	3963	1.	1.	34.	27.	18x	15x	2.	33.	123.						
134	4219	1.	0.	34.	27.	19x	15x	2.	32.	123.						
139	4419	1.	0.	34.	27.	19x	14x	2.	32.	123.						
138	4630	1.	0.	34.	27.	19x	14x	2.	32.	122.						

WOCE Line P16C Station 197 Latitude 28-59.9S Longitude 150-30.2W Date 8/18/91 Bottom Depth 4772

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	6	19.	19.	35.	25.	22x	x	0.	0.	1.	2016	1984	304	293	2346	2309
102	64	18.	18.	35.	25.	21x	1x	0.	0.	1.						
103	84	18.	18.	35.	25.	23x	-x	0.	0.	1.						
164	109	17.	17.	35.	25.	23x	-x	0.	0.	1.						
105	129	17.	17.	35.	25.	23x	x	0.	0.	1.						
106	184	17.	17.	35.	25.	23x	x	0.	0.	1.						
107	239	15.	15.	35.	26.	20x	4x	0.	4.	1.						
168	311	14.	13.	35.	26.	19x	5x	0.	8.	3.						
169	378	11.	11.	34.	26.	19x	7x	1.	13.	4.						
170	448	9.	9.	34.	26.	20x	7x	1.	18.	5.						
111	530	7.	7.	34.	26.	22x	6x	1.	20.	7.						
112	611	7.	7.	34.	26.	23x	6x	1.	21.	8.						
113	702	6.	6.	34.	26.	23x	6x	1.	23.	10.						
137	782	5.	5.	34.	27.	22x	7x	1.	25.	14.						
115	863	5.	5.	34.	27.	21x	9x	1.	27.	19.						
116	965	4.	4.	34.	27.	20x	10x	2.	28.	24.						
117	1065	4.	4.	34.	27.	19x	12x	2.	31.	37.						
118	1167	3.	3.	34.	27.	17x	14x	2.	33.	50.						
119	1270	3.	3.	34.	27.	17x	14x	2.	33.	58.						
120	1371	3.	3.	34.	27.	16x	15x	2.	34.	70.						
121	1523	2.	2.	34.	27.	16x	16x	2.	34.	82.						
122	1726	2.	2.	34.	27.	15x	17x	2.	34.	98.						
123	1929	2.	2.	34.	27.	15x	17x	2.	35.	111.						
124	2132	2.	1.	34.	27.	15x	18x	2.	35.	119.						
125	2336	1.	1.	34.	27.	14x	18x	2.	35.	125.						
126	2539	1.	1.	34.	27.	15x	18x	2.	35.	129.						
127	2742	1.	1.	34.	27.	15x	18x	2.	35.	131.						
128	2943	1.	1.	34.	27.	15x	18x	2.	35.	131.						
129	3146	1.	1.	34.	27.	16x	17x	2.	34.	130.						
130	3349	1.	1.	34.	27.	17x	16x	2.	34.	128.						
131	3554	1.	1.	34.	27.	17x	16x	2.	33.	126.						
132	3757	1.	1.	34.	27.	18x	15x	2.	33.	124.						
133	4012	1.	0.	34.	27.	19x	15x	2.	32.	123.						
134	4267	1.	0.	34.	27.	19x	15x	2.	32.	123.						
139	4521	1.	0.	34.	27.	19x	14x	2.	32.	122.						
138	4762	1.	0.	34.	27.	19x	14x	2.	32.	122.						

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Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)
WOCE Line P16C Station 198 Latitude 28-30.0S Longitude 150-29.8W Date 8/18/91 Bottom Depth 4897

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	TCO2 Obs	TCO2 S=35	pCO2 @ 20	pCO2 @ Theta	Total Alk. Calc	(PALK)s
						uM/kg							uAtm		uEq/kg	
261	1	19.	19.	35.	25.	22x	-x	0.	0.	1.	2016	1983	306	299	2344	2305
202	44	19.	19.	35.	25.	22x	-x	0.	0.	1.	2018	1984	306	296	2347	2308
203	74	18.	18.	35.	25.	22x	x	0.	0.	1.	2025	1993	312	297	2350	2313
264	114	18.	18.	35.	25.	23x	x	0.	0.	1.	2026	1996	322	298	2343	2308
205	153	17.	17.	35.	25.	22x	x	0.	0.	1.	2034	2006	343	311	2336	2305
206	184	17.	17.	35.	25.	22x	1x	0.	1.	1.	2040	2014	351	314	2337	2308
207	226	16.	16.	35.	26.	20x	3x	0.	3.	1.	2067	2044	413	353	2330	2307
268	267	15.	14.	35.	26.	19x	5x	0.	7.	2.	2087	2069	457	369	2330	2318
269	307	13.	13.	35.	26.	19x	6x	0.	9.	3.	2095	2086	497	382	2320	2319
270	357	11.	11.	34.	26.	19x	6x	0.	13.	4.	2111	2117	577	406	2307	2327
211	409	10.	10.	34.	26.	20x	7x	1.	15.	4.	2118	2133	623	417	2299	2332
212	484	8.	8.	34.	26.	21x	6x	1.	18.	5.	2124	2151	675	418	2291	2339
213	561	7.	7.	34.	26.	22x	6x	1.	21.	7.	2129	2163	706	415	2288	2346
237	638	6.	6.	34.	26.	23x	6x	1.	22.	8.	2137	2175	723	414	2293	2357
215	713	6.	6.	34.	27.	23x	6x	1.	23.	10.	2136	2175	741	416	2287	2354
216	815	5.	5.	34.	27.	22x	8x	1.	26.	16.	2151	2194	812	441	2289	2361
217	917	5.	4.	34.	27.	20x	10x	2.	29.	24.	2171	2213	890	472	2296	2371
218	1018	4.	4.	34.	27.	19x	11x	2.	31.	32.	2196	2238	942	490	2314	2390
219	1120	4.	3.	34.	27.	18x	13x	2.	32.	44.	2202	2242	1035	524	2308	2383
220	1272	3.	3.	34.	27.	17x	14x	2.	33.	55.	2228	2266	1066	525	2332	2405
221	1425	2.	2.	34.	27.	16x	16x	2.	34.	77.	2263	2295	1135	548	2360	2429
222	1628	2.	2.	34.	27.	15x	17x	2.	34.	95.	2273	2301	1157	550	2369	2434
224	1831	2.	2.	34.	27.	15x	17x	2.	35.	110.	2293	2318	1171	550	2389	2451
225	2034	2.	1.	34.	27.	15x	18x	2.	35.	119.	2302	2326	1180	550	2399	2460
226	2289	1.	1.	34.	27.	14x	18x	2.	35.	127.	2311	2335	1189	550	2408	2469
227	2542	1.	1.	34.	27.	15x	18x	2.	35.	131.	2310	2332	1177	541	2408	2468
228	2797	1.	1.	34.	27.	15x	18x	2.	35.	133.	2314	2336	1162	532	2415	2474
229	3049	1.	1.	34.	27.	15x	17x	2.	35.	132.	2305	2327	1152	525	2407	2464
230	3304	1.	1.	34.	27.	17x	16x	2.	34.	129.	2295	2316	1100	499	2403	2460
231	3559	1.	1.	34.	27.	17x	16x	2.	33.	126.	2290	2310	1087	490	2399	2454
232	3812	1.	1.	34.	27.	18x	15x	2.	33.	125.	2278	2297	1082	486	2386	2441
233	4117	1.	0.	34.	27.	19x	15x	2.	32.	124.	2277	2296	1060	474	2388	2442
234	4421	1.	0.	34.	27.	19x	15x	2.	32.	124.	2274	2293	1069	478	2384	2438
239	4676	1.	0.	34.	27.	19x	14x	2.	32.	123.	2272	2291	1057	472	2384	2437
238	4938	1.	0.	34.	27.	19x	14x	2.	32.	124.	2274	2293	1057	472	2386	2439

WOCE Line P16C Station 199 Latitude 27-59.8S Longitude 150-29.8W Date 8/19/91 Bottom Depth 3452

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	TCO2 Obs	TCO2 S=35	pCO2 @ 20	pCO2 @ Theta	Total Alk. Calc	(PALK)s
						uM/kg							uAtm		uEq/kg	
161	1	18.	18.	35.	25.	23x	-x	0.	0.	1.	2019	1987	308	295	2347	2309
102	27	18.	18.	35.	25.	23x	-x	0.	0.	1.						
103	52	18.	18.	35.	25.	23x	-x	0.	0.	1.						
164	82	18.	18.	35.	25.	23x	-x	0.	0.	1.						
105	113	18.	18.	35.	25.	23x	x	0.	0.	1.						
106	142	18.	17.	35.	25.	22x	x	0.	0.	1.						
107	173	17.	17.	35.	25.	21x	2x	0.	1.	1.						
168	204	16.	16.	35.	25.	20x	3x	0.	3.	1.						
169	244	15.	15.	35.	26.	19x	4x	0.	5.	2.						
170	285	14.	14.	35.	26.	19x	5x	0.	7.	2.						
111	325	13.	13.	35.	26.	19x	6x	0.	10.	3.						
112	386	11.	11.	34.	26.	19x	7x	1.	13.	4.						
113	447	9.	9.	34.	26.	20x	7x	1.	16.	5.						
137	508	8.	8.	34.	26.	22x	6x	1.	19.	6.						
115	584	7.	7.	34.	26.	23x	6x	1.	21.	7.						
116	660	6.	6.	34.	26.	23x	6x	1.	22.	9.						
117	736	6.	6.	34.	27.	22x	7x	1.	24.	12.						
118	812	5.	5.	34.	27.	22x	8x	1.	26.	16.						
119	913	5.	5.	34.	27.	20x	10x	1.	28.	23.						
120	1014	4.	4.	34.	27.	19x	11x	2.	30.	34.						
121	1116	4.	4.	34.	27.	18x	13x	2.	32.	43.						
122	1268	3.	3.	34.	27.	16x	15x	2.	34.	65.						
123	1420	2.	2.	34.	27.	16x	16x	2.	34.	82.						
124	1624	2.	2.	34.	27.	15x	17x	2.	34.	97.						
125	1828	2.	2.	34.	27.	15x	17x	2.	35.	110.						
126	2030	2.	1.	34.	27.	14x	18x	2.	35.	119.						
127	2232	1.	1.	34.	27.	14x	18x	2.	35.	124.						
128	2425	1.	1.	34.	27.	14x	18x	2.	35.	129.						
129	2624	1.	1.	34.	27.	15x	18x	2.	35.	131.						
131	2826	1.	1.	34.	27.	15x	18x	2.	35.	132.						
130	2827	1.	1.	34.	27.	15x	18x	2.	35.	131.						
133	3024	1.	1.	34.	27.	16x	17x	2.	34.	130.						
132	3025	1.	1.	34.	27.	16x	17x	2.	34.	131.						
134	3223	1.	1.	34.	27.	16x	17x	2.	34.	130.						
139	3431	1.	1.	34.	27.	17x	16x	2.	34.	128.						
138	3567	1.	1.	34.	27.	17x	16x	2.	33.	126.						

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Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P16C Station 200 Latitude 27-30.1S Longitude 150-29.5W Date 8/19/91 Bottom Depth 3678

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	---TCO2---- Obs	S=35	-----pCO2---- @ 20	@ Theta	Total Alk. Calc	(PALK)s
						uM/kg							-----uAtm----		---uEq/kg---	
161	3	19.	19.	35.	25.	22x	-x	0.	0.	1.	2017	1984	304	295	2347	2309
102	52	19.	19.	35.	25.	22x	-x	0.	0.	1.						
103	102	19.	19.	35.	25.	22x	x	0.	0.	1.						
164	153	17.	17.	35.	25.	21x	2x	0.	1.	1.						
105	203	16.	16.	35.	25.	20x	4x	0.	4.	1.						
106	249	15.	15.	35.	26.	19x	5x	0.	6.	2.						
107	295	14.	14.	35.	26.	19x	5x	0.	8.	2.						
168	340	12.	12.	35.	26.	19x	6x	0.	11.	3.						
169	386	11.	11.	34.	26.	19x	7x	1.	14.	4.						
170	437	9.	9.	34.	26.	20x	7x	1.	17.	5.						
111	508	8.	8.	34.	26.	21x	7x	1.	19.	6.						
112	590	7.	7.	34.	26.	22x	6x	1.	21.	7.						
113	671	6.	6.	34.	26.	23x	6x	1.	23.	9.						
137	763	5.	5.	34.	27.	22x	7x	1.	25.	13.						
115	854	5.	5.	34.	27.	21x	9x	1.	27.	20.						
116	944	4.	4.	34.	27.	20x	11x	2.	29.	29.						
117	1036	4.	4.	34.	27.	18x	12x	2.	31.	39.						
118	1126	3.	3.	34.	27.	17x	14x	2.	32.	50.						
119	1214	3.	3.	34.	27.	17x	15x	2.	33.	60.						
120	1314	3.	3.	34.	27.	16x	15x	2.	34.	72.						
121	1417	2.	2.	34.	27.	16x	16x	2.	34.	80.						
122	1519	2.	2.	34.	27.	16x	16x	2.	34.	89.						
124	1642	2.	2.	34.	27.	15x	17x	2.	35.	98.						
125	1776	2.	2.	34.	27.	15x	17x	2.	35.	106.						
126	1928	2.	2.	34.	27.	15x	18x	2.	35.	115.						
127	2081	2.	1.	34.	27.	14x	18x	2.	35.	121.						
128	2236	2.	1.	34.	27.	14x	18x	2.	35.	125.						
129	2388	1.	1.	34.	27.	14x	18x	2.	35.	128.						
130	2539	1.	1.	34.	27.	15x	18x	2.	35.	130.						
131	2667	1.	1.	34.	27.	15x	18x	2.	35.	132.						
132	2841	1.	1.	34.	27.	15x	18x	2.	35.	132.						
133	2988	1.	1.	34.	27.	15x	17x	2.	35.	131.						
134	3139	1.	1.	34.	27.	16x	17x	2.	34.	131.						
139	3292	1.	1.	34.	27.	16x	17x	2.	34.	129.						
138	3510	1.	1.	34.	27.	17x	16x	2.	34.	127.						

WOCE Line P16C Station 201 Latitude 27-00.0S Longitude 150-29.7W Date 8/19/91 Bottom Depth 4753

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	---TCO2---- Obs	S=35	-----pCO2---- @ 20	@ Theta	Total Alk. Calc	(PALK)s
						uM/kg							-----uAtm----		---uEq/kg---	
161	1	20.	20.	35.	25.	22x	-x	0.	0.	1.	2008	1975	286	288	2353	2314
102	44	19.	19.	35.	25.	22x	-x	0.	0.	0.						
103	84	19.	19.	35.	25.	22x	-x	0.	0.	0.						
164	123	19.	19.	35.	25.	22x	-x	0.	0.	0.						
105	163	18.	18.	35.	25.	21x	1x	0.	0.	0.						
106	222	16.	16.	35.	25.	20x	3x	0.	3.	1.						
107	282	14.	14.	35.	26.	19x	5x	0.	6.	2.						
168	352	12.	12.	35.	26.	19x	6x	0.	10.	3.						
169	414	11.	11.	34.	26.	19x	7x	1.	13.	3.						
170	486	9.	9.	34.	26.	20x	7x	1.	17.	5.						
111	556	7.	7.	34.	26.	22x	6x	1.	20.	6.						
112	625	6.	6.	34.	26.	23x	6x	1.	22.	8.						
113	685	6.	6.	34.	26.	23x	6x	1.	23.	9.						
137	765	5.	5.	34.	27.	22x	7x	1.	25.	14.						
115	854	5.	5.	34.	27.	21x	9x	1.	27.	20.						
116	956	4.	4.	34.	27.	19x	11x	2.	30.	30.						
117	1053	4.	4.	34.	27.	18x	13x	2.	32.	42.						
118	1148	3.	3.	34.	27.	17x	14x	2.	33.	54.						
119	1246	3.	3.	34.	27.	16x	15x	2.	34.	64.						
120	1399	2.	2.	34.	27.	16x	16x	2.	34.	80.						
121	1553	2.	2.	34.	27.	15x	17x	2.	34.	91.						
122	1706	2.	2.	34.	27.	15x	17x	2.	35.	103.						
124	1912	2.	2.	34.	27.	15x	18x	2.	35.	113.						
125	2113	2.	1.	34.	27.	14x	18x	2.	35.	121.						
126	2321	1.	1.	34.	27.	14x	18x	2.	35.	127.						
127	2533	1.	1.	34.	27.	15x	18x	2.	35.	129.						
128	2731	1.	1.	34.	27.	15x	18x	2.	35.	131.						
129	2975	1.	1.	34.	27.	15x	18x	2.	35.	131.						
130	3230	1.	1.	34.	27.	16x	17x	2.	34.	129.						
131	3481	1.	1.	34.	27.	17x	16x	2.	34.	126.						
132	3735	1.	1.	34.	27.	18x	15x	2.	33.	123.						
133	3981	1.	1.	34.	27.	18x	15x	2.	33.	123.						
134	4235	1.	0.	34.	27.	19x	14x	2.	32.	122.						
139	4490	1.	0.	34.	27.	19x	14x	2.	32.	121.						
138	4697	1.	0.	34.	27.	19x	14x	2.	32.	121.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P16C Station 202 Latitude 26-30.2S Longitude 150-30.2W Date 8/20/91 Bottom Depth 4777

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	---TCO2---- Obs	S=35	-----pCO2---- @ 20	@ Theta	Total Alk. Calc	(PALK)s
						------------------	------------------	--uM/kg	------------------	------------------	------------------	------------------	-----uAtm----	-----uAtm----	---uEq/kg---	---uEq/kg---
161	2	19.	19.	35.	25.	22x	-x	0.	0.	1.	2009	1975	292	291	2348	2309
102	33	19.	19.	35.	25.	22x	-x	0.	0.	1.	2014	1982	302	296	2345	2308
103	77	19.	19.	35.	25.	22x	x	0.	0.	1.	2013	1981	305	299	2341	2304
164	121	19.	19.	35.	25.	22x	x	0.	0.	1.	2015	1983	302	296	2346	2309
105	163	19.	19.	35.	25.	22x	x	0.	0.	1.	2022	1991	311	301	2347	2312
106	203	17.	17.	35.	25.	20x	3x	0.	2.	1.	2053	2025	373	339	2339	2308
107	254	16.	16.	35.	26.	20x	4x	0.	4.	1.	2072	2049	420	357	2331	2311
168	304	14.	14.	35.	26.	19x	5x	0.	7.	2.	2089	2077	482	380	2321	2315
169	355	13.	13.	35.	26.	19x	6x	0.	10.	3.	2101	2097	524	393	2315	2322
170	406	11.	10.	34.	26.	19x	7x	1.	14.	4.	2118	2130	603	412	2306	2334
111	477	8.	8.	34.	26.	21x	6x	1.	18.	5.	2125	2152	665	412	2295	2343
112	549	7.	7.	34.	26.	22x	6x	1.	20.	6.	2130	2163	699	415	2290	2347
137	669	6.	6.	34.	27.						2137	2176	734	410		
113	669	6.	6.	34.	26.						2136	2175	728	417		
115	771	5.	5.	34.	27.	22x	7x	1.	25.	13.	2147	2190	776	426	2292	2363
116	863	5.	5.	34.	27.	21x	9x	1.	27.	19.	2164	2207	840	450	2298	2372
117	964	4.	4.	34.	27.	20x	11x	2.	30.	29.	2184	2226	931	487	2303	2379
118	1062	4.	4.	34.	27.	18x	12x	2.	32.	40.	2204	2245	999	512	2314	2390
119	1214	3.	3.	34.	27.	17x	15x	2.	33.	60.	2233	2269	1090	542	2334	2406
120	1415	2.	2.	34.	27.	16x	16x	2.	34.	83.	2261	2293	1126	543	2361	2429
121	1616	2.	2.	34.	27.	15x	17x	2.	35.	99.	2278	2306	1143	543	2377	2441
122	1815	2.	2.	34.	27.	15x	17x	2.	35.	110.	2296	2322	1159	544	2395	2458
123	2025	2.	1.	34.	27.	15x	18x	2.	35.	119.	2302	2326	1169	544	2400	2461
124	2230	1.	1.	34.	27.	14x	18x	2.	36.	126.	2310	2334	1172	543	2409	2470
125	2436	1.	1.	34.	27.	15x	18x	2.	35.	129.	2310	2333	1175	542	2409	2469
126	2630	1.	1.	34.	27.	15x	18x	2.	35.	130.	2312	2335	1167	536	2412	2472
127	2828	1.	1.	34.	27.	15x	18x	2.	35.	131.		2350	1157	530	2430	2490
128	3031	1.	1.	34.	27.	16x	17x	2.	35.	130.	2302	2324	1140	520	2404	2463
129	3286	1.	1.	34.	27.	16x	17x	2.	34.	128.	2299	2320	1127	512	2403	2460
130	3539	1.	1.	34.	27.	17x	16x	2.	34.	127.	2293	2314	1118	506	2398	2455
131	3746	1.	1.	34.	27.	17x	16x	2.	34.	127.	2288	2309	1092	492	2397	2452
132	3949	1.	1.	34.	27.	18x	15x	2.	33.	125.	2285	2305	1082	486	2394	2449
133	4157	1.	0.	34.	27.	19x	15x	2.	33.	124.	2276	2295	1053	471	2388	2442
134	4360	1.	0.	34.	27.	19x	15x	2.	32.	123.	2273	2292	1066	476	2383	2437
139	4561	1.	0.	34.	27.	19x	14x	2.	32.	123.	2275	2295	1056	471	2388	2441
138	4739	1.	0.	34.	27.	19x	14x	2.	32.	123.	2273	2293	1067	476	2384	2437

WOCE Line P16C Station 203 Latitude 25-59.9S Longitude 150-29.9W Date 8/20/91 Bottom Depth 4628

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	---TCO2---- Obs	S=35	-----pCO2---- @ 20	@ Theta	Total Alk. Calc	(PALK)s
						------------------	------------------	--uM/kg	------------------	------------------	------------------	------------------	-----uAtm----	-----uAtm----	---uEq/kg---	---uEq/kg---
161	1	19.	19.	35.	25.	22x	-x	0.	0.	1.	2015	1982	296	292	2352	2314
102	38	19.	19.	35.	25.	22x	-x	0.	0.	1.						
103	73	19.	19.	35.	25.	22x	-x	0.	0.	1.						
164	113	19.	19.	35.	25.	22x	x	0.	0.	1.						
105	164	18.	18.	35.	25.	21x	1x	0.	0.	1.						
106	224	16.	16.	35.	25.	20x	4x	0.	4.	2.						
107	281	14.	14.	35.	26.	19x	5x	0.	8.	2.						
168	337	12.	12.	34.	26.	19x	6x	0.	12.	3.						
169	398	10.	10.	34.	26.	19x	7x	1.	15.	5.						
170	459	9.	9.	34.	26.	20x	7x	1.	18.	6.						
111	520	7.	7.	34.	26.	22x	6x	1.	20.	7.						
112	586	6.	6.	34.	26.	23x	6x	1.	22.	8.						
113	656	6.	6.	34.	27.	23x	7x	1.	24.	12.						
137	733	5.	5.	34.	27.	22x	7x	1.	26.	15.						
115	814	5.	5.	34.	27.	21x	9x	1.	27.	20.						
116	893	4.	4.	34.	27.	20x	11x	2.	30.	29.						
117	973	4.	4.	34.	27.	18x	12x	2.	31.	38.						
118	1063	4.	3.	34.	27.	18x	13x	2.	32.	48.						
119	1164	3.	3.	34.	27.	17x	14x	2.	33.	59.						
120	1317	3.	2.	34.	27.	16x	16x	2.	34.	77.						
121	1468	2.	2.	34.	27.	15x	16x	2.	34.	88.						
122	1620	2.	2.	34.	27.	15x	17x									
123	1775	2.	2.	34.	27.	15x	17x	2.	35.	109.						
124	1928	2.	2.	34.	27.	15x	18x	2.	35.	117.						
125	2132	2.	1.	34.	27.				35.							
126	2336	1.	1.	34.	27.	14x	18x	2.	35.	127.						
127	2539	1.	1.	34.	27.	15x	18x	2.	35.	130.						
128	2744	1.	1.	34.	27.	15x	18x	2.	35.	130.						
129	2947	1.	1.	34.	27.	15x	18x	2.	35.	129.						
130	3151	1.	1.	34.	27.	16x	17x	2.	34.	129.						
131	3406	1.	1.	34.	27.	16x	16x	2.	34.	128.						
132	3660	1.	1.	34.	27.	17x	16x	2.	33.	126.						
133	3913	1.	1.	34.	27.	18x	15x	2.	33.	124.						
134	4166	1.	0.	34.	27.	19x	15x	2.	33.	123.						
139	4419	1.	0.	34.	27.	19x	14x	2.	32.	123.						
138	4622	1.	0.	34.	27.	19x	14x	2.	32.	122.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P16C Station 204 Latitude 25-30.2S Longitude 150-29.8W Date 8/20/91 Bottom Depth 2541

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	---TCO2---- Obs	S=35	-----pCO2---- @ 20	@ Theta	Total Alk. Calc	(PALK)s
						---	----	----	----	----uM/kg----	----	----	-----uAtm----		---uEq/kg---	
161	5	20.	20.	35.	25.	22x	-x	0.	0.	1.	2011	1977	290	293	2353	2314
102	46	19.	19.	35.	25.	22x	-x	0.	0.	1.						
103	77	19.	19.	35.	25.	22x	x	0.	0.	1.						
164	87	19.	19.	35.	25.	22x	x	0.	0.	1.						
105	97	19.	19.	35.	25.	22x	x	0.	0.	1.						
107	107	19.	19.	35.	25.	22x	x	0.	0.	1.						
106	107	19.	19.	35.	25.	22x	x	0.	0.	1.						
168	117	19.	19.	35.	25.	21x	1x	0.	0.	1.						
169	127	18.	18.	35.	25.	21x	1x	0.	0.	1.						
170	137	18.	18.	35.	25.	21x	1x	0.	0.	1.						
111	158	18.	18.	35.	25.	21x	2x	0.	1.	1.						
112	197	17.	17.	35.	25.	20x	3x	0.	2.	1.						
113	411	10.	10.	34.	26.	19x	7x	1.	15.	4.						
137	486	8.	8.	34.	26.	21x	7x	1.	18.	5.						
115	564	7.	7.	34.	26.	23x	6x	1.	21.	7.						
116	640	6.	6.	34.	26.	23x	6x	1.	23.	9.						
117	715	6.	6.	34.	27.	23x	7x	1.	24.	11.						
118	815	5.	5.	34.	27.	22x	8x	1.	27.	17.						
119	915	4.	4.	34.	27.	20x	10x	2.	29.	27.						
120	1017	4.	4.	34.	27.	18x	12x	2.	31.	39.						
121	1120	3.	3.	34.	27.	16x	15x	2.	34.	55.						
122	1221	3.	3.	34.	27.	16x	16x	2.	34.	67.						
123	1321	2.	2.	34.	27.	16x	16x	2.	34.	79.						
124	1423	2.	2.	34.	27.	15x	16x	2.	34.	88.						
125	1549	2.	2.	34.	27.	15x	17x	2.	35.	94.						
126	1674	2.	2.	34.	27.	15x	17x	2.	35.	101.						
127	1801	2.	2.	34.	27.	15x	17x	2.	35.	106.						
128	1928	2.	2.	34.	27.	15x	18x	2.	35.	111.						
130	2055	2.	1.	34.	27.	15x	18x	2.	35.	115.						
131	2184	2.	1.	34.	27.	15x	18x	2.	35.	119.						
132	2313	1.	1.	34.	27.	15x	18x	2.	35.	123.						
133	2438	1.	1.	34.	27.	15x	18x	2.	35.	125.						
134	2565	1.	1.	34.	27.	15x	18x	2.	35.	126.						
139	2690	1.	1.	34.	27.	15x	18x	2.	35.	125.						
138	2822	1.	1.	34.	27.	15x	17x	2.	35.	126.						

WOCE Line P16C Station 205 Latitude 25-00.0S Longitude 150-29.9W Date 8/20/91 Bottom Depth 4749

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	---TCO2---- Obs	S=35	-----pCO2---- @ 20	@ Theta	Total Alk. Calc	(PALK)s
						---	----	----	----	----uM/kg----	----	----	-----uAtm----		---uEq/kg---	
161	3	21.	21.	35.	24.	21x	-x	0.	0.	1.	2000	1961	271	294	2359	2313
102	34	21.	21.	35.	24.	21x	x	0.	0.	1.						
103	74	20.	20.	35.	25.	22x	x	0.	0.	1.						
164	115	20.	20.	35.	25.	22x	-x	0.	0.	1.						
105	155	20.	20.	35.	25.	22x	-x	0.	0.	1.						
106	179	19.	19.	35.	25.	22x	x	0.	0.	1.						
107	203	18.	18.	35.	25.	21x	1x	0.	0.	1.						
168	255	16.	16.	35.	25.	20x	3x	0.	3.	1.						
169	307	14.	14.	35.	26.	19x	5x	0.	7.	2.						
170	357	13.	13.	35.	26.	19x	6x	0.	10.	3.						
111	404	12.	11.	34.	26.	19x	6x	0.	12.	4.						
112	503	8.	8.	34.	26.	20x	8x	1.	20.	7.						
113	602	6.	6.	34.	26.	22x	7x	1.	23.	10.						
137	703	5.	5.	34.	27.	22x	7x	1.	25.	13.						
115	804	5.	5.	34.	27.	20x	10x	1.	28.	21.						
116	904	4.	4.	34.	27.	19x	12x	2.	31.	32.						
117	1003	4.	4.	34.	27.	17x	14x	2.	33.	45.						
118	1102	3.	3.	34.	27.	17x	15x	2.	34.	58.						
119	1254	3.	3.	34.	27.	16x	16x	2.	34.	71.						
120	1405	2.	2.	34.	27.	15x	16x	2.	34.	85.						
121	1605	2.	2.	34.	27.	15x	17x	2.	35.	101.						
122	1807	2.	2.	34.	27.	15x	18x	2.	35.	113.						
123	2009	2.	1.	34.	27.	15x	18x	2.	35.	121.						
124	2214	1.	1.	34.	27.	15x	18x	2.	35.	127.						
125	2427	1.	1.	34.	27.			2.	35.	129.						
126	2633	1.	1.	34.	27.	15x	18x	2.	35.	129.						
127	2832	1.	1.	34.	27.	16x	17x	2.	35.	130.						
128	3019	1.	1.	34.	27.	16x	17x	2.	35.	131.						
130	3265	1.	1.	34.	27.	16x	17x	2.	34.	128.						
131	3514	1.	1.	34.	27.	17x	16x	2.	33.	127.						
132	3756	1.	1.	34.	27.	17x	16x	2.	33.	126.						
133	3964	1.	1.	34.	27.	18x	15x	2.	33.	126.						
134	4224	1.	1.	34.	27.	18x	15x	2.	33.	126.						
139	4496	1.	0.	34.	27.	19x	15x	2.	33.	124.						
138	4714	1.	0.	34.	27.	19x	15x	2.	32.	123.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P16C Station 206 Latitude 24-30.1S Longitude 150-29.9W Date 8/21/91 Bottom Depth 4900

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	3	21.	21.	35.	24.	22x	-x	0.	0.	1.	2000	1962	273	295	2357	2313
102	33	20.	20.	35.	25.	22x	-x	0.	0.	1.	2004	1970	283	293	2351	2311
103	73	20.	20.	35.	25.	22x	-x	0.	0.	1.	2004	1971	287	294	2348	2308
164	123	20.	20.	35.	25.	22x	-x	0.	0.	1.	2010	1977	289	295	2353	2314
105	179	20.	20.	35.	25.	22x	x	0.	0.	1.	2008	1976	297	301	2343	2305
106	214	19.	19.	35.	25.	20x	2x	0.	1.	1.	2041	2008	341	331	2346	2310
107	254	18.	18.	35.	25.	19x	3x	0.	2.	1.	2058	2028	376	347	2343	2311
168	285	17.	17.	35.	25.	20x	3x	0.	2.	1.	2063	2037	392	345	2339	2311
169	324	15.	15.	35.	26.	19x	5x	0.	6.	2.	2084	2066	450	367	2330	2316
170	374	13.	13.	35.	26.	19x	6x	0.	10.	3.	2101	2099	524	392	2316	2324
111	427	11.	11.	34.	26.	19x	7x	1.	15.	4.	2119	2134	613	419	2304	2335
112	479	9.	9.	34.	26.	20x	7x	1.	18.	6.	2130	2156	680	432	2296	2343
113	549	7.	7.	34.	26.	21x	7x	1.	21.	8.	2134	2170	730	431	2288	2348
137	630	6.	6.	34.	26.	23x	6x	1.	23.	10.	2140	2180	754	426	2289	2356
115	710	5.	5.	34.	27.	22x	7x	1.	25.	13.	2147	2190	798	438	2287	2359
116	810	5.	5.	34.	27.	21x	10x	1.	28.	22.	2169	2213	887	472	2295	2370
117	909	4.	4.	34.	27.	19x	12x	2.	31.	34.	2192	2234	976	507	2305	2381
118	1009	4.	3.	34.	27.	17x	14x	2.	33.	49.	2219	2258	1082	549	2319	2394
119	1112	3.	3.	34.	27.	16x	15x	2.	33.	60.	2233	2270	1110	554	2331	2404
120	1264	3.	2.	34.	27.	15x	16x	2.	34.	79.	2257	2289	1151	560	2352	2421
121	1408	2.	2.	34.	27.	15x	17x	2.	34.	89.	2271	2301	1160	557	2366	2433
122	1610	2.	2.	34.	27.	15x	17x	2.	35.	105.	2281	2308				
123	1817	2.	2.	34.	27.	15x	18x	2.	35.	114.	2294	2319	1170	549	2391	2454
124	2009	2.	1.	34.	27.	15x	18x	2.	35.	121.	2300	2324	1186	552	2396	2457
125	2204	1.	1.	34.	27.	15x	18x	2.	35.	124.	2303	2327	1169	542	2402	2462
126	2400	1.	1.	34.	27.	15x	18x	2.	35.	127.	2304	2327	1172	541	2402	2462
127	2647	1.	1.	34.	27.	15x	17x	2.	35.	129.	2303	2326	1148	527	2405	2464
128	2900	1.	1.	34.	27.	16x	17x	2.	34.	128.	2298	2320	1136	519	2401	2459
129	3151	1.	1.	34.	27.											
130	3404	1.	1.	34.	27.	17x	16x	2.	34.	126.	2293	2314	1102	499	2400	2457
131	3665	1.	1.	34.	27.	17x	16x	2.	33.	127.	2292	2313	1103	498	2399	2455
132	3925	1.	1.	34.	27.	18x	16x	2.	33.	127.	2284	2304	1086	489	2393	2448
133	4178	1.	1.	34.	27.	18x	15x	2.	33.	125.	2282	2301	1073	481	2392	2446
134	4429	1.	0.	34.	27.	18x	15x	2.	33.	123.	2278	2297	1073	480	2388	2442
139	4690	1.	0.	34.	27.	19x	15x	2.	32.	124.	2280	2300	1064	476	2392	2446
138	4894	1.	0.	34.	27.	19x	15x	2.	32.	124.	2273	2293	1059	473	2385	2438

WOCE Line P16C Station 207 Latitude 24-00.0S Longitude 150-30.0W Date 8/21/91 Bottom Depth 4910

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	2	21.	21.	35.	24.	21x	-x	0.	0.	1.	2000	1960	275	299	2355	2308
102	39	21.	21.	35.	24.	21x	-x	0.	0.	1.						
103	75	21.	21.	35.	24.	21x	-x	0.	0.	1.						
164	109	21.	21.	35.	24.	22x	-x	0.	0.	1.						
105	145	20.	20.	35.	25.	22x	x	0.	0.	1.						
106	185	19.	19.	35.	25.	22x	x	0.	0.	1.						
107	215	19.	19.	35.	25.	20x	2x	0.	1.	1.						
168	239	19.	18.	35.	25.	19x	3x	0.	2.	1.						
169	277	17.	17.	35.	25.	18x	4x	0.	4.	1.						
170	327	15.	15.	35.	26.	19x	5x	0.	6.	2.						
111	398	12.	12.	34.	26.	19x	6x	0.	11.	3.						
112	489	9.	9.	34.	26.	20x	7x	1.	18.	6.						
113	581	7.	7.	34.	26.	22x	7x	1.	22.	8.						
137	668	6.	6.	34.	26.	22x	7x	1.	23.	10.						
115	766	5.	5.	34.	27.	22x	8x	1.	26.	15.						
116	855	5.	5.	34.	27.	20x	10x	2.	29.	24.						
117	952	4.	4.	34.	27.	18x	13x	2.	32.	38.						
118	1052	3.	3.	34.	27.	17x	14x	2.	33.	52.						
119	1199	3.	3.	34.	27.	16x	16x	2.	34.	66.						
120	1398	2.	2.	34.	27.	15x	17x	2.	34.	88.						
121	1596	2.	2.	34.	27.	15x	17x	2.	35.	103.						
122	1791	2.	2.	34.	27.	15x	18x	2.	35.	113.						
123	1986	2.	1.	34.	27.	15x	18x	2.	35.	118.						
124	2189	2.	1.	34.	27.	15x	18x	2.	35.	122.						
125	2389	1.	1.	34.	27.	15x	18x	2.	35.	126.						
126	2592	1.	1.	34.	27.	15x	18x	2.	35.	130.						
127	2794	1.	1.	34.	27.	15x	18x	2.	35.	131.						
128	2990	1.	1.	34.	27.	15x	17x	2.	35.	130.						
129	3191	1.	1.	34.	27.	16x	17x	2.	34.	130.						
130	3393	1.	1.	34.	27.	16x	17x	2.	34.	130.						
131	3644	1.	1.	34.	27.	17x	16x	2.	34.	128.						
132	3898	1.	1.	34.	27.	18x	15x	2.	33.	125.						
133	4147	1.	1.	34.	27.	18x	15x	2.	32.	123.						
134	4402	1.	0.	34.	27.	19x	15x	2.	32.	123.						
139	4652	1.	0.	34.	27.	19x	15x	2.	32.	123.						
138	4899	1.	0.	34.	27.	19x	15x	2.	32.	122.						

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Project/Expedition is TUNES/2 WOCE P17C/P16C 1991
(TCO2)s=35 = TCO2 obs X (35 / Sal)   (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P16C   Station 208   Latitude 23-30.3S Longitude 150-30.0W Date 8/21/91   Bottom Depth 4439

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs	TCO2 S=35	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	2	22.	22.	35.	24.	21x	-x	0.	0.	1.	2002	1962	269	295	2363	2316
102	42	21.	21.	35.	24.	21x	-x	0.	0.	1.						
103	82	21.	21.	35.	24.	21x	x	0.	0.	1.						
164	122	21.	21.	35.	24.	21x	x	0.	0.	1.						
105	163	20.	20.	35.	25.	19x	2x	0.	1.	1.						
106	213	19.	19.	35.	25.	19x	3x	0.	2.	1.						
107	263	18.	17.	35.	25.	19x	4x	0.	3.	1.						
168	314	16.	16.	35.	25.	19x	5x	0.	5.	1.						
169	364	14.	14.	35.	26.	19x	5x	0.	8.	2.						
170	424	12.	12.	34.	26.	19x	7x	0.	12.	3.						
111	486	9.	9.	34.	26.	20x	7x	1.	17.	5.						
112	557	8.	8.	34.	26.	21x	7x	1.	20.	7.						
113	628	7.	6.	34.	26.	22x	7x	1.	22.	9.						
137	697	6.	6.	34.	27.	22x	7x	1.	24.	11.						
115	767	5.	5.	34.	27.	21x	8x	1.	26.	16.						
116	847	5.	5.	34.	27.	19x	11x	2.	29.	25.						
117	929	4.	4.	34.	27.	18x	13x	2.	31.	37.						
118	1010	4.	4.	34.	27.	16x	14x	2.	33.	49.						
119	1113	3.	3.	34.	27.	16x	16x	2.	34.	65.						
120	1317	3.	2.	34.	27.	15x	16x	2.	34.	82.						
121	1520	2.	2.	34.	27.	15x	17x	2.	34.	97.						
122	1521	2.	2.	34.	27.	15x	17x	2.	34.	97.						
123	1722	2.	2.	34.	27.	15x	18x	2.	35.	108.						
124	1923	2.	2.	34.	27.	15x	18x	2.	35.	116.						
125	2125	2.	1.	34.	27.	15x	18x	2.	35.	121.						
126	2328	1.	1.	34.	27.	15x	18x	2.	35.	124.						
127	2534	1.	1.	34.	27.	15x	18x	2.	35.	127.						
128	2739	1.	1.	34.	27.	15x	18x	2.	35.	131.						
129	2943	1.	1.	34.	27.	16x	17x	2.	35.	132.						
130	3148	1.	1.	34.	27.	16x	17x	2.	34.	132.						
131	3352	1.	1.	34.	27.	17x	16x	2.	34.	129.						
132	3555	1.	1.	34.	27.	17x	16x	2.	34.	128.						
133	3759	1.	1.	34.	27.	18x	16x	2.	33.	126.						
134	3987	1.	1.	34.	27.	18x	15x	2.	33.	125.						
139	4215	1.	1.	34.	27.	18x	15x	2.	33.	124.						
138	4413	1.	0.	34.	27.	19x	15x	2.	32.	123.						

WOCE Line P16C   Station 209   Latitude 23-00.0S Longitude 150-30.0W Date 8/21/91   Bottom Depth 4843

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs	TCO2 S=35	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	2	23.	23.	35.	24.	21x	-x	0.	0.	1.	2009	1959	265	303	2377	2319
102	33	22.	22.	35.	24.	21x	-x	0.	0.	1.						
103	73	22.	22.	35.	24.	21x	x	0.	0.	1.						
164	103	21.	21.	35.	24.	21x	x	0.	0.	1.						
105	143	20.	20.	35.	25.	20x	1x	0.	0.	1.						
106	184	20.	20.	35.	25.	19x	2x	0.	1.	1.						
107	223	18.	18.	35.	25.	19x	3x	0.	2.	1.						
168	264	17.	17.	35.	25.	19x	4x	0.	4.	1.						
169	306	15.	15.	35.	26.	19x	5x	0.	6.	1.						
170	357	14.	14.	35.	26.	19x	6x	0.	8.	2.						
111	402	12.	12.	34.	26.	19x	7x	0.	11.	3.						
112	474	9.	9.	34.	26.	20x	7x	1.	18.	6.						
113	549	7.	7.	34.	26.	21x	7x	1.	22.	8.						
137	648	6.	6.	34.	27.	21x	8x	1.	25.	12.						
115	746	5.	5.	34.	27.	21x	9x	1.	27.	18.						
116	844	5.	4.	34.	27.	19x	11x	2.	29.	25.						
117	942	4.	4.	34.	27.	17x	13x	2.	32.	40.						
118	1039	3.	3.	34.	27.	16x	15x	2.	34.	57.						
119	1136	3.	3.	34.	27.	15x	16x	2.	35.	68.						
120	1280	3.	2.	34.	27.	15x	17x	2.	35.	84.						
121	1479	2.	2.	34.	27.	15x	17x	2.	35.	97.						
122	1678	2.	2.	34.	27.	15x	18x	2.	35.	109.						
123	1878	2.	2.	34.	27.	15x	18x	2.	35.	118.						
124	2079	2.	1.	34.	27.	15x	18x	2.	35.	123.						
125	2281	1.	1.	34.	27.	15x	18x	2.	35.	125.						
126	2485	1.	1.	34.	27.	15x	18x	2.	35.	126.						
127	2739	1.	1.	34.	27.	16x	17x	2.	34.	128.						
128	2996	1.	1.	34.	27.	16x	17x	2.	34.	129.						
129	3251	1.	1.	34.	27.	17x	16x	2.	34.	127.						
130	3509	1.	1.	34.	27.	17x	16x	2.	33.	126.						
131	3766	1.	1.	34.	27.	18x	16x	2.	33.	124.						
132	4023	1.	1.	34.	27.	18x	15x	2.	33.	124.						
133	4233	1.	1.	34.	27.	18x	15x	2.	33.	124.						
134	4438	1.	1.	34.	27.	18x	15x	2.	33.	124.						
139	4642	1.	0.	34.	27.	19x	15x	2.	33.	124.						
138	4875	1.	0.	34.	27.	19x	15x	2.	33.	124.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal)   (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P16C Station 210 Latitude 22-30.1S Longitude 150-30.1W Date 8/22/91 Bottom Depth 4578

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
261	1	23.	23.	35.	24.	21x	-x	0.	0.	1.	2004	1952	259	301	2378	2317
202	36	23.	23.	35.	24.	21x	-x	0.	0.	1.	2005	1956	262	302	2376	2318
203	72	23.	23.	35.	24.	21x	-x	0.	0.	1.	2005	1956	265	301	2373	2315
264	102	22.	22.	35.	24.	21x	-x	0.	0.	1.	2006	1962	265	294	2374	2321
205	125	21.	21.	35.	24.	21x	x	0.	0.	1.	2005	1965	279	303	2356	2310
206	160	20.	20.	35.	25.											
207	201	19.	19.	35.	25.	19x	3x	0.	2.	1.	2051	2018	358	347	2347	2311
268	253	17.	17.	35.	25.	19x	4x	0.	3.	1.	2062	2035	387	353	2340	2312
269	303	15.	15.	35.	26.	19x	5x	0.	6.	2.	2078	2061	437	366	2330	2316
270	365	13.	13.	34.	26.	19x	6x	0.	10.	3.	2099	2100	528	395	2312	2323
211	435	10.	10.	34.	26.	19x	7x	1.	15.	5.	2115	2133	622	416	2297	2332
212	503	8.	8.	34.	26.	21x	7x	1.	20.	7.	2134	2166	716	431	2291	2347
213	565	6.	6.	34.	26.	21x	7x	1.	23.	9.	2142	2181	767	440	2289	2354
237	639	6.	6.	34.	27.	22x	7x	1.	25.	12.	2148	2190	793	439	2289	2360
215	726	5.	5.	34.	27.	21x	9x	1.	27.	18.	2165	2208	867	469	2293	2367
216	818	4.	4.	34.	27.	19x	11x	2.	30.	28.	2187	2230	962	507	2301	2377
217	905	4.	4.	34.	27.	17x	14x	2.	32.	40.	2206	2247	1053	546	2309	2385
218	1007	4.	4.	34.	27.	16x	15x	2.	34.	54.	2230	2267	1121	570	2326	2400
219	1125	3.	3.	34.	27.	15x	16x	2.	34.	67.	2246	2281	1173	584	2337	2409
220	1255	3.	3.	34.	27.	15x	17x	2.	35.	81.	2259	2291	1169	571	2353	2421
221	1403	2.	2.	34.	27.	15x	17x	2.	35.	94.	2268	2298	1170	563	2362	2429
222	1554	2.	2.	34.	27.	15x	17x	2.	35.	104.	2279	2306	1174	557	2374	2438
223	1705	2.	2.	34.	27.	15x	18x	2.	35.	109.	2289	2315	1172	552	2386	2449
224	1857	2.	2.	34.	27.	15x	18x	2.	35.	114.	2297	2322	1187	556	2392	2454
225	2007	2.	1.	34.	27.	15x	18x	2.	35.	118.	2297	2321	1181	551	2393	2454
226	2210	2.	1.	34.	27.	15x	18x	2.	35.	123.	2302	2326	1167	542	2401	2462
227	2414	1.	1.	34.	27.	15x	18x	2.	35.	126.	2302	2325	1172	541	2400	2460
228	2614	1.	1.	34.	27.	15x	18x	2.	35.	126.	2303	2325	1148	528	2404	2463
229	2818	1.	1.	34.	27.	16x	17x	2.	34.	126.	2300	2323	1149	526	2401	2460
230	3022	1.	1.	34.	27.	16x	17x	2.	34.	128.	2297	2319	1129	515	2401	2459
231	3226	1.	1.	34.	27.	16x	17x	2.	34.	128.	2296	2317	1131	514	2399	2456
232	3483	1.	1.	34.	27.	17x	16x	2.	34.	126.	2288	2309	1104	500	2394	2451
233	3736	1.	1.	34.	27.	17x	16x	2.	33.	124.	2285	2306	1094	493	2393	2448
234	3991	1.	1.	34.	27.	18x	15x	2.	33.	124.	2277	2297	1089	489	2384	2439
239	4246	1.	1.	34.	27.	18x	15x	2.	33.	124.	2273	2293	1069	479	2384	2438
238	4454	1.	0.	34.	27.	18x	15x	2.	32.	123.	2275	2295	1076	482	2384	2438

WOCE Line P16C Station 211 Latitude 22-00.6S Longitude 150-29.7W Date 8/22/91 Bottom Depth 4788

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	14	24.	24.	35.	24.	21x	-x	0.	0.	1.	1992	1941	258	306	2365	2304
102	36	23.	23.	35.	24.			0.	0.	0.						
103	71	22.	22.	35.	24.	21x	x	0.	0.	0.						
164	107	21.	21.	35.	24.	21x	x	0.	0.	0.						
105	138	20.	20.	35.	25.	20x	1x	0.	0.	0.						
106	156	20.	20.	35.	25.	20x	2x	0.	0.	0.						
107	191	19.	19.	35.	25.	19x	3x	0.	1.	0.						
168	226	18.	18.	35.	25.	19x	3x	0.	2.	1.						
169	267	17.	17.	35.	25.	19x	4x	0.	4.	1.						
170	308	15.	15.	35.	26.	19x	5x	0.	6.	1.						
111	356	13.	13.	35.	26.	19x	6x	0.	9.	2.						
112	408	11.	11.	34.	26.	19x	7x	1.	13.	4.						
113	486	8.	8.	34.	26.	20x	8x	1.	19.	6.						
137	562	7.	7.	34.	26.	21x	7x	1.	22.	8.						
115	641	6.	6.	34.	27.	21x	8x	1.	25.	13.						
116	726	5.	5.	34.	27.	20x	9x	1.	28.	19.						
117	809	5.	5.	34.	27.	19x	11x	2.	30.	27.						
118	961	4.	4.	34.	27.	16x	15x	2.	33.	51.						
119	1111	3.	3.	34.	27.	15x	16x	2.	34.	66.						
120	1266	3.	2.	34.	27.	15x	17x	2.	35.	85.						
121	1419	2.	2.	34.	27.	15x	17x	2.	35.	96.						
122	1617	2.	2.	34.	27.	15x	18x	2.	35.	105.						
123	1821	2.	2.	34.	27.	15x	18x	2.	35.	112.						
124	2030	2.	1.	34.	27.	15x	18x	2.	35.	118.						
125	2287	1.	1.	34.	27.	15x	18x	2.	35.	124.						
126	2537	1.	1.	34.	27.	15x	18x	2.	35.	127.						
127	2791	1.	1.	34.	27.	15x	17x	2.	34.	127.						
128	3046	1.	1.	34.	27.	16x	17x	2.	34.	127.						
130	3303	1.	1.	34.	27.	16x	17x	2.	34.	127.						
131	3559	1.	1.	34.	27.	17x	16x	2.	34.	127.						
132	3812	1.	1.	34.	27.	17x	16x	2.	33.	124.						
133	4067	1.	1.	34.	27.	18x	15x	2.	33.	123.						
134	4321	1.	1.	34.	27.	18x	15x	2.	32.	122.						
139	4574	1.	0.	34.	27.	19x	15x	2.	32.	123.						
138	4770	1.	0.	34.	27.	19x	15x	2.	32.	123.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P16C Station 212 Latitude 21-29.9S Longitude 150-30.4W Date 8/23/91 Bottom Depth 4285

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	2	24.	24.	35.	24.	20x	-x	0.	0.	1.	1995	1942	255	309	2372	2309
162	31	24.	24.	35.	24.	20x	-x	0.	0.	1.						
103	62	24.	24.	35.	24.	20x	x	0.	0.	1.						
164	96	23.	23.	35.	24.	21x	-x	0.	0.	1.						
105	132	22.	22.	35.	24.	20x	x	0.	0.	1.						
106	152	21.	21.	35.	24.	19x	2x	0.	0.	1.						
107	183	20.	20.	35.	25.	20x	1x	0.	0.	1.						
168	213	19.	19.	35.	25.	20x	2x	0.	0.	1.						
169	253	18.	18.	35.	25.	18x	4x	0.	3.	1.						
170	304	16.	16.	35.	25.	19x	4x	0.	5.	1.						
111	355	14.	14.	35.	26.	19x	6x	0.	9.	2.						
112	405	12.	12.	34.	26.	19x	7x	0.	12.	4.						
113	481	9.	9.	34.	26.	20x	8x	1.	19.	6.						
137	558	7.	7.	34.	26.	21x	7x	1.	22.	8.						
115	629	6.	6.	34.	27.	22x	8x	1.	24.	11.						
116	684	5.	5.	34.	27.	21x	8x	1.	26.	15.						
117	758	5.	5.	34.	27.	20x	10x	1.	28.	20.						
118	857	4.	4.	34.	27.	18x	12x	2.	31.	30.						
119	957	4.	4.	34.	27.	16x	14x	2.	33.	45.						
120	1106	3.	3.	34.	27.	15x	16x	2.	34.	64.						
121	1258	3.	3.	34.	27.											
122	1410	2.	2.	34.	27.	15x	17x	2.	35.	94.						
123	1611	2.	2.	34.	27.	15x	18x	2.	35.	106.						
124	1813	2.	2.	34.	27.			2.	35.	114.						
125	2014	2.	1.	34.	27.	15x	18x	2.	35.	119.						
126	2216	1.	1.	34.	27.	15x	18x	2.	35.	122.						
127	2415	1.	1.	34.	27.	15x	18x	2.	35.	124.						
128	2613	1.	1.	34.	27.	15x	18x	2.	35.	125.						
129	2812	1.	1.	34.	27.	16x	17x	2.	34.	127.						
130	3013	1.	1.	34.	27.	16x	17x	2.	34.	127.						
131	3220	1.	1.	34.	27.	16x	17x	2.	34.	126.						
132	3429	1.	1.	34.	27.	17x	16x	2.	33.	126.						
133	3640	1.	1.	34.	27.	17x	16x	2.	33.	124.						
134	3840	1.	1.	34.	27.	18x	15x	2.	33.	124.						
139	4038	1.	1.	34.	27.											
138	4241	1.	1.	34.	27.	18x	15x	2.	33.	123.						

WOCE Line P16C Station 213 Latitude 21-00.0S Longitude 150-29.9W Date 8/23/91 Bottom Depth 4714

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	1	25.	25.	36.	24.	20x	-x	0.	0.	1.	1990	1932	250	311	2372	2303
162	32	25.	25.	36.	24.	20x	-x	0.	0.	1.	2018	1960	251	312	2406	2337
103	62	24.	24.	35.	24.	20x	-x	0.	0.	1.	1993	1939	251	307	2375	2311
164	96	24.	24.	35.	24.	20x	-x	0.	0.	2.	2000	1949	256	309	2376	2317
105	136	22.	22.	35.	24.	18x	2x	0.	0.	1.	2036	1989	308	345	2369	2315
106	176	21.	21.	35.	24.	20x	1x	0.	0.	1.	2028	1991	316	332	2350	2309
107	217	19.	19.	35.	25.	21x	1x	0.	0.	0.	2023	1993	312	310	2347	2312
168	258	19.	19.	35.	25.	20x	2x	0.	1.	0.	2045	2013	344	332	2349	2314
169	305	16.	16.	35.	25.	19x	4x	0.	5.	1.	2072	2051	415	360	2336	2316
170	356	13.	13.	34.	26.	18x	6x	0.	10.	3.	2099	2100	522	397	2315	2325
111	407	11.	11.	34.	26.	18x	8x	1.	15.	6.	2121	2137	631	437	2300	2334
112	465	9.	9.	34.	26.	17x	10x	1.	21.	9.	2144	2172	769	487	2290	2341
113	527	7.	7.	34.	26.	17x	11x	1.	25.	13.	2166	2201	862	512	2295	2358
137	588	6.	6.	34.	26.	18x	11x	1.	27.	16.	2167	2205	897	515	2290	2358
115	647	6.	6.	34.	27.	17x	13x	2.	29.	24.	2192	2231	978	546	2305	2375
116	725	5.	5.	34.	27.	16x	14x	2.	30.	30.	2201	2239	1021	558	2307	2379
117	806	5.	5.	34.	27.	16x	14x	2.	32.	38.	2211	2249	1077	575	2311	2383
118	908	4.	4.	34.	27.	16x	15x	2.	33.	46.	2223	2261	1097	570	2321	2395
119	1011	4.	3.	34.	27.	15x	16x	2.	34.	61.	2242	2277	1157	587	2334	2405
120	1164	3.	3.	34.	27.	15x	17x	2.	34.	74.	2257	2290	1170	579	2349	2419
121	1319	3.	2.	34.	27.	15x	17x	2.	35.	87.	2271	2302	1169	567	2366	2433
122	1522	2.	2.	34.	27.	15x	17x	2.	35.	102.	2285	2313	1170	557	2381	2446
123	1722	2.	2.	34.	27.	15x	18x	2.	35.	111.	2294	2320	1180	556	2390	2453
124	1920	2.	2.	34.	27.	15x	18x	2.	35.	115.	2300	2325	1171	549	2398	2460
125	2118	2.	1.	34.	27.	15x	18x	2.	35.	120.	2303	2327	1180	549	2400	2461
126	2319	1.	1.	34.	27.	15x	18x	2.	35.	124.	2307	2330	1166	540	2406	2466
127	2525	1.	1.	34.	27.	15x	18x	2.	35.	127.	2310	2333	1165	536	2410	2469
128	2723	1.	1.	34.	27.	15x	18x	2.	35.	128.	2308	2330	1164	534	2408	2467
129	2971	1.	1.	34.	27.	16x	17x	2.	34.	128.	2304	2326	1140	521	2407	2465
130	3221	1.	1.	34.	27.	16x	17x	2.	34.	126.	2297	2319	1125	511	2402	2459
131	3486	1.	1.	34.	27.	17x	16x	2.	33.	125.	2297	2317	1109	502	2403	2459
132	3735	1.	1.	34.	27.	17x	16x	2.	33.	125.	2291	2311	1097	495	2398	2454
133	3988	1.	1.	34.	27.	18x	15x	2.	33.	124.	2288	2308	1093	492	2396	2451
134	4251	1.	1.	34.	27.	18x	15x	2.	33.	123.	2284	2304	1072	481	2394	2449
139	4500	1.	1.	34.	27.	18x	15x	2.	32.	122.	2279	2299	1084	486	2388	2442
138	4741	1.	1.	34.	27.	18x	15x	2.	32.	122.	2278	2298	1066	478	2389	2443

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P16C Station 214 Latitude 20-29.8S Longitude 150-29.8W Date 8/23/91 Bottom Depth 4619

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs	TCO2 S=35	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	4	25.	25.	36.	24.	20x	-x	0.	0.	1.	2001	1944	256	317	2379	2312
162	49	24.	24.	35.	24.	20x	-x	0.	0.	0.						
103	95	24.	24.	35.	24.	20x	-x	0.	0.	0.						
164	140	23.	23.	35.	24.	20x	x	0.	0.	0.						
105	160	22.	22.	35.	24.	18x	2x	0.	0.	0.						
106	190	22.	22.	35.	24.	17x	3x	0.	2.	0.						
107	231	20.	20.	35.	25.	18x	4x	0.	2.	0.						
168	277	18.	18.	35.	25.	18x	4x	0.	3.	1.						
169	326	16.	16.	35.	25.	19x	5x	0.	5.	1.						
170	386	13.	13.	35.	26.	18x	6x	0.	10.	2.						
111	446	11.	11.	34.	26.	17x	9x	1.	16.	6.						
112	508	9.	8.	34.	26.	17x	10x	1.	22.	10.						
113	570	7.	7.	34.	26.	18x	11x	1.	25.	14.						
137	642	6.	6.	34.	27.	17x	12x	2.	28.	21.						
115	723	5.	5.	34.	27.	15x	14x	2.	31.	33.						
116	813	5.	5.	34.	27.	15x	15x	2.	32.	38.						
117	913	4.	4.	34.	27.	15x	16x	2.	34.	53.						
118	1014	4.	4.	34.	27.	15x	16x	2.	34.	61.						
119	1141	3.	3.	34.	27.	15x	17x	2.	34.	74.						
120	1268	3.	2.	34.	27.	15x	17x	2.	35.	85.						
121	1419	2.	2.	34.	27.	14x	17x	2.	35.	95.						
122	1569	2.	2.	34.	27.	14x	18x	2.	35.	104.						
123	1719	2.	2.	34.	27.	14x	18x	2.	35.	110.						
124	1924	2.	2.	34.	27.	15x	18x	2.	35.	115.						
125	2124	2.	1.	34.	27.	15x	18x	2.	35.	118.						
126	2325	1.	1.	34.	27.	15x	18x	2.	35.	122.						
127	2527	1.	1.	34.	27.	15x	18x	2.	35.	123.						
128	2719	1.	1.	34.	27.	15x	17x	2.	34.	126.						
129	2926	1.	1.	34.	27.	16x	17x	2.	34.	125.						
130	3126	1.	1.	34.	27.	16x	17x	2.	34.	125.						
131	3377	1.	1.	34.	27.	17x	16x	2.	34.	125.						
132	3627	1.	1.	34.	27.	17x	16x	2.	33.	126.						
133	3871	1.	1.	34.	27.	17x	16x	2.	33.	125.						
134	4135	1.	1.	34.	27.	18x	15x	2.	33.	123.						
139	4392	1.	1.	34.	27.	18x	15x	2.	33.	122.						
138	4614	1.	1.	34.	27.	18x	15x	2.	33.	122.						

WOCE Line P16C Station 215 Latitude 20-00.0S Longitude 150-29.9W Date 8/24/91 Bottom Depth 3777

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs	TCO2 S=35	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	1	25.	25.	36.	24.	20x	-x	0.	0.	1.	2005	1943	253	319	2388	2315
162	33	25.	25.	36.	24.	20x	-x	0.	0.	0.						
103	78	25.	25.	36.	24.	20x	-x	0.	0.	0.						
164	123	24.	24.	35.	24.	20x	x	0.	0.	0.						
105	153	23.	23.	35.	24.	18x	2x	0.	0.	0.						
106	176	22.	22.	35.	24.	17x	3x	0.	2.	0.						
107	200	21.	21.	35.	25.	17x	3x	0.	2.	0.						
168	222	20.	20.	35.	25.	17x	4x	0.	3.	0.						
169	246	19.	19.	35.	25.	17x	4x	0.	3.	0.						
170	294	18.	18.	35.	25.	17x	5x	0.	5.	1.						
111	349	15.	15.	35.	26.	17x	7x	0.	9.	2.						
112	402	12.	12.	34.	26.	17x	9x	1.	14.	5.						
113	454	10.	10.	34.	26.	17x	9x	1.	17.	6.						
137	503	9.	9.	34.	26.	18x	9x	1.	20.	8.						
115	548	7.	7.	34.	26.	19x	10x	1.	23.	10.						
116	650	6.	6.	34.	27.	17x	12x	2.	29.	21.						
117	753	5.	5.	34.	27.	16x	14x	2.	31.	33.						
118	854	4.	4.	34.	27.	15x	15x	2.	33.	46.						
119	954	4.	4.	34.	27.	15x	16x	2.	34.	56.						
120	1053	3.	3.	34.	27.	14x	16x	2.	34.	66.						
121	1205	3.	3.	34.	27.	15x	17x	2.	35.	80.						
122	1408	2.	2.	34.	27.	15x	17x	2.	35.	94.						
123	1604	2.	2.	34.	27.	14x	18x	2.	35.	104.						
124	1800	2.	2.	34.	27.	14x	18x	2.	35.	110.						
125	2001	2.	1.	34.	27.	15x	18x	2.	35.	118.						
126	2201	1.	1.	34.	27.	15x	18x	2.	35.	121.						
128	2400	1.	1.	34.	27.	15x	18x	2.	35.	122.						
127	2401	1.	1.	34.	27.	15x	17x	2.	35.	123.						
129	2595	1.	1.	34.	27.	15x	17x	2.	35.	126.						
130	2797	1.	1.	34.	27.	16x	17x	2.	34.	126.						
131	3001	1.	1.	34.	27.	16x	17x	2.	34.	125.						
132	3205	1.	1.	34.	27.	16x	17x	2.	34.	125.						
133	3205	1.	1.	34.	27.	16x	17x	2.	34.	125.						
134	3407	1.	1.	34.	27.	17x	16x	2.	34.	126.						
139	3572	1.	1.	34.	27.	17x	16x	2.	34.	125.						
138	3720	1.	1.	34.	27.	17x	16x	2.	33.	125.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal) (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P16C Station 216 Latitude 19-30.0S Longitude 150-29.9W Date 8/24/91 Bottom Depth 4264

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	---TCO2---- Obs	S=35	-----pCO2---- @ 20	@ Theta	Total Alk. Calc	(PALK)s
						---uM/kg---							-----uAtm----		---uEq/kg---	
161	3	25.	25.	36.	23.	20x	-x	0.	0.	1.	2000	1940	249	317	2386	2315
162	32	25.	25.	36.	23.	20x	-x	0.	0.	1.	2001	1941	252	321	2384	2313
103	62	25.	25.	36.	23.	20x	-x	0.	0.	1.	2004	1944	248	314	2392	2320
164	102	25.	25.	36.	24.	20x	x	0.	0.	1.	2007	1946	255	322	2388	2315
105	136	23.	23.	36.	24.	18x	2x	0.	1.	1.	2057	1992	311	367	2395	2321
106	150	23.	23.	36.	24.	17x	3x	0.	1.	1.	2062	1997	323	373	2391	2317
107	189	22.	22.	36.	25.	17x	4x	0.	3.	0.	2072	2011	345	376	2385	2319
168	242	20.	20.	35.	25.	17x	4x	0.	3.	0.	2078	2029	374	381	2370	2318
169	304	17.	17.	35.	25.	17x	5x	0.	6.	1.	2085	2059	426	388	2346	2322
170	361	14.	14.	35.	26.	17x	7x	0.	10.	4.	2104	2099	523	416	2320	2326
111	433	10.	10.	34.	26.	17x	9x	1.	17.	7.	2134	2154	689	464	2299	2338
112	507	8.	8.	34.	26.	18x	10x	1.	23.	11.	2153	2187	814	491	2291	2351
113	568	6.	6.	34.	26.	19x	10x	1.	25.	12.						
137	629	6.	6.	34.	27.	21x	9x	1.	26.	13.	2155	2197	841	468	2288	2358
115	712	5.	5.	34.	27.	19x	10x	2.	28.	20.						
116	813	5.	5.	34.	27.	18x	12x	2.	30.	27.	2188	2229	958	508	2303	2378
117	915	4.	4.	34.	27.	15x	15x	2.	33.	47.						
118	1016	4.	4.	34.	27.	15x	16x	2.	34.	60.	2243	2278	1135	579	2339	2410
119	1168	3.	3.	34.	27.	15x	17x	2.	35.	77.						
120	1321	2.	2.	34.	27.	15x	17x	2.	35.	89.	2274	2303	1173	568	2368	2434
121	1523	2.	2.	34.	27.	15x	18x	2.	35.	101.						
122	1726	2.	2.	34.	27.	14x	18x	2.	35.	112.	2296	2322	1186	559	2391	2454
123	1929	2.	2.	34.	27.	14x	18x	2.	35.	117.						
124	2131	2.	1.	34.	27.	15x	18x	2.	35.	121.	2302	2326	1168	543	2401	2461
125	2335	1.	1.	34.	27.	15x	18x	2.	35.	122.						
126	2538	1.	1.	34.	27.	15x	17x	2.	35.	124.	2301	2324	1156	532	2401	2461
127	2739	1.	1.	34.	27.	16x	17x	2.	35.	125.						
128	2939	1.	1.	34.	27.	16x	17x	2.	34.	125.	2301	2323	1145	523	2403	2461
129	3139	1.	1.	34.	27.	16x	17x	2.	34.	125.						
130	3344	1.	1.	34.	27.	17x	16x	2.	34.	126.	2295	2317	1114	506	2401	2458
131	3547	1.	1.	34.	27.	17x	16x	2.	34.	125.						
132	3749	1.	1.	34.	27.	17x	16x	2.	33.	125.	2291	2311	1109	501	2397	2453
133	3749	1.	1.	34.	27.	17x	16x	2.	33.	125.						
134	3951	1.	1.	34.	27.	17x	16x	2.	33.	125.	2289	2310	1109	500	2395	2450
139	4106	1.	1.	34.	27.	18x	15x	2.	33.	124.						
138	4276	1.	1.	34.	27.	18x	15x	2.	33.	124.	2288	2309	1069	481	2400	2455

WOCE Line P16C Station 217 Latitude 19-00.0S Longitude 150-30.0W Date 8/24/91 Bottom Depth 3356

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy	AOU	PO4	NO3	SiO3	---TCO2---- Obs	S=35	-----pCO2---- @ 20	@ Theta	Total Alk. Calc	(PALK)s
						---uM/kg---							-----uAtm----		---uEq/kg---	
161	0	25.	25.	36.	24.	20x	-x	0.	0.	1.	2004	1943	253	320	2387	2314
162	46	25.	25.	36.	24.	20x	-x	0.	0.	1.						
103	91	25.	25.	36.	24.	20x	x	0.	0.	1.						
164	142	24.	24.	36.	24.	18x	1x	0.	0.	1.						
105	191	22.	22.	36.	24.	17x	3x	0.	2.	1.						
106	241	20.	19.	35.	25.	17x	4x	0.	4.	1.						
107	302	16.	16.	35.	25.	17x	6x	0.	7.	1.						
168	362	14.	14.	35.	26.	17x	7x	0.	10.	3.						
169	434	10.	10.	34.	26.			1.	17.	7.						
170	505	8.	8.	34.	26.	17x	11x	1.	22.	10.						
111	577	7.	7.	34.	26.	18x	11x	1.	26.	13.						
112	648	6.	6.	34.	27.	18x	11x	1.	27.	17.						
113	690	5.	5.	34.	27.	18x	11x	2.	29.	20.						
137	751	5.	5.	34.	27.	16x	13x	2.	31.	31.						
115	812	5.	5.	34.	27.	15x	15x	2.	32.	41.						
116	881	4.	4.	34.	27.	15x	16x	2.	33.	51.						
117	961	4.	4.	34.	27.	15x	16x	2.	34.	59.						
118	1057	3.	3.	34.	27.	15x	16x	2.	34.	67.						
119	1152	3.	3.	34.	27.	15x	17x	2.	35.	76.						
120	1250	3.	3.	34.	27.	15x	17x	2.	35.	83.						
121	1354	2.	2.	34.	27.	15x	17x	2.	35.	92.						
122	1508	2.	2.	34.	27.	14x	17x	2.	35.	100.						
123	1662	2.	2.	34.	27.	14x	18x	2.	35.	108.						
124	1817	2.	2.	34.	27.	14x	18x	2.	35.	113.						
125	1969	2.	2.	34.	27.	15x	18x	2.	35.	117.						
126	2122	2.	1.	34.	27.	15x	18x	2.	35.	119.						
127	2331	1.	1.	34.	27.	15x	18x	2.	35.	122.						
128	2539	1.	1.	34.	27.	15x	17x	2.	35.	125.						
129	2743	1.	1.	34.	27.	16x	17x	2.	35.	126.						
130	2948	1.	1.	34.	27.	16x	17x	2.	34.	126.						
131	3150	1.	1.	34.	27.	16x	17x	2.	34.	126.						
132	3402	1.	1.	34.	27.	17x	16x	2.	34.	126.						
133	3655	1.	1.	34.	27.	17x	16x	2.	34.	125.						
134	3910	1.	1.	34.	27.	17x	16x	2.	33.	125.						
139	4166	1.	1.	34.	27.	18x	16x	2.	33.	125.						
138	4408	1.	1.	34.	27.	18x	16x	2.	33.	125.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal)   (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P16C   Station 218   Latitude 18-30.5S   Longitude 150-29.8W   Date 8/24/91   Bottom Depth 4201

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy uM/kg	AOU uM/kg	PO4 uM/kg	NO3 uM/kg	SiO3 uM/kg	TCO2 Obs uM/kg	TCO2 S=35 uM/kg	pCO2 @ 20 uAtm	pCO2 @ Theta uAtm	Total Alk. Calc uEq/kg	Total Alk. (PALK)s uEq/kg
161	1	25.	25.	36.	24.	20x	-x	0.	0.	1.	2007	1944	251	316	2394	2319
162	46	25.	25.	36.	24.	20x	-x	0.	0.	1.						
103	96	25.	25.	36.	24.	20x	x	0.	0.	1.						
164	151	23.	23.	36.	24.	18x	2x	0.	0.	1.						
105	201	22.	22.	35.	24.	17x	3x	0.	2.	1.						
106	252	19.	19.	35.	25.	18x	4x	0.	3.	1.						
107	303	17.	17.	35.	25.	17x	6x	0.	6.	2.						
168	364	13.	13.	34.	26.	16x	9x	1.	14.	6.						
169	424	10.	10.	34.	26.	15x	11x	1.	19.	9.						
170	485	8.	8.	34.	26.	16x	12x	1.	23.	12.						
111	546	7.	7.	34.	26.	17x	11x	1.	26.	14.						
112	607	6.	6.	34.	27.	18x	11x	1.	28.	18.						
113	667	5.	5.	34.	27.	18x	12x	2.	29.	23.						
137	737	5.	5.	34.	27.	15x	14x	2.	32.	38.						
115	808	4.	4.	34.	27.	15x	15x	2.	33.	48.						
116	890	4.	4.	34.	27.	15x	16x	2.	34.	55.						
117	971	4.	4.	34.	27.	14x	16x	2.	34.	60.						
118	1062	3.	3.	34.	27.	15x	16x	2.	35.	69.						
119	1163	3.	3.	34.	27.	15x	17x	2.	35.	81.						
120	1264	3.	2.	34.	27.	14x	17x	2.	35.	89.						
121	1365	2.	2.	34.	27.	14x	17x	2.	35.	95.						
122	1467	2.	2.	34.	27.	14x	18x	2.	35.	100.						
123	1617	2.	2.	34.	27.	14x	18x	2.	35.	105.						
124	1769	2.	2.	34.	27.	14x	18x	2.	35.	111.						
125	1923	2.	2.	34.	27.	15x	18x	2.	35.	116.						
126	2076	2.	1.	34.	27.	15x	18x	2.	35.	118.						
127	2229	1.	1.	34.	27.	15x	18x	2.	35.	120.						
128	2428	1.	1.	34.	27.	15x	17x	2.	35.	123.						
129	2631	1.	1.	34.	27.	16x	17x	2.	35.	125.						
130	2833	1.	1.	34.	27.	16x	17x	2.	35.	128.						
131	3037	1.	1.	34.	27.	16x	17x	2.	35.	127.						
132	3239	1.	1.	34.	27.	17x	16x	2.	34.	127.						
133	3439	1.	1.	34.	27.	17x	16x	2.	34.	127.						
134	3690	1.	1.	34.	27.	17x	16x	2.	34.	127.						
139	3942	1.	1.	34.	27.	17x	16x	2.	34.	127.						
138	4185	1.	1.	34.	27.	17x	16x	2.	34.	126.						

WOCE Line P16C   Station 219   Latitude 18-00.1S   Longitude 150-29.9W   Date 8/25/91   Bottom Depth 3659

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy uM/kg	AOU uM/kg	PO4 uM/kg	NO3 uM/kg	SiO3 uM/kg	TCO2 Obs uM/kg	TCO2 S=35 uM/kg	pCO2 @ 20 uAtm	pCO2 @ Theta uAtm	Total Alk. Calc uEq/kg	Total Alk. (PALK)s uEq/kg
161	0	26.	26.	36.	23.	20x	-x	0.	0.	1.	1999	1938	247	321	2388	2315
162	32	26.	26.	36.	23.	20x	-x	0.	0.	1.						
103	67	25.	25.	35.	24.	20x	-x	0.	0.	0.						
164	102	24.	24.	35.	24.	20x	x	0.	0.	0.						
105	132	24.	23.	35.	24.	19x	1x	0.	0.	0.						
106	162	22.	22.	35.	24.	18x	3x	0.	1.	0.						
107	192	21.	21.	35.	24.	17x	4x	0.	2.	0.						
168	232	20.	20.	35.	25.	17x	4x	0.	4.	1.						
169	278	17.	17.	35.	25.	17x	6x	0.	6.	1.						
170	328	15.	15.	35.	25.	16x	7x	0.	9.	3.						
111	378	13.	13.	34.	26.	16x	9x	1.	14.	5.						
112	428	11.	11.	34.	26.	16x	10x	1.	18.	8.						
113	489	9.	9.	34.	26.	16x	11x	1.	22.	11.						
137	542	7.	7.	34.	26.	17x	11x	1.	25.	14.						
115	601	7.	7.	34.	26.	16x	13x	2.	28.	19.						
116	681	5.	5.	34.	27.	16x	13x	2.	30.	25.						
117	757	5.	5.	34.	27.	15x	14x	2.	32.	37.						
118	844	4.	4.	34.	27.	15x	15x	2.	33.	47.						
119	948	4.	4.	34.	27.	15x	16x									
120	1048	3.	3.	34.	27.	15x	17x	2.	35.	70.						
121	1148	3.	3.	34.	27.	15x	17x	2.	35.	80.						
122	1301	2.	2.	34.	27.	14x	17x	2.	35.	91.						
123	1499	2.	2.	34.	27.	14x	18x	2.	36.	104.						
124	1695	2.	2.	34.	27.	14x	18x	2.	36.	111.						
125	1895	2.	2.	34.	27.	15x	18x	2.	35.	116.						
126	2095	2.	1.	34.	27.	15x	18x	2.	35.	119.						
127	2293	1.	1.	34.	27.	15x	17x	2.	35.	122.						
128	2293	1.	1.	34.	27.	15x	17x	2.	35.	122.						
129	2477	1.	1.	34.	27.	15x	17x	2.	35.	123.						
130	2676	1.	1.	34.	27.	16x	17x	2.	35.	124.						
131	2879	1.	1.	34.	27.	16x	17x	2.	35.	125.						
133	3088	1.	1.	34.	27.	16x	16x	2.	34.	127.						
132	3088	1.	1.	34.	27.	16x	16x	2.	34.	127.						
134	3236	1.	1.	34.	27.	17x	16x	2.	34.	127.						
139	3236	1.	1.	34.	27.	17x	16x	2.	34.	126.						
138	3386	1.	1.	34.	27.	17x	16x	2.	34.	126.						

Project/Expedition is TUNES/2 WOCE P17C/P16C 1991

(TCO2)s=35 = TCO2 obs X (35 / Sal)   (PALK)s = Potential Alkalinity = (TALK + NO3) X (35 / Sal)

WOCE Line P16C Station 220 Latitude 17-30.1S Longitude 150-29.9W Date 8/25/91 Bottom Depth 3604

Bot No.	Depth m	Temp deg C	Pot Temp deg C	Salinity o/oo	Sigma Theta	Oxy (uM/kg)	AOU (uM/kg)	PO4 (uM/kg)	NO3 (uM/kg)	SiO3 (uM/kg)	TCO2 Obs (uM/kg)	TCO2 S=35 (uM/kg)	pCO2 @ 20 (uAtm)	pCO2 @ Theta (uAtm)	Total Alk. Calc (uEq/kg)	Total Alk. (PALK)s (uEq/kg)
161	1	26.	26.	36.	23.	20x	-x	0.	0.	1.	2000	1938	245	322	2391	2317
162	31	26.	26.	36.	23.	20x	-x	0.	0.	1.						
103	66	26.	26.	36.	23.	20x	-x	0.	0.	1.						
164	102	25.	25.	36.	23.	20x	x	0.	0.	1.	2000	1943	246	309	2390	2322
105	122	24.	24.	36.	24.	19x	1x	0.	0.	1.						
106	142	23.	23.	36.	24.	17x	3x	0.	1.	1.	2057	1996	330	380	2379	2310
107	182	21.	21.	35.	25.	17x	4x	0.	3.	1.						
168	211	21.	20.	35.	25.	17x	4x	0.	3.	0.	2075	2023	362	377	2376	2320
169	240	19.	19.	35.	25.	17x	5x	0.	5.	1.						
170	301	16.	16.	35.	25.	17x	6x	0.	7.	2.	2093	2074	465	404	2334	2321
111	361	13.	13.	34.	26.	16x	9x	1.	13.	5.						
112	422	10.	10.	34.	26.	14x	12x	1.	20.	10.	2153	2174	778	524	2299	2342
137	470	8.	8.	34.	26.	14x	14x	1.	26.	16.						
115	550	7.	7.	34.	26.	15x	14x	2.	29.	23.	2188	2224	1016	588	2295	2361
116	618	6.	6.	34.	27.	14x	15x	2.	30.	29.						
117	696	5.	5.	34.	27.	15x	15x	2.	32.	36.	2210	2246	1054	577	2313	2383
118	794	5.	5.	34.	27.	15x	15x	2.	33.	45.						
119	897	4.	4.	34.	27.	14x	16x	2.	34.	59.	2240	2274	1142	591	2334	2405
120	1200	3.	3.	34.	27.	14x	17x	2.	35.	81.						
121	1395	2.	2.	34.	27.	14x	18x	2.	35.	95.	2279	2308	1180	569	2373	2439
122	1592	2.	2.	34.	27.	14x	18x	2.	35.	104.						
123	1790	2.	2.	34.	27.	15x	18x	2.	35.	111.						
124	1997	2.	2.	34.	27.	15x	18x	2.	35.	117.	2295	2320	1165	545	2394	2455
125	2201	1.	1.	34.	27.	15x	18x	2.	35.	121.						
126	2402	1.	1.	34.	27.	15x	17x	2.	35.	123.						
127	2605	1.	1.	34.	27.	15x	17x	2.	35.	125.	2300	2323	1134	521	2403	2462
128	2605	1.	1.	34.	27.	15x	17x	2.	35.	124.						
129	2800	1.	1.	34.	27.	16x	17x	2.	34.	124.						
130	2998	1.	1.	34.	27.	16x	17x	2.	34.	125.						
131	3199	1.	1.	34.	27.	17x	16x	2.	34.	127.	2294	2315	1104	502	2401	2458
133	3403	1.	1.	34.	27.	17x	16x	2.	34.	126.	2294	2315	1112	504	2399	2456
132	3403	1.	1.	34.	27.	17x	16x	2.	34.	127.						
138	3584	1.	1.	34.	27.	17x	16x	2.	34.	125.						

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