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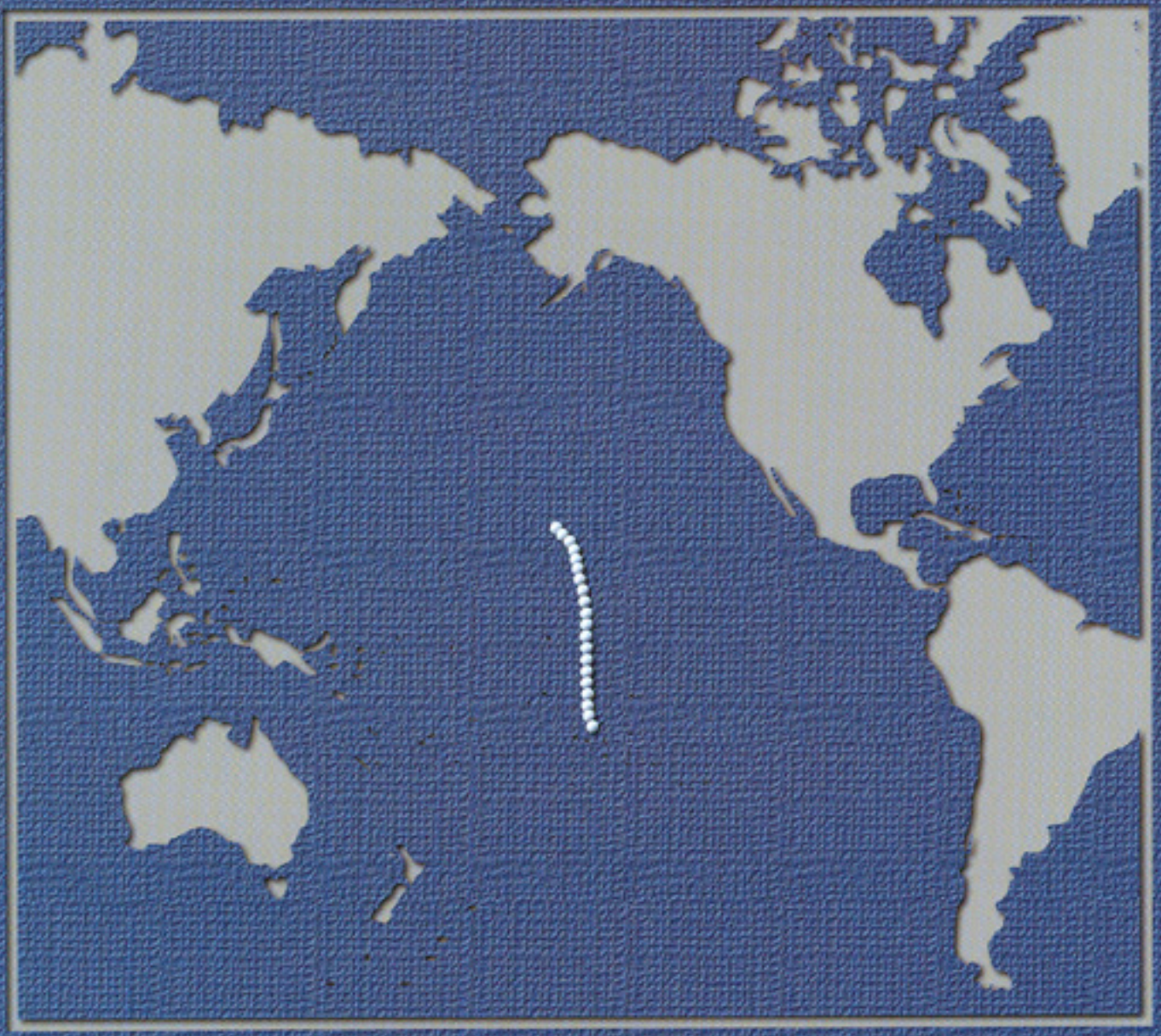
Carbon Dioxide, Hydrographic, and Chemical Data Obtained During the Thomas Washington Cruise Tunes-3 in the Equatorial Pacific Ocean (WOCE Section P16C)



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CARBON DIOXIDE, HYDROGRAPHIC, AND CHEMICAL DATA OBTAINED DURING THE R/V *THOMAS WASHINGTON* CRUISE TUNES-3 IN THE EQUATORIAL PACIFIC OCEAN (WOCE SECTION P16C)

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Oceanic CO_2 Measurements for the WOCE Hydrographic Survey in the Pacific Ocean: Shipboard Alkalinity Measurements on TUNES Leg 3, 1991, by P. R. Guenther, G. Emanuele III, D. J. Moss, T. J. Lueker, and C. D. Keeling. 1994.

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ABSTRACT

Goyet, Catherine, Peter R. Guenther, Charles D. Keeling, and Lynne D. Talley. 1996. Carbon Dioxide, Hydrographic, and Chemical Data Obtained During the R/V *Thomas Washington* Cruise TUNES-3 in the Equatorial Pacific Ocean (WOCE section P16C). ORNL/CDIAC-96, NDP-060. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee. 94 pp.

This data documentation discusses the procedures and methods used to obtain total carbon dioxide (TCO_2), total alkalinity (TALK), hydrographic, and chemical data during the Research Vessel *Thomas Washington* Expedition TUNES-3 in the Equatorial Pacific Ocean (Section P16C). Conducted as a part of the World Ocean Circulation Experiment (WOCE), the cruise began in Papeete, Tahiti, on August 31, 1991, and finished in Honolulu, Hawaii, on October 1, 1991. WOCE Meridional Section P16C along 150° W and between 18° S and 19° N was completed during the 31-day expedition. All 105 hydrographic and 8 large-volume stations were completed to the full water column depth. Station spacing was 30 nautical miles (nm), except between 3° N and 3° S where it was 10 nm. Twenty-five bio-optics stations were sampled for the Joint Global Ocean Flux Study, and at 21 stations carbon dioxide measurements were provided for the U.S. Department of Energy's CO_2 program. Hydrographic and chemical measurements made along WOCE Section P16C included pressure, temperature, salinity, and oxygen measured by conductivity, temperature, and depth sensor; and bottle salinity, oxygen, phosphate, nitrate, nitrite, silicate, chlorofluorocarbon (CFC)-11, CFC-12, TCO_2, and TALK. In addition, potential temperatures were calculated from the measured variables.

The TCO_2 concentration in 652 seawater samples was determined by semiautomated coulometry using an improved version of the instrument earlier described by Johnson et al., (1985, 1987). The precision of these measurements was estimated to be better than ±0.01%. The desired accuracy was better than 4 μmol/kg.

The TALK concentration in 539 seawater samples was determined by a potentiometric acid titration system that was designed and constructed at the Scripps Institution of Oceanography (SIO) by David Moss and Timothy Lueker (Guenther et al. 1994a).

Seventy-one replicate samples 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 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 documentation file, and this printed report, which describes the contents and format of all files and the procedures and methods used to obtain the data.

Keywords: carbon dioxide; total alkalinity; World Ocean Circulation Experiment (WOCE); Pacific Ocean; hydrographic measurements; carbon cycle

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 been conducted, and others are under way. The largest oceanographic experiment ever attempted is the World Ocean Circulation Experiment (WOCE). A major component of the World Climate Research Program, WOCE brings together the expertise of scientists and technicians from more than 30 nations. In the United States, WOCE is supported by the federal government under the Global Change Research Program. The multiagency U.S. effort is led by the National Science Foundation and is supported by major contributions from the National Oceanic and Atmospheric Administration, 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 DOE, is being made on WOCE cruises (through 1998) to measure the global, spatial, and temporal distributions of TCO_2 and other carbon-related parameters. The goal of the CO_2 survey includes 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 31-day Leg 3 of the Research Vessel (R/V) *Thomas Washington* TUNES Expedition (TUNES-3) along the WOCE zonal Section P16C, which is located in the equatorial part of the Pacific Ocean along the 150° W meridian, between 17.5° S and 19.0° N (Fig. 1).

The CO_2 investigation during the TUNES-3 Expedition was supported by a grant (No. DE-FGO2-90-ER60983) from DOE.

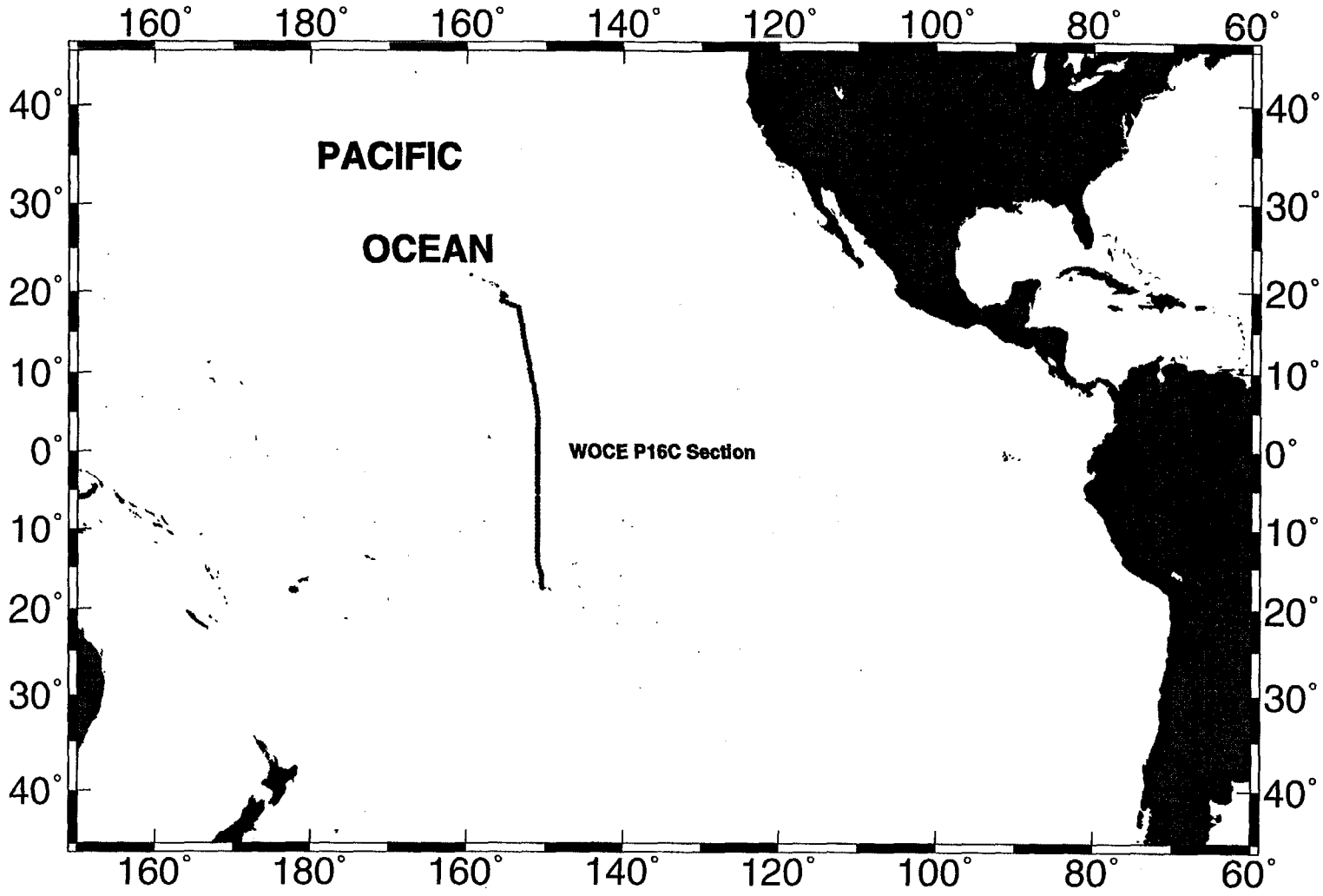

Figure 1. Station locations during R/V *Thomas Washington* TUNES-3 Expedition.

2. DESCRIPTION OF THE EXPEDITION

2.1 R/V *Thomas Washington* Cruise TUNES-3 Information

Ship name: Thomas Washington
Cruise/Leg: TUNES/3
Location: Equatorial Pacific Ocean, WOCE Section P16C
Ports of call: Papeete, Tahiti, to Honolulu, Hawaii, U.S.A.
Dates: August 31–October 1, 1991
Master: T. Desjardins
Chief Scientist: Lynne D. Talley (SIO)

Parameters measured	Institution	Principal investigators
CTD/Hydrography	SIO	Lynne Talley
Nutrients (silicate, phosphate, nitrate, and nitrite)	SIO	Lynne Talley
Bathymetry	SIO	Stuart Smith
Underway pCO_2 and nitrous oxide (N_2O)	SIO	Ray Weiss
CTD/Hydrography support	WHOI	John Toole
Chlorofluorocarbons (CFCs)	PMEL	John Bullister
Deep ^3H (>1200 m)	SIO	Harmon Craig
Floats	SIO	Russ Davis
Acoustic Doppler Current Profiler (ADCP)	UH	Eric Firing
Transmissometer	TAMU	Wilf Gardner
Nutrients support	OSU	Louis Gordon
TCO_2	WHOI	Catherine Goyet
Shallow ^3H and tritium	WHOI	William Jenkins
CO_2 [(TCO_2-shore and total alkalinity (TALK)]	SIO	Charles Keeling
Large volume ^{14}C	PU	Robert Key
Bio-optics	LDEO	John Marra
Surface drifters	SIO	Peter Niller
^{14}C	UW	Paul Quay

Participating Institutions

SIO	Scripps Institution of Oceanography (University of California, San Diego)
WHOI	Woods Hole Oceanographic Institution
PMEL	Pacific Marine Environmental Laboratory
UH	University of Hawaii
TAMU	Texas A&M University
OSU	Ohio State University
PU	Princeton University
LDEO	Lamont-Doherty Earth Observatory (Columbia University)
UW	University of Washington

2.2 Brief Cruise Summary

R/V *Thomas Washington* departed Papeete, Tahiti, for its third consecutive WOCE leg on August 31, 1991. Stations were numbered consecutively from the beginning of the R/V *Thomas Washington* work on Leg 1 (TUNES-1 Expedition, WOCE Section P17C), starting off the coast of California in May 1991. The first station on Leg 3 (station 221) was occupied on September 1, 1991, at ~17° 31' S and 150° 29' W and was a reoccupation of the last station on Leg 2 (station 220) (TUNES-2 Expedition, WOCE Sections P17S and P16S). The last station of the TUNES-3 Expedition was occupied on September 30, 1991, at 18° 53' N and 155° 39' W. On October 1, 1991, R/V *Thomas Washington* arrived in Honolulu, Hawaii.

During the 31-day expedition, 105 hydrographic and 8 large-volume stations were completed. All stations were sampled to the bottom and consisted of a rosette/CTD cast. Basic station spacing was 30 nm, closing to 10 nm between 3° S and 3° N. Sampling was performed with a 36-place, double-ring rosette with mounted CTD (WHOI CTD 10) and transmissometer. CTD data consisted of pressure, temperature, conductivity, oxygen, and transmissometry. Water samples were collected for analyses of salt, oxygen, silicate, phosphate, nitrate, and nitrite on all stations and CFC-11, CFC-12, ^{3}H, tritium, ^{14}C, TCO_2, and TALK on selected stations. Underway measurements included ADCP, surface temperature, and surface water partial pressure of CO_2 and N_2O.

3. DESCRIPTION OF VARIABLES AND METHODS

The data file **tun3.dat** (see Sect. 7 "File Descriptions" in Part 2) in this numeric data package (NDP) contains the following variables: station number; cast number; sample number; bottle number; 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; and data quality flags. The station inventory file **tun3sta.inv** (see Part 2) contains the expedition code, section number, station number, cast number, sampling date (i.e., month, day, and year), sampling time, latitude, longitude, and bottom depth for each station.

3.1 Hydrographic Measurements

All CTD pressure, temperature, salinity, and oxygen 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 for the TUNES-3 Expedition. The full cruise report, that includes details about processing the hydrographic data, and the final CTD data are available from the WOCE Hydrographic Program Office (WHPO) or the WHP Special Analysis Center (SAC) in Germany.

Salinity samples were drawn into 200-mL Kimax high-alumina borosilicate glass bottles with custom-made plastic insert thimbles and Nalgene screw caps which provided low container dissolution and sample evaporation. These bottles were rinsed three times before filling, and measurements were usually made within 8–36 h after collection. Salinity was determined on the basis of electrical conductivity measured by an SIO Oceanographic Data Facility (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).

Water samples for oxygen analyses were collected shortly after the rosette sampler was brought on board and after the samples for CFCs and ^3H were drawn. Sampling flasks (100–125 mL), calibrated before the expedition, were carefully rinsed, and then filled using a drawing tube after being allowed to overflow for at least two flask volumes. Reagents were added to fix the oxygen before sealing the flasks with stoppers. The flasks were shaken immediately after being sealed, and again after 20 min to ensure thorough dispersion of the manganous hydroxide [$Mn(OH)_2$] precipitate. The oxygen concentration in these solutions was determined within 4–36 h using the Winkler titration methods of Carpenter (1965) with modifications by Culberson and Williams (1991). The titrator was calibrated with 0.01 *N* potassium iodate standard solutions prepared using preweighed potassium iodate crystals. 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 22.3914 L/mol (Kester 1975) was used for this purpose.

Nutrient analyses were performed by analysts from OSU using a Technicon AutoAnalyzer II. The AutoAnalyzer used was provided by the ODF of SIO. A data acquisition system and the software used to process the nutrient data were developed and supplied by OSU. The chemical methods used on Leg 3 of the TUNES Expedition were essentially and deliberately the same as those used on the first two legs. All of the reagent and standard materials were provided by ODF of SIO. The methods used are described in Atlas et al. (1971) but with modifications in analytical protocols as employed by ODF.

3.2 Total CO_2 Measurements

During the TUNES-3 Expedition, 652 samples were analyzed for TCO_2 concentrations in seawater. The sampling frequency for measurements of the carbonate parameters was reduced to a complete depth profile (36 samples) ~ every fourth hydrographic station (Fig. 2). This reduction was implemented not according to any prearranged geophysical criterion but to accommodate the time constraints for two analysts on board to perform CO_2 sampling and measurements. In other words, the adopted CO_2 sampling strategy was to measure as many samples as was technically and humanly possible.

For TCO_2 measurements, the seawater samples were drawn into 500-mL borosilicate glass bottles equipped with Rodaviss joint closure systems, poisoned with 100 μL of a saturated solution of mercuric chloride ($HgCl_2$), and analyzed on board generally within 18 h. TCO_2 concentration was measured by semiautomated coulometry using an improved version of the instrument earlier described by Johnson et al. (1985, 1987) and calibrated using the procedure described in Goyet and Hacker (1992). This early "SOMMA-type" system did not have gas loops for calibration. Consequently, plans were to calibrate the system with standard solutions as described in Goyet and Hacker (1992); however, uncontrollable events (i.e., a hurricane occurred in Woods Hole a few days before the cruise) destroyed standard solutions that were prepared for the cruise. As a result, the certified reference materials (CRMs) were used as standards to calibrate the TCO_2 extraction/coulometer system. Precision of the measurements was estimated to be better than ±0.01%; the desired accuracy was better than 4 μmol/kg (Goyet et al. 1995). The automated coulometric system forced the sample into the pipet using a pressurized headspace gas. Pure nitrogen (N_2) headspace gas was used for standard solution measurements, and CO_2 headspace gas (290 ppm in air) was used for seawater sample measurements. The volume of the pipet was calibrated with distilled water and seawater (volume was ~30 mL, depending on the individual pipet used), and there was no significant difference in the delivery volume as a result of possible differences in surface tension at different salinities. The sample was drained from the pipet into a stripper containing 1.5 mL of 8.5% phosphoric acid.

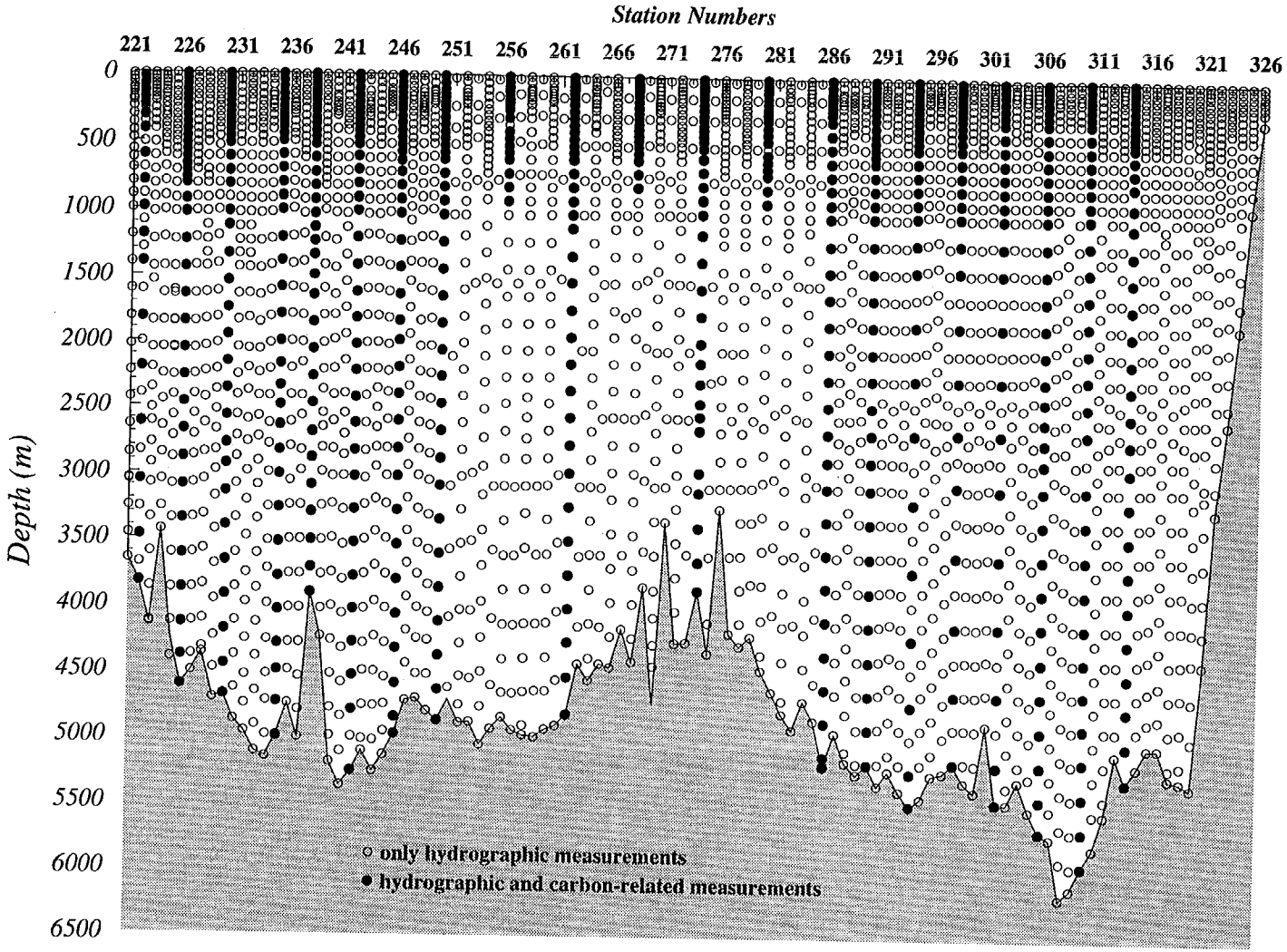

Figure 2. Sampling depths at all hydrographic stations occupied during *R/V Thomas Washington* TUNES-3 Expedition.

This chamber and the added acid were purged of any CO_2 with pure N_2 carrier gas before the sample was added. In the stripper, the CO_2 gas was extracted from the acidified sample by a continuous flow of pure N_2 gas through a frit at the bottom of the stripper. The gas (mainly CO_2, N_2 and water vapor) was passed through a condenser thermostated with 4°C water and magnesium perchlorate [$Mg(ClO_4)$] to remove water vapor. It was then passed through silica gel to remove residual aerosols and traces of hydrogen sulfide (H_2S) and phosphoric acid (H_3PO_4) before being bubbled into a commercially available coulometric solution containing ethanolamine [$NH_2(CH_2)_2OH$], dimethyl sulfoxide [$(CH_3)_2SO$], and thymolphthalein dye (made by UIC, Inc., Joliet, IL, USA). A coil made from glass tubing with thermostated water flowing through it was placed in the cell to maintain the solution at 24°C. The pH of the solution was monitored on an UIC, Inc., total CO_2 coulometer by monitoring the thymolphthalein-absorbance indicator at ~610 nm. Hydroxide (^-OH) ions were generated by the coulometer circuitry to maintain absorbance of the solution at a constant value. The analytical procedure was controlled by a microcomputer that also recorded the coulometric titration and computed the total CO_2 extracted from the sample based on the amount of OH^- generated to reach the end point.

Figure 3 summarizes the analytical results as a contour section plot of the TCO_2 data from the WOCE Section P16C along ~150° W.

3.3 Total Alkalinity Measurements

To determine the TALK concentration in seawater, 539 samples were titrated. Typically, 28 of the 36 samples from Niskin bottles collected on a station were analyzed during the cruise. The TALK was measured on aliquot of seawater taken from the same 500-mL bottle previously analyzed for TCO_2. Duplicate samples were collected on six stations and analyzed for TALK. The closed-cell potentiometric acid titration system was used to determine TALK concentration. The system was designed and constructed at SIO by David Moss with the developmental and experimental assistance of Timothy Lueker. A full description of TALK measurements is provided in Guenther et al. (1994a), a reprint of which is provided in Appendix B.

3.4 Shore-Based Replicate Measurements

The replicate samples from 100 Niskin bottles at 18 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 under controlled laboratory conditions using standards. The replicate sample standard deviation (s) for this large data set of 71 unflagged pairs is 1.0 μmol/kg after omitting the three replicate pairs with deltas greater then 3s (a replicate sample standard deviation calculated from the set of analyses on duplicate samples) (Guenther et al. 1994b).

Substantial reduction in the calculated s of the ship-minus-shore comparison is made by omitting 24 comparisons of singlet replicate samples, plus 5 more that are greater than 3s for either the replicate pairs or the comparison difference. For the 66 remaining comparisons, the average ship-minus-shore difference is -2.1 ± 2.4 μmol/kg (Guenther et al. 1994b). Figure 4 shows the ship-minus-shore differences for all available surface and deep data from the TUNES-3 Expedition. The plotted data indicate a bias for surface data relative to deep data; surface data show better agreement between shipboard and shore-based data than do deep data.

Tables 1 and 2, reprinted from Guenther et al. 1994b, summarize the replicate shore-based measurements of TCO_2 and TALK and their comparisons with shipboard measurements.

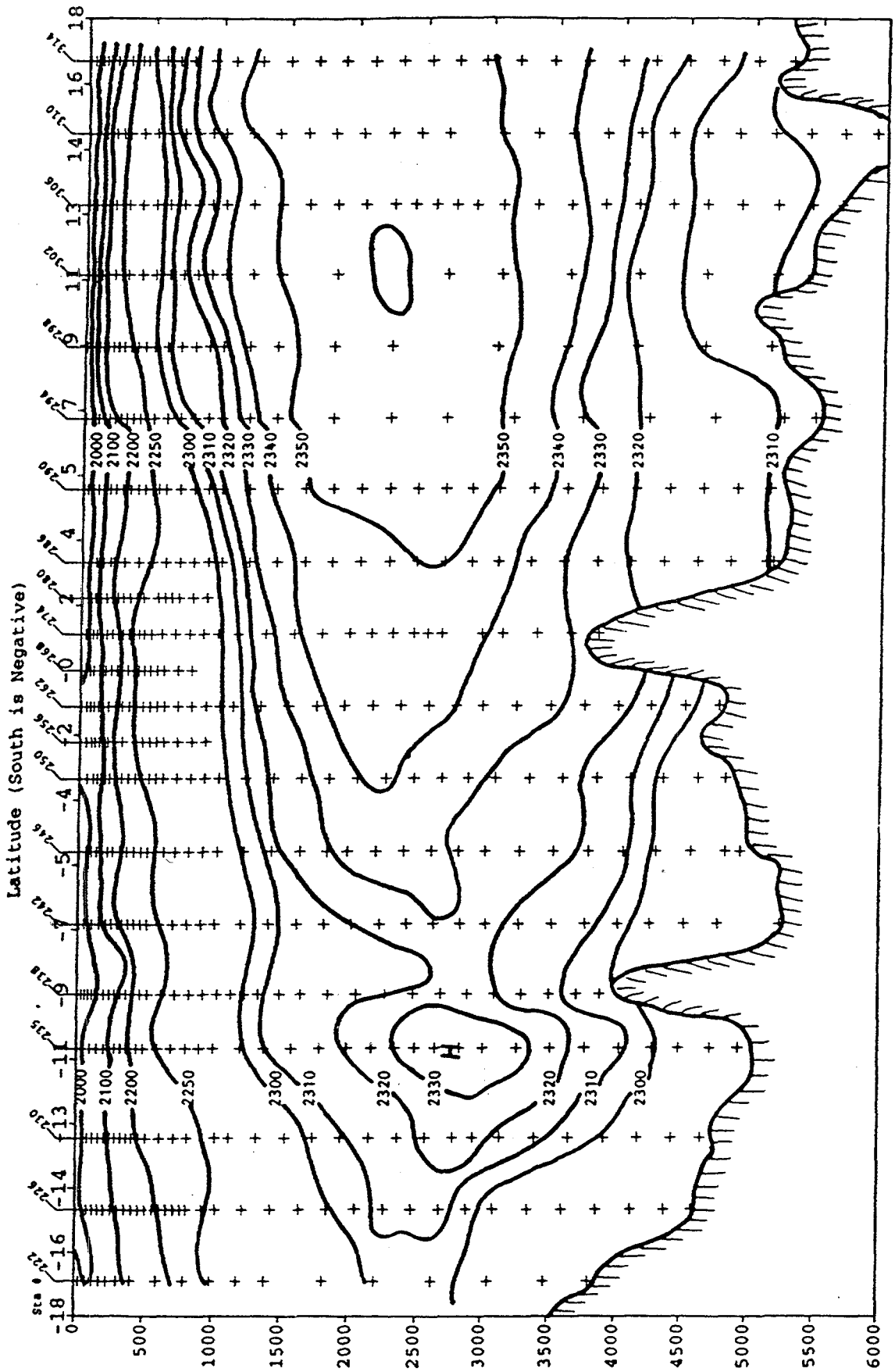

Fig. 3. Distribution of the TCO_2 in seawater along WOCE Section P16C.

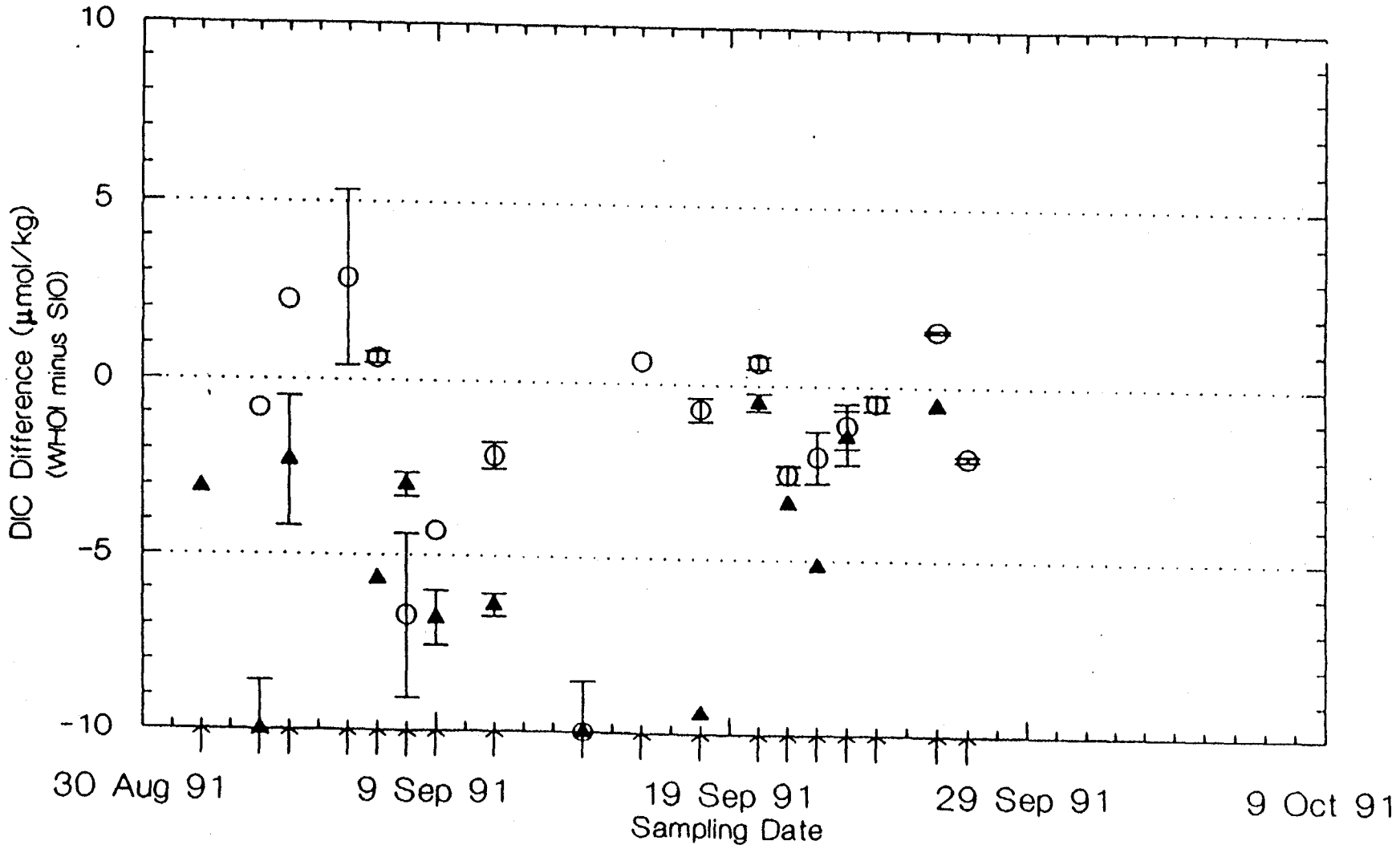

Fig. 4. Shipboard minus shore-based TCO_2 measurements vs date for surface and deep samples. Open circles represent near-surface samples; shaded triangles represent deep samples; vertical bracketed lines represent replicate pair deltas; and arrows indicate dates replicate samples were collected.

Table 1. Summary of TCO_2 replicate data collected during R/V *Thomas Washington* TUNES-3 Expedition

THE CARBON DIOXIDE PROJECT OF THE SCRIPPS INSTITUTION OF OCEANOGRAPHY
TUNES Leg 3 1991 Pacific WOCE Line P16C

SUMMARY OF DISSOLVED INORGANIC CARBON DATA

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	WHOI TCO_2	WHOI -S.I.O.
											(μMOLES/KG SW)						
3	17- 0S	1 36	6	01SEP91	09OCT91	10OCT91	S	R4568	001		1989.51		1989.51				
222	150-30W				09OCT91	10OCT91	S	R4569	001		1990.76		1990.76	+1.25	1990.14		
		1 5	3055		08OCT91	10OCT91	S	R4566	001		2301.30		2301.30				
					08OCT91	10OCT91	S	R4567	001	F	2313.12				2301.30	2298.2	-3.10
3	15- 0S	1 36	7	03SEP91	06NOV91	06NOV91	S	R4592	001		2000.03		2000.03				
226	150-50W				06NOV91	06NOV91	S	R4593	001	EX	1996.88				2000.03	1999.2	-0.83
		1 35	50		06NOV91	06NOV91	S	R4590	001		2001.19		2001.19				
					06NOV91	06NOV91	S	R4591	001		2002.20		2002.20	+1.01	2001.69	1999.8	-1.89
		1 33	130		25OCT91	28OCT91	S	R4588	001		2028.37		2028.37				
					25OCT91	28OCT91	S	R4589	001		2028.99		2028.99	+0.62	2028.68	2027.5	-1.18
		1 31	211		24OCT91	28OCT91	S	R4586	001		2083.06		2083.06				
					24OCT91	28OCT91	S	R4587	001		2082.77		2082.77	-0.29	2082.92	2081.2	-1.72
		1 29	313		24OCT91	28OCT91	S	R4584	001		2105.52		2105.52				
					24OCT91	28OCT91	S	R4585	001		2106.01		2106.01	+0.49	2105.77	2103.5	-2.27
		1 27	413		23OCT91	28OCT91	S	R4582	001		2177.34		2177.34				
					23OCT91	28OCT91	S	R4583	001	F	2202.68				2177.34	2170.9	-6.44
		1 23	618		21OCT91	22OCT91	S	R4580	001		2210.90		2210.90				
					21OCT91	28OCT91	S	R4581	001		2211.69		2211.69	+0.79	2211.29	2205.2	-6.09
		1 18	926		21OCT91	22OCT91	S	R4578	001		2251.25		2251.25				
					21OCT91	22OCT91	S	R4579	001		2250.72		2250.72	-0.53	2250.99	2246.5	-4.49
		1 16	1232		17OCT91	22OCT91	S	R4576	001		2273.12		2273.12				
					17OCT91	22OCT91	S	R4577	001	F	2322.69				2273.12	2274.0	0.88
		1 14	1642		16OCT91	22OCT91	S	R4574	001		2295.35		2295.35				
					16OCT91	22OCT91	S	R4575	001	F	2316.44				2295.35	2293.3	-2.05
		1 12	2056		15OCT91	22OCT91	S	R4572	001		2304.49		2304.49				
					15OCT91	22OCT91	S	R4573	001		2302.96		2302.96	-1.53	2303.73	2307.4	3.67
		1 7	3090		09OCT91	10OCT91	S	R4570	001		2308.10		2308.10				
					09OCT91	10OCT91	S	R4571	001		2310.94		2310.94	+2.84	2309.52	2297.4	-12.12

MANOMETER TYPE:
  S = QUARTZ SPIRAL MANOMETER DATUM
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  M = CONSTANT VOLUME MERCURY 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 3 1991 Pacific WOCE Line P16C

SUMMARY OF DISSOLVED INORGANIC CARBON DATA (cont)

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	BOTTLE DELTA	"NISKIN" AVG	WHOI TCO	WHOI -S.I.O.
											(μMOLES/KG SW)						
3	13- 0S	1 36	7	04SEP91	08NOV91	11NOV91	S	R4596	001		1995.36		1995.36				
230	151- 0W				08NOV91	11NOV91	S	R4597	001	F	2008.06				1995.36	1997.6	2.24
		1 7	3139		08NOV91	11NOV91	S	R4594	001		2323.77		2323.77				
					08NOV91	11NOV91	S	R4595	001		2320.07		2320.07	-3.70	2321.92	2319.6	-2.32
3	10-30S	4 36	6	06SEP91	11NOV91	11NOV91	S	R4600	001		1985.69		1985.69				
235	151- 0W				11NOV91	11NOV91	S	R4601	001		1990.58		1990.58	+4.89	1988.14	1991.0	2.86
		4 9	3007		11NOV91	11NOV91	S	R4598	001	EX	2345.77						
					11NOV91	11NOV91	S	R4599	001	F	2358.27					2335.8	
3	9- 0S	1 36	6	07SEP91	30APR92	08JUL92	E	R4624	001		1987.25						
238	151- 0W				30APR92	08JUL92	E	R4624	002		1987.16	-0.09	1987.21				
					04MAY92	08JUL92	E	R4625	001		1987.50						
					04MAY92	08JUL92	E	R4625	002		1987.53	+0.03	1987.52	+0.31	1987.36	1988.0	0.64
		1 34	60		30APR92	08JUL92	E	R4622	001		1986.11						
					30APR92	08JUL92	E	R4622	002		1986.48	+0.37	1986.30				
					30APR92	08JUL92	E	R4623	001	EX	1988.45						
					30APR92	08JUL92	E	R4623	002		1986.93		1986.93	+0.63	1986.62	1988.9	2.28
		1 32	111		29APR92	07JUL92	E	R4620	001		1996.73						
					29APR92	07JUL92	E	R4620	002		1996.12	-0.61	1996.43				
					29APR92	07JUL92	E	R4621	001		1999.51						
					29APR92	07JUL92	E	R4621	002		2000.85	+1.34	2000.18	+3.75	1998.31	1999.5	1.19
		1 26	321		28APR92	07JUL92	E	R4616	001	EX	2234.40						
					28APR92	07JUL92	E	R4616	002	EX	2233.41						
					28APR92	07JUL92	E	R4617	001		2212.72						
					28APR92	07JUL92	E	R4617	002		2212.66	-0.06	2212.69		2212.69	2210.3	-2.39
		1 24	414		27APR92	07JUL92	E	R4614	001		2221.31						
					27APR92	07JUL92	E	R4614	002		2216.45	-4.86	2218.88		2218.88	2221.8	2.92
		1 21	619		27APR92	06JUL92	E	R4612	001		2242.28						
					27APR92	06JUL92	E	R4612	002		2246.68	+4.40	2244.48		2244.48	2241.5	-2.98
		1 18	925		23APR92	30JUN92	E	R4610	001		2277.16						
					23APR92	30JUN92	E	R4610	002		2276.67	-0.49	2276.92				
					23APR92	30JUN92	E	R4611	001		2277.54						
					23APR92	30JUN92	E	R4611	002		2277.07	-0.47	2277.31	+0.39	2277.11	2276.0	-1.11

MANOMETER TYPE:
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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 3 1991 Pacific WOCE Line P16C

SUMMARY OF DISSOLVED INORGANIC CARBON DATA (cont)

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 TCO2	BOTTLE DELTA	"NISKIN" AVG	WHOI TCO2	WHOI -S.I.O.
											(μMOLES/KG SW)						
3	9- 0S	1 15	1233	07SEP91	23APR92	24APR92	S	R4608	001		2296.51		2296.51				
238	151- 0W				23APR92	24APR92	S	R4609	001	EX	2307.46				2296.51	2294.7	-1.81
		1 12	1643		22APR92	24APR92	S	R4606	001		2314.42		2314.42				
					22APR92	24APR92	S	R4607	001		2314.25		2314.25	-0.17	2314.33	2318.5	4.17
		1 10	2055		20APR92	22APR92	S	R4604	001		2328.73		2328.73				
					20APR92	22APR92	S	R4605	001	EX	2333.18				2328.73	2316.1	-12.63
		1 5	3088		20APR92	22APR92	S	R4602	001		2325.50		2325.50				
					20APR92	22APR92	S	R4603	001	EX	2349.12				2325.50	2319.8	-5.70
3	7- 0S	1 36	7	08SEP91	17DEC91	18DEC91	M	R4628	001		1986.28		1986.28				
242	151- 0W				17DEC91	18DEC91	M	R4629	001		1990.94		1990.94	+4.66	1988.61	1981.9	-6.71
		1 10	3018		16DEC91	17DEC91	M	R4626	001		2325.09		2325.09				
					16DEC91	17DEC91	M	R4627	001		2324.42		2324.42	-0.67	2324.76	2321.8	-2.96
3	5- 0S	2 36	8	09SEP91	15APR92	22APR92	S	R4652	001		1997.78		1997.78				
246	151- 0W				15APR92	22APR92	S	R4653	001	EX	2007.45				1997.78	1993.5	-4.28
		2 35	60		15APR92	16APR92	S	R4650	001		1999.52		1999.52				
					15APR92	16APR92	S	R4651	001		1999.95		1999.95	+0.43	1999.73	1994.2	-5.53
		2 33	137		14APR92	16APR92	S	R4648	001		2078.98		2078.98				
					14APR92	16APR92	S	R4649	001		2079.55		2079.55	+0.57	2079.27	2075.3	-3.97
		2 31	215		14APR92	16APR92	S	R4646	001		2186.68		2186.68				
					14APR92	16APR92	S	R4647	001		2184.05		2184.05	-2.63	2185.36	2179.2	-6.16
		2 29	307		10APR92	10APR92	S	R4644	001		2202.10		2202.10				
					10APR92	10APR92	S	R4645	001		2203.25		2203.25	+1.15	2202.68	2198.0	-4.68
		2 27	409		09APR92	10APR92	S	R4642	001		2266.96		2266.96				
					10APR92	10APR92	S	R4643	001		2264.42		2264.42	-2.54	2265.69	2259.4	-6.29
		2 23	631		09APR92	10APR92	S	R4640	001		2260.93		2260.93				
					09APR92	10APR92	S	R4641	001		2262.44		2262.44	+1.51	2261.69	2255.5	-6.19
		2 20	917		07APR92	08APR92	S	R4638	001	G	2279.81						
					07APR92	08APR92	S	R4639	001		2282.19		2282.19		2282.19	2276.0	-6.19

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Table 1 (continued)

THE CARBON DIOXIDE PROJECT OF THE SCRIPPS INSTITUTION OF OCEANOGRAPHY
TUNES Leg 3 1991 Pacific WOCE Line P16C

SUMMARY OF DISSOLVED INORGANIC CARBON DATA (cont)

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	BOTTLE DELTA	"NISKIN" AVG	WHOI TCO	WHOI -S.I.O.
											(μMOLES/KG SW)						
3	5- 0S	2 16	1629	09SEP91	03APR92	08APR92	S	R4634	001	EX	2344.53						
246	151- 0W				03APR92	08APR92	S	R4635	001		2350.01		2350.01		2350.01	2327.2	-22.81
		2 14	1982		02APR92	06JUL92	E	R4632	001		2335.41						
					02APR92	06JUL92	E	R4632	002		2335.60	+0.19	2335.51				
					02APR92	06JUL92	E	R4633	001		2341.49						
					02APR92	06JUL92	E	R4633	002		2342.23	+0.74	2341.86	+6.35	2338.69	2336.0	-2.69
		2 9	3012		02APR92	22JUN92	E	R4630	001		2334.38						
					02APR92	22JUN92	E	R4630	002		2334.91	+0.53	2334.65				
					02APR92	22JUN92	E	R4631	001		2333.27						
					02APR92	22JUN92	E	R4631	002		2333.01	-0.26	2333.14	-1.51	2333.90	2327.1	-6.80
3	3- 0S	1 36	6	11SEP91	30MAR92	19JUN92	E	R4656	001	EX	2013.31						
250	151- 0W				30MAR92	19JUN92	E	R4656	002		2010.17		2010.17				
					30MAR92	19JUN92	E	R4657	001	EX	2036.46						
					30MAR92	19JUN92	E	R4657	002		2010.88		2010.88	+0.71	2010.53	2008.4	-2.13
		1 8	3084		26MAR92	19JUN92	E	R4654	001		2336.35						
					26MAR92	19JUN92	E	R4654	002		2335.67	-0.68	2336.01				
					26MAR92	19JUN92	E	R4655	001	EX	2348.74						
					26MAR92	19JUN92	E	R4655	002		2336.62		2336.62	+0.61	2336.32	2329.9	-6.42
3	1- 0S	1 36	7	14SEP91	01APR92	22JUN92	E	R4660	001		2011.31						
262	151- 0W				01APR92	22JUN92	E	R4660	002		2010.97	-0.34	2011.14				
					01APR92	22JUN92	E	R4661	001		2014.10						
					01APR92	22JUN92	E	R4661	002		2014.07	-0.03	2014.08	+2.94	2012.61	2001.1	-11.51
		1 8	2980		01APR92	06JUL92	E	R4659	001		2355.34						
					01APR92	06JUL92	E	R4659	002	EX	2442.14						
					01APR92	06JUL92	E	R4659	003	EX	2363.41		2355.34		2355.34	2338.1	-17.24
3	1- 0N	1 34	38	16SEP91	26MAR92	18JUN92	E	R4682	001		1985.80						
274	151- 0W				26MAR92	18JUN92	E	R4682	002		1985.49	-0.31	1985.65				
					26MAR92	18JUN92	E	R4683	001	EX	2022.66						
					26MAR92	18JUN92	E	R4683	002	EX	2022.20				1985.65	1986.3	0.65
		1 33	67		24MAR92	18JUN92	E	R4680	001		2007.19						
					24MAR92	18JUN92	E	R4680	002		2006.66	-0.53	2006.93				
					24MAR92	18JUN92	E	R4681	001		2004.94						
					24MAR92	18JUN92	E	R4681	002		2005.10	+0.16	2005.02	-1.91	2005.98	2007.3	1.32

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Table 1 (continued)

THE CARBON DIOXIDE PROJECT OF THE SCRIPPS INSTITUTION OF OCEANOGRAPHY
TUNES Leg 3 1991 Pacific WOCE Line P16C

SUMMARY OF DISSOLVED INORGANIC CARBON DATA (cont)

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 (μMOLES/KG SW)	BOTTLE DELTA	"NISKIN" AVG	WHOI TCO	WHOI -S.I.O.
3	1- 0N	1 30	154	16SEP91	20MAR92	12JUN92	E	R4678	001	EX	2107.10						
274	151- 0W				20MAR92	12JUN92	E	R4678	002		2104.63		2104.63				
					20MAR92	12JUN92	E	R4679	001	EX	2106.93						
					20MAR92	12JUN92	E	R4679	002		2105.27		2105.27	+0.64	2104.95	2104.8	-0.15
		1 27	278		20MAR92	12JUN92	E	R4676	001		2202.72						
					20MAR92	12JUN92	E	R4676	002		2202.77	+0.05	2202.75				
					20MAR92	12JUN92	E	R4677	001		2203.11						
					20MAR92	12JUN92	E	R4677	002		2202.77	-0.34	2202.94	+0.19	2202.84	2201.9	-0.94
		1 25	354		06MAR92	08JUN92	E	R4674	001		2242.33		2242.33				
					06MAR92	08JUN92	E	R4675	001		2242.49		2242.49	+0.16	2242.41	2239.6	-2.81
		1 18	801		06MAR92	08APR92	S	R4670	001		2287.11		2287.11				
					06MAR92	08APR92	S	R4671	001		2287.96		2287.96	+0.85	2287.54	2281.1	-6.44
		1 16	1007		05MAR92	18MAR92	S	R4668	001	EX	2305.69						
					05MAR92	08APR92	M	R4669	001		2298.18		2298.18		2298.18	2297.9	-0.28
					05MAR92	18MAR92	S	R4669	001		2300.80		2300.80		2300.80	2297.9	-2.90
		1 14	1368		05MAR92	18MAR92	S	R4666	001		2333.58		2333.58				
					05MAR92	18MAR92	S	R4667	001		2332.00		2332.00	-1.58	2332.79	2329.3	-3.49
		1 12	1778		03MAR92	06MAR92	M	R4664	001		2346.37		2346.37				
					03MAR92	04MAR92	S	R4664	001		2346.29		2346.29				
					03MAR92	06MAR92	M	R4665	001		2345.02		2345.02	-1.35	2345.70	2343.5	-2.20
					03MAR92	04MAR92	S	R4665	001	EX	2353.84				2346.29	2343.5	-2.79
3	3- 0N	1 35	7	18SEP91	18DEC91	19DEC91	M	R4690	001		1964.98		1964.98				
286	151- 0W				18DEC91	19DEC91	M	R4691	001		1964.28		1964.28	-0.70	1964.63	1963.9	-0.73
		1 10	3084		17DEC91	18DEC91	M	R4687	001		2352.51		2352.51				
					17DEC91	18DEC91	M	R4688	001	F	2388.23				2352.51	2343.1	-9.41
3	5- 0N	1 36	8	20SEP91	27FEB92	28FEB92	S	R4714	001		1911.47		1911.47				
290	151- 0W				27FEB92	28FEB92	S	R4715	001		1911.83		1911.83	+0.36	1911.65	1912.3	0.65
		1 34	81		27FEB92	28FEB92	S	R4712	001		1987.07		1987.07				
					02MAR92	04MAR92	S	R4713	001		1988.76		1988.76	+1.69	1987.92	1989.2	1.28
		1 33	120		27FEB92	28FEB92	S	R4710	001		2010.32		2010.32				
					27FEB92	28FEB92	S	R4711	001		2010.48		2010.48	+0.16	2010.40	2009.9	-0.50

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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)

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TUNES Leg 3 1991 Pacific WOCE Line P16C

SUMMARY OF DISSOLVED INORGANIC CARBON DATA (cont)

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 TCQ (μMOLES/KG SW)	BOTTLE DELTA	"NISKIN" AVG	WHOI TCQ	WHOI -S.I.O.
3	5- 0N	1 31	205	20SEP91	25FEB92	26FEB92	S	R4708	001		2183.54		2183.54				
290	151- 0W				25FEB92	26FEB92	S	R4709	001		2184.77		2184.77	+1.23	2184.16	2183.8	-0.36
		1 29	296		25FEB92	26FEB92	S	R4706	001	G	2200.77						
					25FEB92	26FEB92	S	R4707	001		2198.48		2198.48		2198.48	2197.8	-0.68
		1 27	411		24FEB92	26FEB92	S	R4704	001		2228.90		2228.90				
					24FEB92	26FEB92	S	R4705	001		2232.08		2232.08	+3.18	2230.49	2225.6	-4.89
		1 23	616		20FEB92	21FEB92	S	R4702	001		2285.54		2285.54				
					20FEB92	21FEB92	S	R4703	001		2286.29		2286.29	+0.75	2285.92	2285.8	-0.12
		1 20	924		20FEB92	21FEB92	S	R4700	001		2317.36		2317.36				
					20FEB92	21FEB92	S	R4701	001		2318.51		2318.51	+1.15	2317.94	2318.2	0.26
		1 18	1230		20FEB92	21FEB92	S	R4698	001		2332.71		2332.71				
					20FEB92	21FEB92	S	R4699	001		2329.61		2329.61	-3.10	2331.16	2329.6	-1.56
		1 16	1642		18FEB92	19FEB92	S	R4696	001		2351.26		2351.26				
					18FEB92	19FEB92	S	R4697	001		2352.54		2352.54	+1.28	2351.90	2350.2	-1.70
		1 14	2054		18FEB92	19FEB92	S	R4694	001		2356.78		2356.78				
					18FEB92	19FEB92	S	R4695	001		2355.39		2355.39	-1.39	2356.08	2354.7	-1.38
		1 9	3089		18FEB92	19FEB92	S	R4692	001		2350.14		2350.14				
					18FEB92	19FEB92	S	R4693	001		2350.66		2350.66	+0.52	2350.40	2349.9	-0.50
3	6-58N	1 36	10	21SEP91	13FEB92	14FEB92	S	R4718	001		1876.38		1876.38				
294	151-22W				13FEB92	14FEB92	S	R4719	001		1876.88		1876.88	+0.50	1876.63	1874.1	-2.53
		1 10	3191		14FEB92	18FEB92	M	R4716	001	F	2370.05						
					14FEB92	14FEB92	S	R4716	001	F	2370.11						
					14FEB92	14FEB92	S	R4717	001		2351.85		2351.85		2351.85	2348.5	-3.35
3	8-56N	1 36	16	22SEP91	11FEB92	14FEB92	S	R4722	001		1874.30		1874.30				
298	151-45W				11FEB92	14FEB92	S	R4723	001		1875.76		1875.76	+1.46	1875.03	1873.0	-2.03
		1 9	3058		10FEB92	12FEB92	S	R4720	001		2356.37		2356.37				
					10FEB92	12FEB92	S	R4721	001	F	2372.85				2356.37	2351.2	-5.17

MANOMETER TYPE:
  S = QUARTZ SPIRAL MANOMETER DATUM
  E = ELECTRONIC CONSTANT-VOLUME MANOMETER DATUM
  M = CONSTANT VOLUME MERCURY 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 3 1991 Pacific WOCE Line P16C

SUMMARY OF DISSOLVED INORGANIC CARBON DATA (cont)

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 (μMOLES/KG SW)	BOTTLE DELTA	"NISKIN" AVG	WHOI TCO	WHOI -S.I.O.
3	10-54N	1 36	8	23SEP91	06FEB92	07FEB92	S	R4746	001		1883.39		1883.39				
302	152- 7W				06FEB92	07FEB92	S	R4747	001		1882.09		1882.09	-1.30	1882.74	1881.6	-1.14
		1 34	60		06FEB92	12FEB92	S	R4744	001		2019.82		2019.82				
					06FEB92	12FEB92	S	R4745	001		2018.41		2018.41	-1.41	2019.11	2016.1	-3.01
		1 32	110		04FEB92	07FEB92	S	R4742	001		2105.50		2105.50				
					04FEB92	07FEB92	S	R4743	001		2106.06		2106.06	+0.56	2105.78	2104.7	-1.08
		1 29	212		04FEB92	07FEB92	S	R4740	001		2256.50		2256.50				
					04FEB92	07FEB92	S	R4741	001		2256.63		2256.63	+0.13	2256.56	2251.8	-4.76
		1 27	314		03FEB92	05FEB92	S	R4738	001		2269.21		2269.21				
					03FEB92	05FEB92	S	R4739	001		2268.05		2268.05	-1.16	2268.63	2264.8	-3.83
		1 26	416		03FEB92	05FEB92	S	R4736	001		2283.28		2283.28				
					03FEB92	05FEB92	S	R4737	001		2284.03		2284.03	+0.75	2283.66	2278.7	-4.96
		1 24	621		30JAN92	31JAN92	S	R4734	001		2306.12		2306.12				
					30JAN92	31JAN92	S	R4735	001		2306.76		2306.76	+0.64	2306.44	2304.4	-2.04
		1 21	928		30JAN92	31JAN92	S	R4732	001		2337.18		2337.18				
					30JAN92	31JAN92	S	R4733	001		2336.67		2336.67	-0.51	2336.93	2336.0	-0.93
		1 19	1237		29JAN92	31JAN92	S	R4730	001		2346.32		2346.32				
					29JAN92	31JAN92	S	R4731	001		2346.92		2346.92	+0.60	2346.62	2344.4	-2.22
		1 17	1647		29JAN92	31JAN92	M	R4728	001		2356.28		2356.28				
					29JAN92	03FEB92	M	R4729	001		2356.63		2356.63	+0.35	2356.46		
		1 15	2058		28JAN92	31JAN92	M	R4726	001		2358.55		2358.55				
					28JAN92	31JAN92	M	R4727	001		2358.78		2358.78	+0.23	2358.67		
		1 10	3086		28JAN92	30JAN92	M	R4724	001		2352.68		2352.68				
					28JAN92	31JAN92	M	R4725	001		2354.21		2354.21	+1.53	2353.45	2352.0	-1.45
3	12-52N	1 36	9	24SEP91	10FEB92	12FEB92	S	R4750	001		1902.07		1902.07				
306	152-30W				10FEB92	12FEB92	S	R4751	001		1902.50		1902.50	+0.43	1902.29	1901.8	-0.49
3	14-50N	1 36	9	26SEP91	19DEC91	20DEC91	M	R4754	001		1905.97		1905.97				
310	152-53W				19DEC91	20DEC91	M	R4755	001		1905.89		1905.89	-0.08	1905.93	1907.5	1.57

MANOMETER TYPE:
  S = QUARTZ SPIRAL MANOMETER DATUM
  E = ELECTRONIC CONSTANT-VOLUME MANOMETER DATUM
  M = CONSTANT VOLUME MERCURY 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 3 1991 Pacific WOCE Line P16C

SUMMARY OF DISSOLVED INORGANIC CARBON DATA (cont)

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 TCO2	BOTTLE DELTA	"NISKIN" AVG	WHOI TCO2	WHOI -S.I.O.
											(μMOLES/KG SW)						
3	14-50N	1 12	3081	26SEP91	18DEC91	19DEC91	M	R4752	001		2350.86		2350.86				
310	152-53W				18DEC91	19DEC91	M	R4753	001	EX	2289.18				2350.86	2350.3	-0.56
3	16-48N	2 36	9	27SEP91	22JAN92	23JAN92	M	R4778	001		1945.09		1945.09				
314	153-16W				22JAN92	23JAN92	M	R4779	001		1944.96		1944.96	-0.13	1945.03	1943.0	-2.03
		2 34	76		21JAN92	22JAN92	M	R4776	001		1969.99		1969.99				
					21JAN92	22JAN92	M	R4777	001		1969.09		1969.09	-0.90	1969.54	1967.0	-2.54
		2 33	107		21JAN92	22JAN92	M	R4774	001		1992.20		1992.20				
					21JAN92	22JAN92	M	R4775	001		1991.67		1991.67	-0.53	1991.94	1990.3	-1.64
		2 30	216		17JAN92	17JAN92	M	R4772	001		2119.99		2119.99				
					17JAN92	17JAN92	M	R4773	001		2119.22		2119.22	-0.77	2119.60	2118.4	-1.20
		2 28	318		16JAN92	17JAN92	M	R4770	001		2203.32		2203.32				
					16JAN92	17JAN92	M	R4771	001		2204.20		2204.20	+0.88	2203.76	2201.3	-2.46
		2 25	442		16JAN92	17JAN92	M	R4768	001		2290.49		2290.49				
					16JAN92	17JAN92	M	R4769	001		2288.47		2288.47	-2.02	2289.48	2286.9	-2.58
		2 22	676		15JAN92	16JAN92	M	R4766	001		2317.23		2317.23				
					15JAN92	16JAN92	M	R4767	001		2316.61		2316.61	-0.62	2316.92	2313.5	-3.42
		2 20	933		15JAN92	16JAN92	M	R4764	001		2339.44		2339.44				
					15JAN92	16JAN92	M	R4765	001		2336.69		2336.69	-2.75	2338.06	2336.2	-1.86
		2 18	1291		14JAN92	16JAN92	S	R4762	001		2351.69		2351.69				
					14JAN92	16JAN92	S	R4763	001		2354.33		2354.33	+2.64	2353.01	2349.6	-3.41
		2 16	1698		08JAN92	16JAN92	S	R4760	001		2360.20		2360.20				
					08JAN92	16JAN92	S	R4761	001		2360.46		2360.46	+0.26	2360.33	2357.7	-2.63
		2 14	2113		08JAN92	10JAN92	S	R4758	001		2361.29		2361.29		2361.29	2358.6	-2.69
		2 9	3201		07JAN92	16JAN92	S	R4757	001	EX	2279.37					2346.1	

MANOMETER TYPE:
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  M = CONSTANT VOLUME MERCURY 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 TALK replicate data collected during R/V *Thomas Washington* TUNES-3 Expedition

THE CARBON DIOXIDE PROJECT OF THE SCRIPPS INSTITUTION OF OCEANOGRAPHY
TUNES Leg 3 1991 Pacific WOCE Line P16C

SUMMARY OF ALKALINITY DATA

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	CDRG ALK	CDRG -S.I.O.
										(UEQUIV/KG SW)						
3	17- 0S	1 36	6	01SEP91	18OCT91	G	R4568	1		2369.35		2369.35				
222	150-30W				22OCT91	G	R4569	1		2365.81		2365.81	-3.54	2367.58	2365.21	-2.37
					03JUN92	V	R4569	5		2347.46		2347.46		2347.46	2365.21	17.75
		1 5	3055		18OCT91	G	R4566	1		2393.48		2393.48				
					18OCT91	G	R4567	1	F	2373.14				2393.48	2397.67	4.19
3	15- 0S	1 36	7	03SEP91	18NOV91	G	R4592	1		2386.17		2386.17				
226	150-50W				18NOV91	G	R4593	1		2386.40		2386.40	+0.23	2386.28	2387.58	1.30
		1 35	50		15NOV91	G	R4590	1		2383.16		2383.16				
					15NOV91	G	R4591	1		2382.72		2382.72	-0.44	2382.94	2383.75	0.81
		1 33	130		15NOV91	G	R4588	1		2393.34						
					18NOV91	G	R4588	2	X	2358.20		2393.34				
					15NOV91	G	R4589	1	X	2412.23				2393.34	2391.97	-1.37
		1 31	211		15NOV91	G	R4586	1		2376.32		2376.32				
					15NOV91	G	R4587	1		2375.48		2375.48	-0.84	2375.90	2378.77	2.87
		1 29	313		24OCT91	G	R4584	1		2320.91		2320.91				
					24OCT91	G	R4585	1		2314.79		2314.79	-6.12	2317.85	2315.84	-2.01
		1 27	413		13NOV91	G	R4582	1		2285.19		2285.19				
					15NOV91	G	R4583	1		2286.84		2286.84	+1.65	2286.02	2293.12	7.10
		1 23	618		25OCT91	G	R4580	1		2301.78		2301.78				
					13NOV91	G	R4581	1		2300.40		2300.40	-1.38	2301.09	2303.49	2.40
		1 18	926		23OCT91	G	R4578	1		2326.90		2326.90				
					25OCT91	G	R4579	1		2331.31		2331.31	+4.41	2329.10	2333.60	4.50
		1 16	1232		23OCT91	G	R4576	1		2360.06		2360.06				
					23OCT91	G	R4577	1	F	2369.57				2360.06	2357.94	-2.12
		1 14	1642		23OCT91	G	R4574	1		2371.03						
					07NOV91	G	R4574	2		2369.53	-1.50	2370.28				
					23OCT91	G	R4575	1	F	2363.83				2370.28	2379.13	8.85
		1 12	2056		23OCT91	G	R4572	1		2386.19		2386.19				
					23OCT91	G	R4573	1		2390.19		2390.19	+4.00	2388.19	2393.54	5.35
		1 7	3090		22OCT91	G	R4570	1		2399.27		2399.27				
					22OCT91	G	R4571	1		2391.76		2391.76	-7.51	2395.52	2403.26	7.74

TITRATION SYSTEM:
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 EX: Data excluded from analysis

Table 2 (continued)

THE CARBON DIOXIDE PROJECT OF THE SCRIPPS INSTITUTION OF OCEANOGRAPHY
TUNES Leg 3 1991 Pacific WOCE Line P16C

SUMMARY OF ALKALINITY DATA (cont.)

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	CDRG ALK	CDRG -S.I.O.
										(UEQUIV/KG SW)						
3	13- 0S	1 36	7	04SEP91	19NOV91	G	R4596	1		2385.08		2385.08				
230	151- 0W				20NOV91	G	R4597	1		2383.29		2383.29	-1.79	2384.19	2384.35	0.16
		1 7	3139		19NOV91	G	R4594	1		2393.57						
					19NOV91	G	R4594	2		2394.24	+0.67	2393.91				
					19NOV91	G	R4595	1		2400.67		2400.67	+6.76	2397.29	2423.69	26.40
3	10-30S	4 36	6	06SEP91	20NOV91	G	R4600	1		2359.32		2359.32				
235	151- 0W				20NOV91	G	R4601	1		2348.53		2348.53	-10.79	2353.93	2360.58	6.65
		4 9	3007		20NOV91	G	R4598	1		2385.09		2385.09				
					20NOV91	G	R4599	1	F	2424.77				2385.09	2417.37	32.28
3	9- 0S	1 34	60	07SEP91	24JUN92	V	R4622	1		2362.92		2362.92				
238	151- 0W				25JUN92	V	R4623	1		2365.34		2365.34	+2.42	2364.13	2363.90	-0.23
		1 32	111		24JUN92	V	R4620	1		2370.45		2370.45				
					24JUN92	V	R4621	1		2365.87		2365.87	-4.58	2368.16	2370.94	2.78
		1 29	200		24JUN92	V	R4618	1		2371.74		2371.74				
					24JUN92	V	R4619	1		2372.88		2372.88	+1.14	2372.31	2374.50	2.19
		1 26	321		24JUN92	V	R4616	1		2306.75		2306.75				
					24JUN92	V	R4617	1		2297.02		2297.02	-9.73	2301.89	2306.34	4.45
		1 24	414		23JUN92	V	R4614	1		2302.86		2302.86				
					24JUN92	V	R4615	1		2302.18		2302.18	-0.68	2302.52	2302.29	-0.23
		1 21	619		23JUN92	V	R4612	1		2304.82		2304.82				
					23JUN92	V	R4613	1		2309.67		2309.67	+4.85	2307.25	2308.71	1.46
		1 18	925		23JUN92	V	R4611	1		2339.78		2339.78		2339.78	2342.12	2.34
		1 15	1233		29APR92	V	R4608	1		2361.81		2361.81		2361.81	2366.27	4.46
		1 12	1643		28APR92	V	R4606	1		2388.43		2388.43				
					28APR92	V	R4607	1		2397.44		2397.44	+9.01	2392.94	2390.04	-2.90
		1 10	2055		29APR92	V	R4604	1		2386.94		2386.94		2386.94	2402.16	15.22
		1 5	3088		28APR92	V	R4602	1		2415.77		2415.77				
					29APR92	V	R4603	1		2417.29		2417.29	+1.52	2416.53	2415.86	-0.67

TITRATION SYSTEM:
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BOTTLE TYPE:
 R = RODAVISS S = S TYPE

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

Table 2 (continued)

THE CARBON DIOXIDE PROJECT OF THE SCRIPPS INSTITUTION OF OCEANOGRAPHY
TUNES Leg 3 1991 Pacific WOCE Line P16C

SUMMARY OF ALKALINITY DATA (cont.)

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	CDRG ALK	CDRG -S.I.O.
										(UEQUIV/KG SW)						
3	7- 0S	1 36	7	08SEP91	14JAN92	V	R4628	1		2322.81		2322.81				
242	151- 0W				14JAN92	V	R4629	1		2313.68		2313.68	-9.13	2318.25	2322.62	4.37
		1 10	3018		27DEC91	V	R4626	1		2423.34						
					09JAN92	V	R4626	3		2421.54	-1.80	2422.44				
					27DEC91	V	R4627	1		2420.80						
					09JAN92	V	R4627	2		2417.63	-3.17	2419.22	-3.22	2420.83	2421.04	0.21
3	5- 0S	2 36	8	09SEP91	29APR92	V	R4652	1		2322.37		2322.37				
246	151- 0W				29APR92	V	R4653	1		2324.68		2324.68	+2.31	2323.53	2330.70	7.17
		2 35	60		28APR92	V	R4650	1		2324.31		2324.31				
					29APR92	V	R4651	1		2324.93		2324.93	+0.62	2324.62	2328.18	3.56
		2 33	137		28APR92	V	R4648	1		2391.43		2391.43				
					28APR92	V	R4649	1		2388.40		2388.40	-3.03	2389.92	2390.78	0.86
		2 31	215		27APR92	V	R4646	1		2317.16		2317.16				
					28APR92	V	R4647	1		2319.68		2319.68	+2.52	2318.42	2315.57	-2.85
		2 29	307		27APR92	V	R4644	1		2303.79		2303.79				
					28APR92	V	R4645	1		2302.89		2302.89	-0.90	2303.34	2304.23	0.89
		2 27	409		27APR92	V	R4642	1		2296.21		2296.21				
					27APR92	V	R4643	1		2303.38		2303.38	+7.17	2299.79	2305.23	5.44
		2 23	631		27APR92	V	R4640	1		2308.46		2308.46				
					27APR92	V	R4641	1		2305.95		2305.95	-2.51	2307.21	2309.52	2.31
		2 20	917		16APR92	V	R4638	1		2338.21		2338.21				
					16APR92	V	R4639	1		2334.98		2334.98	-3.23	2336.59	2340.41	3.82
		2 18	1221		14APR92	V	R4636	1		2363.64		2363.64				
					15APR92	V	R4637	1		2363.65		2363.65	+0.01	2363.65	2370.58	6.93
		2 16	1629		14APR92	V	R4634	1		2375.49		2375.49				
					14APR92	V	R4635	1		2368.65		2368.65	-6.84	2372.07	2394.12	22.05
		2 14	1982		14APR92	V	R4632	1		2405.05		2405.05				
					14APR92	V	R4633	1		2397.61		2397.61	-7.44	2401.33	2407.20	5.87

TITRATION SYSTEM:
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BOTTLE TYPE:
 R = RODAVISS S = S TYPE

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

Table 2 (continued)

THE CARBON DIOXIDE PROJECT OF THE SCRIPPS INSTITUTION OF OCEANOGRAPHY
TUNES Leg 3 1991 Pacific WOCE Line P16C

SUMMARY OF ALKALINITY DATA (cont.)

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	CDRG ALK	CDRG -S.I.O.
										(UEQUIV/KG SW)						
3	5- 0S	2 9	3012	09SEP91	14APR92	V	R4630	1		2424.18		2424.18				
246	151- 0W				14APR92	V	R4631	1		2421.44		2421.44	-2.74	2422.81	2424.62	1.81
3	3- 0S	1 36	6	11SEP91	09APR92	V	R4656	1		2333.21		2333.21				
250	151- 0W				09APR92	V	R4657	1		2330.49		2330.49	-2.72	2331.85	2328.48	-3.37
		1 8	3084		09APR92	V	R4654	1		2422.52		2422.52				
					09APR92	V	R4655	1		2424.76		2424.76	+2.24	2423.64	2422.42	-1.22
3	1- 0S	1 36	7	14SEP91	14APR92	V	R4660	1		2321.75		2321.75				
262	151- 0W				14APR92	V	R4661	1		2317.14		2317.14	-4.61	2319.45	2329.90	10.45
		1 8	2980		27APR92	V	R4658	1		2378.73		2378.73				
					27APR92	V	R4659	1		2409.39		2409.39	+30.66	2394.06	2426.45	32.39
3	1- 0N	1 34	38	16SEP91	16APR92	V	R4682	1		2293.37		2293.37				
274	151- 0W				16APR92	V	R4683	1		2300.63		2300.63	+7.26	2297.00	2292.02	-4.98
		1 33	67		15APR92	V	R4680	1	EX	2322.63						
					16APR92	V	R4680	2		2300.09		2300.09				
					16APR92	V	R4681	1		2303.56		2303.56	+3.47	2301.83	2301.57	-0.26
		1 30	154		15APR92	V	R4679	1		2297.45		2297.45		2297.45	2298.60	1.15
		1 27	278		14APR92	V	R4676	1		2308.10		2308.10				
					14APR92	V	R4677	1		2307.77		2307.77	-0.33	2307.94	2292.74	-15.20
		1 25	354		16MAR92	V	R4674	1		2303.65		2303.65				
					17MAR92	V	R4675	1	EX	2321.29						
					17MAR92	V	R4675	2		2305.28		2305.28	+1.63	2304.47	2303.31	-1.16
		1 36	393		27APR92	V	R4684	1		2306.02		2306.02				
					27APR92	V	R4685	1		2306.93		2306.93	+0.91	2306.48	2303.21	-3.27
		1 18	801		16MAR92	V	R4670	1		2334.23		2334.23				
					16MAR92	V	R4671	1		2335.95		2335.95	+1.72	2335.09	2334.54	-0.55
		1 16	1007		10MAR92	V	R4668	1		2351.71		2351.71				
					16MAR92	V	R4669	1		2353.33		2353.33	+1.62	2352.52	2350.74	-1.78
		1 14	1368		10MAR92	V	R4666	1		2383.81		2383.81				
					10MAR92	V	R4667	1		2383.55		2383.55	-0.26	2383.68	2388.19	4.51

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Table 2 (continued)

THE CARBON DIOXIDE PROJECT OF THE SCRIPPS INSTITUTION OF OCEANOGRAPHY
TUNES Leg 3 1991 Pacific WOCE Line P16C

SUMMARY OF ALKALINITY DATA (cont.)

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	CDRG ALK	CDRG -S.I.O.
										(UEQUIV/KG SW)						
3	1- 0N	1 12	1778	16SEP91	06MAR92	V	R4664	1		2403.70		2403.70				
274	151- 0W				06MAR92	V	R4665	1		2405.01		2405.01	+1.31	2404.35	2407.50	3.15
		1 4	3126		14APR92	V	R4662	1		2408.86		2408.86		2408.86	2425.33	16.47
3	3- 0N	1 35	7	18SEP91	27DEC91	V	R4690	1		2291.47						
286	151- 0W				07JAN92	V	R4690	2		2286.62	-4.85	2289.05				
					27DEC91	V	R4691	1		2291.21						
					07JAN92	V	R4691	2		2285.21	-6.00	2288.21	-0.84	2288.63	2267.03	-21.60
		1 10	3084		17JAN92	V	R4687	1		2425.61						
					23JAN92	V	R4687	2		2419.23	-6.38	2422.42				
					17JAN92	V	R4688	1	F	2438.13				2422.42	2434.29	11.87
3	5- 0N	1 36	8	20SEP91	06MAR92	V	R4714	1		2268.77		2268.77				
290	151- 0W				06MAR92	V	R4715	1		2270.13		2270.13	+1.36	2269.45	2264.37	-5.08
		1 34	81		06MAR92	V	R4712	1		2301.23		2301.23				
					06MAR92	V	R4713	1		2298.33		2298.33	-2.90	2299.78	2297.08	-2.70
		1 33	120		06MAR92	V	R4710	1		2302.51		2302.51				
					06MAR92	V	R4711	1		2295.19		2295.19	-7.32	2298.85	2288.56	-10.29
		1 31	205		06MAR92	V	R4708	1		2290.66		2290.66				
					06MAR92	V	R4709	1		2292.09		2292.09	+1.43	2291.38	2290.10	-1.28
		1 29	296		16MAR92	V	R4706	2		2306.02		2306.02				
					16MAR92	V	R4707	1		2303.56		2303.56	-2.46	2304.79	2303.52	-1.27
		1 27	411		10MAR92	V	R4704	1		2306.81						
					16MAR92	V	R4704	2		2308.30	+1.49	2307.56				
					10MAR92	V	R4705	1		2293.86						
					16MAR92	V	R4705	2		2298.58	+4.72	2296.22	-11.34	2301.89	2306.92	5.03
		1 23	616		27FEB92	V	R4702	1		2317.84		2317.84				
					27FEB92	V	R4703	1	EX	2327.72						
					05MAR92	V	R4703	2		2315.42		2315.42	-2.42	2316.63	2317.17	0.54
		1 20	924		27FEB92	V	R4700	1		2344.09		2344.09				
					27FEB92	V	R4701	1		2341.15		2341.15	-2.94	2342.62	2347.91	5.29
		1 18	1230		24FEB92	V	R4698	1		2377.21		2377.21				
					24FEB92	V	R4699	1		2375.96		2375.96	-1.25	2376.58	2374.63	-1.95

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Table 2 (continued)

THE CARBON DIOXIDE PROJECT OF THE SCRIPPS INSTITUTION OF OCEANOGRAPHY
TUNES Leg 3 1991 Pacific WOCE Line P16C

SUMMARY OF ALKALINITY DATA (cont.)

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	CDRG ALK	CDRG -S.I.O.
										(UEQUIV/KG SW)						
3	5- 0N	1 16	1642	20SEP91	24FEB92	V	R4696	1		2404.42		2404.42				
290	151- 0W				24FEB92	V	R4697	1		2398.55		2398.55	-5.87	2401.49	2402.44	0.95
		1 14	2054		24FEB92	V	R4694	1		2423.76		2423.76				
					24FEB92	V	R4695	1		2417.42		2417.42	-6.34	2420.59	2420.23	-0.36
		1 9	3089		24FEB92	V	R4692	1		2435.17		2435.17				
					24FEB92	V	R4693	1		2432.69		2432.69	-2.48	2433.93	2424.48	-9.45
3	6-58N	1 36	10	21SEP91	05MAR92	V	R4718	1		2223.80		2223.80				
294	151-22W				05MAR92	V	R4719	1	EX	2230.37						
					06MAR92	V	R4719	2		2227.42		2227.42	+3.62	2225.61	2227.68	2.07
		1 10	3191		05MAR92	V	R4716	1		2397.31		2397.31				
					05MAR92	V	R4717	1	F	2424.67				2397.31	2433.44	36.13
3	8-56N	1 36	16	22SEP91	05MAR92	V	R4722	1		2212.18		2212.18				
298	151-45W				05MAR92	V	R4723	1		2211.53		2211.53	-0.65	2211.85	2220.76	8.91
		1 9	3058		11FEB92	V	R4720	1		2428.54		2428.54				
					11FEB92	V	R4721	1	F	2410.73				2428.54	2438.19	9.65
3	10-54N	1 36	8	23SEP91	10FEB92	V	R4746	1		2224.68		2224.68				
302	152- 7W				10FEB92	V	R4747	1		2226.17		2226.17	+1.49	2225.43	2219.63	-5.80
		1 34	60		10FEB92	V	R4744	1	EX	2300.11						
					11FEB92	V	R4744	2		2289.12		2289.12				
					10FEB92	V	R4745	1		2289.56		2289.56	+0.44	2289.34	2283.51	-5.83
		1 32	110		10FEB92	V	R4742	1		2274.25		2274.25				
					10FEB92	V	R4743	1		2274.71		2274.71	+0.46	2274.48	2272.20	-2.28
		1 29	212		07FEB92	V	R4740	1		2299.76		2299.76				
					07FEB92	V	R4741	1		2301.09		2301.09	+1.33	2300.43	2296.03	-4.40
		1 27	314		07FEB92	V	R4738	1		2308.10		2308.10				
					07FEB92	V	R4739	1		2309.66		2309.66	+1.56	2308.88	2305.85	-3.03
		1 26	416		07FEB92	V	R4736	1		2317.30		2317.30				
					07FEB92	V	R4737	1		2316.15		2316.15	-1.15	2316.73	2317.00	0.27
		1 24	621		07FEB92	V	R4734	1		2334.50		2334.50				
					07FEB92	V	R4735	1		2335.57		2335.57	+1.07	2335.04	2336.30	1.26

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Table 2 (continued)

THE CARBON DIOXIDE PROJECT OF THE SCRIPPS INSTITUTION OF OCEANOGRAPHY
TUNES Leg 3 1991 Pacific WOCE Line P16C

SUMMARY OF ALKALINITY DATA (cont.)

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	CDRG ALK	CDRG -S.I.O.
										(UEQUIV/KG SW)						
3	10-54N	1 21	928	23SEP91	03FEB92	V	R4732	1		2364.78		2364.78				
302	152- 7W				03FEB92	V	R4733	1		2365.34		2365.34	+0.56	2365.06	2364.16	-0.90
		1 19	1237		03FEB92	V	R4730	1		2390.20		2390.20				
					03FEB92	V	R4731	1		2390.43		2390.43	+0.23	2390.31	2385.09	-5.22
		1 17	1647		03FEB92	V	R4728	1		2411.42		2411.42				
					03FEB92	V	R4729	1		2411.27		2411.27	-0.15	2411.34	2409.38	-1.96
		1 15	2058		03FEB92	V	R4726	1		2432.61		2432.61				
					03FEB92	V	R4727	1		2427.58		2427.58	-5.03	2430.10	2423.61	-6.49
		1 10	3086		03FEB92	V	R4724	1		2430.97		2430.97				
					03FEB92	V	R4725	1		2432.61						
					03FEB92	V	R4725	2	EX	2436.95		2432.61	+1.64	2431.79	2436.65	4.86
3	12-52N	1 36	9	24SEP91	10FEB92	V	R4750	1		2244.44		2244.44				
306	152-30W				10FEB92	V	R4751	1		2246.90		2246.90	+2.46	2245.67	2242.65	-3.02
3	14-50N	1 36	9	26SEP91	09JAN92	V	R4754	2		2245.92		2245.92				
310	152-53W				09JAN92	V	R4755	1		2245.93		2245.93	+0.01	2245.93	2246.20	0.27
		1 12	3081		20JAN92	V	R4752	1		2432.55		2432.55				
					20JAN92	V	R4753	1		2431.47		2431.47	-1.08	2432.01	2432.53	0.52
3	16-48N	2 36	9	27SEP91	23JAN92	V	R4778	1		2283.39		2283.39				
314	153-16W				23JAN92	V	R4779	1		2282.56		2282.56	-0.83	2282.98	2280.08	-2.90
		2 34	76		23JAN92	V	R4776	1		2301.59		2301.59				
					23JAN92	V	R4777	1		2302.10		2302.10	+0.51	2301.85	2300.94	-0.91
		2 33	107		23JAN92	V	R4774	1		2311.76		2311.76				
					23JAN92	V	R4775	1		2313.75		2313.75	+1.99	2312.76	2307.89	-4.87
		2 30	216		21JAN92	V	R4772	1		2271.88		2271.88				
					21JAN92	V	R4773	1		2272.54		2272.54	+0.66	2272.21	2269.58	-2.63
		2 28	318		21JAN92	V	R4770	1		2281.47		2281.47				
					21JAN92	V	R4771	1		2280.45		2280.45	-1.02	2280.96	2280.04	-0.92

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Table 2 (continued)

THE CARBON DIOXIDE PROJECT OF THE SCRIPPS INSTITUTION OF OCEANOGRAPHY
TUNES Leg 3 1991 Pacific WOCE Line P16C

SUMMARY OF ALKALINITY DATA (*cont.*)

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	CDRG ALK	CDRG -S.I.O.
										(UEQUIV/KG SW)						
3	16-48N	2 25	442	27SEP91	20JAN92	V	R4768	1		2312.17						
314	153-16W				27JAN92	V	R4768	2		2312.34	+0.17	2312.26				
					20JAN92	V	R4769	1		2312.81						
					27JAN92	V	R4769	2		2312.05	-0.76	2312.43	+0.17	2312.34	2311.10	-1.24
		2 22	676		20JAN92	V	R4766	1		2334.20		2334.20				
					20JAN92	V	R4767	1		2339.02		2339.02	+4.82	2336.61	2338.75	2.14
		2 20	933		20JAN92	V	R4764	1		2362.07		2362.07				
					20JAN92	V	R4765	1		2365.13		2365.13	+3.06	2363.60	2364.44	0.84
		2 18	1291		20JAN92	V	R4762	1		2392.43		2392.43				
					20JAN92	V	R4763	1		2389.57		2389.57	-2.86	2391.00	2394.47	3.47
		2 16	1698		20JAN92	V	R4760	1	EX	2416.26						
					21JAN92	V	R4760	2		2410.51		2410.51				
					20JAN92	V	R4761	1		2409.25		2409.25	-1.26	2409.88	2410.35	0.47
		2 14	2113		21JAN92	V	R4758	1		2415.97		2415.97				
					21JAN92	V	R4759	1		2420.93		2420.93	+4.96	2418.45	2421.86	3.41
		2 9	3201		21JAN92	V	R4756	1		2429.71		2429.71				
					21JAN92	V	R4757	1		2429.92		2429.92	+0.21	2429.81	2431.89	2.08

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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) review of data before distribution. Data received at CDIAC are rarely in a condition that permits 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-3 Expedition in the South Pacific Ocean (WOCE Section P16C).

1. Carbon-related data and preliminary hydrographic measurements were provided to CDIAC by Catherine Goyet of WHOI and Peter Guenther and Dave Keeling of SIO. Hydrographic measurements and the station information files were provided by Lynne Talley of SIO and 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. 5 and 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 (Fig. 7), 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 Lynne Talley.

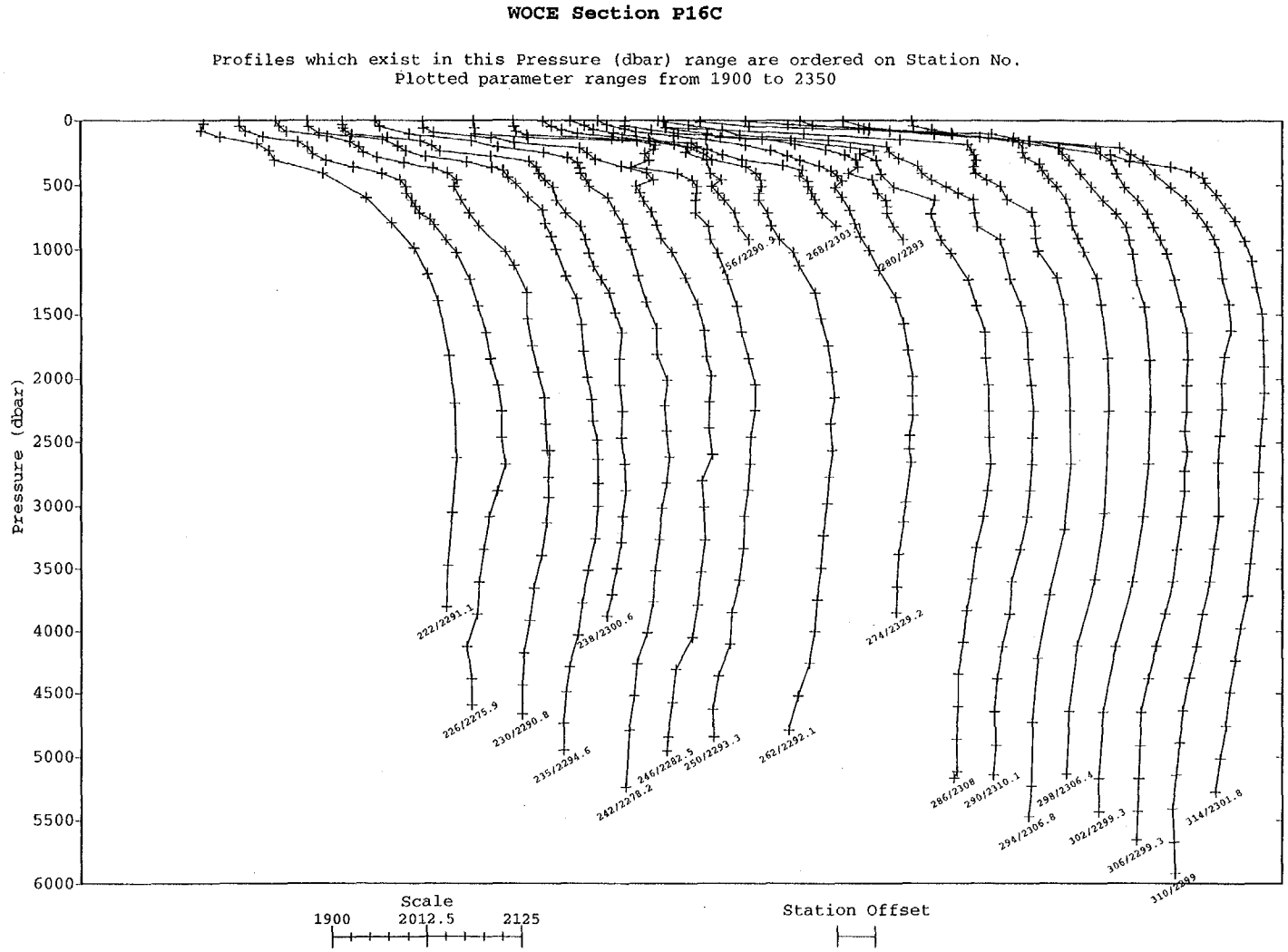

Figure 5. Nested profiles: Total carbon (μmol/kg) vs pressure (dbar).

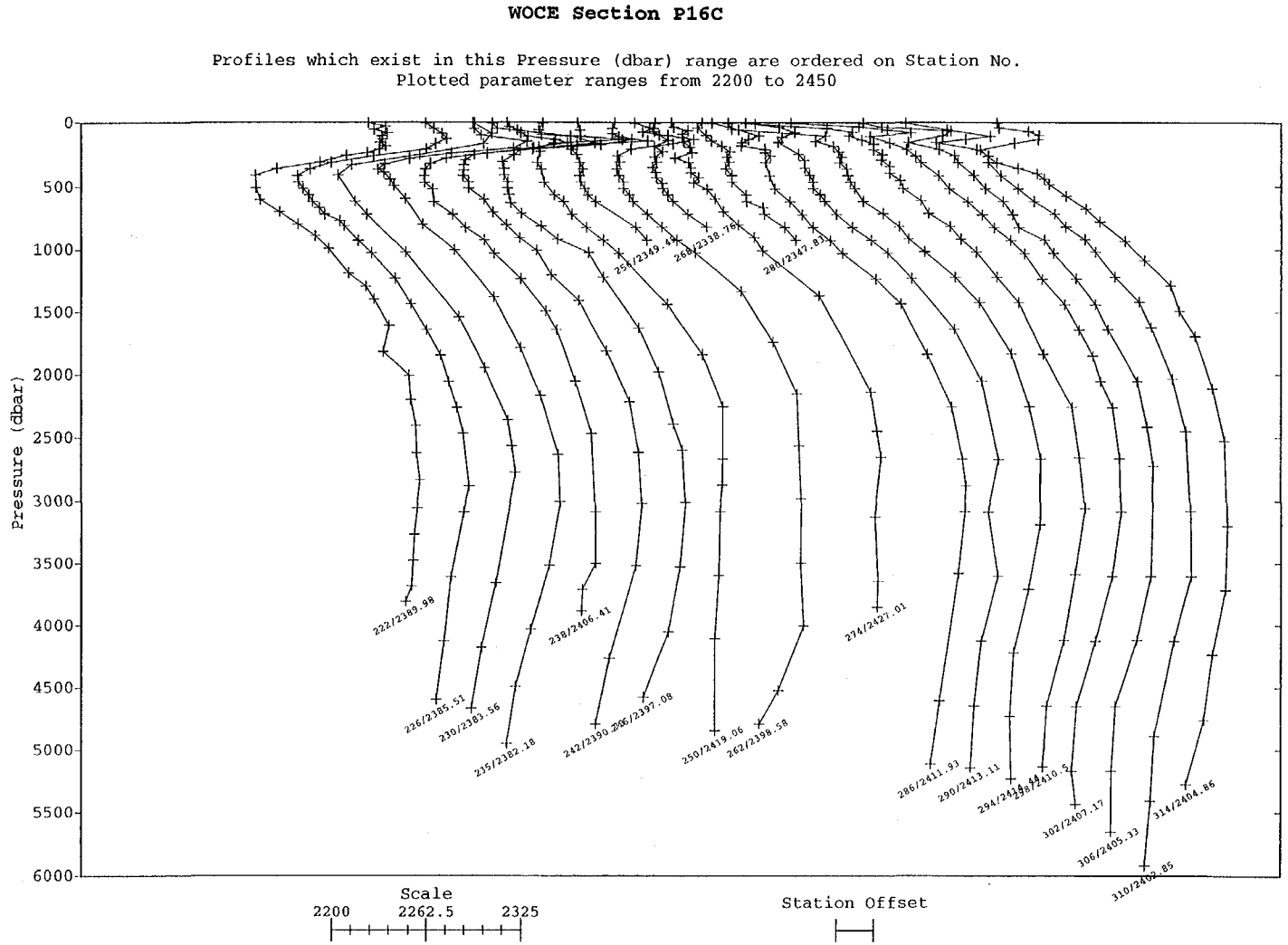

Figure 6. Nested profiles: Total alkalinity (μmol/kg) vs pressure (dbar).

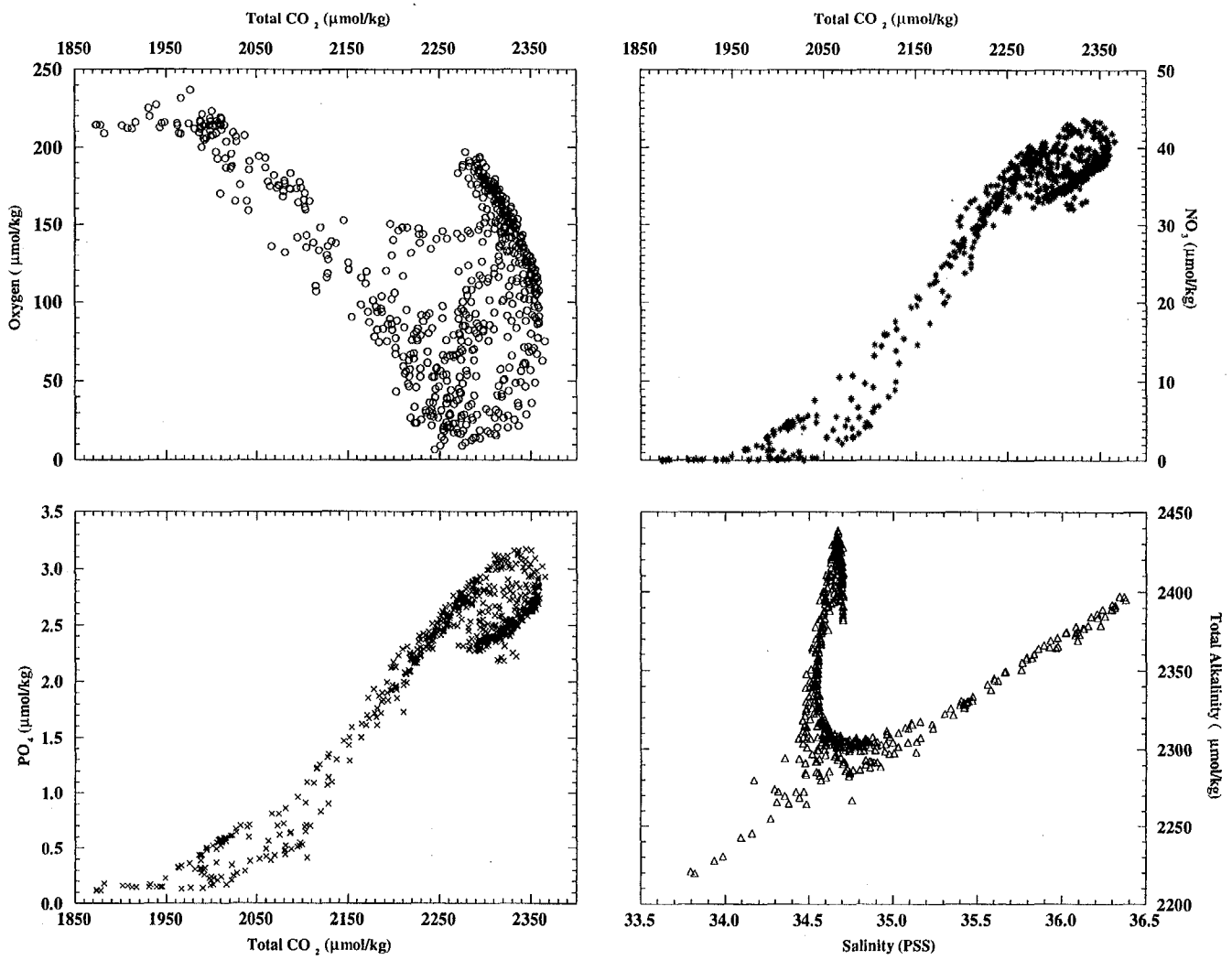

Figure 7. Property-property plots for all stations occupied during R/V *Thomas Washington* TUNES-3 Expedition.

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; 8-mm tape; 150-MB, 0.25-in. tape cartridge; MAC- or IBM-formatted floppy diskettes; or from CDIAC's anonymous file transfer protocol (FTP) area via the 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, nonlabeled tapes with ASCII characters. Requests should be addressed to

Carbon Dioxide Information Analysis Center
Oak Ridge National Laboratory
P. O. Box 2008
Oak Ridge, TN 37831-6335
U.S.A.

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

Electronic Mail: cdiac@ornl.gov

The data files can also be acquired from CDIAC's anonymous FTP area via the 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/ndp060," and
- Acquire the files using the FTP "get" or "mget" command.

or

access the following 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., **NDP060.doc**), 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. **NDP060.doc**: a detailed description of the cruise network, the two FORTRAN 77 data retrieval routines, and the two oceanographic data files	1,965	165,587	8,000	80
2. **stainv.for**: a FORTRAN 77 data retrieval routine to read and print **tun3sta.inv** (File 4)	45	1,344	8,000	80
3. **tun3dat.for:** a FORTRAN 77 data retrieval routine to read and print **tun3.dat** (File 5)	49	2,099	8,000	80
4. **tun3sta.inv**: a listing of the station locations, sampling dates, and sounding bottom depths for each of all stations	117	8,253	4,100	41
5. **tun3.dat:** hydrographic, carbon dioxide, and chemical data from all stations	3,283	567,182	16,000	160
Total	5,459	742,665		

NDP060.doc (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 **tun3sta.inv** (File 4). The following is a listing of this program. For additional information regarding variable definitions, variable length, variable type, units, and codes, please see the description for **tun3sta.inv**.

```
c**********************************************************************
c* This is a Fortran retrieval code to read and format the            *
c* station inventory cruise TUNES-3 R/V T. Washington WOCE P16C line *
c**********************************************************************

c*Defines variables*

       INTEGER  stat, cast, depth
       REAL latdcm, londcm
       CHARACTER expo*11, sect*4, date*6, time*4
       OPEN (unit=1, file='tun3sta.inv')
       OPEN (unit=2, file='tunes3sta.inv')
       write (2, 5)

c*Writes out column labels*

 5     format (3X, 'STATIONS INVENTORY: R/V THOMAS WASHINGTON',/,
     1 3X,'EXPOCODE',1X,'SECT',1X,'STNBR',2X,'CAST',
     2 5X,'DATE',1X,'TIME',2X,'LATITUDE',2X,'LONGITUDE',2X,
     3 'DEPTH',/)

c*Sets up a loop to read and format all the data in the file*
       read (1, 6)
 6     format (/////////)

 7     CONTINUE
       read (1, 10, end=999) expo, sect, stat, cast, date, time,
     1 latdcm, londcm, depth

 10    format (A11, 1X, A4, 3X, I3, 5X, I1, 3X, A6, 1X, A4, 3X,
     1 F7.3, 3X, F8.3, 3X, I4)

       write (2, 20) expo, sect, stat, cast, date, time,
     1 latdcm, londcm, depth

 20    format (A11, 1X, A4, 3X, I3, 5X, I1, 3X, A6, 1X, A4, 3X,
     1 F7.3, 3X, F8.3, 3X, I4)

       GOTO 7
 999   close(unit=5)
       close(unit=2)
       stop
       end
```

tun3dat.for (File 3)

This file contains a FORTRAN 77 data retrieval routine to read and print **tun3.dat** (File 5). The following is a listing of this program. For additional information regarding variable definitions, variable length, variable type, units, and codes, please see the description for **tun3.dat**.

```
c*****************************************************************
c* FORTRAN 77 data retrieval routine to read and print the       *
c* file named "tun3.dat" (File 5).                               *
c*****************************************************************
      CHARACTER qualt*13
      INTEGER sta, cast, samp, bot
      REAL pre, ctdtmp, ctdsal, ctdoxy, theta, sal, oxy, silca
      REAL nitrat, nitrit, phspht, cfc11, cfc12, tcarb, talk
      OPEN (unit=1, file='tun3.dat')
      OPEN (unit=2, file='tunes3.dat')
      write (2, 5)

 5    format (2X,'STNNBR',2X,'CASTNO',2X,'SAMPNO',2X,'BTLNBR',2X,
     1 'CTDPRS',2X,'CTDTMP',4X,'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',
     4 8X,'QUALT1',/,
     5 36X,'DBAR',2X,'ITS-90',4X,'PSS-78',1X,'UMOL/KG',2X,'ITS-90',
     6 4X,'PSS-78',1X,5('UMOL/KG',1X,),1X,'PMOL/KG',2X,'PMOL/KG',1X,
     7 2('UMOL/KG',1X,),12X,'*',/,25X,'*******',19X,2('*******',1X,),
     8 10X,6('*******',1X,),1X,'*******',2X,3('*******',1X,),
     9 12X,'*',)

      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, qualt

 10   format (5X, I3, 7X, I1, 6X, I2, 5X, I3, 1X, F7.1, 1X, F7.4,
     1 1X, F9.4, 1X, F7.2, 1X, F7.4, 1X, F9.4, 1X, F7.2, 1X, F7.2,
     2 1X, F7.2, 1X, F7.2, 1X, F7.2, 1X, F8.3, 1X, F8.3, 1X, F7.1,
     3 1X, F7.2, 1X, A13)

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

 20   format (5X, I3, 7X, I1, 6X, I2, 5X, I3, 1X, F7.1, 1X, F7.4,
     1 1X, F9.4, 1X, F7.2, 1X, F7.4, 1X, F9.4, 1X, F7.2, 1X, F7.2,
     2 1X, F7.2, 1X, F7.2, 1X, F7.2, 1X, F8.3, 1X, F8.3, 1X, F7.1,
     3 1X, F7.2, 1X, A13)

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

tun3sta.inv (File 4)

This file provides station inventory information for each of the 125 stations occupied during the R/V *Thomas Washington* TUNES-3 Expedition. Each record of the file contains an expocode, section number, station number, cast number, sampling date, sampling time, latitude, longitude, 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, cast, depth
      REAL latdcm, londcm
      CHARACTER expo*11, sect*4, date*6, time*4

      read (1, 10, end=999) expo, sect, stat, cast, date, time,
     1 latdcm, londcm, depth

 10   format (A11, 1X, A4, 3X, I3, 5X, I1, 3X, A6, 1X, A4, 3X,
     1 F7.3, 3X, F8.3, 3X, 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	4	13	16
stat	Numeric	3	20	22
cast	Numeric	1	28	28
date	Character	6	32	37
time	Character	4	39	42
latdcm	Numeric	7	46	52
londcm	Numeric	8	56	63
depth	Numeric	4	67	70

where

expo is the expocode of the cruise;

sect is the WOCE section number;

stat is the station number (values range from 221 to 326);

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

time is the sampling time (Greenwich mean time);

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

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

depth is the sounding depth of the station (meters).

tun3.dat (File 5)

This file provides hydrographic, CO_2, and chemical data for the 105 stations occupied during the R/V *Thomas Washington* TUNES-3 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, TCO_2, and TALK; 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 **tun3dat.for**, File 3):

```
      CHARACTER qualt*13
      INTEGER sta, cast, samp, bot
      REAL pre, ctdtmp, ctdsal, ctdoxy, theta, sal, oxy, silca
      REAL nitrat, nitrit, phspht, cfc11, cfc12, tcarb, talk

10    format (5X, I3, 7X, I1, 6X, I2, 5X, I3, 1X, F7.1, 1X, F7.4,
     1 1X, F9.4, 1X, F7.2, 1X, F7.4, 1X, F9.4, 1X, F7.2, 1X, F7.2,
     2 1X, F7.2, 1X, F7.2, 1X, F7.2, 1X, F8.3, 1X, F8.3, 1X, F7.1,
     3 1X, F7.2, 1X, A13)
```

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	2	31	32
pre	Numeric	6	35	40
ctdtmp	Numeric	7	42	48
ctdsal	Numeric	9	50	58
ctdoxy	Numeric	7	60	66
theta	Numeric	7	68	74
sal	Numeric	9	76	84
oxy	Numeric	7	86	92
silca	Numeric	7	94	100
nitrat	Numeric	7	102	108

nitrit	Numeric	7	110	116
phspht	Numeric	7	118	124
cfc11	Numeric	8	126	133
cfc12	Numeric	8	135	142
tcarb	Numeric	7	144	150
talk	Numeric	7	152	158
qualt	Character	13	160	172

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 (dbar);

ctdtmp is the CTD temperature (°C);

ctdsal* is the CTD salinity (on the practical salinity scale);

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

theta is the potential temperature (°C);

sal* is the bottle salinity;

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

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

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

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

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

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

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

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

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

qualt is a 13-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 NDP 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 five and last five lines of a data file.

Table 4. Partial listing of "tun3sta.inv" (File 4)

First five lines of the file:

```
31WTTUNES/3 P16C   221     1   090191 0937   -17.510   -150.481   3600
31WTTUNES/3 P16C   222     1   090191 1535   -16.994   -150.494   3770
31WTTUNES/3 P16C   223     1   090191 2148   -16.500   -150.502   4090
31WTTUNES/3 P16C   224     1   090291 0333   -15.988   -150.502   3375
31WTTUNES/3 P16C   225     2   090291 1454   -15.526   -150.653   4243
```

Last five lines of the file:

```
31WTTUNES/3 P16C   322     1   093091 1114    18.855   -155.568   3100
31WTTUNES/3 P16C   323     1   093091 1422    18.849   -155.599   2400
31WTTUNES/3 P16C   324     1   093091 1655    18.871   -155.609   1720
31WTTUNES/3 P16C   325     1   093091 1853    18.879   -155.639    900
31WTTUNES/3 P16C   326     1   093091 2007    18.881   -155.656    240
```

Table 5. Partial listing of "tun3.dat" (File 5)

First five lines of the file:

```
     221       1      36      36     9.1 26.6452   36.0902 -999.90 26.6431   36.0125  211.26     0.85     0.76
0.00    0.19    1.736    0.909  -999.9 -999.90 2252222222299
     221       1      35      35    39.0 26.5801   36.0897 -999.90 26.5712   36.0869  212.03     0.86     0.21
0.00    0.19    1.733    0.924  -999.9 -999.90 2252222222299
     221       1      34      34    68.4 26.5697   36.1019 -999.90 26.5541   36.1152  211.67     1.26     0.21
0.00    0.19 -999.900 -999.900  -999.9 -999.90 2252222221199
     221       1      33      33   109.6 25.9976   36.0599 -999.90 25.9730   36.0459  214.31     0.88     0.21
0.00    0.16 -999.900 -999.900  -999.9 -999.90 2252222221199
     221       1      32      32   128.2 25.6561   36.0471 -999.90 25.6277   36.1015  196.74     0.88     0.44
0.09    0.23 -999.900 -999.900  -999.9 -999.90 2252222221199
```

Last five lines of the file:

```
     326       1       5       5    80.4 24.7524   34.9463  222.33 24.7351   34.9490  215.10     2.85     0.14
0.00    0.08 -999.900 -999.900  -999.9 -999.90 2222222221199
     326       1       4       4   120.0 21.8640   35.1125  208.80 21.8404   35.1098  206.79     3.25     0.47
0.11    0.15 -999.900 -999.900  -999.9 -999.90 2222222221199
     326       1       3       3   158.9 20.0164   35.0678  192.69 19.9870   35.0575  192.27     4.06     2.39
0.05    0.28 -999.900 -999.900  -999.9 -999.90 2222222221199
     326       1       2       2   199.4 15.0942   34.5223  181.08 15.0639   34.5241  183.94     8.94     8.64
0.01    0.71 -999.900 -999.900  -999.9 -999.90 2222222221199
     326       1       1       1   284.4  9.9364 -999.9000 -999.90  9.9037   34.1426  162.18    25.61    19.87
0.01    1.50 -999.900 -999.900  -999.9 -999.90 2552222221199
```

APPENDIX A:

STATION INVENTORY

APPENDIX A:
STATION INVENTORY

This appendix lists station inventory information for the 105 sites occupied during the R/V *Thomas Washington* TUNES-3 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;

SECT is the WOCE section number;

STNBR is the station number;

CAST is the cast number;

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

TIME is the sampling time (Greenwich mean time);

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

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

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

Table A.1 Station inventory information for the 105 sites occupied during R/V *Thomas Washington* TUNES-3 Expedition

```
*****************************************************************************
*  Source:    P. Guenther                        C. Goyet                   *
*             C. Keeling            Woods Hole Oceanographic Institution    *
*             L. Talley                                                     *
*  Scripps Institution of Oceanography                                      *
*  University of California, San Diego                                      *
*****************************************************************************
*  STATION INVENTORY: R/V THOMAS WASHINGTON
*  EXPOCODE SECT STNBR  CAST     DATE TIME  LATITUDE  LONGITUDE  DEPTH

31WTTUNES/3 P16C   221     1   090191 0937   -17.510   -150.481   3600
31WTTUNES/3 P16C   222     1   090191 1535   -16.994   -150.494   3770
31WTTUNES/3 P16C   223     1   090191 2148   -16.500   -150.502   4090
31WTTUNES/3 P16C   224     1   090291 0333   -15.988   -150.502   3375
31WTTUNES/3 P16C   225     2   090291 1454   -15.526   -150.653   4243
31WTTUNES/3 P16C   225     5   090391 0013   -15.528   -150.704   4243
31WTTUNES/3 P16C   226     1   090391 0547   -14.999   -150.835   4528
31WTTUNES/3 P16C   227     1   090391 1217   -14.509   -150.991   4432
31WTTUNES/3 P16C   228     1   090391 1843   -14.007   -150.998   4308
31WTTUNES/3 P16C   229     1   090491 0055   -13.502   -151.014   4620
31WTTUNES/3 P16C   230     1   090491 0718   -12.993   -151.003   4595
31WTTUNES/3 P16C   231     1   090491 1326   -12.500   -151.008   4783
31WTTUNES/3 P16C   232     1   090491 2004   -12.004   -150.999   4870
31WTTUNES/3 P16C   233     1   090591 0329   -11.504   -150.997   4990
31WTTUNES/3 P16C   234     1   090591 1018   -11.012   -151.002   5033
31WTTUNES/3 P16C   235     4   090691 1247   -10.508   -150.988   4910
31WTTUNES/3 P16C   236     1   090691 1925   -10.003   -150.989   4690
31WTTUNES/3 P16C   237     1   090791 0224    -9.497   -150.994   4910
31WTTUNES/3 P16C   238     1   090791 0836    -9.000   -150.996   3840
31WTTUNES/3 P16C   239     1   090791 1426    -8.501   -150.994   4050
31WTTUNES/3 P16C   240     1   090791 2057    -8.007   -150.995   4975
31WTTUNES/3 P16C   241     1   090891 0410    -7.508   -151.001   5210
31WTTUNES/3 P16C   242     1   090891 1114    -7.018   -151.003   5182
31WTTUNES/3 P16C   243     1   090891 1750    -6.498   -151.000   4900
31WTTUNES/3 P16C   244     3   090991 0719    -6.031   -151.008   5117
31WTTUNES/3 P16C   245     1   090991 1818    -5.496   -151.006   4960
31WTTUNES/3 P16C   246     2   091091 0121    -5.013   -151.005   4985
31WTTUNES/3 P16C   247     1   091091 0809    -4.519   -151.007   4655
31WTTUNES/3 P16C   248     1   091091 1438    -4.009   -151.014   4560
31WTTUNES/3 P16C   249     2   091091 2152    -3.492   -151.018   4715
31WTTUNES/3 P16C   250     1   091191 0408    -3.007   -151.013   4765
31WTTUNES/3 P16C   251     1   091191 0952    -2.842   -151.004   4705
31WTTUNES/3 P16C   252     1   091191 1429    -2.683   -151.012   4796
31WTTUNES/3 P16C   253     1   091191 1907    -2.505   -151.008   4806
31WTTUNES/3 P16C   254     2   091291 0006    -2.334   -151.014   4910
31WTTUNES/3 P16C   255     1   091291 0326    -2.163   -150.997   4835
31WTTUNES/3 P16C   256     1   091291 0944    -1.998   -150.991   4749
31WTTUNES/3 P16C   257     1   091291 1412    -1.833   -150.993   4825
31WTTUNES/3 P16C   258     1   091291 1819    -1.669   -150.996   4874
31WTTUNES/3 P16C   259     5   091391 1310    -1.525   -150.992   4858
31WTTUNES/3 P16C   260     1   091391 2016    -1.330   -150.995   4839
31WTTUNES/3 P16C   261     1   091491 0137    -1.168   -151.002   4840
31WTTUNES/3 P16C   262     1   091491 0615    -1.007   -150.997   4720
31WTTUNES/3 P16C   263     1   091491 1049    -0.831   -150.991   4250
31WTTUNES/3 P16C   264     1   091491 1439    -0.671   -150.989   4454
31WTTUNES/3 P16C   265     1   091491 1850    -0.497   -150.990   4342
31WTTUNES/3 P16C   266     2   091491 2327    -0.343   -150.999   4385
31WTTUNES/3 P16C   267     1   091591 0349    -0.174   -151.001   4110
31WTTUNES/3 P16C   268     1   091591 0802    -0.005   -150.999   4340
31WTTUNES/3 P16C   269     1   091591 1225     0.153   -150.997   3780
31WTTUNES/3 P16C   270     1   091591 1622     0.329   -150.997   4731
31WTTUNES/3 P16C   271     1   091591 2038     0.505   -151.001   3250
31WTTUNES/3 P16C   272     1   091691 0040     0.667   -150.997   4200
31WTTUNES/3 P16C   273     1   091691 0503     0.828   -151.002   4235
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Table A.1 (continued)

31WTTUNES/3	P16C	274	1	091691 0855	0.993	-150.998	3770
31WTTUNES/3	P16C	275	1	091691 1318	1.151	-151.006	4276
31WTTUNES/3	P16C	276	1	091691 1700	1.333	-151.001	3130
31WTTUNES/3	P16C	277	1	091691 2100	1.493	-151.000	4120
31WTTUNES/3	P16C	278	1	091791 0133	1.653	-150.999	4215
31WTTUNES/3	P16C	279	1	091791 0606	1.829	-151.008	4120
31WTTUNES/3	P16C	280	1	091791 1022	1.996	-151.002	4409
31WTTUNES/3	P16C	281	1	091791 1455	2.147	-151.001	4502
31WTTUNES/3	P16C	282	1	091791 1920	2.328	-151.003	4725
31WTTUNES/3	P16C	283	1	091891 0054	2.484	-151.001	4715
31WTTUNES/3	P16C	284	1	091891 0528	2.656	-151.010	4615
31WTTUNES/3	P16C	285	1	091891 1025	2.825	-151.005	4780
31WTTUNES/3	P16C	286	1	091891 1500	2.978	-151.003	5070
31WTTUNES/3	P16C	287	2	091891 2220	3.500	-151.003	4845
31WTTUNES/3	P16C	288	2	091991 1039	4.009	-151.016	5041
31WTTUNES/3	P16C	289	1	091991 2117	4.500	-150.997	5150
31WTTUNES/3	P16C	290	1	092091 0422	4.996	-151.003	5060
31WTTUNES/3	P16C	291	1	092091 1052	5.482	-151.095	5215
31WTTUNES/3	P16C	292	1	092091 1716	5.998	-151.180	5110
31WTTUNES/3	P16C	293	2	092191 0019	6.461	-151.257	5255
31WTTUNES/3	P16C	294	1	092191 0704	6.959	-151.348	5370
31WTTUNES/3	P16C	295	1	092191 1352	7.448	-151.464	5275
31WTTUNES/3	P16C	296	1	092191 2022	7.967	-151.571	5106
31WTTUNES/3	P16C	297	1	092291 0316	8.434	-151.648	5125
31WTTUNES/3	P16C	298	1	092291 0944	8.943	-151.755	5040
31WTTUNES/3	P16C	299	1	092291 1600	9.419	-151.822	5190
31WTTUNES/3	P16C	300	3	092391 0445	9.927	-151.935	5240
31WTTUNES/3	P16C	301	1	092391 1509	10.403	-152.024	4690
31WTTUNES/3	P16C	302	1	092391 2136	10.907	-152.112	5312
31WTTUNES/3	P16C	303	1	092491 0654	11.385	-152.212	5350
31WTTUNES/3	P16C	304	1	092491 1340	11.875	-152.314	5186
31WTTUNES/3	P16C	305	1	092491 2019	12.355	-152.407	5397
31WTTUNES/3	P16C	306	1	092591 0411	12.865	-152.503	5545
31WTTUNES/3	P16C	307	1	092591 1102	13.347	-152.591	5660
31WTTUNES/3	P16C	308	3	092691 0135	13.842	-152.673	6010
31WTTUNES/3	P16C	309	1	092691 1419	14.325	-152.781	5950
31WTTUNES/3	P16C	310	1	092691 2120	14.839	-152.891	5791
31WTTUNES/3	P16C	311	1	092791 0449	15.321	-152.987	5650
31WTTUNES/3	P16C	312	1	092791 1132	15.822	-153.063	5414
31WTTUNES/3	P16C	313	1	092791 1758	16.298	-153.169	4947
31WTTUNES/3	P16C	314	2	092891 0111	16.802	-153.267	5185
31WTTUNES/3	P16C	315	1	092891 0744	17.281	-153.363	5075
31WTTUNES/3	P16C	316	1	092891 1334	17.640	-153.431	4914
31WTTUNES/3	P16C	317	3	092991 0114	18.002	-153.497	4950
31WTTUNES/3	P16C	318	1	092991 1206	18.209	-153.977	5152
31WTTUNES/3	P16C	319	1	092991 1829	18.400	-154.474	5162
31WTTUNES/3	P16C	320	1	093091 0057	18.597	-154.952	5220
31WTTUNES/3	P16C	321	1	093091 0712	18.820	-155.424	4450
31WTTUNES/3	P16C	322	1	093091 1114	18.855	-155.568	3100
31WTTUNES/3	P16C	323	1	093091 1422	18.849	-155.599	2400
31WTTUNES/3	P16C	324	1	093091 1655	18.871	-155.609	1720
31WTTUNES/3	P16C	325	1	093091 1853	18.879	-155.639	900
31WTTUNES/3	P16C	326	1	093091 2007	18.881	-155.656	240

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