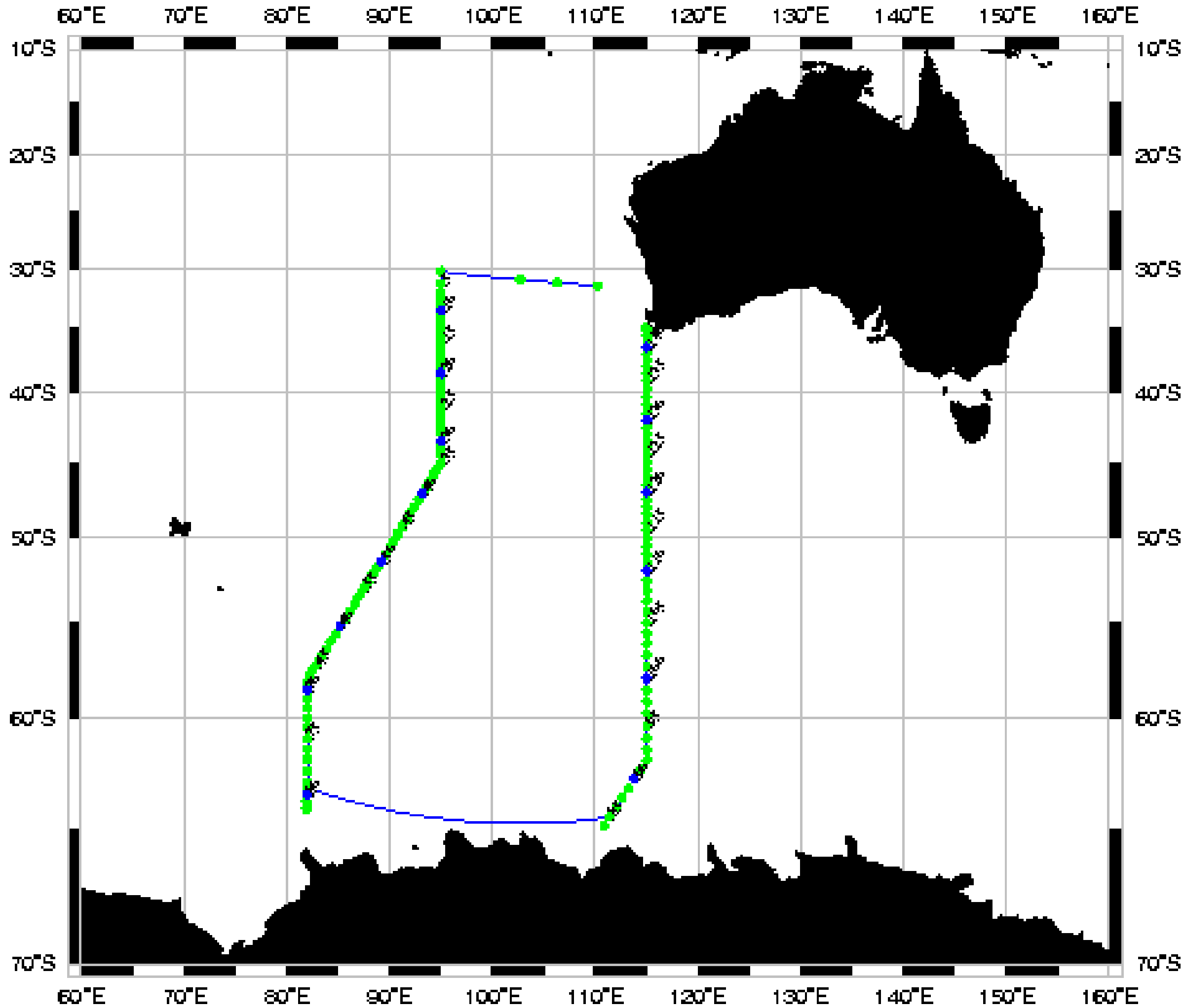
WHP Ref. No.: I08S/I09S
Last updated: 2000.09.27

A. Cruise Narrative

A.1 Highlights

A.1.a	WOCE designation	I08S/I09S
A.1.b	EXPOCODE	316N145_5
A.1.c	Chief Scientist	Mike McCartney Woods Hole Oceanographic Institute Woods Hole, MA 02543 phone: 508-457-2000 ext. 2797 Fax: 508-457-2181 e-mail: mike@gaff.whoi.edu Thomas Whitworth III Department of Oceanography Texas A&M University Mail Stop 3146 College Station, TX 77843-3146
A.1.d	Ship	R/V Knorr
A.1.e	Ports of call	Freantle, Australia
A.1.f	Cruise dates	1 December 1994 - 19 January 1995

A.2 Cruise Summary Information



(Cruise track produced by WHPO staff)

A.2.a Geographic boundaries

A.2.b Stations occupied

A.2.c Floats and drifters deployed

A.2.d Moorings deployed or recovered

A.3 List of Principal Investigators

A.4 Scientific Programme and Methods

DESCRIPTION OF SCIENTIFIC PROGRAM

The object of this cruise was to occupy a series of CTD-O2 (Conductivity-Temperature-Depth-Oxygen) stations along two, approximately north-south tracks. The first track started at 30∞ S. 95∞ E and ended at the edge of the ice of Antarctica at 82∞ E. The second track began at the ice edge at 111∞ E and proceeded north to the continental shelf of Australia at 115∞ E.

This collection of high-quality water-property data will help define the pattern of circulation in the Indian Ocean. At each station measurements of temperature, salinity, and dissolved-oxygen concentration were made continuously with depth, and the concentrations of dissolved silica, phosphate, nitrate, and nitrite were measured at up to 36 discrete levels. In addition, measurements of freon, tritium concentrations and CO2 were made at selected levels. The station spacing ranged from 5 to 40 nautical miles, and all flowerings were made to within 10-20 m of the bottom. Continuous echo-sounding was maintained along the cruise track, as well as ADCP current measurements.

OBSERVATIONS AND SAMPLES

The beginning, bottom and end positions of all the CTD stations occupied on this cruise are listed in the attached table, with the stations numbered sequentially through the cruise. Positions are also shown on the attached chart. We anticipate completion of the calibration and editing of the various data by 1 August 1996. As the hydrographic data for this section are WOCE data, the data then move through an additional quality-evaluation stage managed by the WOCE Hydrographic Programme Office (WHPO) in Woods Hole, which is generally expected to be completed within two years of cruise end and which includes the formal issuing (by WHPO) of a final ship-based data report about one year after the cruise end; and a final ship- and shore-based data report about two years after the cruise end.

As this is the most intensive phase of WOCE, the timing of these reports is quite approximate due to the heavy workload of the technical groups making the measurements and doing the quality control assessments. With that in mind, we intend to issue to Australia the preliminary version that results from the calibration and editing phase in mid1996, and subsequently issue revisions should the latter WHPO process lead to alterations. The data will be in digital form on 9-track magnetic tape, or other suitable media; and the final report will be printed copy and/or a text file.

A.5 Major Problems and Goals not Achieved

A.6 Other Incidents of Note

A.7 List of Cruise Participants

Name	Institution	Responsibility
McCartney, Michael	WHOI	Co-Chi. Sci.
		CTD-O2/Rosette
Whitworth, Thomas III	TAMU	Co-Chi. Sci.
		CTD-O2/Rosette
Swartz, H.Marshall, Jr.	WHOI	CTD team leader
		Watch leader
Rutz, Steven B.	TAMU	CTD Watch Leader
Goepfert, Laura	WHOI	CTD Data Analysis
Knapp, George	WHOI	Water sample processor
Turner, Toshiko	WHOI	Water sample processor
Hufford, Gwyneth	WHOI	CTD Watchstander
Bennett, Paul	WHOI	CTD Watchstander
Bouchard, George	WHOI	CTD Watchstander
McKay, Thomas Jason	WHOI	CTD Watchstander
Primeau, Francois	WHOI	CTD Watchstander
Jennings, Joseph J.	OSU	Nutrient Analysis
Mordy, Calvin W.	PMEL	Nutrient Analysis
Firing, Eric	U Hawaii	ADCP specialist
Hargreaves, Kirk	PMEL	CFC Analysis
Mathieu, Guy	LDEO	CFC Analysis
Mathieu, Sally	LDEO	CFC Analysis
Johnson, Kenneth M.	BNL	CO2 analysis
Haynes, Charlotte H.	BNL	CO2 analysis
Haynes, Elizabeth M.	BNL	CO2 analysis
Wysor, Brian S.	BNL	CO2 analysis
Brockington, Melinda	U Washington	C14 analysis
Boenisch, Gerhard W.	LDEO	Helium/Tritium analysis
Ludin, Andrea	LDEO	Helium/Tritium analysis
Tynan, Cynthia T.	NOAA Marine Mammal Lab	Observations
Cotton, James M.	NOAA Marine Mammal Lab	Observations
Pitman, Robert L., Jr.	NOAA Marine Mammal Lab	Observations
Rowlett, Richard A.	NOAA Marine Mammal Lab	Observations

C.2 EQUIPMENT CONFIGURATION

Equipment used aboard the R/V Knorr for WOCE section I8SI9S was provided by both Woods Hole Oceanographic Institution CTD Operations (WHOI CTD Ops) and the Scripps Institute of Oceanography's Shipboard Technical Services/ Ocean Data Facility (SIO STS/ODF). A total of 147 stations were taken during the cruise.

Two complete sampler frames were provided by ODF, each consisting of a coated aluminum frame and thirty-six ODF-built 10-liter bottles. For this cruise two CTDs were usually attached to the frame, one providing real-time data via FSK telemetry, and another recording internally. Also mounted on the frame were a GO pylon, independent ocean temperature modules (OTM), a lowered acoustic doppler current profiler (LADCP) provided by the University of Hawaii, and an Ocean Instruments System's 12 kHz pinger for bottom-finding. 141 of the 147 CTD station data came from WHOI CTD 9, a WHOI-modified Neil Brown MK-3b CTD, sampling at 23.8 Hz, and incorporating a Sensormedics oxygen sensor assembly, a titanium strain gauge pressure tranducer and a platinum temperature sensor with a lag of 150 ms.

A General Oceanics (GO) model 1016-36 position pylon was mounted to the 36-bottle frame to control the firing of the bottles at depth. The 1016 pylon was driven by a GO 1016-SCI Surface Control Interface (SCI) in the lab, which provided power and commands down the sea cable, and received status data back. The SCI was controlled through a dedicated personal computer. Due to SCI performance problems, the 1016-36 pylon was replaced with two GO 1015-24 pylons mounted one on top of the other. The 1015-24 pylons were controlled by two GO 1015PM deck units, which provided power and commands down the cable.

One of two Falmouth Scientific CTDs, ICTD1338 and ICTD1344, were placed on the primary frame in internal-recording mode to acquire comparison data. In addition, one of two Falmouth Scientific OTMs were placed on the frame to provide an independent temperature measurement channel in the CTD data stream.

During rough weather a smaller specially-designed stainless steel frame was used. The frame was built at WHOI and is based on a design from John Bullister's group at NOAA/PMEL, uses 25 4-liter sample bottles, and is intended to provide CTD capability in high seas. Five stations were taken with this frame using a 1015-24 pylon and WHOI CTD 12, a GO-upgraded MK3c CTD sampling at 25.0 Hz, a Sensormedics oxygen sensor assembly, a titanium pressure transducer, a platinum temperature sensor with a lag of 200ms, and a fast thermistor.

EQUIPMENT PROBLEMS

Stations 1-3 were test stations. Station 1 used ICTD1338, with the 1016-36 pylon and SCI. Numerous problems were encountered including communication interferences between the fsk ICTD data and the pylon-SCI communication. It was also found that the oxygen sensor was not working properly and it was deduced after the cruise that the SeaCon underwater connectors were failing open-circuit at various pressures.

Station 2 used CTD9, 1016 SCI and pylon, and again communication problems developed causing synch errors in the CTD data and unreliable operation of the pylon. The oxygen assembly on CTD9 was not secured properly thus not recording reliable oxygen data. Station 3 used CTD12 and the 1016-36 pylon and SCI, and again the cast had communication interference between the SCI and the CTD. Efforts were made to adjust the telemetry levels to minimize the data disruption.

For stations 4 and 5, CTD9 was used with the 1016 SCI and pylon, again communication problems were noted. During the down cast the pylon was turned off and only turned on during the upcast. The acquisition program was placed in stand-by when firing bottles because the CTD data had unacceptably high error rates when the pylon was used.

After station 5, the 1016-36 position pylon was removed from the frame and replaced with a GO 1015-24 position pylon. For station 6 through station 29 only 24 bottles were tripped, as only one 24-position pylon was able to be used. For station 30, a second 24-position pylon was stacked underneath the first, providing the capability to trigger all 36 sample bottles.

On numerous occasions, data reported by the FSI OTM would indicate a data latch-up, sometimes accompanied by a subsequent restart. The problem was not solved on the cruise, but was later traced to insufficient clearances of the internal components in the pressure case.

The three GO 1016-36 pylons which were initially tried all failed. Two failures were traced to damaged internal power supplies, and one had a broken position-indicating switch. All pylons were initially supplied in fully tested and satisfactory condition, but it was later found that using them with the GO-supplied SCIs could cause the power supply failures. We have since stopped using the GO-supplied SCIs. The mechanical failure to the position switch caused the pylon to lose it's place, and thus become useless. As a result, the technician first rigged one 1015-24 pylon in place of the 1016-36, and by station 30, added another 1015-24, providing sufficient release mechanisms for all 36 frame sample bottles. The Knorr's engine department provided outstanding assistance in making the necessary support mounts and modifications to help meet the science objectives.

The GO 1015-24 pylons were a source of occasional uncertainty, as it could not always be determined where a bottle tripped. Sometimes, hydrographic data indicated that two bottles closed at one stop, and although every effort was made to maintain, align and clean the pylons, this problem was not entirely eliminated. They performed better than anticipated, however, going for more than 40 consecutive stations without a mistrip, and allowed the cruise to gather 36 samples per cast.

Early on in the cruise, the tensiometer for the starboard winch failed. This forced us to use the port winch for the remainder of the cruise. In addition, station 81 was aborted due to winch problems, when a bearing for the tension block failed.

On stations 50 through 53, the oxygen sensor with CTD9 was found to be operating erratically. It was subsequently replaced. CTD9 had been provided with a new design of pressure compensation for the mineral-oil reservoir behind the sensor. This was demonstrated to provide smoother pressure compensation and fewer jumps in the data as the pressure differential equalized across the oxygen sensor membrane.

AQUISITION AND PROCESSING METHODS

Data from CTD 9 was acquired at 23.8 Hz and with a temperature lag of 150 ms. Data from CTD 12 was acquired at 25.0 Hz and with a temperature lag of 200 ms. The temperature lag was checked by comparing density reversals in theta salinity (TS) plots (Giles and McDonald, 1986). It was found that the afore mentioned lags showed the least amount of looping or density reversals.

Data was acquired by an EG&G Mk-III deck unit providing demodulated data to two personal computers running EG&G version 5.2 rev 2 CTD acquisition software (EG&G, Oceansoft acquisition manual, 1990), one providing graphical data to screen and plotter, and the other a running listing output. Bottom approach was controlled by following the pinger direct and bottom return signals on the ship-provided PDR trace.

After each station, the CTD data was forwarded to another set of personal computers running both EG&G CTD post-processing 3.0 software and custom-built software from WHOI (Millard and Yang, 1993). The data was first-differenced, lag corrected, pressure sorted, and pressure-centered into 2 decibar bins for final data quality control and analysis, including fitting to water sample salinity and oxygen results.

SUMMARY OF LABORATORY CALIBRATIONS FOR CTDs

The pressure, temperature, and conductivity sensors were calibrated by Maren Tracy Plueddemann and Marshall Swartz at the Woods Hole Oceanographic Institution's CTD Calibration Laboratory.

PRESSURE CALIBRATIONS

Method/Calibration Standards The pressure transducers of CTD9, CTD12, ICTD1338, and ICTD1344 were calibrated in a temperature controlled bath to WHOI's Ruska Model 2480 Dead Weight Tester (DWT) as described by Millard and Yang (1993) over the range of atmospheric to 6,200 dbars.

The pre-cruise pressure calibration was performed at three different temperatures, 1.78¯C, 14.82¯C, and 30.10¯C. The calibrations were completed November 7, 1994. Post-cruise pressure calibrations were performed at only one temperature point, 1.20¯C and were completed April 7, 1995.

		BIAS	SLOPE	QUADRATIC
CTD 9				
pre-cruise	1.78°C	-.495103E+01	.100588E+00	.112622E-10
	14.82°C	-.439017E+01	.100576E+00	.100853E-09
	30.10°C	-.371797E+01	.100592E+00	-.192585E-09
post-cruise	1.20°C	-.421198E+01	.100585E+00	.847090E-10
CTD 12				
pre-cruise	1.78°C	-.405781E+02	.107379E+00	.430549E-09
	14.82°C	-.399422E+02	.107390E+00	.370115E-09
	30.10°C	-.392364E+02	.107395E+00	.383934E-09
post-cruise	1.20°C	-.395154E+02	.107384E+00	.385736E-09
ICTD 1338				
pre-cruise	1.78°C	.707844E+00	.999402E-01	.131998E-09
	14.82°C	.674421E+00	.999320E-01	.368154E-09
	30.10°C	.177411E+00	.999467E-01	.248022E-09
post-cruise	1.20°C	.152460E+01	.998550E-01	.734740E-09
ICTD 1344				
pre-cruise	1.78°C	.293056E+01	.999521E-01	-.263500E-09
	14.82°C	.168364E+01	.999844E-01	-.360033E-09
	30.10°C	.171705E+01	.999784E-01	-.291289E-09
post-cruise	1.20°C	.410510E+01	.999568E-01	-.466373E-09

TEMPERATURE CALIBRATIONS

Method/Calibration Standards

For both the pre and post cruise temperature calibrations an Automated Systems Laboratory (ASL) F18 temperature bridge with a Rosemount 162-CE SPRT were used as transfer standards. During the calibration, the CTD was fully immersed in a well-stirred constant temperature 700-liter salt water bath. The pre-cruise temperature calibration was completed November 1, 1994 for all instruments brought on the cruise. The post-cruise temperature calibration was completed March 17, 1995 on CTD 9. Due to a failure of CTD 12, a post-cruise calibration could not be performed. The CTD worked fine during the cruise, however during the post cruise calibration the CTD was unable to synch on the data. Data is reported to WOCE on the ITS-90 scale, but is processed internally on the IPTS-68 scale for compatibility with the equations for the Practical Salinity Scale of 1978 (PSS-78).

CTD PRIMARY PLATINUM TEMPERATURE

	BIAS	SLOPE	QUADRATIC
CTD9			
pre-cruise	-.179120E+01	.496261E-03	.385531E-11
post-cruise	-.179285E+01	.496217E-03	.467567E-11
CTD12			
pre-cruise	.621572E+01	.499695E-03	.688332E-12
post-cruise	N/A	N/A	N/A
ICTD1338			
pre-cruise	.198004E-02	.499934E-03	-.483458E-12
post-cruise	.213918E-02	.499918E-03	-.971791E-12
ICTD1344			
pre-cruise	-.452392E-02	.500201E-03	-.330744E-11
post-cruise	-.643159E-02	.500258E-03	-.404936E-11

OXYGEN TEMPERATURE

CTD9			
pre-cruise	.717010E-02	.124856E+00	-.381392E-05
post-cruise	.197632E+00	.123681E+00	-.494725E-05
CTD12			
pre-cruise	-.771413E+01	.761267E-03	-.186160E-08
post-cruise	N/A	N/A	N/A
ICTD1338			
pre-cruise	N/A	N/A	N/A
post-cruise	-.201461E+01	.161598E+00	-.127533E-03
ICTD1344			
pre-cruise	-.374508E+01	.153921E+00	-.836036E-04
post-cruise	-.401615E+01	.159201E+00	-.125456E-03

PRESSURE TEMPERATURE

CTD9	S1	S2	T0	
pre-cruise	.376241E+02	-.938036E-02	-1.7188E-2	.0353811.78
post-cruise	.374444E+02	-.920480E-02		
CTD12				
pre-cruise	.145943E+03	-.374919E-02	4.1010E-7	.0473161.78
post-cruise	N/A	N/A		

(Note: ICTDs do not have a separately reporting temperature channel).

CONDUCTIVITY CALIBRATIONS

Method/Calibration Standards

A pre-cruise conductivity calibration was performed on CTD 9 and CTD 12. Five salinity samples were drawn and analyzed on a Guildline Autosal 8100-B autosalinometer at each temperature point during the temperature calibration. These values were then converted to conductivity and compared to the values read by the CTD at the different temperatures (Millard and Yang, 1993).

CTD9		
pre-cruise	-.113915E-01	.998004E-03
post-cruise	-.724614E-02	.998114E-03

CTD12		
pre-cruise	.278165E-01	.100049E-02
post-cruise	N/A	N/A

For final processing of the data the pre-cruise calibration constants were used to scale the data for CTD12, ICTD1338, and CTD9.

CTD DATA

SUMMARY OF AT SEA CALIBRATIONS

The pressure of the CTDs at the sea surface was recorded at the beginning of each station. The on deck pressure was found using by graphing the calculated pressure prior to the package entering the water. This number was then subtracted from the pressure bias term for each station.

CONDUCTIVITY CALIBRATION

Basic fitting procedure

The CTD conductivity sensor data was fit to the water sample conductivity as described in Millard and Yang 1993. The stations were fit as a drift of the sensor was noted.

OXYGEN CALIBRATIONS

Basic Fitting procedure

The CTD oxygen sensor variables were fit to water sample oxygen data to determine the six parameters of the oxygen algorithm (Millard and Yang, 1993). As with conductivity, the stations were fit as a drift in the sensor was noted.

QUALITY CONTROL OF 2DB CTD DATA AND SEA FILES

Stations 3, 8, 31, and 62 had several pressure bins where there was no CTD data. These bins have been marked as 6's in the *.CTD files. During these stations there were a lot of synch errors in the raw data that had to be cleaned up and this resulted in very few good scans in several pressure bins.

For stations 1 and 2, where the oxygen sensors were not working, the CTD values in the *.CTD and *.SEA files were changed to -9.000 and the quality word to 5. For CTD9, stations 50- 53 the oxygen sensor showed erroneous values. The CTD oxygen values were again changed to -9.000 and the quality word change to 5 to reflect the bad sensor. For stations 46 and 47 it was noted that the sensor may have begun failing, thus the quality word for these oxygen CTD values was changed to 3 to reflect a questionable oxygen value in both the *.CTD and *.SEA file.

In the *.SEA files the down trace CTD oxygen value is used, in some cases there was no pressure bin in the down trace so the oxygen value was taken from the nearest pressure bin. These values are marked as questionable in the *.SEA files.

References:

Giles, Alan B. and Trevor J. McDonald. 1986. Two methods for the reduction of Salinity Spiking of CTDs. Deep Sea Research, Vol 33, no 9. 1253-1274.

Mangum, B.W. and G.T. Furukawa. 1990. Guidelines for Realizing the International Temperature Scale of 1990 (ITS-90). NIST Technical Notes 1265.

Millard, R. C. and K. Yang. 1993. CTD Calibration and Processing Methods used at Woods Hole Oceanographic Institution. Technical Report No. 93-44, 96 pages.

Oceansoft MKIII/SCTD Acquisition Software Manual. 1990. P/N Manual 10239. EG&G Marine Instruments.

Owens, Brechner W. and Robert C. Millard, Jr. 1985. A New Algorithm for CTD Oxygen Calibrations. J. Phys. Oc. vol 15.621-631.

CFC-11 and CFC-12 Measurements on WOCE I08S/I09S

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Specially designed 10 liter water sample bottles were used on the cruise to reduce CFC contamination. These bottles have the same outer dimensions as standard 10 liter Niskin bottles, but use a modified end-cap design to minimize the contact of the water sample with the end-cap O-rings after closing. The O-rings used in these water sample bottles were vacuum-baked prior to the first station on the Indian Ocean Expedition. Stainless steel springs covered with a nylon powder coat were substituted for the internal elastic tubing standardly used to close Niskin bottles.

CFC samples were drawn from approximately 50% of 4600 water samples collected during the expedition. Water samples for CFC analysis were usually the first samples drawn from the 10 liter bottles. Care was taken to co-ordinate the sampling of CFCs with other samples to minimize the time between the initial opening of each bottle and the completion of sample drawing. In most cases, dissolved oxygen, total CO2, alkalinity and pH samples were collected within several minutes of the initial opening of each bottle. To minimize contact with air, the CFC samples were drawn directly through the stopcocks of the 10 liter bottles into 100 ml precision glass syringes equipped with 2-way metal stopcocks. The syringes were immersed in a holding tank of clean surface seawater until analysed.

To reduce the possibility of contamination from high levels of CFCs frequently present in the air inside research vessels, the CFC extraction/analysis system and syringe holding tank were housed in a modified 20' laboratory van on the aft deck of the ship.

For air sampling, a ~100 meter length of 3/8" OD Dekaron tubing was run from the CFC lab van to the bow of the ship. Air was pulled through this line into the CFC van using an Air Cadet pump. The air was compressed in the pump, with the downstream pressure held at about 1.5 atm using a back-pressure regulator. A tee allowed a flow (~100 cc/min) of the compressed air to be directed to the gas sample valves, while the bulk flow of the air (>7 liters per minute) was vented through the back pressure regulator.

Concentrations of CFC-11 and CFC-12 in air samples, seawater and gas standards on the cruise were measured by shipboard electron capture gas chromatography, using techniques similar to those described by Bullister and Weiss (1988). The CFC system used was built at the Scripps Institution of Oceanography and had been used on several Pacific WOCE legs as well as several Indian Ocean WOCE legs. The SIO system was modified from the Bullister and Weiss (1988) design to use a fixed volume, variable pressure gas loop injection system. The sample loops were either pressurized or evacuated to known pressures in order to vary the amount of gas sample introduced. The sample loop(s) were periodically filled with CFC-free gas to one atmosphere and analyzed to check for analytical blanks. The typical analysis time for a seawater, air, standard or blank sample was about 12 minutes.

The CFC analytical system functioned well during this expedition.

Concentrations of CFC-11 and CFC-12 in air, seawater samples and gas standards are reported relative to the SIO93 calibration scale (Cunnold, et. al., 1994). CFC concentrations in air and standard gas are reported in units of mole fraction CFC in dry gas, and are typically in the parts-per-trillion (ppt) range. Dissolved CFC concentrations are given in units of picomoles of CFC per kg seawater (pmol/kg). CFC concentrations in air and seawater samples were determined by fitting their chromatographic peak areas to multi-point calibration curves, generated by pressurizing sample loops and injecting known volumes of gas from a CFC working standard (PMEL cylinder 38415) into the analytical instrument. The concentrations of CFC-11 and CFC-12 in this working standard were calibrated versus a primary CFC standard (36743) (Bullister, 1984) before the cruise and a secondary standard (32386) before and after the cruise.

Full range calibration curves were run several times (approx. every 5 days during the cruise. Single injections of a fixed volume of standard gas at one atmosphere were run much more frequently (at intervals of 1 to 2 hours) to monitor short term changes in detector sensitivity.

As expected, low (~0.015 pmol/kg) but non-zero CFC concentrations were measured in deep and bottom samples along the northern ends (~32S) of I8S and I9S. Deep and bottom CFC concentrations increased significantly southward along the sections. It is likely that most of the deep CFC signals observed on I8S and I9S, which are strongly correlated with elevated dissolved oxygen and cold temperatures, are due to deep ventilation processes in this high latitude region, and not simply blanks due of the sampling and analytical procedures. The measured levels of CFC in deep water samples on the northern ends I8S and I9S sections are considerable higher than those found on WOCE sections in the low latitude Indian Ocean. For example, typical measured deep water CFC measurements along WOCE section I2 (at about 8S) were ~0.003 pmol/kg for CFC-11 and <0.001 for CFC-12. Since no "zero" CFC water was present anywhere along I8S or I9S, and later cruises (e.g. I2) showed low CFC blanks for the sampling procedures, no corrections for 'sampling blanks' have been applied to the reported CFC signals for I8S and I9S. A few samples (~86 of a total of ~2300) had clearly anomalous CFC-11 and/or CFC-12 concentrations relative to adjacent samples. These appeared to occur more or less randomly, and were not clearly associated with other features in the water column (e.g. elevated oxygen concentrations, salinity or temperature features, etc.). This suggests that the high values were due to isolated low-level CFC contamination events. These samples are included in this report and are flagged as either 3 (questionable) or 4 (bad) measurements. A total of 32 analyses of CFC-11 were assigned a flag of 3 and 25 analyses of CFC-12 were assigned a flag of 3. A total of 17 analyses of CFC-11 were assigned a flag of 4 and 24 CFC-12 samples assigned a flag of 4.

On this expedition, we estimate precisions (1 standard deviation) of about 1% or 0.005 pmol/kg (whichever is greater) for dissolved CFC-11 and 1% or 0.005 pmol/kg (whichever is greater) for dissolved CFC-12 measurements (see listing of replicate samples given at the end of this report).

In addition to the file of mean CFC concentrations,
ID), tables of the following are included in this report:

Table 1a. I8SI9S Replicate dissolved CFC-11 analyses
Table 1b. I8SI9S Replicate dissolved CFC-12 analyses
Table 2. I8SI9S CFC air measurements
Table 3. I8SI9S CFC air measurements interpolated to station locations

A value of -9.0 is used for missing values in the listings.

References:

Bullister, J.L. Anthropogenic Chlorofluoromethanes as Tracers of Ocean Circulation and Mixing Processes: Measurement and Calibration Techniques and Studies in the Greenland and Norwegian Seas, Ph.D. dissertation, Univ. Calif. San Diego, 172 pp.

Bullister, J.L. and R.F. Weiss, Determination of CCl3F and CCl2F2 in seawater and air. Deep-Sea Research, 35 (5), 839-853, 1988.

Cunnold, D.M., P.J. Fraser, R.F. Weiss, R.G. Prinn, P.G. Simmonds, B.R. Miller, F.N. Alyea, and A.J.Crawford. Global trends and annual releases of CCl3F and CCl2F2 estimated from ALE/GAGE and other measurements from July 1978 to June 1991. J. Geophys. Res., 99, 1107-1126, 1994.

Table 1a. Replicate F-11 Samples

Sta	Samp	F-11
1	6	0.024
1	6	0.029
1	6	0.031
1	12	0.020
1	12	0.032
1	14	0.036
1	14	0.032
1	21	0.161
1	21	0.025
2	1	0.013
2	1	0.029
2	8	0.012
2	8	0.015
2	15	0.028
2	15	0.028
3	1	0.022
3	1	0.014
3	7	0.011
3	7	0.026
3	13	0.017
3	13	0.015
3	25	0.016
3	25	0.018
3	31	0.013
3	31	0.042
4	18	0.201
4	18	0.195
4	19	0.436
4	19	0.422
4	25	3.107
4	25	3.303
4	25	3.326
4	31	2.953
4	31	2.955
7	6	0.009
7	6	0.012
7	23	2.601
7	23	2.541
9	14	0.570
9	14	0.569
9	17	3.310
9	17	3.277
11	19	3.167

Sta	Samp	F-11
11	19	3.206
12	15	2.150
12	15	2.126
13	9	0.023
13	9	0.046
13	21	3.084
13	21	3.164
15	14	1.568
15	14	1.570
16	10	0.024
16	10	0.020
16	15	2.263
16	15	2.277
16	21	3.435
16	21	3.395
16	21	3.473
17	6	0.030
17	6	0.005
17	23	3.151
17	23	3.164
18	13	1.165
18	13	1.156
18	14	1.551
18	14	1.527
19	15	2.309
19	15	2.340
19	21	3.387
19	21	3.389
21	15	2.770
21	15	2.804
21	17	3.605
21	17	3.573
22	13	0.871
22	13	0.883
22	17	3.649
22	17	3.586
22	21	3.506
22	21	3.496
24	7	0.041
24	7	0.042
24	23	3.409
24	23	3.408
24	23	3.416

Sta	Samp	F-11
29	15	1.962
29	15	1.949
29	18	3.453
29	18	3.232
30	21	1.336
30	21	1.350
34	22	1.868
34	22	1.832
34	30	4.299
34	30	4.317
35	28	3.668
35	28	3.640
37	34	4.459
37	34	4.348
40	24	2.485
40	24	2.506
40	27	3.556
40	27	3.545
41	2	0.112
41	2	0.110
44	1	0.313
44	1	0.309
44	32	4.450
44	32	4.444
46	27	2.553
46	27	2.562
50	2	0.582
50	2	0.576
55	3	0.652
55	3	0.629
55	32	5.446
55	32	5.451
56	19	0.169
56	19	0.175
56	29	2.721
56	29	2.745
62	7	0.529
62	7	0.550
62	33	5.957
62	33	5.758
75	9	0.062
75	9	0.064
79	3	0.060

Sta	Samp	F-11
79	3	0.057
79	34	6.568
79	34	6.595
82	31	1.461
82	31	1.469
85	2	1.458
85	2	1.416
85	21	0.326
85	21	0.330
85	35	6.081
85	35	6.158
87	9	0.486
87	9	0.489
87	29	2.740
87	29	2.739
92	5	0.745
92	5	0.756
92	33	6.201
92	33	6.178
94	2	1.260
94	2	1.246
94	33	6.619
94	33	6.644
97	34	6.385
97	34	6.434
99	8	0.260
99	8	0.255
99	16	0.145
99	16	0.141
100	12	0.565
100	12	0.564
100	16	4.962
100	16	4.953
101	6	0.232
101	6	0.231
101	22	5.964
101	22	5.952
103	14	0.068
103	14	0.070

Sta	Samp	F-11
105	5	0.348
105	5	0.350
105	28	3.033
105	28	2.959
105	34	5.529
105	34	5.514
107	35	5.521
107	35	5.550
111	16	0.086
111	16	0.085
111	29	2.387
111	29	2.427
114	6	0.047
114	6	0.047
116	6	0.040
116	6	0.040
116	32	4.646
116	32	4.636
120	14	0.242
120	14	0.238
120	35	4.067
120	35	4.039
122	31	3.721
122	31	3.733
122	33	3.905
122	33	3.900
124	18	1.522
124	18	1.524
124	21	2.120
124	21	2.104
124	33	3.725
124	33	3.721
126	6	0.049
126	6	0.050
126	34	3.692
126	34	3.673
127	32	3.635
127	32	3.661
129	2	0.070

Sta	Samp	F-11
129	2	0.073
129	2	0.035
129	33	3.596
129	33	3.575
130	1	0.068
130	1	0.072
130	2	0.072
130	2	0.067
130	2	0.069
130	2	0.067
131	5	0.067
131	5	0.064
131	28	3.621
131	28	3.605
133	6	0.033
133	6	0.037
133	34	3.422
133	34	3.405
135	26	3.394
135	26	3.378
135	33	3.140
135	33	3.136
137	21	1.577
137	21	1.578
137	32	3.307
137	32	3.355
137	33	3.276
137	33	3.252
137	34	3.171
137	34	3.167
139	34	3.225
139	34	3.221
141	30	3.226
141	30	3.232
141	32	3.073
141	32	3.145
144	10	0.013
144	10	0.013
144	33	2.426
144	33	2.418

Table 1b. Replicate F-12 Samples

Sta	Samp	F-12	Sta	Samp	F-12	Sta	Samp	F-12
1	6	0.057	11	19	1.672	29	15	0.965
1	6	0.060	12	15	1.071	29	15	0.954
1	6	0.066	12	15	1.049	29	18	1.770
1	12	0.059	13	9	0.007	29	18	1.732
1	12	0.058	13	9	0.021	30	21	0.646
1	14	0.020	13	21	1.641	30	21	0.658
1	14	0.045	13	21	1.677	34	22	0.889
1	21	0.019	15	14	0.798	34	22	0.895
1	21	0.069	15	14	0.810	34	30	2.133
2	1	-0.004	16	10	0.005	34	30	2.200
2	1	0.002	16	10	0.003	35	28	1.901
2	8	0.003	16	15	1.153	35	28	1.898
2	8	-0.008	16	15	1.142	37	34	2.271
2	15	-0.001	16	21	1.816	37	34	2.151
2	15	-0.006	16	21	1.783	40	24	1.182
3	1	-0.002	16	21	1.842	40	24	1.197
3	1	0.003	17	6	0.015	40	27	1.734
3	7	-0.008	17	6	-0.002	40	27	1.744
3	7	-0.004	17	23	1.689	41	2	0.053
3	13	0.003	17	23	1.689	41	2	0.058
3	13	-0.001	18	13	0.577	44	1	0.153
3	25	0.009	18	13	0.606	44	1	0.154
3	25	0.010	18	14	0.811	44	32	2.254
3	31	0.010	18	14	0.763	44	32	2.244
3	31	0.006	19	15	1.158	46	27	1.206
4	18	0.104	19	15	1.156	46	27	1.224
4	18	0.105	19	21	1.816	50	2	0.276
4	19	0.220	19	21	1.730	50	2	0.283
4	19	0.214	21	15	1.416	55	3	0.307
4	25	1.529	21	15	1.418	55	3	0.297
4	25	1.623	21	17	1.855	55	32	2.671
4	25	1.595	21	17	1.834	55	32	2.674
4	31	1.462	22	13	0.439	56	19	0.076
4	31	1.457	22	13	0.444	56	19	0.083
7	6	0.006	22	17	1.906	56	29	1.287
7	6	0.008	22	17	1.842	56	29	1.299
7	23	1.392	22	21	1.823	62	7	0.259
7	23	1.363	22	21	1.827	62	7	0.268
9	14	0.283	24	7	0.019	62	33	2.909
9	14	0.281	24	7	0.029	62	33	2.866
9	17	1.562	24	23	1.772	75	9	0.034
9	17	1.547	24	23	1.761	75	9	0.038
11	19	1.620	24	23	1.781	79	34	3.188

Sta	Samp	F-12	Sta	Samp	F-12	Sta	Samp	F-12
79	34	3.099	105	5	0.169	129	2	0.038
82	31	0.683	105	28	1.442	129	2	0.017
82	31	0.681	105	28	1.421	129	33	1.892
85	2	0.682	105	34	2.705	129	33	1.852
85	2	0.665	105	34	2.701	130	1	0.043
85	21	0.149	107	35	2.716	130	1	0.043
85	21	0.151	107	35	2.748	130	2	0.045
85	35	2.872	111	16	0.034	130	2	0.042
85	35	2.884	111	16	0.035	130	2	0.038
87	9	0.229	111	29	1.117	130	2	0.039
87	9	0.228	111	29	1.170	131	5	0.043
87	29	1.282	114	6	0.027	131	5	0.043
87	29	1.278	114	6	0.029	131	28	1.889
92	5	0.351	116	6	0.019	131	28	1.854
92	5	0.350	116	6	0.020	133	6	0.026
92	33	2.981	116	32	2.343	133	6	0.032
92	33	2.949	116	32	2.356	133	34	1.784
94	2	0.592	120	14	0.119	133	34	1.795
94	2	0.567	120	14	0.116	135	26	1.715
94	33	3.142	120	35	2.079	135	26	1.705
94	33	3.167	120	35	2.105	135	33	1.664
97	34	2.999	122	31	1.896	135	33	1.671
97	34	3.021	122	31	1.880	137	21	0.757
99	8	0.127	122	33	1.993	137	21	0.783
99	8	0.123	122	33	1.987	137	32	1.728
99	16	0.066	124	18	0.729	137	32	1.794
99	16	0.064	124	18	0.728	137	33	1.700
100	12	0.265	124	21	1.038	137	33	1.701
100	12	0.262	124	21	1.034	139	34	1.673
100	16	2.329	124	33	1.933	139	34	1.692
100	16	2.353	124	33	1.898	141	30	1.681
101	6	0.116	126	6	0.027	141	30	1.656
101	6	0.108	126	6	0.028	141	32	1.625
101	22	2.817	126	34	1.873	141	32	1.649
101	22	2.871	126	34	1.911	144	10	0.015
103	14	0.031	127	32	1.912	144	10	0.017
103	14	0.032	127	32	1.903	144	33	1.333
105	5	0.164	129	2	0.049	144	33	1.304

Table 2. i8s/i9s CFC Air Measurements:

Leg 1

Date	Time (hhmm)	Latitude	Longitude	F11 PPT	F12 PPT
5 Dec 94	0258	30 40.7 S	099 46.5 E	-9.0	513.7
5 Dec 94	0307	30 40.7 S	099 46.5 E	-9.0	513.0
5 Dec 94	0316	30 40.7 S	099 46.5 E	-9.0	514.3
5 Dec 94	0325	30 40.7 S	099 46.5 E	-9.0	514.1
5 Dec 94	0335	30 40.7 S	099 46.5 E	-9.0	514.4
7 Dec 94	2020	33 06.2 S	094 57.8 E	-9.0	515.4
7 Dec 94	2029	33 06.2 S	094 57.8 E	-9.0	515.5
7 Dec 94	2038	33 06.2 S	094 57.8 E	-9.0	512.3
9 Dec 94	2247	36 50.7 S	095 00.5 E	260.1	516.1
9 Dec 94	2256	36 50.7 S	095 00.5 E	259.3	513.5
9 Dec 94	2305	36 50.7 S	095 00.5 E	259.7	513.6
10 Dec 94	1908	38 10.7 S	095 00.7 E	259.5	513.2
10 Dec 94	1917	38 10.7 S	095 00.7 E	259.7	511.7
10 Dec 94	1926	38 10.7 S	095 00.7 E	259.9	510.1
13 Dec 94	1323	43 23.4 S	095 01.0 E	260.5	512.0
13 Dec 94	1332	43 23.4 S	095 01.0 E	260.1	513.7
13 Dec 94	1341	43 23.4 S	095 01.0 E	260.3	509.4
18 Dec 94	1143	50 34.0 S	090 02.0 E	262.4	515.7
18 Dec 94	1152	50 34.0 S	090 02.0 E	260.9	510.8
18 Dec 94	1201	50 34.0 S	090 02.0 E	260.8	513.2
22 Dec 94	1528	55 26.8 S	085 22.8 E	260.5	510.7
22 Dec 94	1537	55 26.8 S	085 22.8 E	261.1	514.6
22 Dec 94	1546	55 26.8 S	085 22.8 E	261.5	512.8
26 Dec 94	1839	61 58.5 S	082 01.0 E	261.0	514.6
26 Dec 94	1847	61 58.5 S	082 01.0 E	259.9	515.0
26 Dec 94	1856	61 58.5 S	082 01.0 E	260.0	514.9

Table 2. i8s/i9s CFC Air Measurements:

Leg 2

Date	Time (hhmm)	Latitude	Longitude	F11 PPT	F12 PPT
2 Jan 95	0445	64 51.1 S	110 49.2 E	260.1	513.4
2 Jan 95	0454	64 51.1 S	110 49.2 E	260.4	512.2
2 Jan 95	0503	64 51.1 S	110 49.2 E	260.4	513.2
2 Jan 95	0514	64 51.1 S	110 49.2 E	261.0	513.8
5 Jan 95	1925	58 07.5 S	115 00.1 E	260.3	512.3
5 Jan 95	1934	58 07.5 S	115 00.1 E	261.1	512.8
5 Jan 95	1952	58 07.5 S	115 00.1 E	260.6	514.2
5 Jan 95	2001	58 07.5 S	115 00.1 E	261.4	512.7
7 Jan 95	1529	55 00.0 S	115 00.0 E	260.5	514.7
7 Jan 95	1538	55 00.0 S	115 00.0 E	259.5	513.2
7 Jan 95	1548	55 00.0 S	115 00.0 E	260.5	512.2
8 Jan 95	1929	52 36.4 S	114 59.1 E	260.6	513.3
8 Jan 95	1938	52 36.4 S	114 59.1 E	260.3	514.5
8 Jan 95	1946	52 36.4 S	114 59.1 E	259.7	514.7
10 Jan 95	1645	49 00.1 S	115 00.2 E	260.7	514.6
10 Jan 95	1653	49 00.1 S	115 00.2 E	259.5	511.9
10 Jan 95	1702	49 00.1 S	115 00.2 E	260.9	516.3
14 Jan 95	1351	41 30.4 S	114 59.8 E	260.4	513.4
14 Jan 95	1400	41 30.4 S	114 59.8 E	259.7	512.0
14 Jan 95	1408	41 30.4 S	114 59.8 E	258.8	511.7

Table 3. i8s/i9s CFC Air values (interpolated to station locations)

STA #	Latitude	Longitude	Date	F11 PPT	F12 PPT
1	31 29.3 S	110 13.5 E	2 Dec 94	259.6	513.6
2	31 13.3 S	106 17.0 E	3 Dec 94	259.6	513.6
3	30 57.2 S	102 44.7 E	4 Dec 94	259.7	513.6
4	30 18.0 S	095 00.0 E	5 Dec 94	259.7	513.6
5	31 18.0 S	095 00.0 E	6 Dec 94	259.7	513.6
6	32 00.5 S	095 00.3 E	6 Dec 94	259.7	513.6
7	32 00.2 S	095 00.3 E	7 Dec 94	259.7	513.6
8	32 30.0 S	095 00.0 E	7 Dec 94	259.7	513.6
9	33 00.0 S	094 59.7 E	7 Dec 94	259.7	513.6
10	33 30.0 S	095 00.0 E	7 Dec 94	259.7	513.6
11	34 00.0 S	095 00.0 E	8 Dec 94	259.7	513.5
12	34 30.0 S	095 00.0 E	8 Dec 94	259.7	513.5
13	34 59.7 S	095 00.0 E	8 Dec 94	259.7	513.5
14	35 29.8 S	095 00.0 E	9 Dec 94	259.7	513.5
15	35 59.7 S	095 00.2 E	9 Dec 94	259.7	513.5
16	36 30.0 S	095 00.0 E	9 Dec 94	259.7	513.0
17	36 59.8 S	095 00.2 E	9 Dec 94	259.7	513.0
18	37 30.0 S	095 00.0 E	10 Dec 94	259.7	513.0
19	37 59.8 S	095 00.0 E	10 Dec 94	259.7	513.0
20	38 29.3 S	095 01.2 E	11 Dec 94	259.7	513.0
21	38 59.5 S	095 00.2 E	11 Dec 94	259.7	513.0
22	39 29.8 S	095 00.2 E	11 Dec 94	259.7	513.0
23	40 00.0 S	094 59.8 E	11 Dec 94	259.9	512.6
24	40 30.0 S	095 00.0 E	12 Dec 94	260.0	511.7
25	41 00.3 S	095 00.5 E	12 Dec 94	260.0	511.7
26	41 30.2 S	094 59.8 E	12 Dec 94	260.0	511.7
27	41 59.8 S	095 00.0 E	12 Dec 94	260.0	511.7
28	42 30.2 S	095 00.3 E	13 Dec 94	260.0	511.7
29	43 00.0 S	095 00.2 E	13 Dec 94	260.0	511.7
30	43 30.0 S	094 59.8 E	13 Dec 94	260.0	511.7
31	43 45.0 S	095 00.0 E	13 Dec 94	260.0	511.7
32	44 00.0 S	095 00.0 E	13 Dec 94	260.0	511.7
33	44 15.0 S	095 00.0 E	14 Dec 94	260.0	511.7
34	44 29.8 S	095 01.0 E	14 Dec 94	260.5	512.2
35	44 59.5 S	095 00.2 E	14 Dec 94	260.5	512.2
36	45 25.7 S	094 38.3 E	14 Dec 94	260.8	512.5
37	45 50.2 S	094 16.8 E	15 Dec 94	260.8	512.5
38	46 16.7 S	093 53.0 E	15 Dec 94	260.8	512.5
39	46 42.8 S	093 31.5 E	15 Dec 94	260.8	512.5
40	47 08.8 S	093 09.5 E	16 Dec 94	260.8	512.5
41	47 33.7 S	092 45.2 E	16 Dec 94	260.8	512.5

Table 3. (cont.) i8s/i9s CFC Air values (interpolated to station locations)

STA #	Latitude	Longitude	Date	F11 PPT	F12 PPT
42	47 59.7 S	092 22.2 E	16 Dec 94	260.8	512.5
43	48 25.3 S	091 59.7 E	17 Dec 94	260.8	512.5
44	48 51.0 S	091 36.2 E	17 Dec 94	260.8	512.5
45	49 16.7 S	091 13.0 E	17 Dec 94	260.8	512.5
46	49 42.0 S	090 49.0 E	17 Dec 94	260.9	512.5
47	50 07.8 S	090 25.2 E	18 Dec 94	261.2	513.0
48	50 33.5 S	090 02.3 E	18 Dec 94	261.2	513.0
49	50 59.2 S	089 36.5 E	19 Dec 94	261.2	513.0
50	51 25.2 S	089 12.2 E	19 Dec 94	261.2	513.0
51	51 37.7 S	088 59.5 E	19 Dec 94	261.2	513.0
52	51 50.2 S	088 45.8 E	19 Dec 94	261.2	513.0
53	52 15.5 S	088 19.8 E	20 Dec 94	261.2	513.0
54	52 41.2 S	087 53.7 E	20 Dec 94	261.2	513.0
55	53 06.3 S	087 27.8 E	20 Dec 94	261.2	513.0
56	53 31.5 S	087 01.0 E	21 Dec 94	261.2	513.0
57	53 57.2 S	086 34.0 E	21 Dec 94	261.2	513.0
58	54 22.3 S	086 07.0 E	22 Dec 94	261.2	513.0
59	54 47.7 S	085 39.5 E	22 Dec 94	261.2	513.0
60	55 12.7 S	085 11.3 E	22 Dec 94	261.2	513.0
61	55 38.2 S	084 43.7 E	23 Dec 94	261.2	513.0
62	56 03.7 S	084 14.8 E	23 Dec 94	260.9	513.6
63	56 29.0 S	083 46.3 E	23 Dec 94	260.7	513.8
64	56 54.2 S	083 17.8 E	24 Dec 94	260.7	513.8
65	57 19.7 S	082 47.7 E	24 Dec 94	260.7	513.8
66	57 30.8 S	082 32.3 E	24 Dec 94	260.7	513.8
67	57 36.8 S	082 24.3 E	24 Dec 94	260.7	513.8
68	57 55.2 S	082 14.0 E	24 Dec 94	260.7	513.8
69	58 13.0 S	082 00.0 E	25 Dec 94	260.7	513.8
70	58 36.7 S	082 00.2 E	25 Dec 94	260.7	513.8
71	59 00.0 S	082 00.2 E	25 Dec 94	260.7	513.8
72	59 30.0 S	082 00.0 E	25 Dec 94	260.7	513.8
73	60 00.0 S	082 00.2 E	25 Dec 94	260.7	513.8
74	60 28.8 S	082 00.2 E	26 Dec 94	260.7	513.8
75	61 00.0 S	082 00.0 E	26 Dec 94	260.7	513.8
76	61 29.5 S	082 00.3 E	26 Dec 94	260.7	513.8
77	61 58.5 S	082 00.7 E	26 Dec 94	260.7	513.8
78	62 30.3 S	082 00.3 E	26 Dec 94	260.7	513.8
79	63 00.2 S	082 00.2 E	27 Dec 94	260.7	513.8
80	63 30.8 S	081 59.5 E	27 Dec 94	260.7	513.8
82	64 09.0 S	081 53.5 E	27 Dec 94	260.7	513.8
83	63 50.5 S	081 54.8 E	28 Dec 94	260.7	513.8

Table 3. (cont.) i8s/i9s CFC Air values (interpolated to station locations)

STA #	Latitude	Longitude	Date	F11 PPT	F12 PPT
84	63 15.5 S	082 00.2 E	28 Dec 94	260.7	513.8
85	64 30.7 S	111 23.8 E	1 Jan 95	260.7	513.1
86	64 51.8 S	110 49.5 E	2 Jan 95	260.7	513.1
87	64 05.8 S	112 05.3 E	2 Jan 95	260.7	513.1
88	63 40.8 S	112 35.7 E	2 Jan 95	260.7	513.1
89	63 15.8 S	113 12.8 E	2 Jan 95	260.7	513.1
90	62 51.0 S	113 47.2 E	3 Jan 95	260.7	513.1
91	62 24.8 S	114 25.7 E	3 Jan 95	260.7	513.1
92	62 00.2 S	115 00.0 E	3 Jan 95	260.7	513.1
93	61 30.0 S	115 00.3 E	3 Jan 95	260.7	513.1
94	61 00.0 S	114 59.8 E	4 Jan 95	260.7	513.1
95	60 23.8 S	115 00.2 E	4 Jan 95	260.7	513.1
96	59 47.5 S	115 01.5 E	4 Jan 95	260.6	513.2
97	59 11.8 S	115 00.0 E	5 Jan 95	260.6	513.2
98	58 36.0 S	115 00.0 E	5 Jan 95	260.6	513.2
99	58 00.0 S	115 00.3 E	5 Jan 95	260.6	513.2
100	58 00.0 S	115 00.3 E	6 Jan 95	260.6	513.2
101	57 23.8 S	114 59.7 E	6 Jan 95	260.6	513.2
102	56 48.0 S	115 00.2 E	6 Jan 95	260.6	513.2
103	56 11.7 S	115 00.2 E	6 Jan 95	260.6	513.2
104	55 36.0 S	115 00.2 E	7 Jan 95	260.5	513.5
105	55 00.2 S	115 00.3 E	7 Jan 95	260.2	513.8
106	54 24.0 S	115 00.3 E	7 Jan 95	260.2	513.8
107	53 48.0 S	115 00.0 E	8 Jan 95	260.2	513.8
108	53 12.2 S	115 00.8 E	8 Jan 95	260.2	513.8
109	52 36.0 S	115 00.0 E	8 Jan 95	260.2	513.8
110	52 00.2 S	115 00.3 E	8 Jan 95	260.2	513.8
111	51 30.0 S	115 00.3 E	9 Jan 95	260.3	514.2
112	51 00.2 S	115 00.3 E	9 Jan 95	260.3	514.2
113	50 30.0 S	115 00.5 E	9 Jan 95	260.3	514.2
114	50 00.0 S	115 00.3 E	10 Jan 95	260.3	514.2
115	49 30.0 S	115 00.2 E	10 Jan 95	260.3	514.2
116	49 00.0 S	115 00.3 E	10 Jan 95	260.3	514.2
117	48 29.7 S	115 00.3 E	10 Jan 95	260.3	514.2
118	48 00.0 S	115 00.3 E	11 Jan 95	260.3	514.2
119	47 30.0 S	115 00.0 E	11 Jan 95	260.1	513.6
120	47 00.2 S	115 00.0 E	11 Jan 95	260.1	513.6
121	46 30.0 S	115 00.2 E	11 Jan 95	260.0	513.3
122	45 59.8 S	115 00.7 E	12 Jan 95	260.0	513.3
123	45 29.8 S	115 00.3 E	12 Jan 95	260.0	513.3
124	45 00.0 S	114 59.8 E	12 Jan 95	260.0	513.3

Table 3. (cont.) i8s/i9s CFC Air values (interpolated to station locations)

STA #	Latitude	Longitude	Date	F11 PPT	F12 PPT
125	44 29.8 S	115 00.2 E	12 Jan 95	260.0	513.3
126	43 59.8 S	115 00.2 E	13 Jan 95	260.0	513.3
127	43 29.8 S	115 00.2 E	13 Jan 95	260.0	513.3
128	43 00.0 S	115 00.0 E	13 Jan 95	260.0	513.3
129	42 29.7 S	115 00.2 E	14 Jan 95	260.0	513.3
130	42 00.0 S	115 00.0 E	14 Jan 95	260.0	513.3
131	41 30.3 S	114 59.8 E	14 Jan 95	260.0	513.3
132	40 53.7 S	115 00.2 E	14 Jan 95	260.0	513.3
133	40 18.0 S	115 00.0 E	15 Jan 95	260.0	513.3
134	39 41.8 S	115 00.0 E	15 Jan 95	260.0	513.3
135	39 05.8 S	115 00.0 E	15 Jan 95	260.0	513.3
136	38 29.8 S	115 00.0 E	15 Jan 95	260.0	513.3
137	38 00.0 S	114 59.8 E	16 Jan 95	260.0	513.3
138	37 29.8 S	115 00.0 E	16 Jan 95	260.0	513.3
139	37 00.0 S	115 00.0 E	16 Jan 95	260.0	513.3
140	36 29.8 S	115 00.0 E	17 Jan 95	260.0	513.3
141	36 00.0 S	115 00.0 E	17 Jan 95	260.0	513.3
142	35 39.0 S	114 59.7 E	17 Jan 95	260.0	513.3
143	35 38.8 S	115 00.7 E	17 Jan 95	260.0	513.3
144	35 31.0 S	114 59.7 E	17 Jan 95	260.0	513.3
145	35 12.0 S	115 00.0 E	18 Jan 95	260.0	513.4
146	34 57.8 S	115 00.2 E	18 Jan 95	260.0	513.4
147	34 49.2 S	114 59.8 E	18 Jan 95	260.0	513.4

DATA PROCESSING NOTES:

1998.02.23
Date: Mon, 23 Feb 1998 11:52:27 -0500 (EST)
From: Alexander Kozyr 1000 ms6335 40390
alex@utpel033.prg.utk.edu>
Reply-to: Alexander Kozyr 1000 ms6335 40390
alex@utpel033.prg.utk.edu>
Subject: I8S/I9S CO2 data
To: whpo@ucsd.edu
Cc: wallace@bnl.gov, akozyr@utk.edu

Dear Steve and Jim,

I have recently looked at the PUBLIC data files for the WOCE I8S/I9S Sections that are currently posted through WHPO WEB site. I discovered that the TCO2 and Alkalinity are completely deferent from those I have from BNL PIs Ken Johnson and Doug Wallace. I thing the TCO2 and TALK data you have are from the Chief Scientist and are the row data from the cruise records. These data have to be removed from the final data set on the WEB.

I am currently preparing WOCE formatted CO2 data files for this and other Indian Ocean cruises, and will send them to you as soon as I finish.

I wish you the best,
> Alex.

1998.02.23
Subject: Re: I8S/I9S CO2 data
Date: Mon, 23 Feb 1998 12:19:29 +0000
From: "Douglas Wallace" <wallace@bnl.gov>
To: whpo@ucsd.edu, Alexander Kozyr 1000 ms6335 40390
<alex@utpel033.prg.utk.edu>
CC: wallace@bnl.gov, akozyr@utk.edu, mike.riches@oer.doe.gov

Dear Steve and Jim:

further to Alex' message I just want to mention that there is a strong possibility that this type of situation will continue to occur. In many cases there is quite little interaction between the WOCE and JGOFS(CO2) PIs after a cruise and there is therefore an ever-present risk that old, preliminary CO2 data get carried through in the WOCE reporting stream and end up being submitted to the WHPO.

The easiest way to deal with this risk is to make use of Alex as a central resource for checking and signing off on any CO2-related parameter that comes into the WHPO. This is strictly true only for the CO2-data collected by investigators, however note that US CO2 PIs have participated in several foreign cruises (mainly German ones). Alex has a complete list of all the cruises that the US CO2 PIs have participated in, and has the most up-to-date data holdings for CO2-related parameters originating from those PIs. So he should be able to help out on this and this should take some of the workload off the WHPO.

Please feel free to make use of Alex to check/verify any CO2-related data that come into the WHPO: that's (in part) what he is there for.... It may be worth adding "check with Alex" as an action item prior to making a data set public at the WHPO. I know that he will be very cooperative.

With best regards,
Doug

1998.12.01: CFCs removed (masked) from bottle files and decrypted for public consumption per McCartney's instructions. Also removed ALKALI and TCARBN as well as replacing the string "FC02" (with a zero) with the string "FCO2" (with an 'o') in both the i09s and i08s bottle files.

1998.12.23WHPOSIODM

i08s.note

i08ssu.txt - Original first header line is "R/V KNORR, KA45, I8SI9S, LEG 5" Used CR. "145" as indicated in EXPOCODE. Changed WOCT SECT from "I8" to "I08S" and "I9" to "I09S".

- Stations 23, 118, 124 & 136 Casts 2 (TYPE "FLT") have parameters "23,24" (Total Carbon & Total Alkalinity). Probably accidentally duplicated from Cast 1 (ROS). Left unchanged.

- THIS IS THE EXAMPLE SUM in the General Information section of the WOCE web page done by SA Feb 6, 1998. Has Sarilee already done the Indian Ocean SUM reformatting? I didn't notice this until I'd finished and was doing my final check. The current web Indian Ocean summary files have not been reformatted.

EXPOCODES not yet changed.

1999.02.03

Steve and Jerry - I made a small change to the first header line of the i08shy.txt and i09shy.txt files - they are from the same cruise and neither of them had the right expocode.

Expocode was changed to 316N145_5 in both files.

Lynne

1999.06.16
From: sdiggs (Steve Diggs)
Subject: Re: I08S I09S bottle data
To: pmele@ldeo.columbia.edu (phil mele)
Date: Wed, 16 Jun 1999 11:36:11 -0700 (PDT)
MIME-Version: 1.0

Phil,

Somehow, I may not have replied to this message before. If I have not, please excuse the delay.

You are correct, the values were in ml/l and the CTD files were in a non-WOCE format. I have rectified this situation by replacing both the CTD zipfile and the hydro file with newer versions that are in WOCE format (CTD) and a newer hydro file with the correct units for Oxygen.

-sd

> Stephen - I downloaded the data for I08S and I09S today, 26 May.
> I compared the water sample data to data I had retrieved in April
> 1995 from the Indian Ocean preliminary data site at WHOI available
> to Indian Ocean PIs (I work for Arnold Gordon). The data from
> your WHPO site has less resolution than the data from 1995. The
> oxygens in the hydro files have a resolution of only one decimal
> place, compared to three in 1995. Phosphate has two compared to
> three. The difference seems to be more than a rounding error, as
> the 1995 data rounded to one decimal place does not result in the
> value I retrieved. I suppose if the data were updated and then

> rounded, this could account for the difference.
> Also, I see in the data description that the CTD data was
> reformatted by WHPO. The data downloaded is still in the original
> WHOI format, dated Aug 1995. Is there a final version?
>
> Thanks,
> Phil Mele
>

2000.02.08
Subject: Please merge I08S CFC and CO2 data
Date: Tue, 8 Feb 100 14:51:20 -0800 (PST)
From: Steve Diggs <sdiggs@odf>
To: dbartolacci@ucsd.edu (Danielle Bartolacci), dnewton@ucsd.edu
CC: jswift@ucsd.edu (Dr. James Swift (WHPO)), sdiggs@ucsd.edu (Steve Diggs), jkappa@ucsd.edu (Jerry Kappa (WHPO))

Danie and David,

I have reformatted John Bullister's CFC data received 1999/12/16 into WOCE format (that's what David's program needs, eh?) Could one of you use the code to merge in the new CFCs -AND- a file call i8s.co2 (Kozyr's Co2 data) into the existing bottle data file?

All files are in the 'original' directory under I08s.

thanks,
-sd

2000.02.09
Subject: I08S/I09S updated (CFC, CARBON)
Date: Wed, 9 Feb 100 16:06:24 -0800 (PST)
From: Steve Diggs <sdiggs@odf>
To: jkappa@ucsd.edu (Jerry Kappa (WHPO)), johnb@pmel.noaa.gov
CC: whpo@ucsd.edu, alex@utpel033.prg.utk.edu

Jerry,

David Newton and I have done some work on I08S/I09S bottle data. The CFCs have been updated with values from J. Bullister's 12/1999 data submission and Alex Kozyr's carbon values. The carbon values on-line have been masked out pending public release from Alex.

All tables and files have been updated accordingly.

-sd

2000.04.25

i08si09s

Nutrients were labeled UMOL/KG but were really UMOL/L.
Converted mislabeled nutrients from UMOL/L to UMOL/KG.

Subtracted NITRIT from NO2+NO3 to get NITRAT.

Sarilee Anderson

2000.07.05_HLB

Moved 2000.02.14_CO2_KOZYR_i8si9sdat.txt from
/usr/export/ftp-incoming.2000.02.14/2000.02.14_CO2_KOZYR.

Data has not been merged, ALKALI and TCARBN need to be merged.

Email is as follows:

Date: Mon, 14 Feb 2000 13:30:56 -0500 (EST)
Reply-To: Alexander Kozyr 1000 ms6335 40390 <alex@utpel033.prg.utk.edu>
Subject: Atlantic and Indian Oceans carbon data
To: whpo@ucsd.edu
Content-MD5: O9MPzmWSf/MOhb5+PFq4mQ==

Hi Steve,
I've just put a total of 13 files [carbon data measured in Indian (6 files) and Atlantic (7 files) oceans] to the WHPO ftp area. Please let me know if you get data okay.

Thank you,
Alex.