WHP Cruise Summary Information

WOCE section designation	I06S
Expedition designation (EXPOCODE)	35MFCIVA_1
Chief Scientist(s) and their affiliation	Alain Poisson, LPCM/UPMC/CNRS
Dates	1993.01.23 - 1993.03.09
Ship	MARION DUFRESNE
Ports of call	La Réunion, France to Durban, Republic of South Africa
Number of stations	49
Geographic boundaries of the stations	68˚59.71''S 28˚56.59''E 31˚09.00''E 30˚00.54''S
Floats and drifters deployed	none
Moorings deployed or recovered	none
Contributing Authors (In order of appearance)	M. Fieux T. Huck B. Schauer J.F. Minster J. Escalier C. Brunet

WHP Cruise and Data Information

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

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

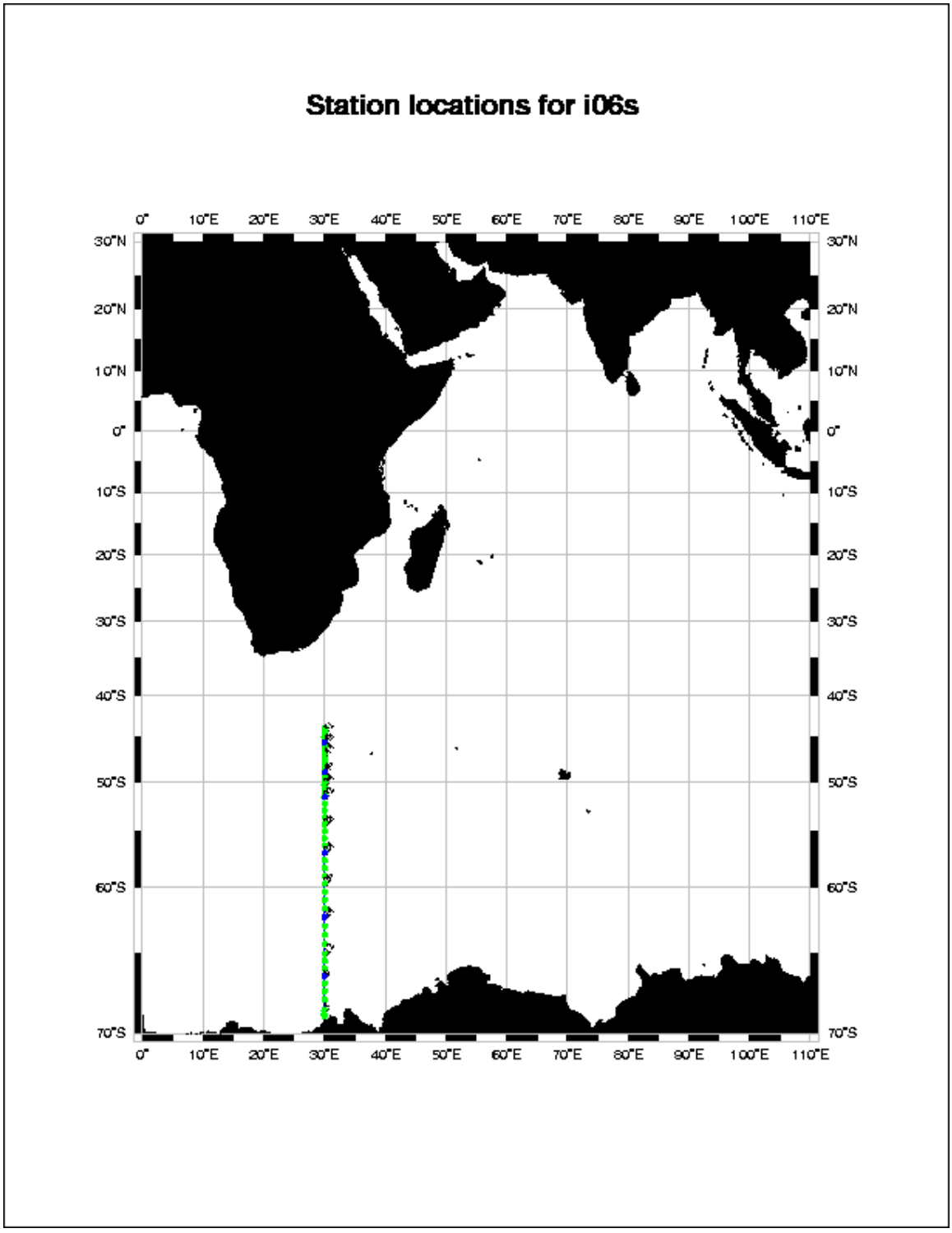

Fig. 1 (Produced from .SUM files by WHPO)

WOCE Designation : I06

Expedition Designation : MD 74 / CIVA 1

Chief scientist : Alain Poisson,
Laboratoire de Physique et Chimie Marines,
Université Pierre et Marie Curie, case 134
4, place Jussieu
75252, Paris Cedex 05, France
Telephone: 33 1 4427 4869
Telefax: 33 1 4427 4993
Internet: apoisson@ccr.jussieu.fr

Ship : R/V Marion Dufresne

Ports of call : La Réunion (France) to Durban (Republic of South Africa)

Cruise dates : January 23 to March 9, 1993

CRUISE SUMMARY

Cruise track.

The track of the cruise is shown in Figure 1.

Type and number of Stations.

Two types of stations were occupied:

- Long stations: 3 CTD/rosette casts to get 36 water samplings from the surface to the bottom.
- short stations: 2 CTD/rosette casts to get 24 water samplings from surface to 1600m, but with CTD down to the bottom..

28 long stations and 21 short stations were occupied from 69˚S to 44˚S at 30˚E. The other stations were adapted to the depth, especially near the antarctic continent. The location of the CTD stations are shown in Figure 2.

113 XBT probes, T6 and T7 type, were launched along the track of the cruise between the stations. Their locations are indicated in Figure 3 and in the summary Table 1.

Sampling accomplished.

Salinity, Temperature, Pressure and Oxygen concentration were measured using a CTD probe and Temperature also with XBT; The location in the water column of the measurement of these parameters all along the section is shown in Figure 4. Water bottle samples were collected, using a 12 bottle rosette with 12 litres Niskin/General Oceanic water sampling bottles; shipboard measurements of Salinity, Oxygen, Nutrients (Nitrate, Nitrites, Phosphate and Silicate), Total Inorganic Carbon, Total Alkalinity as well as the CFC-11 and CFC-12 concentrations were made on all the bottles collected. The locations in the water column of the bottle samplings of these parameters are shown in Figure 5a.

Additional samples were collected for shore based laboratory measurements: Tritium, Helium-3, Carbon-14 (small samples), Oxygen-18, Carbon-13 and Barium. The locations in the water column of these samplings are respectively shown in figure 5b, c, d, and e.

List of Principal Investigators.

Names	Responsibility	Affiliation
Arnold M.	Carbon 14	CFR/CEA/CNRS
Dehairs F.	Barium	LVAS/VUB
Fieux M.	CTD, S, XBT, ADCP	LODYC/UPMC/CNRS
Jean-Baptiste P.	Helium/Tritium	LMCE/CEA
Minster J.F.	Nutrients	GRGS/CNES
Pierre C.	Oxygen 18, Carbon 13	LODYC/UPMC/CNRS
Poisson A.	O2, CFCs, TCO2, pCO2, AT	LPCM/UPMC/CNRS

Scientific programme and methods.

The aim of the CIVA programme was to study the circulation and the ventilation of the Antarctic ocean in the Indian sector, especially in the western zone of this sector. The principal objectives of this programme were to study :

- the flux at the Atlantic/Indian ocean boundary
- the zonal circulation in this region
- the evolution of the Weddell Antarctic bottom water
- the air-sea flux of CO2 in this region

The Marion Dufresne being also a supply ship for the French Indian ocean subantarctic islands, she departed La Réunion for Kerguelen archipelago on January 23, and occupied the station Kerfix (WOCE station SRS1), 60 nautical miles south of Kerguelen, to test the CTD and the rosette.

The CTD used was a Niel Brown Mark III instrument equipped with a dissolved oxygen sensor. The rosette, manufactured by General Oceanics, was equiped with 12 Niskin bottles of 12 litres manufactured by General Oceanics and a 10 kHz location pinger. The cable was a 8.6mm steel rope and the winch was built by Kley France. After each cast the rosette was secured on the deck and washed with fresh water, especially the sensors which were then covered with protective housings; samples were collected following the order recommended in the WOCE operations manual: CFC, Helium, Oxygen, TCO2+TA, Carbon-14, Tritium, Carbon-13, Oxygen-18, Nutrients, Salinity, Barium. The temperature, pressure and conductivity sensors of the CTD were calibrated at IFREMER in Brest before and after the cruise. The conductivity and oxygen sensors were also calibrated using data collected during the cruise on the bottles taken at all the stations : Salinity was measured with a 8400 type Guildline salinometer in a constant temperature laboratory and Oxygen by an automatic potentiometric titration system (Metler DL21).

Samples were collected from each Niskin bottle for shipboard measurements of nutrients (Nitrate, Nitrites, Silicate and Phosphate) with two automatic Technicon AAII analysers, Total Alkalinity and Total Inorganic Carbon with a semi-automated potentiometric titration system (Radiometer) and Total Inorganic carbon with a coulometer UIC Coulometrics 5011. Samples were also collected with pyrex 100ml syringes directly on all the Niskin bottles to measure CFC-11 and CFC-12 with a Shimadzu GC8A gas chromatograph in a portable laboratory located on the deck of the ship.

All the samplings were performed on the deck. The methods of measurement are reported later in this report.

Underway measurements:

XBTs were launched between the stations every about 10 nm using a Sippican system. Acoustic Dopler Current Profiler measurements were made with a R.D. Instruments ADCP only on the way from Antarctica to Durban; It was the first time that this instrument was used on the R/V Marion Dufresne and some problems arose especially during the transits, due to the instrument itself and the roughness of the sea. Underway measurements of Temperature and Salinity were made by a Bisset-Berman thermosalinograph; Depth was recorded all along the track of the cruise on thermal paper using an EDO system. Fugacity of carbon dioxide was measured all along the track of the cruise with a Siemens IR analyser, together with fluorescence with a Turner fluorimeter and Oxygen with an Orbisphere Laboratory sensor.

Major Problems encountered during the cruise.

Several technical problems arose during the cruise and a sanitary evacuation imposed to go directly to Durban when the ship was at 54˚S. Twelve days were lost and the section expected to be occupied was not entirely completed.

When the cast was at a depth greater than 4500/5000m the General Oceanics rosette presented a malfunctionning from time to time: either there was no back signal but the bottle closed, or there was a back signal but the bottle did not close, or there was a double-trigging of the bottles. Although the tension of the trigging lanyards was reduced this problem remained until the end of the cruise for the deep casts.

We had problems with the pumps of the "autosal" salinometer, although this apparatus was new, especially when the sea was rough: it was difficult or at least very long to fill the cell with seawater. The instrument was disassembled and the cell was cleaned and the pumps were checked. Nevertheless the problem was not entirely resolved.

We also had a problem with the winch, the wheel of which broke down; it was repaired but the cheeks were not exactly parallel and the wire could not be rewound well and the deep casts took a longer time than usually.

List of cruise participants.

The cruise participants are listed in Table 2.

Measurement Techniques and Calibrations.

Salinity:

(by M. Fieux and T. Huck)

Salinities were measured with a Guildline Autosal Model 8400B Laboratory salinometer. It was calibrated for each set of measurements (about daily) with IAPSO Standard Seawater batch P-121. The cell was rinsed and filled with distilled water after each set of measurements. Before the standardisation, the cell was rinsed at least ten times with seawater from previous set of samples, then at least 3 times with Standard Seawater and 5 measurements were made on this Standard Seawater in order to calibrate the instrument. The cell was rinsed 3 times between each sample and 3 measurements were made; All the measurements were made between 24 and 48H after the samplings.The reported salinity data are the arithmetic means of the 3 measurements.

The apparatus was located in a laboratory container, the temperature of which was stabilized at about 1˚C below the temperature of the salinometer water bath. This was 18˚C when the atmospheric temperature was low and 21˚C when the

outside temperature was greater than about 15˚C. At each station at least 2 or 3 duplicate samples were collected; the differences of the two measurements are shown in Table 4.

The samples were collected in IAPSO bottles which were stored in the same laboratory container at least 10 hours before the measurements.

Oxygen:

(by B. Schauer)

An automated potentiometric titration system (Mettler DL21) was used to measure oxygen on the samples collected in all the Niskin bottles, according to the Winkler method revised by Carpenter (1969). Samples were collected in special pyrex flasks with a grounded stopper designed in such a way that approximately a volume equivalent to the one of the titrant to add was preserved for the titration. The flask was rinced three times with seawater and filled in order to overflow three times its volume. The concentration of the titrant (Na2S2O3,5H2O) was measured with a potassium iodate (KIO3) solution prepared by weight in a shore based laboratory before the cruise and stored in recycled standard seawater ampoules. Duplicate measurements were made on several samples; the differences are shown in Table 4.

Nutrients:

(by J.F. Minster and J. Escalier)

The measurements of nutrients were made using two automatic Technicon AAII analysers.

Nitrates were reduced according to the Woods method (1967), adapted to the automatic systems by Grasshof (1983) and Tréguer and Le Corre (1974). Nitrites obtained are titrated with the colorimetric technique described by Benschreider and Robinson (1952). The cadnium column was a U-shaped pyrex tube filled with Cd granulates whose diameters were 0.315 and 0.715 mm; the reduction occured at room temperature.

Phosphates were measured using the Murphy and Riley method (1962), modified by Tréguer (1976); The reaction occured at 37˚C.

Silicates were measured according to the Mullin and Riley technique (1962) revised by Grasshoff (1983) and Treguer (1976); the reaction occured at 37˚C.

Samples were collected in 125 ml prolypropylene flasks after three rinsings. Analyses were performed immediately after the sampling of the water.

Replicate samples were taken at all the stations The difference between the two measurements are shown in Table 4.

Standard solutions were prepared by diluting NO3, PO4 and SiO2 standards with surface seawater collected near la Réunion island, filtered on 0.45 mm filter and stored at room temperature.

NO3 standard was a 5000 mmol/kg KNO3 solution
PO4 standard was a 500 mmol/kg KH2PO4 solution
SiO2 standard was a 17000 mmol/kg Na2SiO3 solution.
Concentrations of standard solutions (mmol/litre):

	Sdt 0	**Sdt 1**	**Sdt 2**	**Sdt 3**	**Sdt 4**
NO3	0	5	10	20	30
PO4	0	0.5	1	2	3
SiO2	0	34	85	136	170

Wavelength for NO3 : 540 nm
PO4 : 880 nm
SiO2 : 660 nm

length of the cell for NO3 : 1.5 / 50 mm
PO4 : 2 / 50 mm
SiO2 : 1.5 / 1.5 mm

CFC-11 and CFC-12:
(by B. Schauer):

The measurement of CFC-11 (trichlorofluoromethane) and CFC-12 (dichloro-difluoromethane) were performed by a Shimadzu GC8A electron -capture gas chromatograph, according to the method described by Bullister and Weiss (1988); The peacks were integrated using a Spectra Physics SP4920 integrator during the measurements; they will be checked in a shore-based laboratory using the Winner programme.

Seawater was collected in 100 ml glass syringes, with a metal tap, directly on the Niskin bottles when the rosette arrived on the deck. The Niskin bottles were previously cleaned with Decon detergent and the O-rings and taps were cleaned and put in an oven under low pressure at 60°C during 24H. The syringes were stored in an open tank where a flow of surface water was continuously running. All the measurements were done in the 5 hours following the samplings.

The ECD detector signal was calibated at each station with an air from Kerguelen Island,whose CFC-11 and CFC-12 concentrations (close to the ones in seawater) were previously calibrated relatively to SIO standards with a precision of 0.5% for both the CFC.

The precision of the method was tested at station 12 and duplicate samples were collected at all the stations. the results of these measurements are shown in Table 3 and Table 4 respectively. At station 12, measurements were made on 9 Niskin bottles; the precision were 0.4% for CFC-11 and 1.1% for CFC-12, including the blank correction which was not taken into account for all these preliminary data. The signals were checked using Winner program in a base laboratory after the cruise.

TABLE 3:
Replicate measurement of CFC-11 and CFC-12 in surface water at station 12.

depth (m)	CFC-11 (mmol/kg)	CFC-12 (mmol/kg)
10	7,297	3,075
10	7,367	3,030
10	7,334	3,027
10	7,375	3,002
10	7,386	3,079
10	7,359	3,022
10	7,369	3,010
10	7,360	3,002
10	7,353	2,977
mean	7,356	3,025
std dev	0,36%	1,11%

Total Alkalinity, TA p and Total Inorganic Carbon, TCO2 p:
(by C. Brunet)

Samples were collected in 500 ml pyrex flasks with a screw stopper; the flask was rinced twice with seawater and filled in order to overflow twice its volume.

A potentiometric titration derived from the method developped by Edmond (1970) was used to estimate Total Inorganic Carbon (TCO2 p) and Total Alkalinity (TA p). The titration system was composed of a Radiometer ABU 80 burette, a Radiometer PHM80 pHmeter and a PC/AT Tandon micro-computer to drive the burette and record the data. The titration curve was used as recommended in the US Department of Energy report (DOE, 1991) to determine TCO2 and TA. The acid (HCl, 0.1N) used for the titration was calibrate once or twice a day with the Reference Material prepared by A. Dickson from Scripps Institution for the JGOFS programme. The measurements were made between 12 and 48H after the sampling.

To test the precision of the method, replicate samples were taken at all the stations The difference between the two measurements are shown in Table 4. Another way to estimate the precision of the measurements is to calculate the

regression curve of TCO2 versus potential temperature in deep water. the calculation was made on the 460 samples whose temperature is between -0.8˚C and 0.4˚C; 14 data of TA and 22 of TCO2 were rejected because very far from the regression curve. This is possibly due to bad samplings or any problem during the titration. The standard deviation was 2.4meq./kg for TA and 3.7 mmole/kg for TCO2.

Total Inorganic Carbon,TCO2 c:

(by B. Schauer)

Samples were collected in 500 ml pyrex flasks with a screw stopper; the flask was rinced twice with seawater and filled in order to overflow twice its volume.

A coulometric titration described by Johnson et al (19) was used with a 5011 UIC Coulometrics coulometer. Phosphoric acid was used for the titration and nitrogen for the bubling in the stripper. A micro-computer drive the coulometer and the device used for the titration.

The calibration of the method was made using sodium carbonate solutions prepared under nitrogen atmosphere whose concentrations were between 0 and 2200 mmole/kg.

To test the precision of the method, replicate samples were taken at all the stations The difference between the two measurements are shown in Table 4.

CTD :

The pressure and temperature sensors of the CTD probe were calibrated at the IFREMER standard laboratory in Brest before the cruise. As the CTD was used also by the cruise following CIVA-1 (ANTARES-1) on board the Marion Dufresne, the probe was calibrated a second time in the same laboratory after the cruise

Conductivity and oxygen sensors were calibrated using salinity and oxygen concentrations measured on the Niskin bottles of the rosette.

TABLE 2:

Cruise participants

Name	**Responsibility**	**Affiliation**
POISSON Alain	Chief Scientist	LPCM/UPMC
CHARRIAUD Edwige	CTD, XBT	LOP/MNHN
BOUFFARD Brice	CTD, Salinity	LODYC/UPMC
KESTENARE Elodie	CTD	LODYC/UPMC
DOUCELANCE Régis	Sampling	LODYC/UPMC
SARAGONI Gilles	Sampling	LODYC/UPMC

LACAZE Thomas	Sampling	LODYC/UPMC
NIZARD Gaëlle	Salinity, Oxygen	LPCM/UPMC
HUCK Thierry	CTD, Salinity	LPO/UBO
LOUANCHI Ferial	Data managing	LPCM/UPMC
BROTONS Pascal	Oxygen	LPCM/UPMC
MANGALO Raymond	Oxygen	LPCM/UPMC
LEROUX M-Madeleine	Oxygen	LPCM/UPMC
SCHAUER Bernard	CFCs	LPCM/UPMC
REVERT Ludovic	CFCs	LPCM/UPMC
THOMAS Fabienne	CFCs	LPCM/UPMC
ESCALIER Jocelyne	Nutrients	GRGS/CNES
LEMOINE Jean-Michel	Nutrients	GRGS/CNES
SARTHOU Géraldine	Nutrients	GRGS/CNES
BOURGOIN Pascal	TCO2/coulometry	LPCM/UPMC
CLAVEL Olivier	TCO2/coulometry	LPCM/UPMC
RAILLON Raphaële	TCO2/coulometry	LPCM/UPMC
BRUNET Christian	AT+TCO2/potentiometry	LPCM/UPMC
CABON Suzane	AT+TCO2/potentiometry	LPCM/UPMC
MAURICE Laurence	AT+TCO2/potentiometry	LPCM/UPMC
BLANC Christine	pCO2	LPCM/UPMC
YIOU Pascal	C14+He/Tritium	LMCE/CEA
PICOT Gabriel	Sampling	LPCM/UPMC
LAGARDE Jean-Philippe	Sampling	LPCM/UPMC
MORTIER Laurent	Sampling	LPCM/UPMC
OLLIVIER Bernard	Hardware, electronics	IFRTP
BOUCHARD Olivier	Software	IFRTP
KLEIN Christophe	Electronics	IFRTP

TABLE 4: Differences of replicate measurements.

STN NBR	uncorrected depth (m)	SALNTY PSS-78	OXYGEN µMOL/KG	SILICAT µMOL/KG	NITRAT µMOL/KG	PHSPHT µMOL/KG	CFC-11 pMOL/KG	CFC-12 pMOL/KG	TA mEQ/KG	TCO2 p mMOL/KG	TCO2 c mMOL/KG
2	250	0,000	0,2	4,63	0,07	0,04	0,001	0,016	0,001	0,004	0,008
3	255	0,000	0,76	0,14	0,02	0,059	0,001			0,001	
3	1255	0,000	1,9	0,00	0,00	0,00	0,004	0,009	0,008	0,002	0,008
4	250	0,002	0,5	0,00	0,14	0,12	0,028	0,009	0,059	0,055	0,017
4	2177	0,000	0,2	0,00	0,14	0,02	0,393	0,028	0,000	0,005	0,003
5	250	0,002	0,5	0,00	0,00	0,05	0,056	0,036	0,001	0,010	0,001
5	3055	0,005	2,1	1,67	0,29	0,03	0,008	0,005	0,000	0,010	0,003
6	250	0,002	1,1	0,84	0,00	0,00	0,011	0,006	0,006	0,011	0,002
7	250	0,002	0,3	1,64	0,17	0,01	0,041	0,009	0,014	0,018	0,001
7	1600	0,002	1,5	0,82	0,00	0,03	0,000	0,011			0,001
8	250	0,004	0,2	0,81	0,00	0,00	0,013	0,008	0,004	0,005	0,000
8	1300	0,001	0,2	1,56	0,00	0,00	0,015	0,012	0,003	0,008	0,003
8	3987	0,001	0,4	1,55	0,00	0,01	0,035	0,008	0,012	0,001	0,001
9	250	0,003	0,8	0,00	0,00	0,05	0,070	0,023	0,003	0,001	0,000
9	1600	0,002	0,0	0,80	0,15	0,00	0,045	0,038	0,007	0,006	0,005
10	250	0,000	0,8	0,00	0,13	0,09	0,034	0,010	0,000	0,007	0,002
10	1350	0,001	1,5	0,81	0,13	0,01			0,006	0,002	0,004
10	4000	0,004	2,3	0,80	0,06	0,02	0,214	0,077	0,004	0,018	0,001
11	1600	0,000	0,2	0,00	0,13	0,02	0,001	0,002	0,004	0,005	0,001
12	250	0,004	1,1	0,00	1,41	0,02	0,066	0,015	0,000	0,007	0,009
12	1350	0,001	0,3	2,46	0,16	0,00	0,005	0,003	0,003	0,006	0,003
12	3000	0,001	0,1	0,00	0,00	0,02	0,009	0,011	0,009	0,009	0,000
13	250	0,001	1,1	0,92	0,16	0,00	0,008	0,026			0,002
13	1600	0,000	0,2	1,38	0,08	0,02	0,000	0,007	0,012		0,003
13	4000	0,002	2,8	2,20	0,23	0,19	0,017	0,014	0,007	0,007	0,003

STN NBR	uncorrected depth (m)	SALNTY PSS-78	OXYGEN µMOL/KG	SILICAT µMOL/KG	NITRAT µMOL/KG	PHSPHT µMOL/KG	CFC-11 pMOL/KG	CFC-12 pMOL/KG	TA mEQ/KG	TCO2 p mMOL/KG	TCO2 c mMOL/KG
14	250	0,000	0,1	0,00	0,00	0,03	0,031	0,009	0,000	0,002	0,001
14	1350	0,000	0,8	0,00	0,00	0,00	0,005	0,021	0,002	0,002	0,001
14	4000	0,002	1,8	7,67	0,00	0,02	0,178	0,080	0,001	0,018	0,001
15	250	0,000	0,5	0,00	0,00	0,02	0,005	0,004	0,001	0,002	0,003
15	1600	0,002	0,2	0,84	0,00	0,00	0,009	0,010	0,001	0,003	0,002
16	250	0,001	0,0	0,00	0,00	0,00	0,017	0,010	0,001	0,001	0,005
16	1350	0,000	3,1	0,42	0,00	0,02	0,024	0,013	0,000		0,004
16	4000	0,000	0,4	0,00	0,00	0,00		0,003	0,002	0,014	0,012
17	250	0,000	0,7	0,00	0,00	0,00	0,006	0,007			0,002
17	1600	0,000	0,1	0,85	0,09	0,00	0,001	0,001	0,003	0,004	0,004
18	250	0,000	0,1	2,17	0,00	0,01	0,002	0,032	0,003	0,000	0,002
18	1350	0,001	0,1	1,73	0,00	0,01	0,012	0,020	0,001	0,005	0,003
18	4000	0,001	0,3	1,73	0,00	0,01	0,114	0,042	0,012	0,001	0,001
19	250	0,001	0,8	0,41	0,00	0,03	0,019	0,027	0,001	0,001	0,001
19	1600	0,002	0,3	0,83	0,08	0,04	0,035	0,020	0,003	0,033	0,005
20	250	0,003	0,7	0,81	0,15	0,03	0,001	0,010	0,000	0,000	0,001
20	1350	0,000	0,4	0,00	0,08	0,02	0,000	0,005	0,001	0,007	0,006
20	4000	0,000	0,5	0,82	0,15	0,02	0,006	0,019	0,000	0,001	0,025
21	250	0,002	0,4	0,82	0,23	0,02	0,064	0,012			0,001
21	1600	0,007	0,1	0,82	0,07	0,02	0,000	0,000	0,002	0,001	0,003
22	250	0,001	0,2	0,00	0,00	0,00	0,035	0,024	0,002	0,005	0,002
22	1350	0,000	0,6	0,84	0,07	0,01	0,041	0,033	0,001	0,001	0,001
23	250	0,002	0,2	0,41	0,00	0,01	0,006	0,010	0,003	0,001	0,000
23	1600	0,001	0,7	0,00	0,00	0,00	0,008	0,007	0,001	0,004	0,045
24	250	0,011	2,4	2,08	0,16	0,02	0,123	0,062			0,001
24	1350	0,000	0,5	0,41	0,00	0,02	0,029	0,005	0,005	0,001	0,003
25	250	0,006		0,00	0,00	0,01	0,062	0,021	0,000	0,004	0,000

STN NBR	uncorrected depth (m)	SALNTY PSS-78	OXYGEN µMOL/KG	SILICAT µMOL/KG	NITRAT µMOL/KG	PHSPHT µMOL/KG	CFC-11 pMOL/KG	CFC-12 pMOL/KG	TA mEQ/KG	TCO2 p mMOL/KG	TCO2 c mMOL/KG
25	1600	0,000	0,2	0,00	0,00	0,00	0,004	0,004	0,000	0,006	0,002
26	250	0,000	0,7	0,00	0,08	0,01	0,006	0,002	0,001	0,002	0,004
26	1350	0,002	0,1	0,42	0,00	0,01	0,016	0,034	0,004	0,003	0,003
27	250	0,000	1,1	0,00	0,08	0,00	0,091	0,001	0,002	0,000	0,006
27	1600	0,001	0,3	0,00	0,00	0,00	0,007	0,014	0,000	0,001	0,014
28	250	0,002	1,2	0,00	0,00	0,01	0,032	0,042	0,002	0,002	0,033
28	1350	0,000	0,7	0,43	0,00	0,03	0,030	0,054	0,004	0,002	0,001
29	250			2,82	0,40	0,05	0,558	0,264	0,003	0,002	0,007
29	1600	0,001	0,2	0,00	0,00	0,02	0,005	0,031	0,004	0,003	0,003
30	250	0,002	0,6	0,00	0,08	0,00	0,061	0,013	0,001	0,000	0,003
30	4000	0,000	0,0	0,90	0,08	0,00	0,006	0,006	0,003	0,004	0,001
31	250	0,001	0,4	0,00	0,00	0,00	0,011	0,018	0,002	0,003	0,003
31		0,000	0,5	0,00	0,00	0,00	0,033	0,000	0,013	0,029	0,011
32	250	0,001	0,1	0,00	0,00	0,01	0,063	0,044	0,001	0,008	0,002
32	1350	0,001	1,2	0,42	0,07	0,01	0,048	0,009	0,001	0,003	0,001
32	4000	0,000	0,4	0,84	0,22	0,00	0,006	0,021	0,005	0,002	0,004
33	250	0,000	6,1	0,82	0,39	0,03	0,313	0,052	0,003	0,004	0,002
33	1600	0,000	0,2	0,00	0,00	0,03	0,057	0,059	0,005	0,000	0,009
34	250	0,000	0,0	0,42	0,15	0,00	0,043	0,045	0,003	0,015	0,001
34	1350	0,000	0,1	1,26	0,08	0,02	0,033	0,000	0,001	0,002	0,002
35	250	0,000	0,3	0,00	0,08	0,00	0,043	0,004	0,000	0,001	0,003
35	1600	0,000	0,3	0,44	0,08	0,00	0,013	0,000	0,001	0,002	0,005
36	250	0,010	3,7	1,35	0,33	0,00	0,177	0,085	0,001	0,001	0,003
36	1100	0,000	0,5	0,46	0,08	0,01	0,027	0,103	0,001	0,001	0,002
36	3865	0,000	0,4	0,00	0,08	0,00	0,061	0,083	0,002	0,005	0,003
37	250	0,004	1,4	0,91	0,07	0,01	0,000	0,048	0,000	0,003	0,001
37	1600	0,001	0,1	0,00	0,08	0,02	0,022	0,000	0,006	0,003	0,002

STN NBR	uncorrected depth (m)	SALNTY PSS-78	OXYGEN µMOL/KG	SILICAT µMOL/KG	NITRAT µMOL/KG	PHSPHT µMOL/KG	CFC-11 pMOL/KG	CFC-12 pMOL/KG	TA mEQ/KG	TCO2 p mMOL/KG	TCO2 c mMOL/KG
38	250	0,000	0,0	0,45	0,00	0,03	0,055	0,010	0,002	0,002	0,001
38	1350	0,001	0,1	0,00	0,07	0,01	0,012	0,040	0,004	0,000	0,002
39	250	0,000	0,3	0,00	0,23	0,01	0,014	0,052	0,002	0,005	0,001
39	1600	0,000		0,00	0,16	0,01	0,054	0,043	0,008	0,001	0,005
40	250	0,002	0,6	0,00	0,00	0,00	0,003	0,004	0,002	0,001	0,002
40	1350	0,002		0,43	0,00	0,05	0,011	0,010	0,001	0,010	0,002
40	3500	0,001	0,2	0,00	0,07	0,00	0,063	0,015	0,005	0,001	0,020
41	250	0,012	3,3	0,00	0,47	0,03	0,144	0,040	0,003	0,002	0,002
41	1600	0,002	0,4	0,89	0,15	0,02	0,008	0,018	0,007	0,006	0,001
42	250	0,004	0,7	0,45	0,08	0,03	0,016	0,049	0,006	0,002	0,001
42	1350	0,001	0,0	0,00	0,39	0,06	0,007	0,084	0,007	0,003	0,002
43	250	0,005	0,6	0,00	0,00	0,05	0,013	0,010	0,005	0,004	0,001
43	1600	0,001	1,0	0,00	0,30	0,00	0,006	0,029	0,000	0,014	0,007
44	250	0,000		0,42	0,00	0,02	0,011	0,011	0,001	0,003	0,001
44	1000	0,001	0,3	0,00	0,31	0,02	0,021	0,034	0,002	0,000	0,008
45	250	0,003	4,0	0,00	1,68	0,07	0,128	0,133			0,004
45	1600	0,000	0,6	0,00	0,00	0,01	0,029	0,034	0,002	0,003	0,000
46	250	0,007	0,5	0,00	0,22	0,03	0,094	0,065	0,002	0,005	0,006
46	1350	0,004	0,4	0,88	0,56	0,05	0,075	0,071	0,000	0,000	0,002
46	4000	0,000	0,6	0,44	0,07	0,00	0,091	0,052	0,001	0,004	0,001
47	250	0,000	0,5	0,00	0,15	0,03	0,002	0,009	0,002	0,002	0,004
47	1000	0,000	3,3	0,44	0,00	0,01	0,034	0,025	0,001	0,001	0,003
47	1600	0,002	8,4	0,88	0,22	0,00	0,000	0,034	0,002	0,002	0,004
48	250	0,005	0,4	0,00	0,15	0,02	0,014	0,035	0,001	0,003	0,003
48	1350	0,005	0,0	0,00	0,00	0,04	0,006	0,027	0,001	0,005	0,005
49	250	0,001	0,2	0,00	0,07	0,00	0,009	0,028	0,000	0,002	0,000
49	1600	0,005	0,1	0,00	0,15	0,03	0,002	0,056	0,001	0,001	0,006

STN NBR	uncorrected depth (m)	SALNTY PSS-78	OXYGEN µMOL/KG	SILICAT µMOL/KG	NITRAT µMOL/KG	PHSPHT µMOL/KG	CFC-11 pMOL/KG	CFC-12 pMOL/KG	TA mEQ/KG	TCO2 p mMOL/KG	TCO2 c mMOL/KG
50	250	0,004	0,0	0,52	0,07	0,01	0,005	0,005	0,001	0,004	0,000
50	1350	0,001	0,2	0,54	1,34	0,02	0,016	0,001	0,001	0,003	0,016
51	250	0,000	0,7	0,49	0,00	0,02	0,000	0,008	0,003	0,001	0,002
51	1350	0,001	0,1	0,52	0,00	0,01	0,059	0,010	0,001	0,004	0,002
52	250	0,000	1,8	0,00	0,00	0,00	0,044	0,047	0,003	0,007	0,003
52	1350	0,002	0,4	0,00	0,37	0,06	0,004	0,007	0,003	0,002	0,004
mean		0,002	0,8	0,59	0,13	0,02	0,043	0,027	0,003	0,005	0,004
sdt dev		0,002	1,2	1,00	0,25	0,03	0,077	0,034	0,006	0,007	0,006