WHP Cruise Summary Information

WOCE section designation	A21, S04, SR02
Expedition designation (EXPOCODE)	06MT11_5
Chief Scientist(s) and their affiliation	Wolfgang Roether, UB
Dates	1990.01.23 – 1990.03.08
Ship	METEOR
Ports of call	Ushuaia to Cape Town
Number of stations	79
Geographic boundaries of the stations	41°57.90''S 68°15.80''W 18°27.00''E 63°10.60''S
Floats and drifters deployed	10 Floats
Moorings deployed or recovered	none
Contributing Authors	none listed

WHP Cruise and Data Information

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

Cruise Summary Information	
Description of scientific program	CTD - general
Cruise track (figure)	
Description of stations	
Description of parameters sampled	
Bottle depth distributions (figure)	Salinity
Floats and drifters deployed	Oxygen
	Nutrients
	CFCs
Principal Investigators for all measurements	Helium
Cruise Participants	Tritium
Problems and goals not achieved	
	Other parameters
	References
XBT and/or XCTD	
	Data Status Notes

Chief Scientist's Cruise Report to WOCE WHP

METEOR cruise 11/5
Ushuaia to Cape Town
Jan. 23 to Mar. 8, 1990

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Funding: Deutsche Forschungsgemeinschaft
Bundesministerium fur Forschung und Technologie,
Bonn, Germany

Description of scientific program:

The cruise did WOCE WHP sections S1/A21 (Drake Passage) and S2/A12 (passage south of Africa; incomplete), with full tracer coverage. Additional work was carried out in the northern Weddell Sea. Taken together this work at the same time completed the SAVE field work, and by this the large-volume WOCE tracer work in the Atlantic sector. Fig. 1 gives the cruise track and Table 1 some basics for the cruise. Table 2 lists the measurements taken and the PI's responsible. A list of participants is given in Table 3. An account of the cruise (in German, including all 5 legs of cruise no. 11) has been given to Roether et al. (1990). Basic cruise funding came from the Deutsche Forschungsgemeinschaft and the Bundesministerium für Forschung und Technologie, Bonn, Germany.

Table 1: METEOR Cruise No. 11, Leg 5

leave Ushuaia	January 23, 1990
return for winch repair	Feb. 2-3, 1990
enter Cape Town	Mar. 8, 1990
scientists	30
crew	32
master	Henning Papenhagen
stations	79
tracers	full suite
WOCE sections	S1/A21, S2/A12

Description of stations

The work was limited by the available ship time. The two WOCE sections and in particular the Drake Passage section were given highest priority. On S2/A12 about 60nm station spacing was achieved. The work in between consisted of a short section north and east of the South Orkney Islands, in order to cross a possible deep-water outflow from the Weddell Sea, as well as boundary flow at the northern margin of the Weddell Basin. Furthermore, a section was obtained from the South Sandwich Trench eastward up to the African Passage section, crossing the deep outflow through the trench as well as a possible north-south exchange across the American-Antarctic Ridge. Sta. 149 (Fig. 1) reoccupied Sta. 234 of WWSP 86, and, nearly, GEOSECS station 89'. WWSP 86 (Huber et al., 1989), that likewise included small and large-volume tracers, may be taken as the southward extension of our African passage section southward to the Antarctic continent. The Drake Passage section was placed westward of the "classical" ones (Sievers and Nowlin, 1984). While this coincided with the section as indicated in the WOCE implementation Plan, the idea behind was to stay west of major deep topography, in order to characterize the waters inflowing from the Pacific and minimum admixture from the Atlantic sector. As the Polar Front bends southward around the South Shetlands, our choice meant a rather wide Polar Frontal Zone. As for the passage south of Africa, we attempted to stay west of the Agulhas Retroflexion, and to follow the deep topography in order to enable characterization of deep and bottom waters in the Agulhas and Cape Basins. This resulted in crossing the ACC at least than 90 degrees, so that the fronts in our section appear as rather more gradual (cf. Witworth and Nowlin, 1987), as well as in some curvature in the track. The part east of the South Sandwich trench was placed just north of the axis of the Antarctic American Ridge.

METEOR entered Ushuaia Jan. 20, 1990 and installation of equipment started immediately. Some gear was found to be stuck at Buenos Aires, but finally reached the ship in time before departure. METEOR left Ushuaia on the morning of Jan. 23, 1990. We managed to start station work across Drake Passage already the next morning, following a trial station immediately after laving the Beagle Channel. The section started SW of Cape Horn on the shelf, and continued south at 30nm spacing. Basic equipment was a Neil Brown Mark IIIB CTD (AWI, calibrated at Scripps ODF) and a 24 x 12 liter GO Rosette system. A special cast was carried out to check for CFM sampling blanks, which were found to be vanishingly small except for a certain set of Niskin bottles that we consequently avoided to use. Large-volume stations (Fig. 1) were placed between the fronts so as to characterize the four principle hydrographic zones of the passage (Sievers and Nowlin, 1984). Apart from P_{CO2} which became operative only toward the end of the section, all measurements were carried out successfully. Salinity, nutrient and oxygen measurements were made in standard fashion. ^{14}C, ^{39}Ar and ^{85}Kr sample processing used the Heidelberg vacuum extraction system, and Ra processing the Princeton procedures. TOT-CO_2 and P_{CO2} measurement was coulometric. The CFM equipment employed was an automated system based on the

Weiss and Bullister design (Bullister and Weiss, 1988). It was in routine use at sea for the first time, which led to some modification of procedures during the cruise.

The section was accompanied by XBT drops at 10nm spacing, and thermosalinograph readings were obtained continuously. We also ran the ship's ADCP, together with calibration runs. Quality of the ADCP data is open at this stage, and only partial GPS availability was a drawback.

Floats and drifters deployed

A total of 10 prototype ALACE floats were deployed north of the Polar Front. Deployment was found to be straightforward, and 8 of the instruments, which were set at 750 m depth and fortnightly surfacing, have operated perfectly since. Weather was advantageous for all of the Drake Passage section.

Problems and goals not achieved

After three days of station work, a breakdown of the winch computer system was encountered. The ship managed to provide makeshift operation for the CTD/Rosette winch, and trawl winch operation was similarly resumed two days later. It was decided to continue the section, and to return to Ushuaia for repair thereafter. The section was ended at the break of the South Shetland Arc shelf off Smith Island. It consisted of 13 standard and 4 large-volume stations. However, the large-volume part in the Polar Frontal Zone was only done on the way back to Ushuaia, i.e. not simultaneous with the corresponding main CTD/Rosette work. Likewise on the way back, some CFM fill-in sampling was carried out. A related ^{39}Ar station (Sta. 121) was only done away from the Drake Passage section proper. In total, at least four days were lost by the incident.

After leaving Ushuaia (Feb. 2-3, 1990) again, station work was resumed on Feb. 6, 1990 with a short section north and east of the South Orkneys (Stas. 122-131). From here on and up to the Bouvet Fracture Zone region the ship encountered icebergs and growlers regularly. After a further break, and after having rounded Southern Thule of the South Sandwich Islands, station work started once more on Feb. 12, 1990 near to the South Sandwich Trench, to be continued up to the African shelf (Stas. 132-179). These sections were again accompanied by XBT drops (30 to 45nm spacing).

The cruise had been planned with some contingency time to allow for delays enforced by bad weather. Actually, only about 40 hours were spent for this. Hydrographic and even large-volume sampling work turned out to be feasible up to considerable wind force, i.e. 8. A larger part of the bad weather contingency was used for the winch repair, and some in the ship's speed having to be lowered on account of growlers (2-6 knots at night). One bad storm was encountered, however, on Feb. 20-21, 1990 with 90nm gusts and 17m waves, and some lesser storms before and after this event. Between there and Cape Town, a table tennis tournament and a cruise party brought a little variety to the somewhat monotonous station work.

In total, we managed to complete also the second WOCE section adequately. It ended at the African shelf break late on Mar. 6, 1990. CFM measurements were unfortunately missed on four consecutive stations of this section because of a system breakdown. Starting from Sta. 165 (45.5°S), we ran two Rosette/CTD systems, which enabled us to obtain about 36 sampling depths per station. Whereas further south 24 depths appeared as adequate to resolve the hydrographic structure, higher vertical resolution was now regarded as relevant. A shallow rosette cast was done first, which rosette was sampled while the deep rosette cast (carrying the primary CTD instrument) was made. This procedure meant no more than about 45 min extra time per station. During the cruise, and particularly while two rosette/CTS systems were operated, a comparison was made of the AWI and Scripps-ODF data handling and operation procedures. The comparison looked favorable, although a detailed account of has yet to be made.

METEOR entered Cape Town on the morning of Mar. 8, 1990. A historic remark: The German pre-war METEOR ran a cruise Ushuaia - Cape Town from Jan. 21 to March 10, 1926, which was cruise 5 of its famous South Atlantic survey. The scientific topic, i.e. hydrography, was quite similar. Stations totaled 34 (6 across Drake Passage), properties measured three (temperature, salinity, oxygen), and depths sampled were typically 26 (in three casts, naturally no continuous depth traces). Progress is slow after all.

Data obtained

Samples taken for shore-based measurement are listed in Table 4. The complete station list with some comment is given in Table 5. Data obtained aboard ship were quality-checked immediately, apart from the CFM data that were carefully evaluated and screened later on. A computerized bottle data list was set up. Working from it, sections were made using objective analysis with variable correlation length-scales (R. Schlitzer). A selection of these sections follows below.

XBT temperature readings were corrected 0.25 K downward and depth upward (by 20 m at 300 m depth), according to comparisons with simultaneous CTD casts. Bucket and thermosalinograph temperatures were noted for each drop. Thermosalinograph readings were corrected upward by 0.05 ± 0.04 K and 0.33 ± 0.2 PSU.

Drake Passage: Fig. 2-6 give sections of potential temperature, salinity, density, silicate, and CFM 11, respectively. Subantarctic front is found near Sta. 105, Polar Front near Sta. 112, and Scotia Front near Sta. 116. The Fig. 2-5 sections are similar to previous ones, whereas a CFM section (Fig. 6) was done for the first time. Fig. 6 shows that the Lower Circumpolar Deep Water, represented by the salinity maximum layer in Fig. 3, i.e. the presumed source of Warm Deep Water in the Weddell Sea (Sievers and Nowlin, 1984), is CFM-free when entering Drake Passage from the west.

Orkney section: The CFM 11 section in Fig. 7 indicates higher concentrations in the Scotia Sea area (Sta. 126-128) than in the Weddell Basin (Sta. 129-131).

Section South Sandwich Trench and east: Potential temperature (Fig. 8), oxygen (Fig. 9), and silicate (Fig. 10) show relative extreme in the trench area (Sta. 133-135), and well correlated features (eddies, front meanders?) in the top 1000m.

African Passage section: The hydrographic structure given in Figs. 11 and 12 is as expected from the literature (Witworth and Nowlin, 1987), but strong features related to the Agulhas retroflexion are apparent (Sta. 175ff).

XBT and thermosalinograph sections are displayed in Figs. 13-15, and an XBT list is given in Table 6.

Fig. 16 gives ALACE float motions Jan. – end of August, 1990.

References:

Bullister, J.L., and R.F. Weiss (1988): Determination of CCl_3F and CCl_2F_2 and air. Deep-Sea Res., 35,839-853.

Huber, B.A., et al. (1989): ANT V/2 CTD and Hydrographic Data, LDGO-89-3, Lamont-Doherty Geological Observatory of Columbia University, Palisades New York, 1989.

Roether, W., M. Sarnthein, T.J. Muller, W. Nellen and D. Sahrhage (1990): Sudatlantik-Zirkumpolarstrom, Reise Nr. 11, 3. Oktober 1989 -11. Marz 1990. METEOR-Berichte, Universitat Hamburg, 90-2, 169 p.

Sievers, H.A., and W.D. Nowlin (1984): The stratification and water masses at Drake Passage. J. Geophys. Res., 89, 10,489-10,514.

Witworth, T., III, and W.D. Nowlin (1987): Water masses of the Southern Ocean at the Greenwich Meridian. J. Geophys. Res., 92, 6462-6476.

Table 2: Principal Investigators for all measurements

Parameter	Institution	PI
CTD, Salinity	AWI	G. Rohardt, E. Fahrbach
Nutrients, Oxygen	ODF Scripps	J. Swift, F. Delahoyde
CFMs	Uni Bremen	W. Roether
Tritium, 3He	Uni Bremen	W. Roether
14C (L-V & AMS)	IUP Heidelberg	P. Schlosser, K.O. Munnich
39Ar	Uni Bern	H.H. Loosli
85Kr	LDGO	W. M. Smethie
CO2-Parameters	LDGO	D. Chipmann, T. Takahashi
226/228Ra	Uni Prenceton	R. Key
	IfM Kiel	M. Rhein
XBT, Thermosalinograph	AWI	U. Schauer, E. Fahrbach
ADCP	AWI	E. Fahrbach
CTD-intercomparison	AWI/ODF Scripps	G. Rohardt, F. Delahoyde
ALACE Drifter	SIO, Texas A&M	R. Davis, W.D. Nowlin

METEOR 11/5 (Jan-Mar 1990)

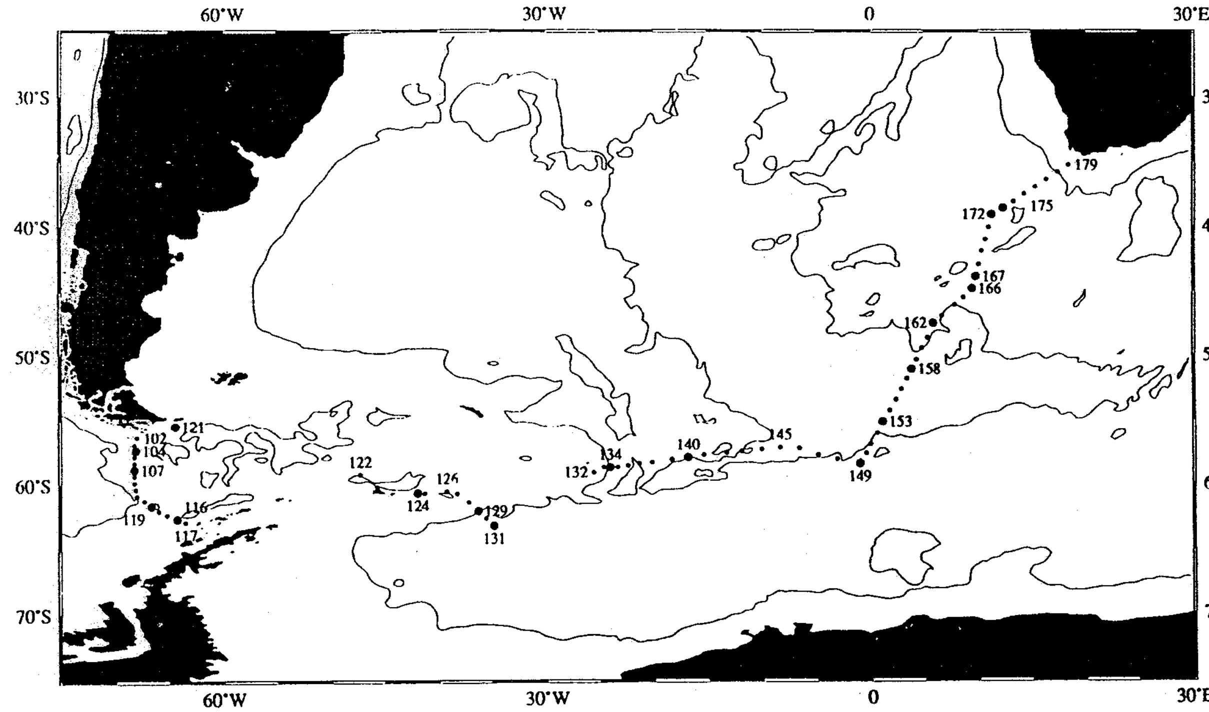


Fig. 1: Cruise track and stations (large dots: large volume stations), METEOR cruise 11/5

DRAKE PASSAGE – Potential Temp. [C]

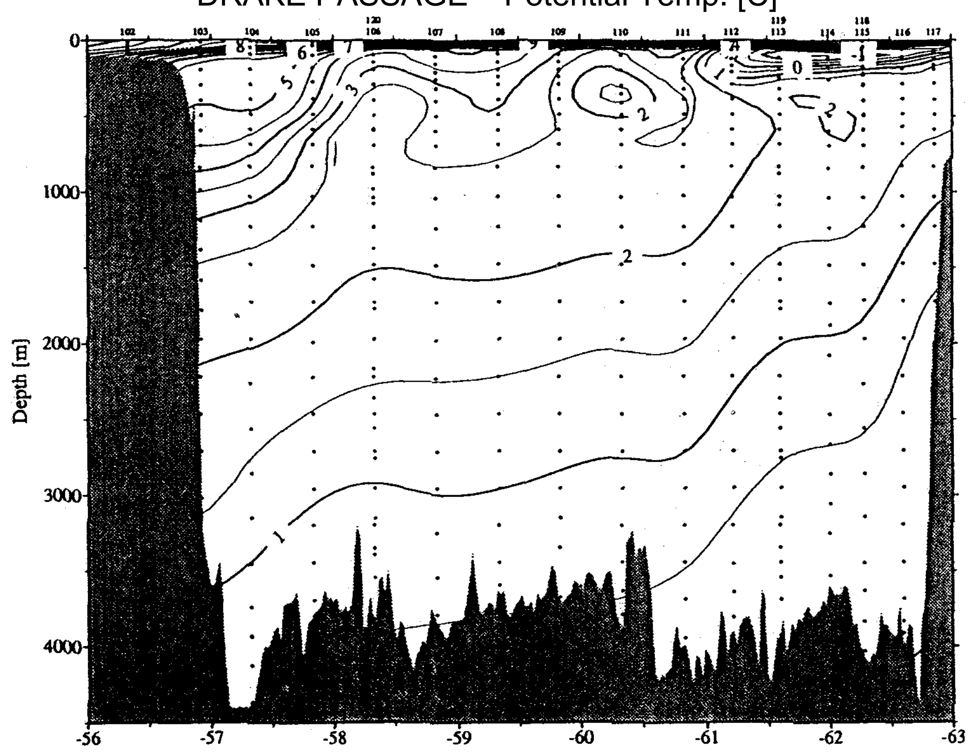


Fig. 2: Potential temperature section, Drake Passage, METEOR 11/5 (WOCE S1/A21). Station positions see Fig. 1 and Table 4. Isolines by objective analysis of original data (indicated by dots) by R. Schlitzer. Bottom depth from ships recordings.

DRAKE PASSAGE – Salinity [psu]

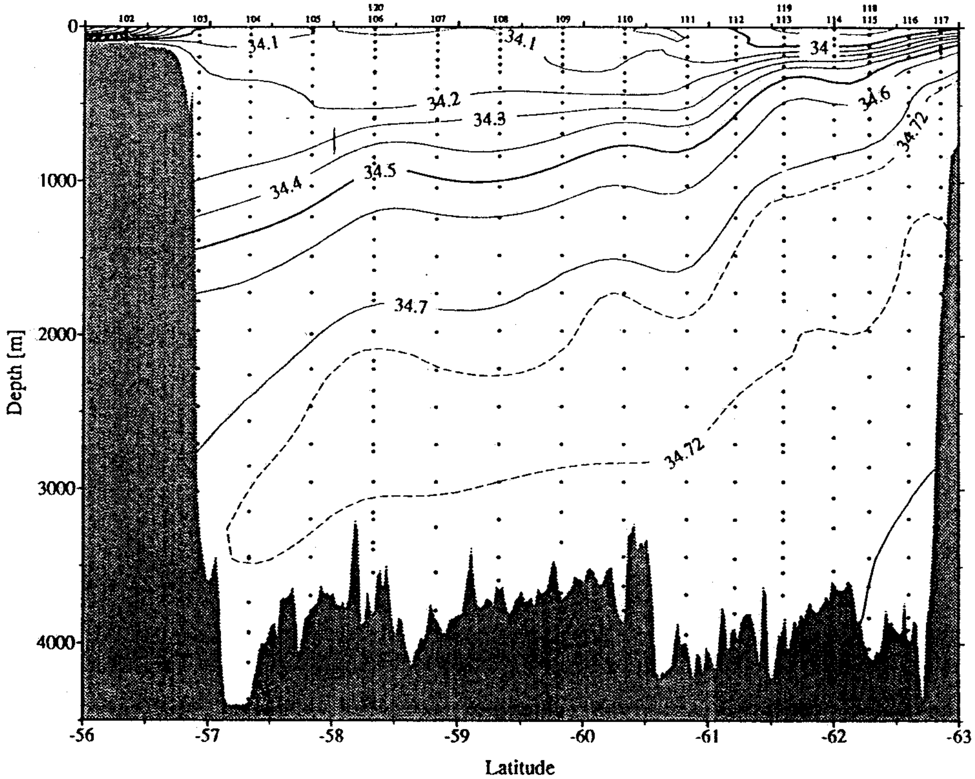


Fig. 3: same, salinity section.

DRAKE PASSAGE – Potential Density

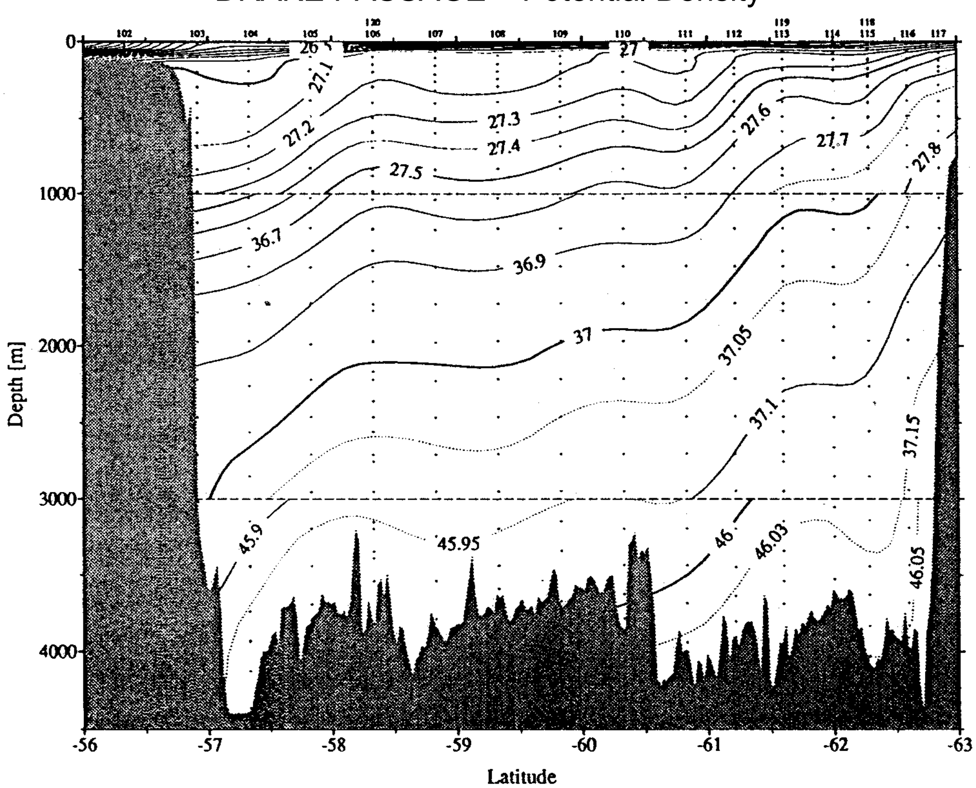


Fig. 4: same, density parameter, σ_0 (0-1000 m), σ_2 (1000-3000 m); σ_4 (3000-bottom)

DRAKE PASSAGE – Silicate [µmol/kg]

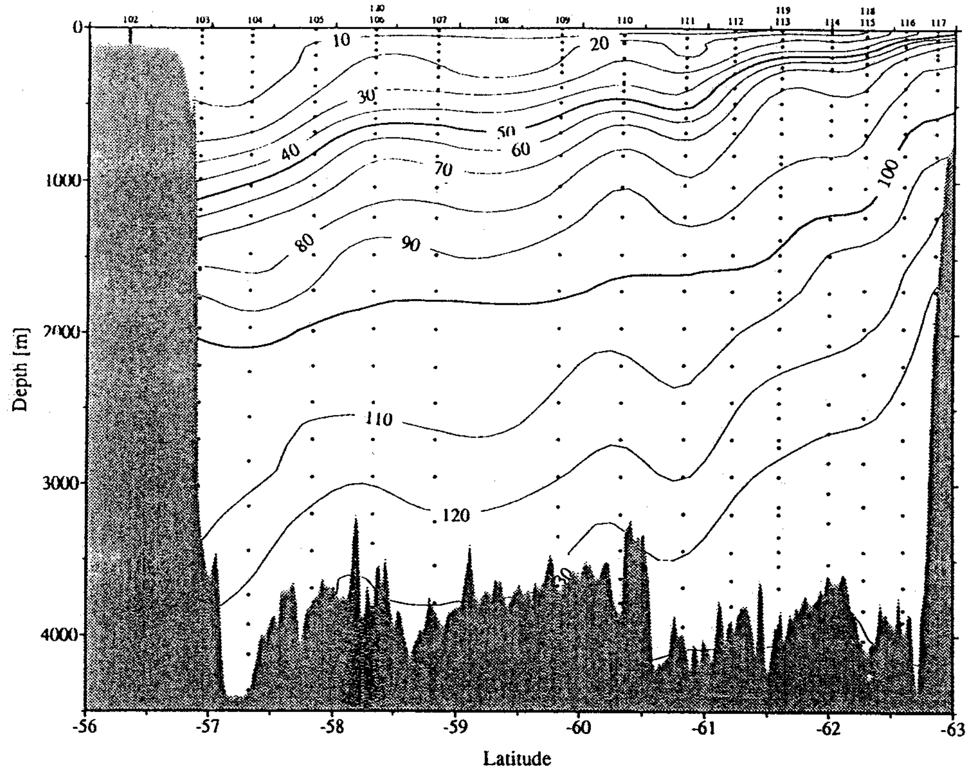


Fig. 5: same, silicate section.

DRAKE PASSAGE – Freon-11 [pmol/kg]

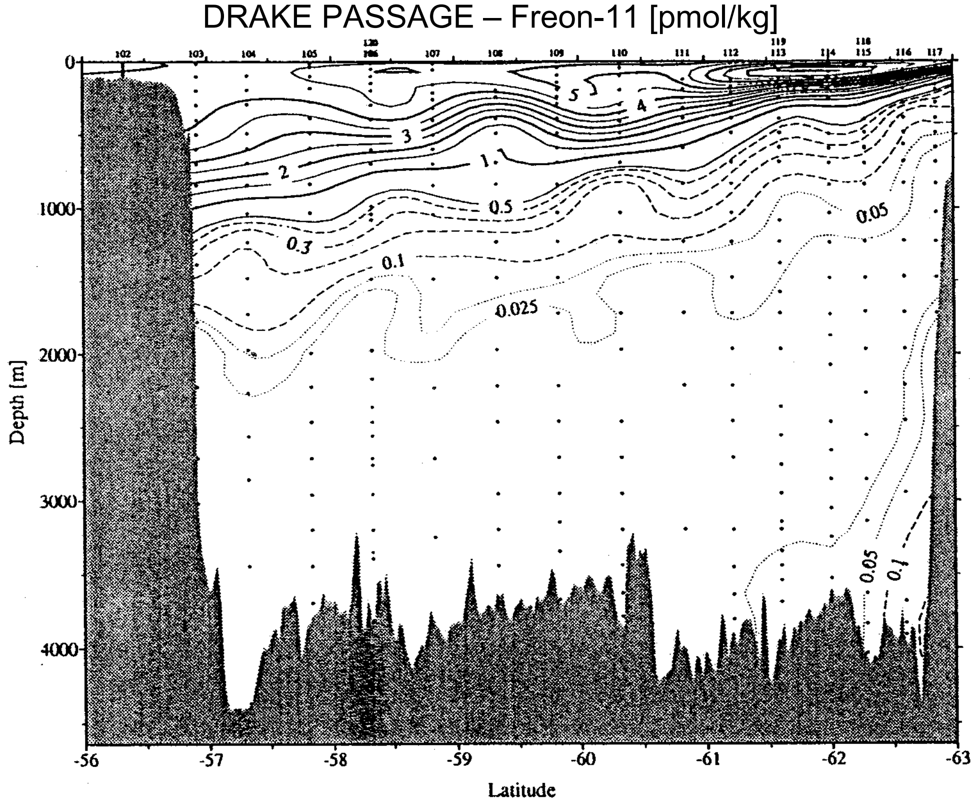


Fig. 6: same, CFM 11 section. The position of the lowest isoline, 0.025 pM, is somewhat uncertain, for being near to the data error of about 0.01 pmol/kg.

ORNEY 3 – Freon-11 [pmol/kg]

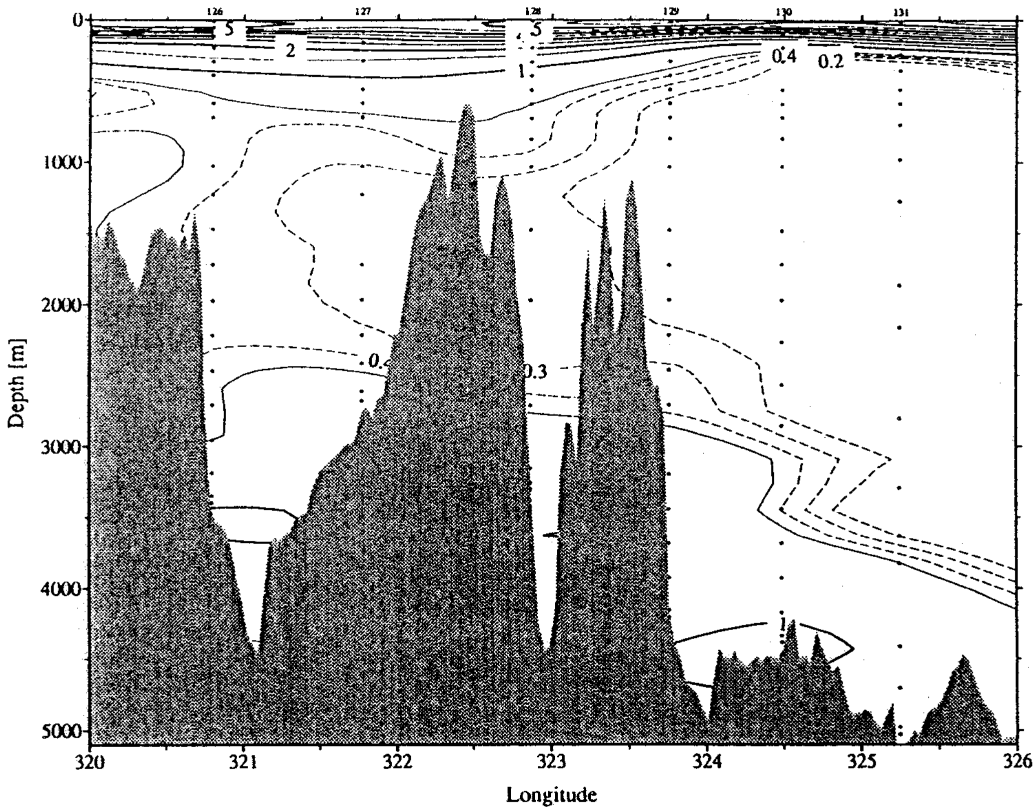


Fig. 7: CFM 11 section, Orkney Stas. (Fig. 1), for explanation see Fig. 2.

SANDWICH – Potential Temp. [C]

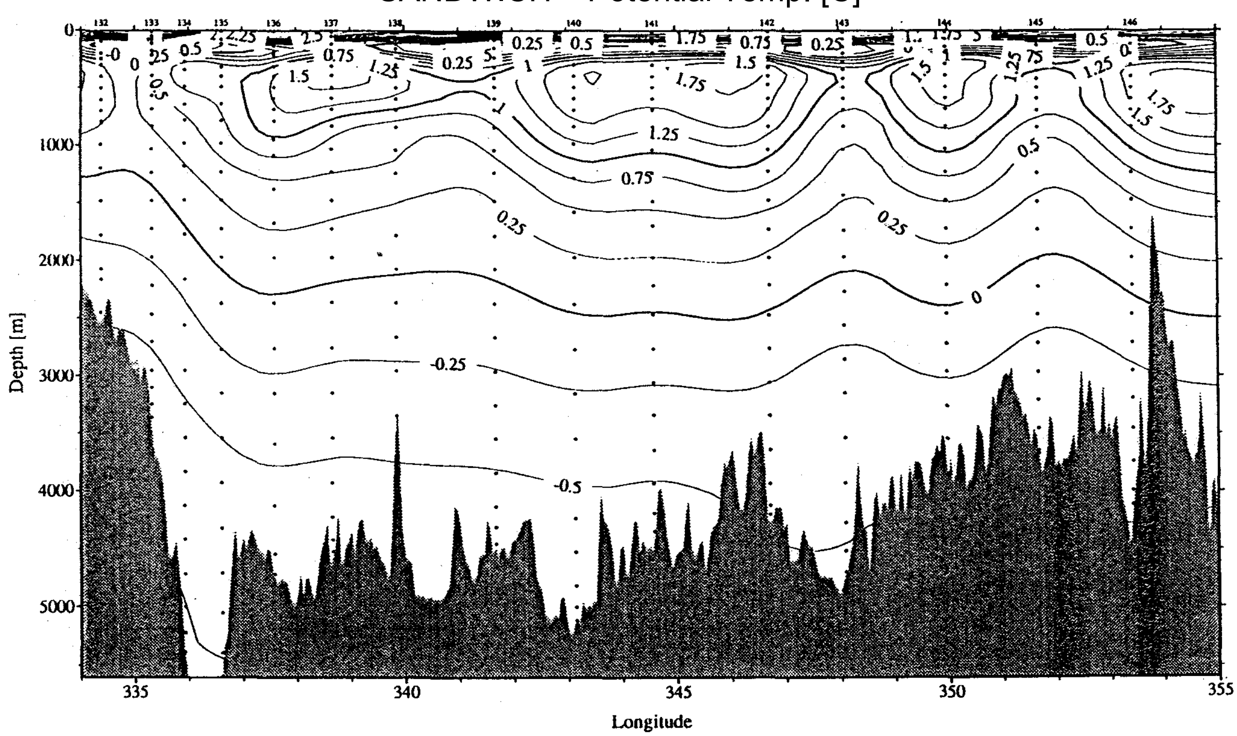


Fig. 8: South Sandwich trench and east, potential temperature section, Stas. see Fig. 1, for explanation see Fig. 2.

SANDWICH – Oxygen [μmol/kg]

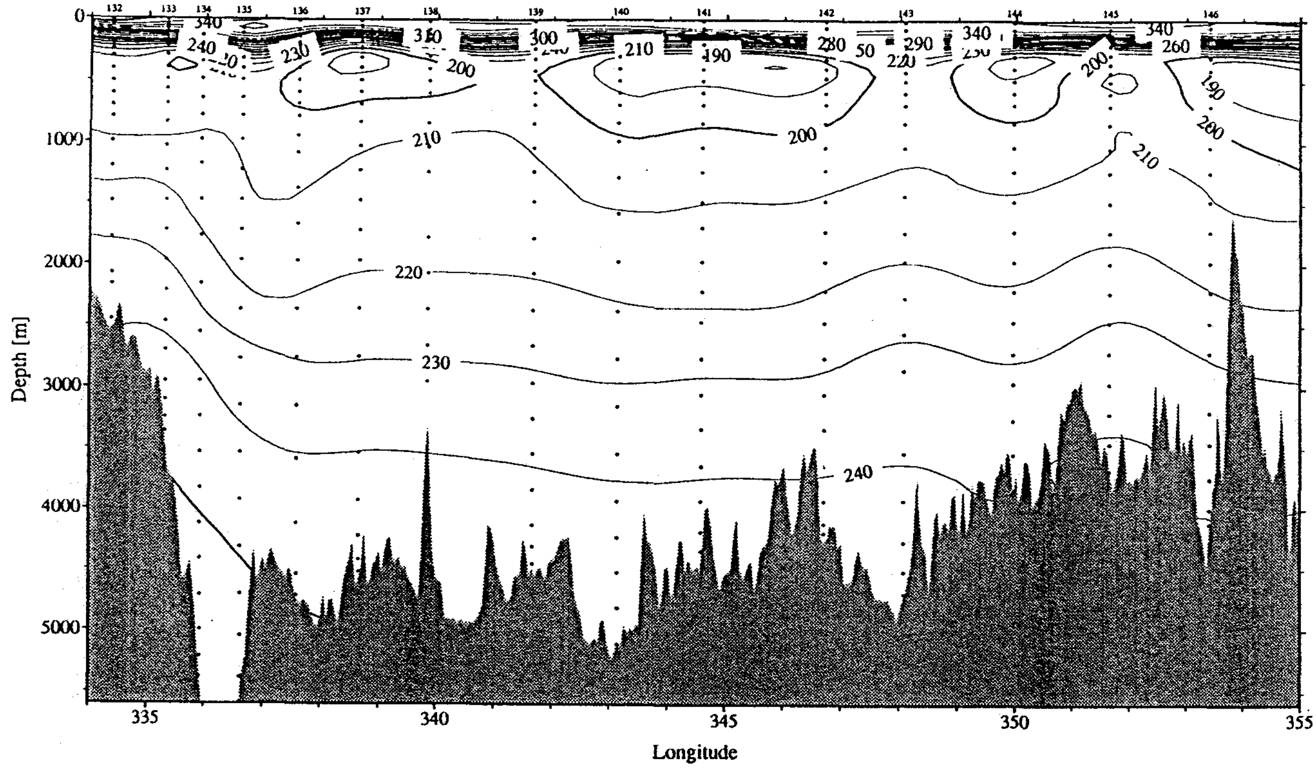


Fig. 9: same, oxygen section.

SANDWICH – Silicate [μmol/kg]

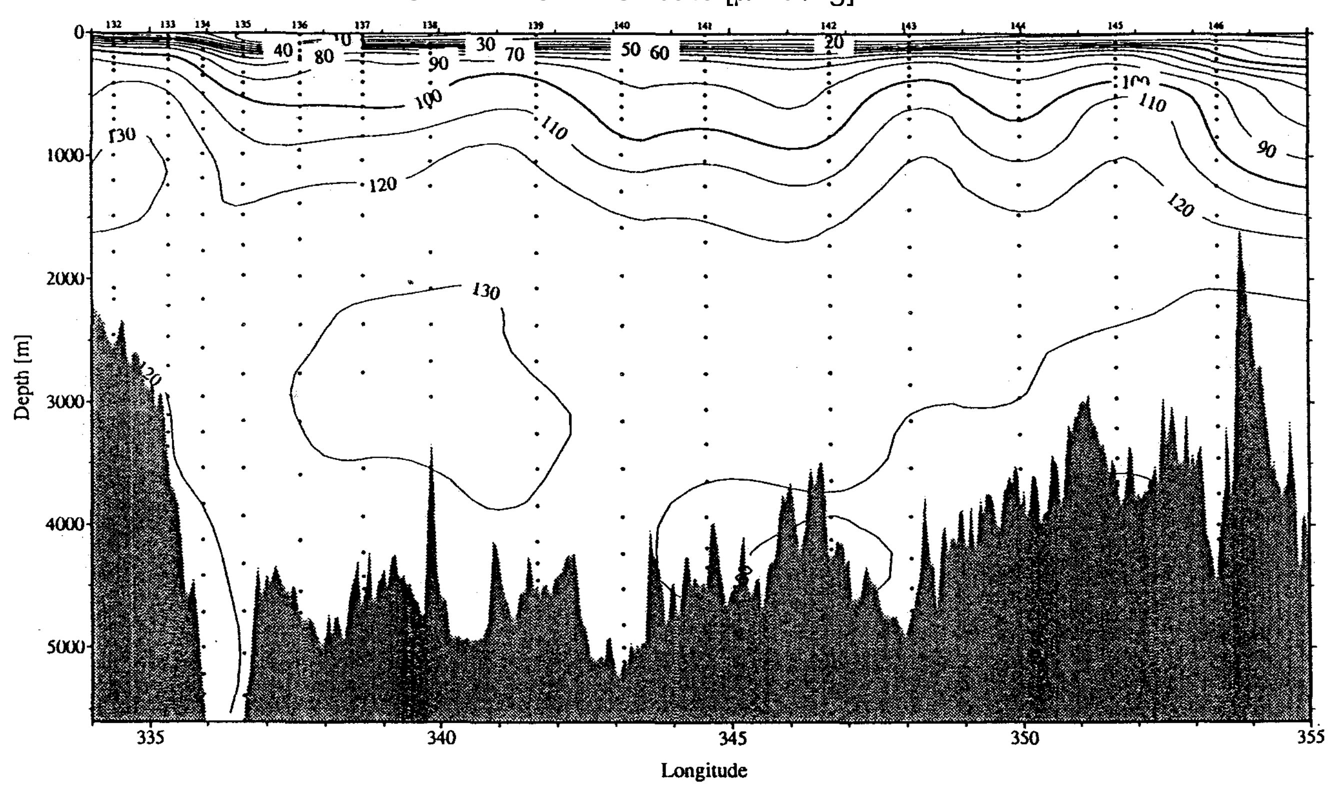


Fig. 10: same silica section.

CIRCUM – Potential Temp. [C]

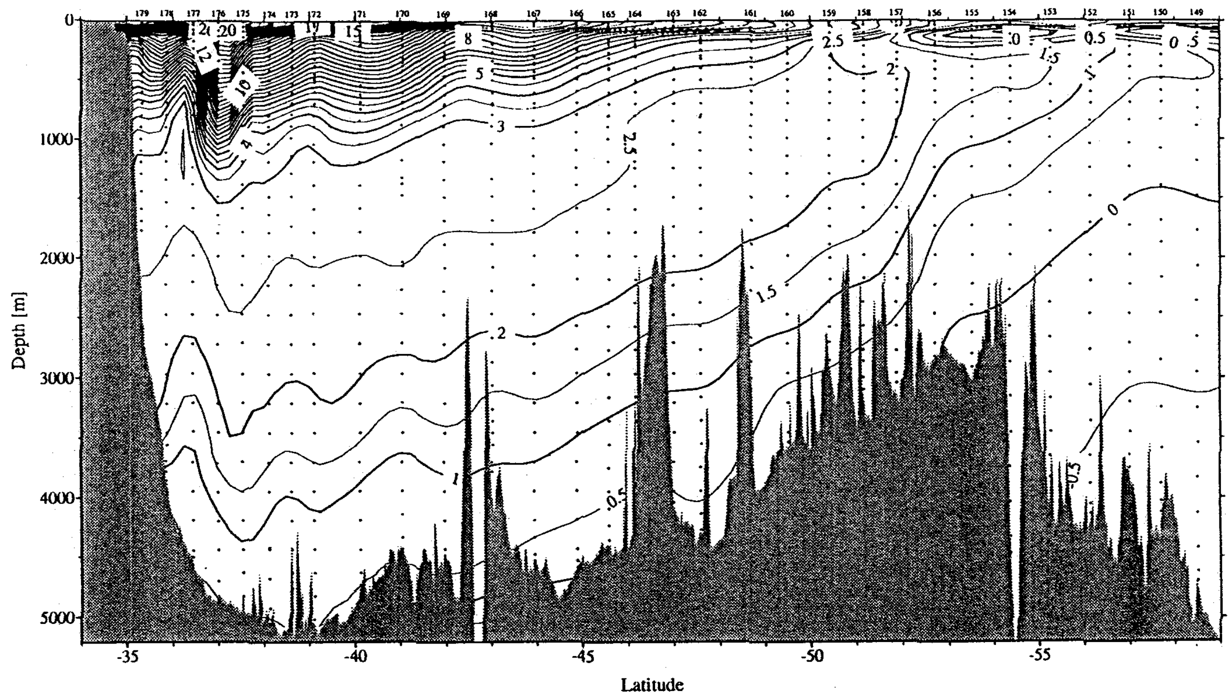


Fig. 11: African Passage section (WOCE S2/A12), potential temperature. Stas. see Fig. 1, for explanation see Fig. 2.

CIRCUM – Salinity [psu]

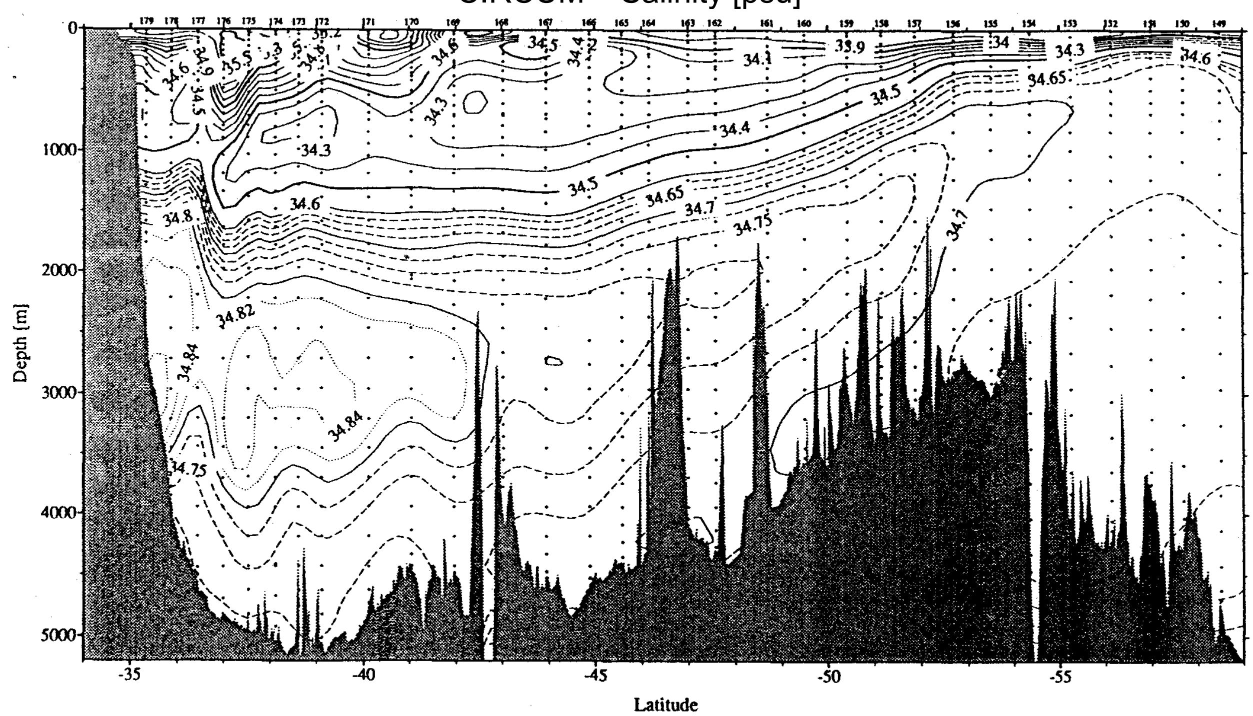


Fig. 12: same, salinity section.

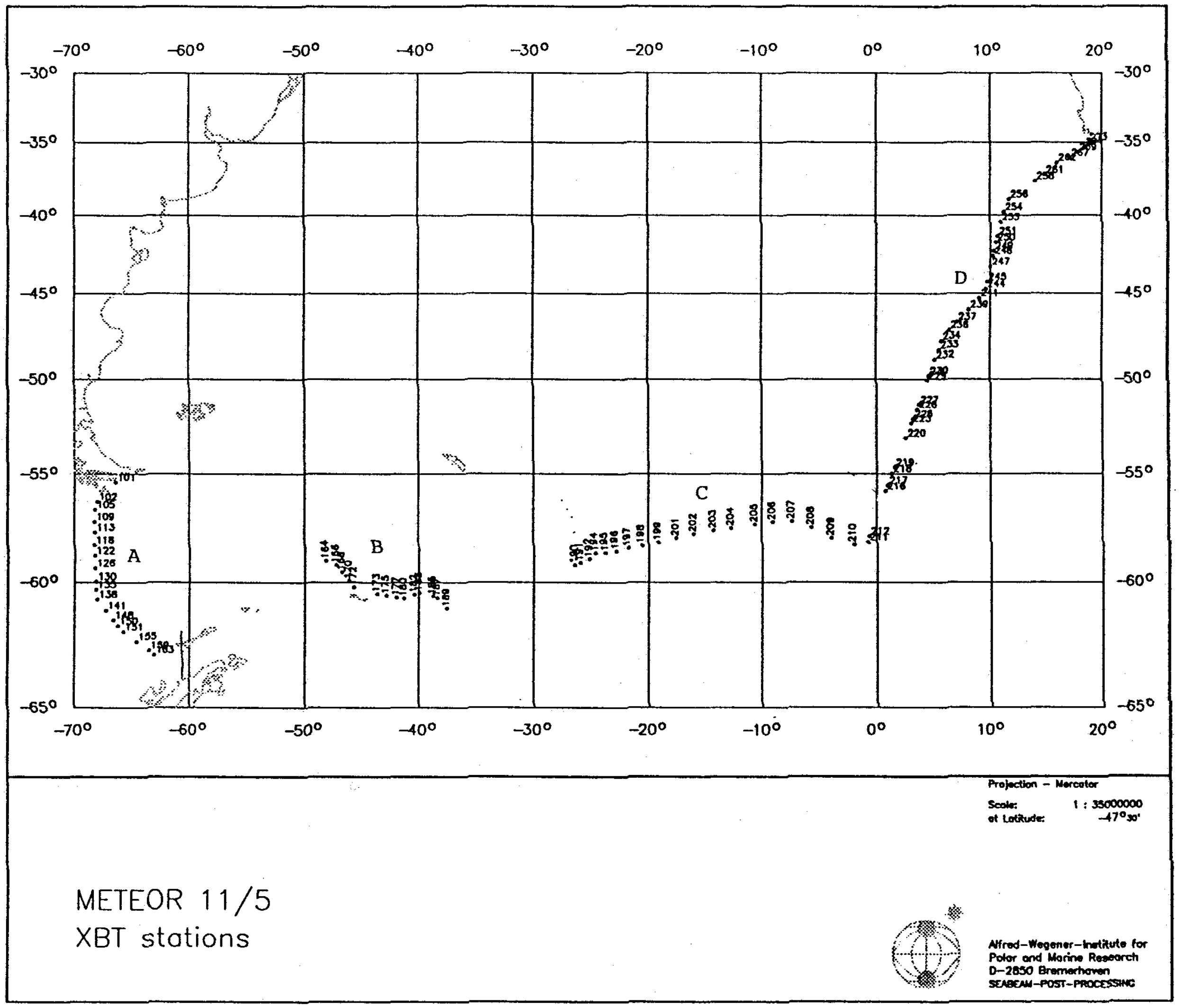


Fig. 13: Map of XBT drops, some numbers are omitted for clarity.

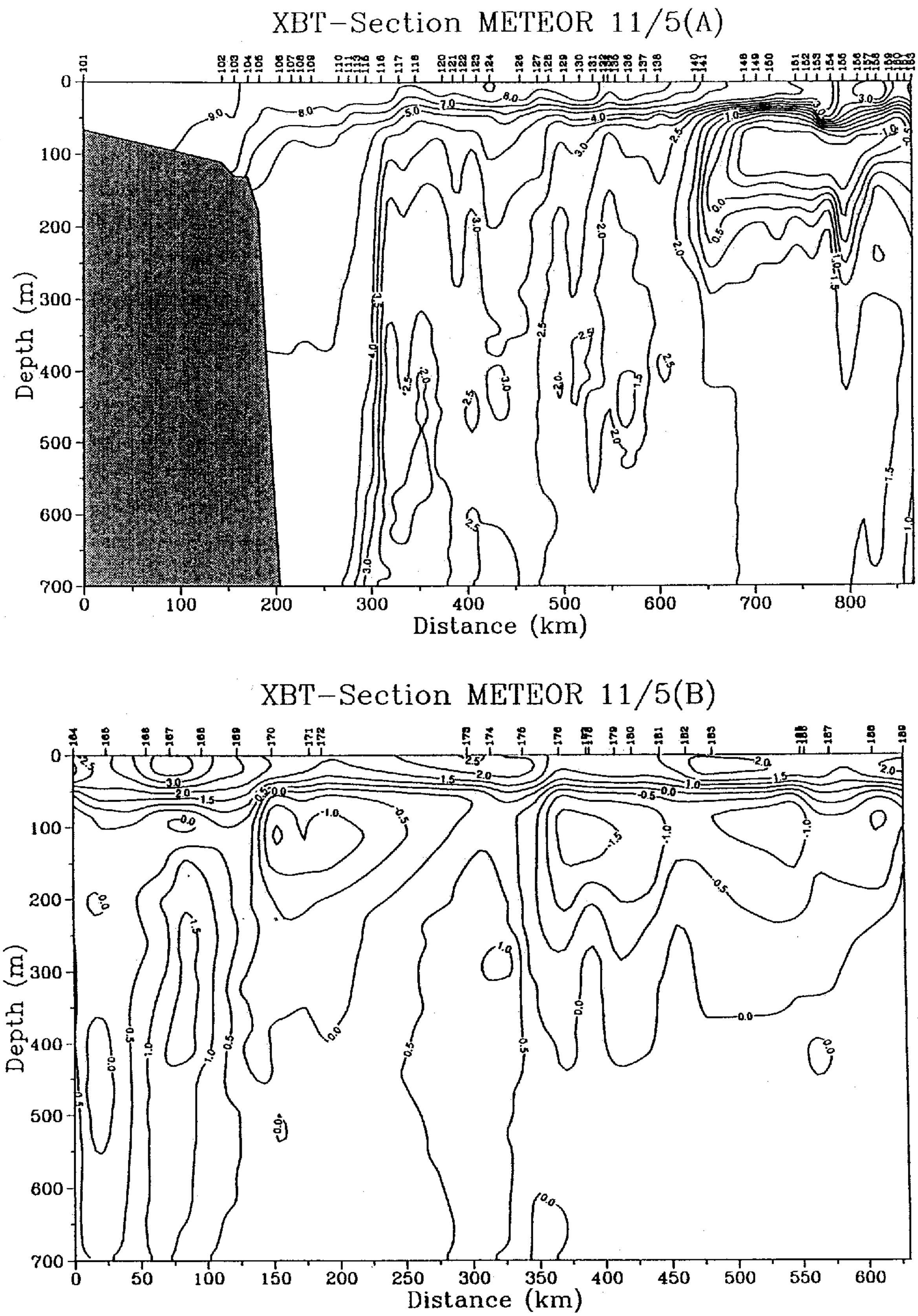
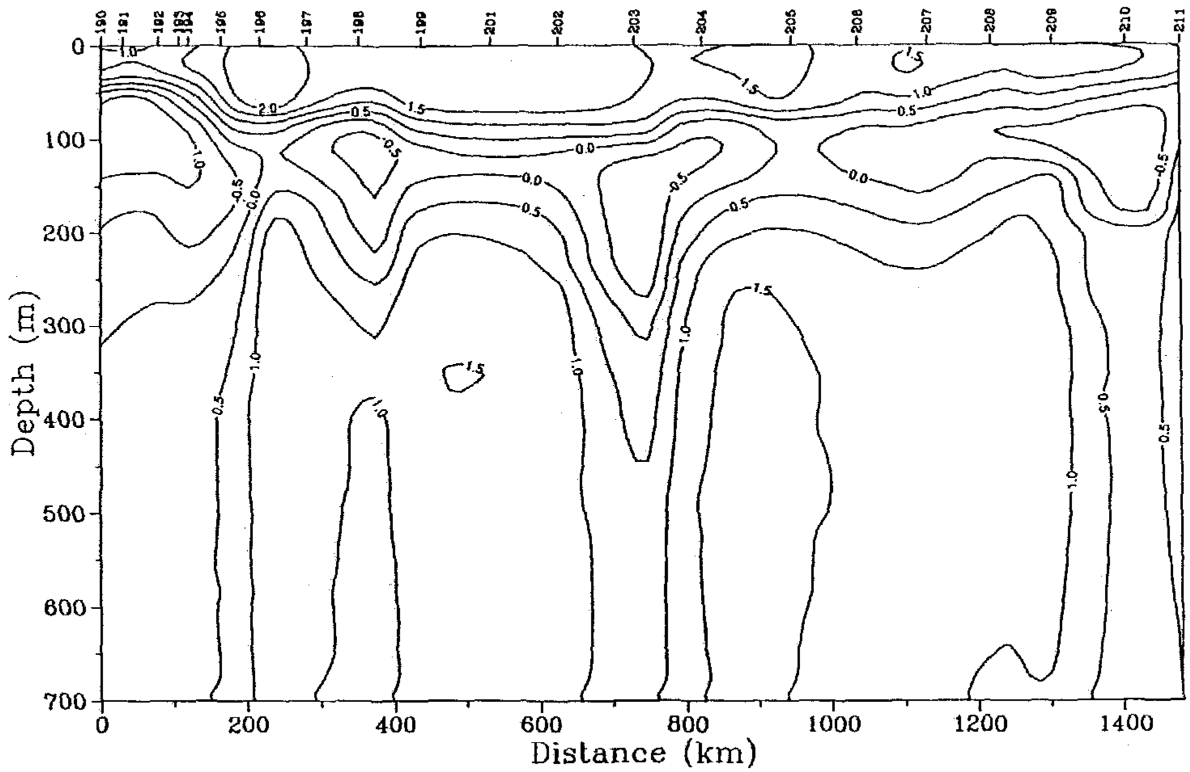


Fig. 14: XBT section, 0 to 700 m, in four parts as indicated in Fig. 13.

XBT-Section METEOR 11/5(C)



XBT-Section METEOR 11/5(D)

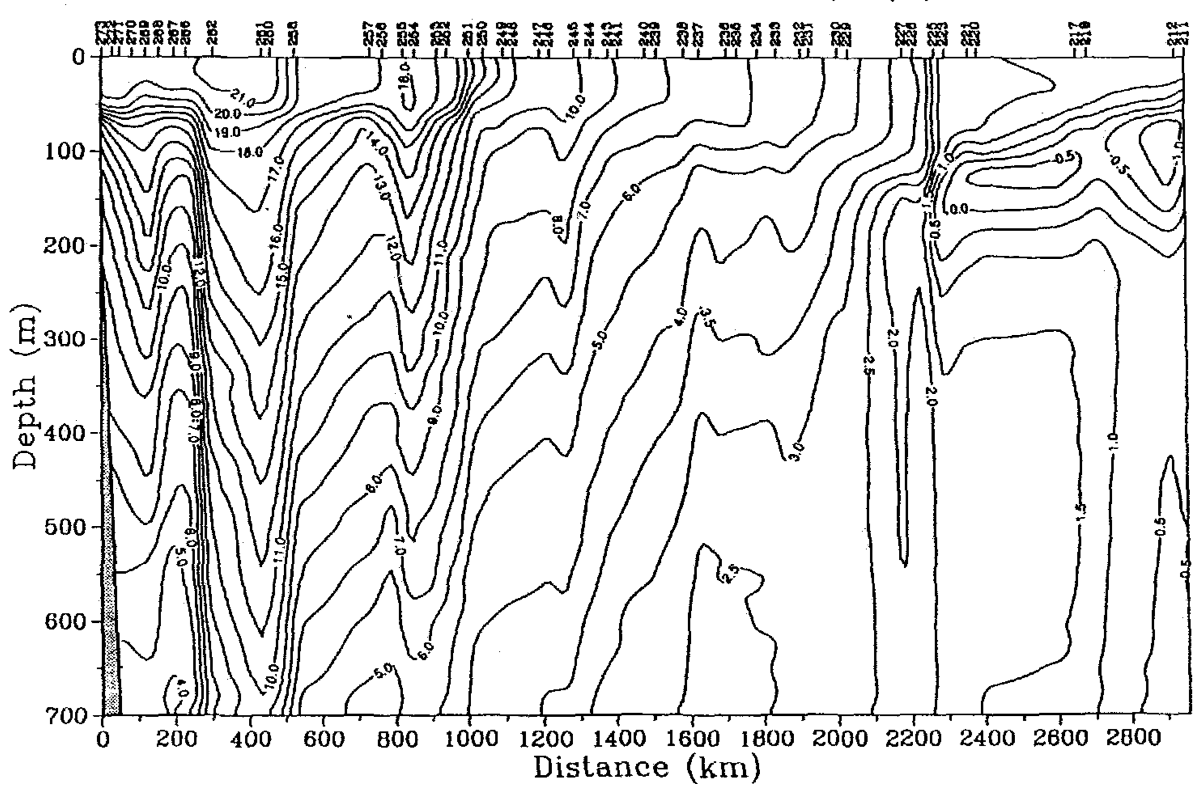
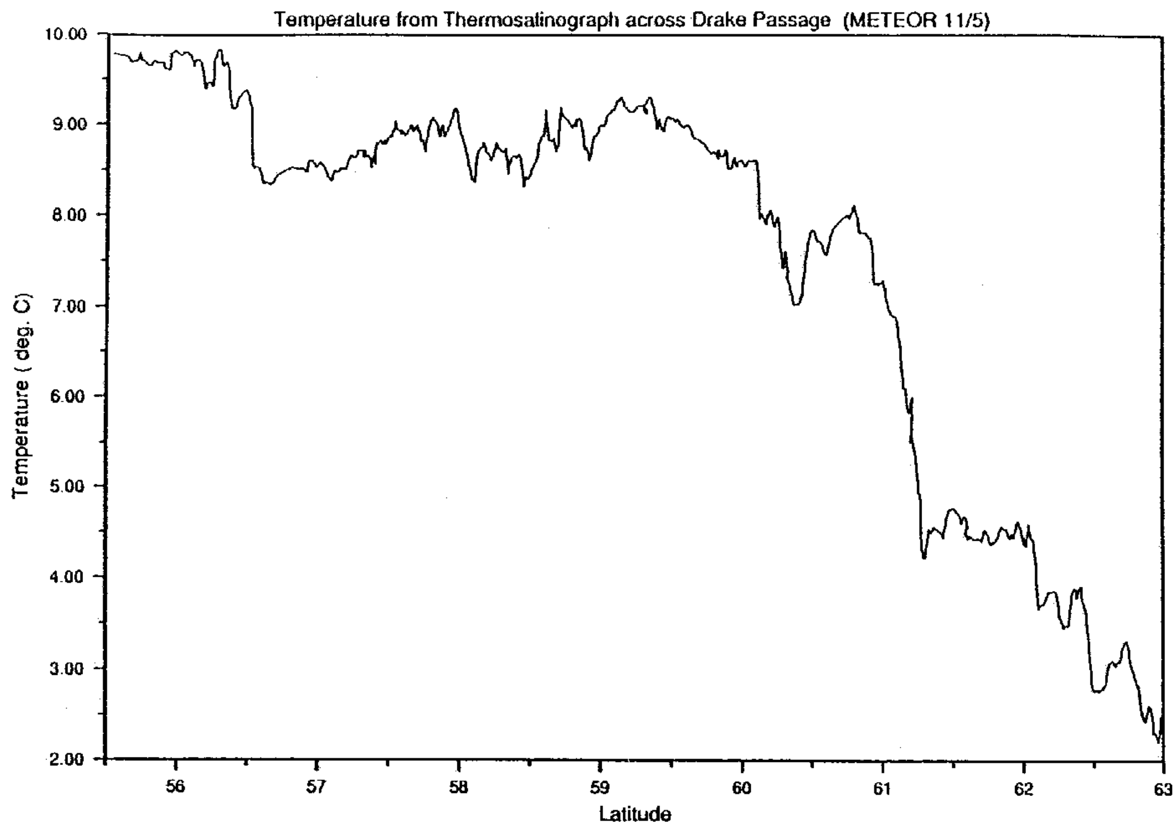


Fig. 14 (continued)



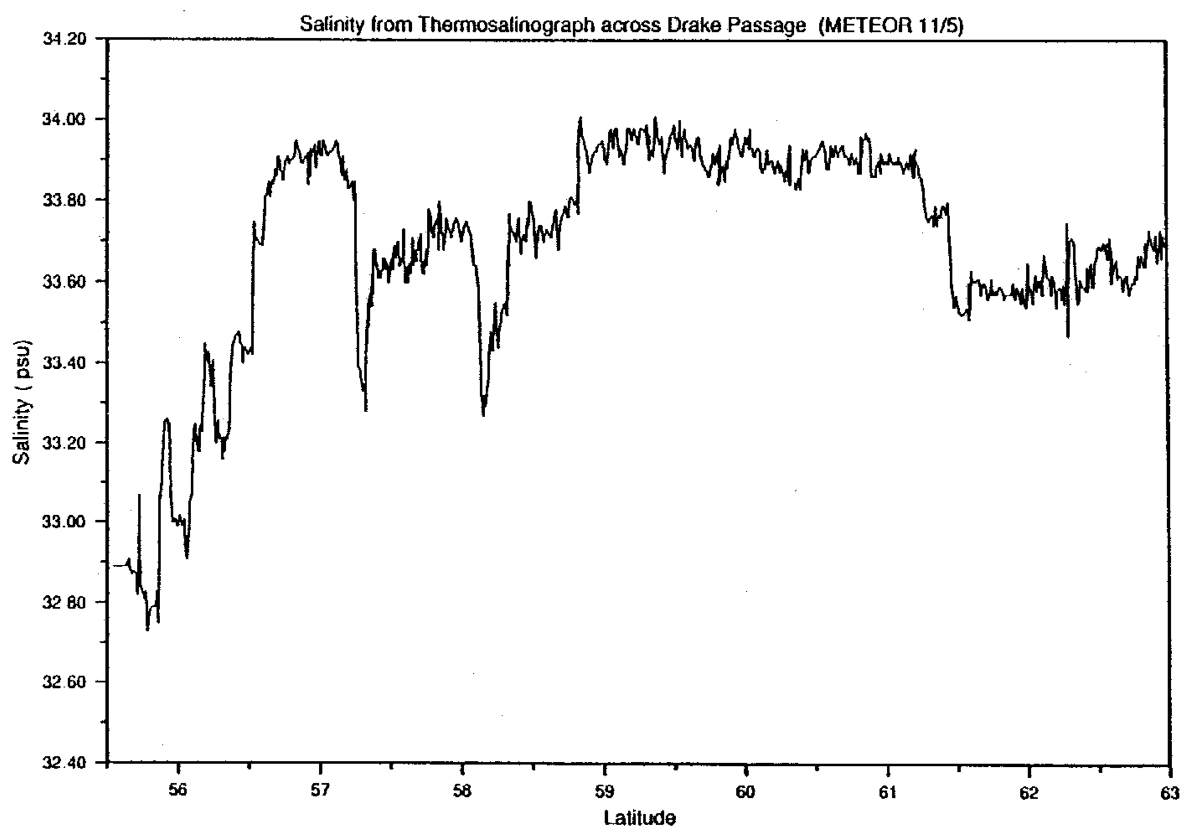
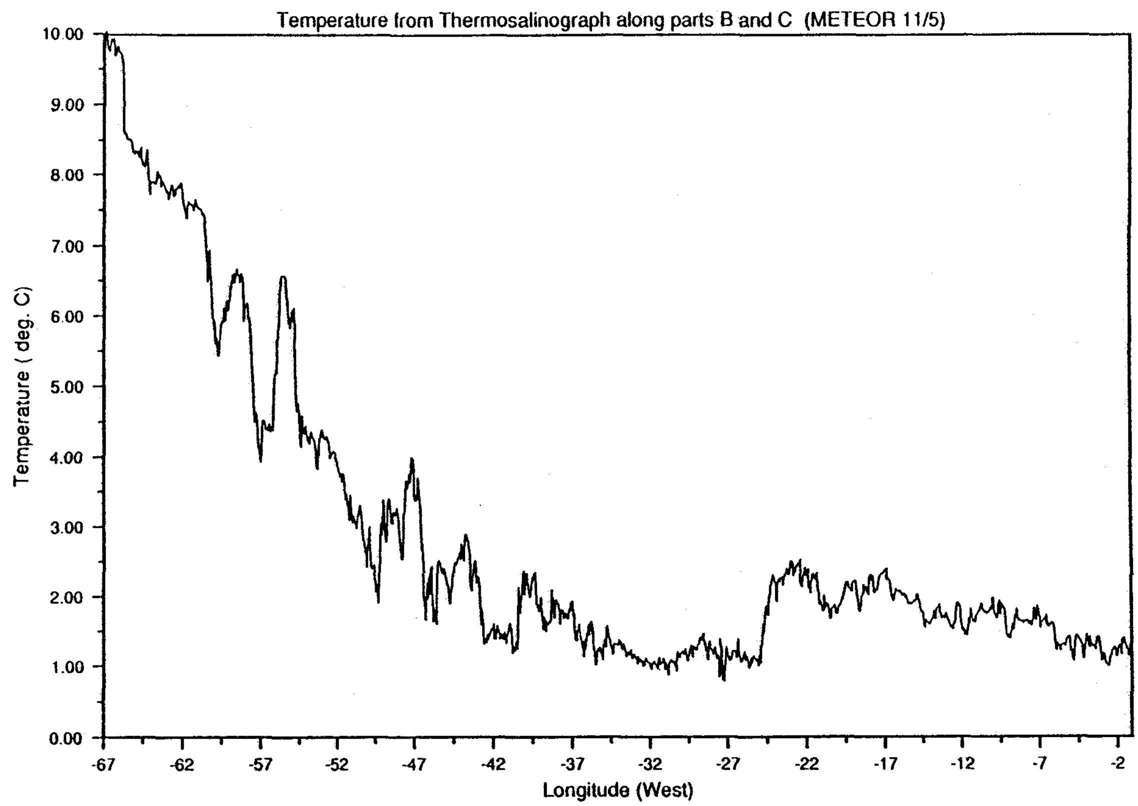


Fig. 15: Thermosalinograph section, in three parts as indicated in Fig. 13.



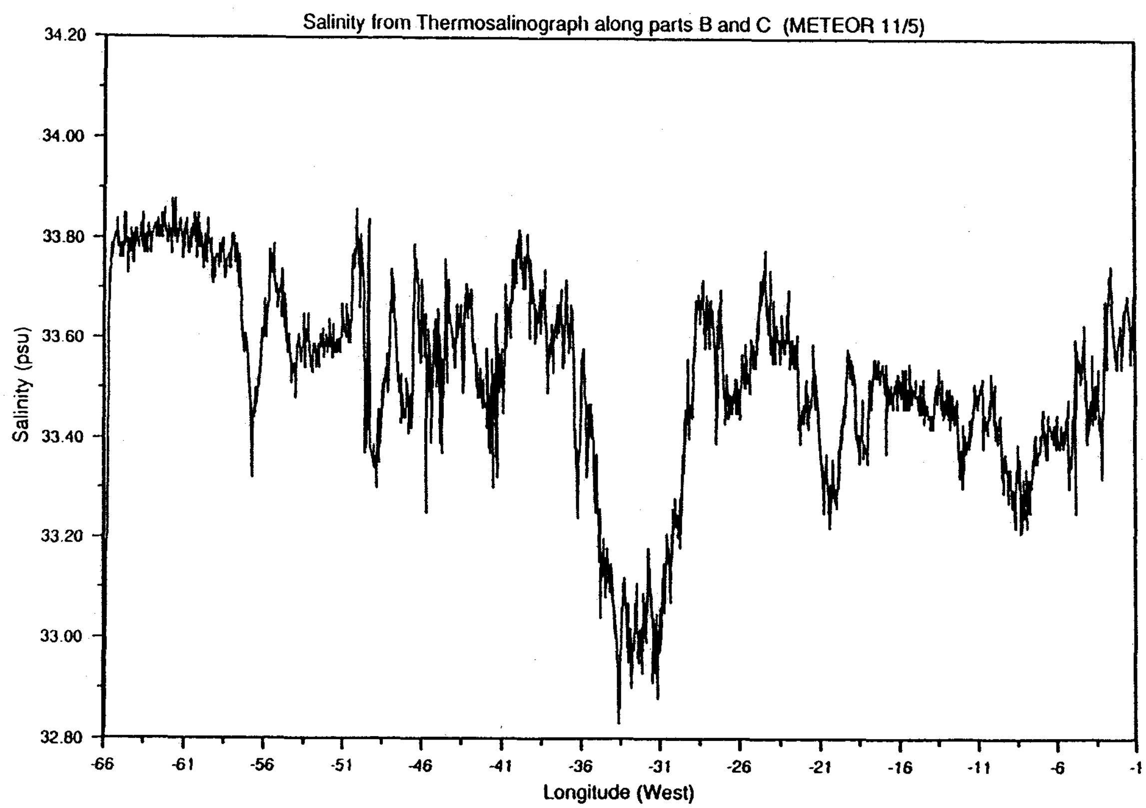
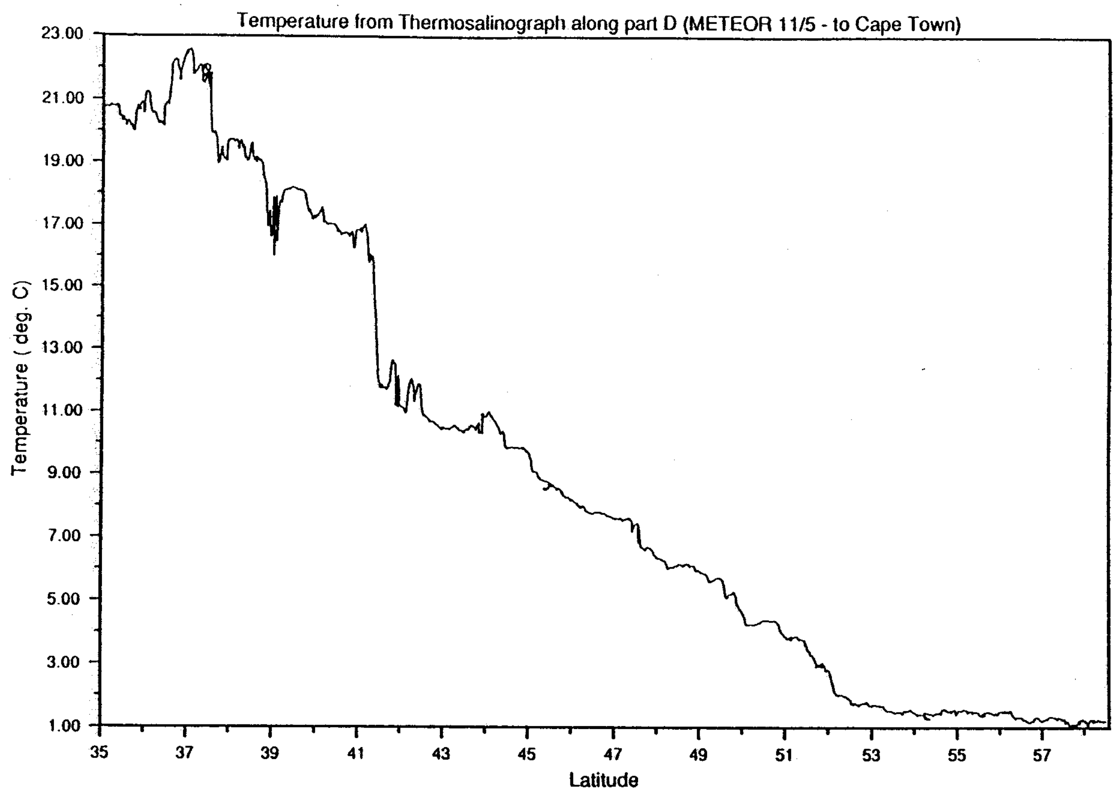


Fig. 15 (continued)



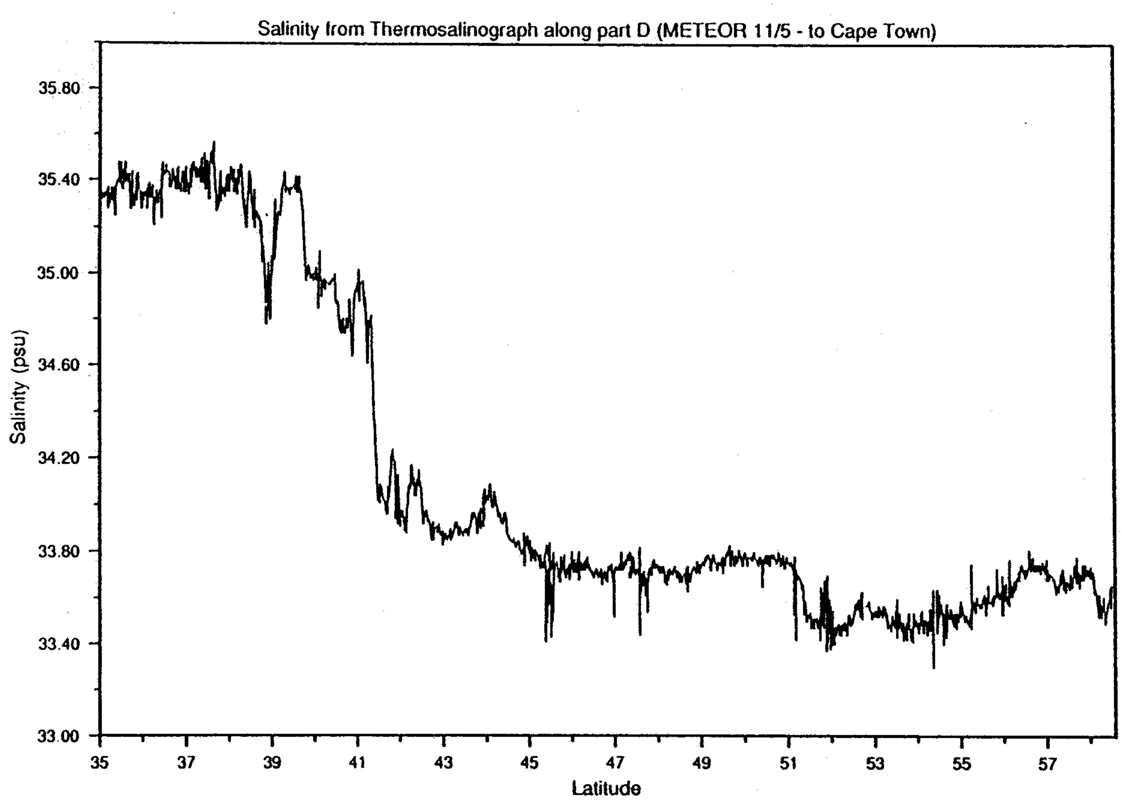


Fig. 15 (continued)

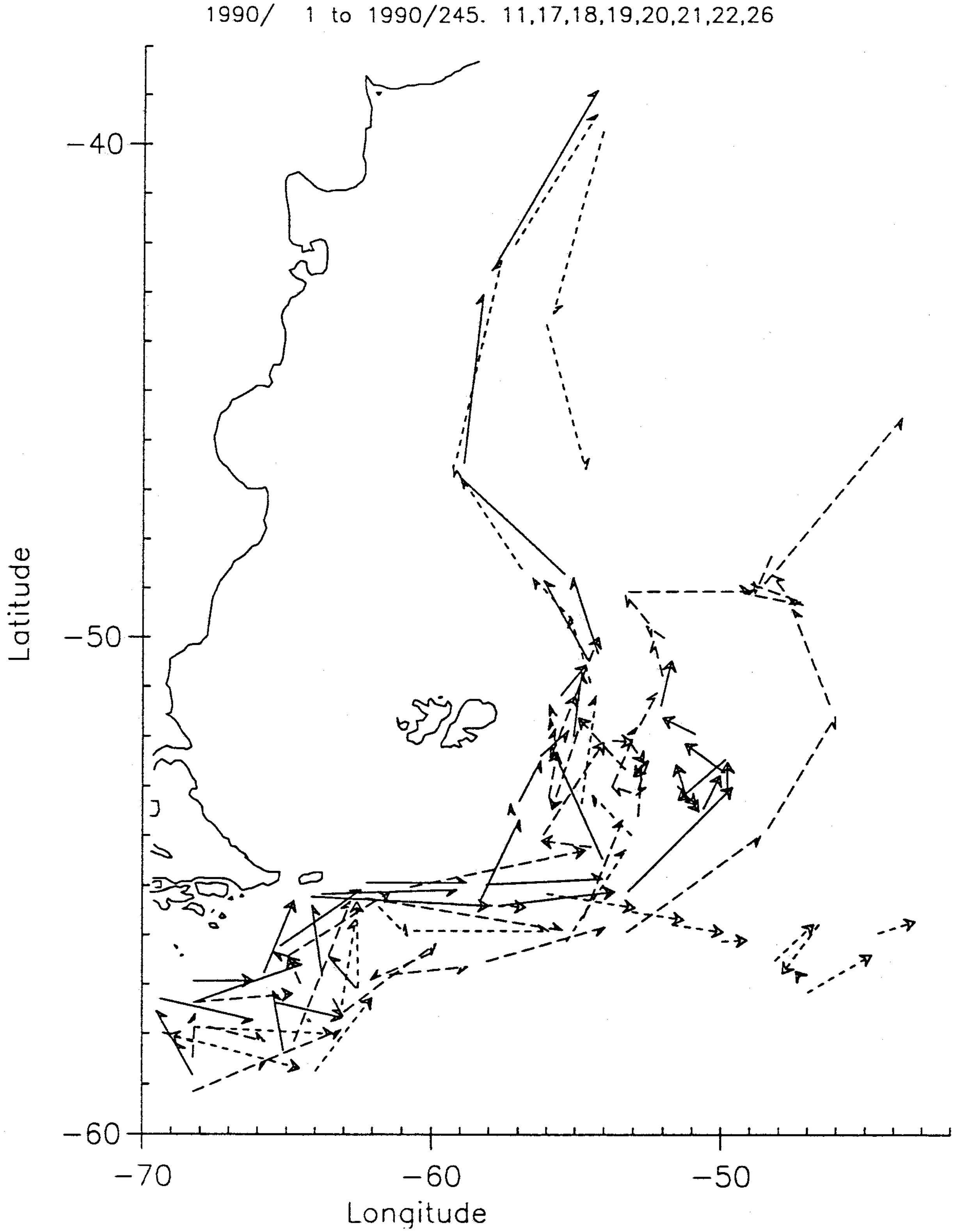


Fig. 16: Alace float trajectories, Jan. to end of August 1990. Vector displacements for 14 day period between dive and surfacing position are shown, coded for the individual floats; gap between vectors is surface time (24 h). Float rise velocity exceeds 1 km/h, descent starts at 700 m/h approaching zero at equilibrium depth.

Table 3: Cruise Participants

Name	Responsibility	Institution
Roether, Wolfgang, Prof. Dr.	Chief Scientist	UBTO
Arango, Jose Maria	Observer	IADO
Beining, Peter	CFM measurement	UBTO
Bulsiewicz, Klaus	CFM measurement	UBTO
Ballegooyen, R. C.van	Observer	NRIO
Bargen, D. van	Meteorologist	DWD
Bos, David L.	Nutrients	ODF
Breger, Dee	CO_2	LDGO
Chipman, David W.	CO_2	LDGO
Costello, James. P.,	Oxygen	ODF
Delahoyde, Frank M.,	CTD, data processing	ODF
Döscher, H.-J.	Meteorology	DWID
Fraas, Gerhard	Rosette, sampling	UBTO
Helas, G., Dr.	Air chemistry	MPCB
Junghans, Christel	^{14}C processing	IUP
Junghans, Hans-Georg	^{14}C processing	IUP
Key, Robert M., Dr.	Ra processing	AOSP
Legutke, Stefanie.	CTD	IFMH
Nowlin, Worth D., Prof. Dr.	Data analysis, ADCP	TAMU
Plep, Wilfried	Rosette, sampling	UBTO
Putzka, Alfted, Dr.	CFM measurement	UBTO
Ritschel, Kirstin	^{14}C processing	IUP
Rohardt, Gerd	CTD, data processing	AWI
Schlitzer, Reiner, Dr.	Bottle data analysis	UBTO
Schlosser, Peter, Dr.	L-V sampling	LDGO
Schauer, Ursel	CTD, XBT	AWI
Schebeske, G.	Air chemistry	MPCB
Theisen, Stefan	Rosette, sampling	UBTO
Weppernik, Ralph	^{39}Ar, ^{85}Kr processing	PIB
Zaucker, Friedrich	L-V sampling	LDGO

AOSP Program in Atmospheric & Oceanic Sci., Dept. of Geol. & Geophys. Sci., Princeton University, P. 0. Box CN 7 10, Princton, NJ 08544-07 1 0,USA
AWI Alfred-Wegner-Institut für Polar- und Meeresforschung, Columbusstraße, 2850 Bremerhaven
DWD Deutscher Wetterdienst, Seewetteramt, Postfach 301190, 2000 Hamburg 36
IADO Instituto Argentina de Oceanografia, Av. Alem 53, CP 8000 Bahia Blanca, Argentinien
IFMH Institut für Meereskunde, Universität Hamburg, Troplowitzstr. 7, 2000 Hamburg 54
IUP Institut für Umweltphysik, Universidit Heidelberg, Im Neuenheimer Feld 366, 6900 Heidelberg
LDGO Lamont - Doherty, Geological Observatory, Geochemstry Dept., Palisades, N.Y. 10964, USA

MPCB Abteilung Biogeochemie, Max-Planck-Institut für Chernie, Postfach 3060, 6500 Mainz
NRIO National Research Institute for Oceanology, CSIR, P. 0. Box 320, 7600 Stellenbosch, SUdafrika
ODF Oceanographic Data Facility, Scripps Institution of Oceanography, U. Cal. S. D., La Jolla, CA 92093, USA
PIB Physikalisches Institut der Universtät Bern, Bern, Schweiz
TAMU Department of Oceanography, Texas A & M University, College Station, TX 77843-3146, USA
UBTO Universtät Bremen, FB, 1, Tracer-Ozeanographie, Postfach 330 440, 2800 Bremen 33

Table 4: Tracer samples taken for shore-based analysis

The number of samples for each station is given. Columns (1) to (5): sampled by rosette; (6) - (10): by Gerards

Stat. Nr.	(1) He	(2) Tri	(3) $^{13}C/^{18}O$	(4) Ba	(5) ^{14}C	(6) ^{14}C	(7) ^{228}Ra	(8) ^{226}Ra	(9) ^{85}Kr	(10) ^{39}Ar
101			2	2	3					
102	4	3								
103	12	11								
104	24	24	18	24		16	16	16	13	
105										
106	14	13								
107	25	24	20	20		18	18	18	13	1
108										
109	14	13								
110	13	12								
111	13	14			24					
112	6	6								
113	25	24		19						
114					11					
115	8	8								
116	24	24			6	15	15	16	14	
117	12	12		19						
118	10	9								
119						17	17	17	9	1
120										
121						1				1
122	23	22								
123	7	7								
124	24	24		24		16	16	16	2	1
125										
126	13	13								
127	21	21								
128										
129	24	24		24		16	16	16	13	
130	8	7								
131	23	23	23	23		14	15	15	11	1
132	16	15								

Stat. Nr.	(1) He	(2) Tri	(3) $^{13}C/^{18}O$	(4) Ba	(5) ^{14}C	(6) ^{14}C	(7) ^{228}Ra	(8) ^{226}Ra	(9) ^{85}Kr	(10) ^{39}Ar
133	5	5								
134	24	24	24	24		18	18	17	14	1
135										
136	24	24								
137										
138	22	22								
139										
140	25	24		24		18	18	18	14	
141	9	9								
142	25	24	24							
143										
144	24	24								
145										
146	24	24								
147	15	15								
148										
149	24	24	24	24	11	9	5	9	4	
150										
151	24	24								
152										
153	24	24	24	24		18	18	17	13	
154	7	7								
155	12	12								
156										
157	12	12								
158	18	13	24	24		16	16	16	13	
159										
160	25	24								
161										
162	30	30	22	30		16	16	16	12	
163										
164	31	30								
165										
166	31	30	22	30		18	18	18	8	
167						2				2
168	28	28								
169										
170	30	29								
171										
172	28	20	24	32		15	18	18	7	1
173						7				1
174	27	22								
175										
176	26	20								
177										
178	39	30								
179										

Table 5: Station Inventory

Ship: METEOR (06-MT-cruise11, leg 5)
WHP section S1/A21: Stas. 102 - 120 (suppl. ^{39}Ar Sta.: 121)
WHP section S2/A12: Stas. 149 - 179

Salinity, nutrients and oxygen were measured on all samples, and CFM's (11 and 12) on most. For other properties see Table 5. CO_2 parameters (pCO_2, Tot-CO_2) were measured on virtually all stations, but to varying degree.

Station/cast with non-normal operation (single bottle misfirings not noted):

101/1:	trial station only, no samples
102/1:	shelf station, some depth repeats
104/4:	CFM blank check only (3500 - 4000 m)
109/1:	winch computer breakdown followed after this cast
115/1:	top 8 bottles misfired
118/1:	at position of Sta. 115, to fill in above 1000 in depth; bottle-depth relation had to be rotated; CFM test 600 m
119/1+3:	Gerard casts at position of Sta. 109
119/2:	supporting rosette cast, samples below 500 m only; CFM test 2000 m
120/1:	at position of Sta. 106; CFM test 3400 m
121/1:	support for ^{39}Ar cast, to 2400 m only
121/2:	^{39}Ar cast to support Drake Passage section
122/1:	some firing problems
135/1:	bottle-depth relation had to be rotated
140/2:	bottle-depth relation had to be rotated
154/1:	very high sea
164/2:	only even rosette positions were sampled, mix-up 10 and 100 in possible
165/1+2:	delay between casts due to high sea
167/3:	^{39}Ar cast in connection with L-V Sta. 166
173/3:	^{39}Ar cast in connection with L-V Sta. 172
178/1:	CFM check 900 m

Table has one line per station, with data being arranged as follows: Sta. No. - cast/date type/latitude longitude/time - depth/CTD institution - "CTD#1" no. of rosette bottles fired

Format of entries:

- latitude and longitude in the degrees/min.fraction of min, at beginning of cast
- time in UTC, beginning of cast
- depth in m
- AWI CTD #l: AWI instrument no. 1, ODF calibrated; AWI rosette 24 X 12 liter
- SIO CTD #l: ODF instrument no. 1, Bremen rosette 24 X 10 liter

streport

101	1230190	ROS5519.4S	6621.9W2021	71AWI	CTD	#1	24 bottles
102	1240190	ROS5619.8S	6759.7W0709	103AWI	CTD	#1	24 bottles
103	1240190	ROS5655.0S	6815.0W1232	3090AWI	CTD	#1	24 bottles
104	1240190	ROS5319.8S	6815.0W1900	4390AWI	CTD	#1	24 bottles
104	2250190	GER5720.8S	6804.7W0216	4391			
104	3250190	ROS5720.0S	6814.7W0919	4390AWI	CTD	#1	24 bottles
105	1250190	ROS5750.1S	6814.5W2330	3757AWI	CTD	#1	24 bottles
106	1260190	ROS5820.1S	6814.3W0519	3855AWI	CTD	#1	24 bottles
107	1260190	GER5850.4S	6815.8W1032	3866			
107	2260190	ROS5850.0S	6814.9W1443	3842AWI	CTD	#1	24 bottles
107	3260190	GER5849.8S	6815.3W1649	3823			
108	1260190	ROS5919.9S	6814.8W2323	3665AWI	CTD	#1	24 bottles
109	1270190	ROS5949.9S	6815.0W0527	3738AWI	CTD	#1	24 bottles
110	1270190	ROS6019.8S	6808.0W1921	3818AWI	CTD	#1	24 bottles
111	1280190	ROS6049.9S	6800.0W0112	3954AWI	CTD	#1	24 bottles
112	2280190	ROS6112.9S	6719.8W1257	3849AWI	CTD	#1	24 bottles
113	1280190	ROS6135.9S	6640.3W1837	4013AWI	CTD	#1	24 bottles
114	1290190	ROS6200.0S	6559.1W0446	3587AWI	CTD	#1	24 bottles
115	1290190	ROS6216.9S	6512.7W0959	4083AWI	CTD	#1	24 bottles
116	1290190	GER6236.4S	6404.9W1603	3859			
116	1290190	ROS6236.0S	6416.3W1920	4015AWI	CTD	#1	24 bottles
116	3290190	GER6235.8S	6406.7W2237	4025			
117	1300190	ROS6251.4S	6331.5W0517	2099AWI	CTD	#1	24 bottles
118	1300190	ROS6217.0S	6513.0W1300	3860AWI	CTD	#1	24 bottles
119	1300190	GER6136.0S	6639.0W2020	3974			
119	2010290	ROS6136.0S	6640.3W2353	3995AWI	CTD	#1	24 bottles
119	3310190	GER6136.2S	6640.5W0244	3760			
120	1010290	ROS5820.1S	6815.3W0037	3855AWI	CTD	#1	24 bottles
121	1030290	ROS5529.4S	6429.1W2313	3642AWI	CTD	#1	24 bottles
121	2040290	GER5528.7S	6427.0W0025	3635			
122	1060290	ROS5915.1S	4715.0W1233	3895AWI	CTD	#1	24 bottles
123	1060290	ROS6012.3S	4539.9W2203	3785AWI	CTD	#1	24 bottles
124	1070290	GER6041.7S	4153.9W1405	3946			
124	2070290	ROS6039.1S	4156.1W1715	3978AWI	CTD	#1	24 bottles
124	3070290	GER6039.5S	4155.9W1935	4170			
125	1080290	ROS6041.2S	4117.2W0344	2905AWI	CTD	#1	24 bottles
126	1080290	ROS6032.3S	3911.8W1211	3471AWI	CTD	#1	24 bottles
127	1080290	ROS6042.4S	3814.0W1701	2738AWI	CTD	#1	24 bottles
128	1080290	ROS6121.8S	3707.6W2336	3556AWI	CTD	#1	24 bottles
129	1090290	GER6123.9S	37 4.0W0232	4355			
129	2090290	ROS6202.6S	3614.3W1046	4264AWI	CTD	#1	24 bottles
129	3090290	GER62 2.5S	3614.5W1252	4198			
130	1090290	ROS6236.0S	3530.4W2003	4469AWI	CTD	#1	24 bottles
131	1100290	GER63 1.7S	3455.8W0137	4860			
131	2100290	ROS6309.9S	3444.8W0445	5098AWI	CTD	#1	24 bottles
131	3100290	GER6310.6S	3444.7W0822	5104			
132	1120290	ROS5906.6S	2537.2W0248	2524AWI	CTD	#1	24 bottles
133	1120290	ROS5843.0S	2440.9W0907	3448AWI	CTD	#1	24 bottles
134	1120290	GER5844.2S	24 3.8W1340	5464			
134	2120290	ROS5844.0S	2404.0W1555	5413AWI	CTD	#1	24 bottles
134	3120290	GER5844.5S	24 3.5W2024	5491			
135	1130290	ROS5842.6S	2322.7W0446	5551AWI	CTD	#1	24 bottles

136	1130290	ROS5835.5S	2224.7W1112	4769AWI	CTD	#1	24 bottles
137	1130290	ROS5827.0S	2120.5W1946	4580AWI	CTD	#1	24 bottles
138	1140290	ROS5822.1S	2009.2W0456	3420AWI	CTD	#1	24 bottles
139	1140290	ROS5808.2S	1819.9W1314	4485AWI	CTD	#1	24 bottles
140	1140290	GER5758.6S	1651.9W2049	5138			
140	2140290	ROS5759.4S	1651.3W2307	5143AWI	CTD	#1	24 bottles
140	3150290	GER5758.7s	1652.0W0307	5155			
141	1150290	ROS5748.1S	1524.9W1042	4541AWI	CTD	#1	24 bottles
142	1150290	ROS5739.1S	1317.6W1925	4235AWI	CTD	#1	24 bottles
143	1160290	ROS5731.9S	1155.5W0542	4766AWI	CTD	#1	24 bottles
144	1160290	ROS5723.4S	1002.4W1433	3949AWI	CTD	#1	24 bottles
145	1170290	ROS5714.9S	820.7W0022	3688AWI	CTD	#1	24 bottles
146	1170290	ROS5719.7S	635.4W0912	4225AWI	CTD	#1	24 bottles
147	1170290	ROS5749.1S	451.5W1708	4142AWI	CTD	#1	24 bottles
148	1180290	ROS5809.0S	306.2W0414	4321AWI	CTD	#1	24 bottles
149	1180290	ROS5829.9S	100.0W1301	4759AWI	CTD	#1	24 bottles
149	2180290	GER5829.8S	100.2W1745	4768			
150	1190290	ROS5742.0S	025.0W0309	4101AWI	CTD	#1	24 bottles
151	1190290	ROS5659.9S	000.0E1037	3849AWI	CTD	#1	24 bottles
152	1190290	ROS5607.9S	037.6E1931	4157AWI	CTD	#1	24 bottles
153	1200290	GER5514.5S	109.4E0615	3423			
153	2200290	ROS5515.2S	105.6E0757	4130AWI	CTD	#1	24 bottles
153	3200290	GER5514.4S	105.2E1216	4125			
154	1210290	ROS5421.7S	145.1E1940	4890AWI	CTD	#1	24 bottles
155	1220290	ROS5331.0S	220.1E0557	3002AWI	CTD	#1	24 bottles
156	1220290	ROS5242.1S	249.9E1448	2910AWI	CTD	#1	24 bottles
157	1230290	ROS5152.6S	320.9E1034	3116AWI	CTD	#1	24 bottles
158	1230290	GER5108.9S	346.5E1853	3200			
158	2230290	ROS5109.4S	347.1E2212	3170AWI	CTD	#1	24 bottles
158	3240290	GER5110.3S	346.6E0222	4139			
159	1240290	ROS5025.1S	414.8E0853	2902AWI	CTD	#1	24 bottles
160	1240290	ROS4929.9S	445.0E1540	3574AWI	CTD	#1	24 bottles
161	1240290	ROS4841.6S	515.7E2329	3067AWI	CTD	#1	24 bottles
162	1250290	ROS4735.0S	549.3E0900	4321AWI	CTD	#1	24 bottles
162	2250290	GER4734.5S	550.0E1044	4283			
162	3250290	ROS4734.2S	549.6E1153	4289AWI	CTD	#1	24 bottles
162	4250290	GER4735.0S	549.6E1610	4315			
163	1260290	ROS4700.0S	640.0E0021	4093AWI	CTD	#1	24 bottles
164	1260290	ROS4609.6S	751.3E0938	3352AWI	CTD	#1	24 bottles
164	2260290	ROS4609.6S	751.0E1450	4055SIO	CTD	#1	24 bottles
165	1270290	ROS4534.9S	840.9E0254	4396SIO	CTD	#1	12 bottles
165	2270290	ROS4535.0S	841.0E1103	4394AWI	CTD	#1	24 bottles
166	1270290	ROS4453.2S	929.8E1835	4562AWI	CTD	#1	12 bottles
166	2270290	GER4453.6S	929.2E2050	5132			
166	3270290	ROS4453.1S	930.1E2228	4563AWI	CTD	#1	24 bottles
166	4280290	GER4454.1S	930.3E0316	4562			
167	1280290	ROS4357.0S	950.1E1033	4529SIO	CTD	#1	12 bottles
167	2280290	ROS4356.9S	951.0E1116	4539AWI	CTD	#1	24 bottles
167	3280290	GER4356.4S	949.5E1536	4507			
168	1010390	ROS4301.7S	1007.6E0058	4047SIO	CTD	#1	12 bottles
168	2010390	ROS4300.0S	1007.3E0147	4091AWI	CTD	#1	24 bottles
169	1010390	ROS4157.9S	1025.1E0928	4448SIO	CTD	#1	12 bottles
169	2010390	ROS4156.9S	1023.4E1057	4534AWI	CTD	#1	24 bottles
170	1010390	ROS4103.0S	1044.0E2214	4417SIO	CTD	#1	12 bottles

170	2010390	ROS4103.1S	1044.6E2308	4420AWI	CTD	#1	24 bottles
171	1020390	ROS4006.9S	1103.8E0809	4727SIO	CTD	#1	12 bottles
171	2020390	ROS4006.6S	1103.2E0855	4731AWI	CTD	#1	12 bottles
172	1020390	ROS3907.0S	1119.8E1849	5051AWI	CTD	#1	24 bottles
172	2020390	GER3905.7S	1117.4E2219	5063			
172	3020390	ROS3906.6S	1118.4E2247	5045AWI	CTD	#1	24 bottles
172	4030390	GER3906.0S	1116.3E0409	5065			
173	1030390	ROS3837.2S	1222.2E1137	4838SIO	CTD	#1	12 bottles
173	2030390	ROS3837.1S	1222.9E1222	4764AWI	CTD	#1	24 bottles
173	3030390	GER3837.1S	1222.6E1258	4741			
174	1030390	ROS3807.4S	1320.2E2230	5035SIO	CTD	#1	12 bottles
174	2030390	ROS3807.2S	1321.6E2327	5036AWI	CTD	#1	24 bottles
175	1040390	ROS3732.2S	1421.1E0724	4958SIO	CTD	#1	12 bottles
175	2040390	ROS3732.1S	1420.8E0816	4963AWI	CTD	#1	24 bottles
176	1050390	ROS3659.8S	1523.1E0504	4804SIO	CTD	#1	12 bottles
176	2050390	ROS3700.0S	1522.8E0617	4803AWI	CTD	#1	24 bottles
177	1050390	ROS3626.8S	1624.8E1706	4506AWI	CTD	#1	12 bottles
177	2050390	ROS3626.8S	1624.8E1845	4507AWI	CTD	#1	24 bottles
178	1060390	ROS3552.2S	1727.2E0332	3891AWI	CTD	#1	12 bottles
178	2060390	ROS3552.1S	1727.5E0556	3869AWI	CTD	#1	24 bottles
179	1060390	ROS3519.9S	1827.0E1855	1794AWI	CTD	#1	24 bottles

Table 6: XBT-Stations METEOR 11/5

Date 1990	Time (GMT)	Station	Latitude	Longitude
Drake Passage (part A)				
23.01.	2215	101	55 24.4 S	66 25.4 W
24.01.	0747	102	56 21.2 S	68 00.6 W
24.01.	0852	103	56 28.7 S	68 04.3 W
24.01.	0958	104	56 36.6 S	68 08.4 W
24.01.	1059	105	56 43.3 S	68 11.6 W
24.01.	1535	106	56 56.2 S	68 14.7 W
24.01.	1637	107	57 03.8 S	68 15.8 W
24.01.	1733	108	57 10.6 S	68 14.1 W
24.01,	1829	109	57 17.5 S	68 14.2 W
25.01.	1803	110	57 36.1 S	68 09.8 W
25.01.	1931	111	57 42.4 S	68 09.0 W
25.01.	2055	113	57 47.0 S	68 12.0 W
25.01.	2224	114	57 52.6 S	68 15.0 W
26.01.	0231	115	57 52.1 S	68 12.5 W
26.01.	0331	116	58 01.4 S	68 13.2 W
26.01.	0429	117	58 11.8 S	68 14.7 W
26.01.	0818	118	58 21.6 S	68 14.7 W
26.01.	0908	119	58 30.0 S	68 15.1 W
26.01.	0944	120	58 37.5 S	68 14.9 W
26.01.	1015	121	58 43.6 S	68 15.0 W
26.01.	1739	122	58 49.8 S	68 15.4 W
26.01.	2047	123	58 57.4 S	68 15.3 W
26.01.	2131	124	59 05.4 S	68 15.4 W
26.01.	2224	125	59 13.1 S	68 15.2 W
27.01.	0239	126	59 23.1 S	68 13.7 W

27.01.	0343	127	59 32.9 S	68 15.5 W
27.01.	0424	128	59 39.7 S	68 14.1 W
27.01.	0516	129	59 48.5 S	68 14.0 W
27.01.	1140	130	59 58.2 S	68 08.1 W
27.01.	1251	131	60 05.8 S	68 09.4 W
27.01.	1353	132	60 12.5 S	68 04.6 W
27.01.	1454	133	60 19.1 S	68 06.9 W
28.01.	0015	134	60 14.9 S	68 06.3 W
28.01.	0342	135	60 18.9 S	68 08.3 W
28.01.	0426	136	60 26.5 S	68 06.2 W
28.01.	0513	137	60 35.5 S	68 04.0 W
28.01.	0557	138	60 43.8 S	68 01.6 W
28.01.	1208	140	61 07.1 S	67 27.6 W
28.01.	1559	141	61 12.2 S	67 14.8 W
28.01.	1854	147	61 35.9 S	66 40.1 W
29.01.	0209	148	61 36.5 S	66 36.1 W
29.01.	0253	149	61 43.4 S	66 26.3 W
29.01.	0342	150	61 51.2 S	66 13.0 W
29.01.	0812	151	62 05.5 S	65 44.3 W
29.01.	0901	152	62 11.2 S	65 27.1 W
29.01.	1028	153	62 16.7 S	65 13.3 W
29.01.	1407	154	62 23.3 S	64 53.4 W
29.01.	1456	155	62 29.3 S	64 35.4 W
29.01.	2150	156	62 36.4 S	64 16.5 W
30.01.	0336	157	62 41.2 S	64 00.3 W
30.01.	0415	158	62 45.0 S	63 48.5 W
30.01.	0655	159	62 50.9 S	63 31.3 W
30.01.	0725	160	62 54.8 S	63 21.4 W
30.01.	0748	161	62 57.9 S	63 13.0 W
30.01.	0808	162	63 00.5 S	63 06.4 W
30.01.	0823	163	63 01.1 S	63 04.9 W
		South Orkney (part B)		
6.02.	0918	164	59 04.1 S	48 08.4 W
6.02.	1057	165	59 09.6 S	47 45.2 W
6.02.	1243	166	59 15.2 S	47 14.8 W
6.02.	1626	167	59 22.3 S	47 00.6 W
6.02.	1745	168	59 34.0 S	46 44.5 W
6.02.	1853	169	59 45.1 S	46 25.2 W
6.02.	2000	170	59 56.3 S	46 06.6 W
6.02.	2116	171	60 09.1 S	45 47.8 W
6.02.	2210	172	60 12.3 S	45 40.0 W
6.02.	0940	173	60 29.9 S	43 37.8 W
6.02.	1032	174	60 31.6 S	43 17.7 W
6.02.	1141	175	60 33.9 S	42 50.0 W
6.02.	1257	176	60 37.4 S	42 20.1 W
6.02.	1722	177	60 39.1 S	41 56.3 W
7.02.	2336	178	60 38.9 S	41 53.2 W
8.02.	0146	179	60 42.0 S	41 33.0 W
8.02.	0402	180	60 41.5 S	41 16.8 W
8.02.	0735	181	60 36.3 S	40 48.0 W
8.02.	0839	182	60 32.3 S	40 22.4 W
8.02.	0946	183	60 27.4 S	39 56.8 W
8.02.	0958	184	60 27.4 S	39 56.8 W

8.02.	1534	185	60 36.3 S	38 44.9 W
8.02.	1541	186	60 36.9 S	38 41.3 W
8.02.	1642	187	60 40.6 S	38 21.7 W
8.02.	2025	188	60 56.0 S	37 51.7 W
8.02.	2152	189	61 07.2 S	37 30.8 W
American-Antarctic Ridge (part C)				
11.02.	2315	190	59 15.5 S	26 29.0 W
11.02.	0114	191	59 09.3 S	26 00.0 W
11.02.	0625	192	58 59.1 S	25 12.7 W
11.02.	0815	193	58 49.1 S	24 49.7 W
11.02.	0924	194	58 43.1 S	24 41.1 W
12.02.	0211	195	58 42.6 S	23 49.3 W
12.02.	0947	196	58 37.7 S	22 53.1 W
12.02.	1700	197	58 29.9 S	21 47.8 W
14.02.	0239	198	58 23.5 S	20 34.9 W
14.02.	1101	199	58 15.4 S	19 06.4 W
14.02.	1846	201	58 03.2 S	17 31.6 W
15.02.	0851	202	57 51.7 S	16 00.0 W
15.02.	1640	203	57 42.0 S	14 15.0 W
16.02.	0116	204	57 35.4 S	12 41.1 W
16.02.	1225	205	57 25.1 S	10 35.9 W
16.02.	2009	206	57 18.1 S	09 03.3 W
16.02.	0628	207	57 17.5 S	07 24.4 W
16.02.	1443	208	57 34.1 S	05 41.9 W
17.02.	2346	209	58 03.4 S	03 55.4 W
18.02.	1016	210	58 20.6 S	01 59.9 W
18.02.	2144	211	58 14.5 S	00 43.8 W
NS-Section to Cape Town (part D)				
19.02.	0026	212	57 58.1 S	00 37.0 W
20.02.	0030	216	55 50.5 S	00 45.4 E
20.02.	0301	217	55 33.6 S	00 56.4 E
20.02.	1605	218	54 58.6 S	01 17.8 E
20.02.	1843	219	54 40.0 S	01 32.6 E
22.02.	1140	220	53 10.2 S	02 33.1 E
22.02.	1304	221	52 57.8 S	02 40.2 E
22.02.	1304	222	52 57.8 S	02 40.2 E
22.02.	1925	223	52 23.2 S	03 01.9 E
22.02.	1925	224	52 23.2 S	03 01.9 E
22.02.	2108	225	52 08.6 S	03 11.3 E
23.02.	1422	226	51 38.8 S	03 32.3 E
23.02.	1557	227	51 23.2 S	03 41.2 E
24.02.	1239	228	50 03.4 S	04 28.2 E
51.02.	5003	229	50 03.4 S	04 28.2 E
24.02.	1407	230	49 48.1 S	04 36.2 E
24.02.	2016	231	49 06.2 S	04 59.8 E
24.02.	2124	232	48 54.2 S	05 07.8 E
25.02.	0351	233	48 20.2 S	05 30.2 E
25.02.	0705	234	47 49.7 S	05 42.2 E
25.02.	2033	235	47 20.1 S	05 59.2 E
25.02.	2243	236	47 12.4 S	06 22.9 E
26.02.	0507	237	46 43.7 S	07 03.5 E
26.02.	0717	238	07 25.5 S	46 27.6 E
26.02.	2039	239	45 59.1 S	08 06.8 E

26.02.	2340	240	45 47.6 S	08 24.0 E
27.02.	1557	241	45 17.4 S	09 01.9 E
27.02.	1706	243	45 05.8 S	09 14.3 E
27.02.	0720	244	44 43.5 S	09 36.8 E
27.02.	0851	245	44 16.6 S	09 43.1 E
27.02.	2158	246	43 35.9 S	09 56.6 E
28.02.	2321	247	43 19.3 S	10 00.9 E
1.03.	0601	248	42 37.2 S	10 14.5 E
1.03.	0734	249	42 18.5 S	10 18.7 E
1.03.	1727	251	41 45.7 S	10 29.1 E
1.03.	1932	251	41 21.9 S	10 37.6 E
2.03.	0415	252	40 44.0 S	10 51.6 E
2.03.	0606	253	40 26.7 S	10 57.5 E
2.03.	1447	254	39 46.7 S	11 13.6 E
2.03.	1706	255	39 26.0 S	11 21.3 E
3.03.	0830	256	38 55.8 S	11 41.6 E
3.03.	0959	257	38 46.7 S	12 02.9 E
4.03.	0536	258	37 43.4 S	14 01.1 E
4.03.	0536	259	37 43.4 S	14 01.1 E
4.03.	2109	260	37 27.0 S	14 41.7 E
4.03.	2318	261	37 17.1 S	14 51.6 E
5.03.	1253	262	36 14.8 S	15 47.0 E
5.03.	1253	263	36 14.8 S	15 47.0 E
5.03.	1438	264	36 26.9 S	15 57.6 E
5.03.	1515	265	36 26.3 S	16 06.0 E
5.03.	2330	266	36 15.4 S	16 46.1 E
6.03.	0113	267	36 06.9 S	17 06.4 E
6.03.	0356	268	35 53.2 S	17 27.4 E
6.03.	0955	269	35 42.5 S	17 48.9 E
6.03.	1246	270	35 29.9 S	18 07.1 E
6.03.	1904	271	35 20.0 S	18 27.1 E
6.03.	2225	272	35 12.6 S	18 35.9 E

METEOR Cruise 1115, Ushuaia to Cape Town, 23 Jan. to 8 March 1990

Comment to Data Report submitted to WOCE WHP

Wolfgang Roether, Univ. of Bremen, FB 1, 2800 Bremen 33, Germany

This report refers to the METEOR bottle data, i.e., T, S, oxygen, nutrients, and CFM 11 and 12. Following is a brief explanation of the measurements and of the data table. Further explanation is offered in the Chief Scientist's cruise report.

Measurements:

Basic instrumentation was a 24 x 12 liter General Oceanics Rosette and a Neil Brown Mark IIIB CTD with oxygen sensor, both from the AWI, Bremerhaven. Pressure and temperature sensors were calibrated at SIO before the cruise and thereafter. During the cruise, the stability of the temperature and pressure sensors was monitored with reversing mercury and electronic thermometers and pressure gauges. The in-situ calibration of the conductivity and oxygen sensors was based on water samples from the Rosette, usually taken at 24 depth levels. Salinities were measured with a Guildline Autosal 8400A. 16 stations consist of two casts where samples in 36 depth levels have been taken. The shallow cast was carried out with a second 24 x 10 liter Rosette, with an identical CTD from Scripps/ODF.

During the entire cruise, two different CDT data acquisition and processing systems were operated in parallel; one system from SIO, and one system from the AWL The processed data sets consist of 2 decibar pressure series. No major differences were found in processing techniques or the data sets.

Nutrient and dissolved oxygen analysis was done by Scripps/ODF. Nutrient concentrations were analyzed colorimetrically using a 4-channel Technicon auto-analyzer system, one channel for each of NO_2, NO_3, PO_4 and SiO_3. No major problems were encountered in the analyses. Dissolved oxygen concentrations were analyzed using a modified Winkler titration method, again with no major problems.

The data set quality was monitored by cross-checking the independent measurements for consistency. Malfunctioning or leaking Niskin bottles were identified. Due to tripping problems, the bottle-depth relation had to be rotated in a few instances, but the true relation was always unambiguous.

Following is a description of the CFM measurements and an assessment of CFM data quality.

CFM measurements:

The measuring system employed is an automated variety of the Bullister and Weiss (Deep Sea Res., 1988) design. Water samples are taken in the common way using glass syringes. The system contains calibrated 30 ml water sample containers (Hastalloy C) connected to a 2 x 8 multiposition GC valve (Vici-Valco), into which samples are introduced (upward displacement) through a regular GC valve manually. For measurement, container content is automatically transferred into the extraction burette by a flow of carrier gas (downward displacement). All valves are air-actuated. Temperature of the collection trap is forced by Peltier cooling/heating. Carrier gas purge (separately for GC and sample processing parts of the system) uses two lines each, of which one is back-flushed at higher temperature with a small flow of purified gas. System control and data handling is provided by a PC. It has peak integration installed for quick data inspection, but final peak evaluation occurred off-line by fitting Gaussians to the data. Calibration used compressed air from a tank, the CFM concentrations of which were later on calibrated by comparison with gas standards provided by R. F. Weiss, Scripps.

This was the first time that the system was used at sea, which led to some modification of procedures during the cruise. In general, the system and in particular the automation operated well. Some outliers (more than we had hoped) were observed, the cause of which was not always clear. A substantial blank was encountered in the beginning. However, the sample preparation line blank was quite stable and indistinguishable between water sample containers, as well as from the lowest values obtained in sample measurement. This showed that a sampling blank was negligible within errors, and at the same time gave proof of vanishingly low concentrations. A special cast was made early on into supposedly CFM-free water to compare different sets of Niskin bottles available, of which one was found contaminated. To monitor detection efficiency, gas standards were run regularly, and full calibration runs repeatedly (non-linearity was rather larger than usual). Sta. 145 was omitted, and four stations (Sta. 162 -165) were missed when water accidentally went beyond the extraction burette. The calibration curve was substantially different after this incident.

The data have been post-processed carefully and an error analysis has been made. The data blank was taken to be the sample preparation line blank, agreement between which and the lowest-concentration samples (see above) being found both at the beginning of the cruise (Drake Passage section) and towards the end (Cape Basin stations). Precision/accuracy estimates (standard errors throughout) were made considering the following error contributions (found to be similar for CFM 11 and 12):

- blank uncertainty (± 0.01 pmol/kg);
- sample replicate precision (about ± 1% for high concentrations);
- standard interpolation uncertainty (about ± 1.5%);
- uncertainty of calibration curve (<- ± 0.5%);
- uncertainty by drift in non-linearity (<- ± 0.5%);
- calibration uncertainty relative to the Scripps CFM scale (± 0.3%; ignoring any drift between the time of measurements at sea and the calibration later on).

By error propagation, the overall accuracy (relative to Scripps) is obtained as ± 2% or 0.01 pmol/kg, whichever is greater.

The calibration data points were fitted by a third order polynomial. The highest CFM 11 concentrations were outside the calibration range (by at most 40%). The polynomial was extrapolated towards higher concentrations and the uncertainty of the extrapolation was calculated from the fit. The added uncertainty due to the extrapolation is calculated to be ±2% for the maximum CFM 11 concentrations (about 6 pmol/kg), for which the total error thus becomes ± 3%.

Gas standard runs (temperature and pressure corrected) were fitted (in sections) by a straight line, and the standard interpolation uncertainty (apparently the largest error contribution, see above) is the standard deviation around such fit. Standard deviation among gas standards run consecutively was much smaller (about ±0.3%). This suggests that detection efficiency varies substantially on a time scale of several hours. Had gas standard runs been made somewhat more often and more regularly, it might have been possible to monitor these variations and reduce the overall error substantially.

The CFM 11 and 12 errors transform into a CFM 11/12 ratio error of ±3% for large concentrations, rising to about 3.5% for CFM 11 approaching 6 pmol/kg. As a consequence of the blank uncertainty (±0.01 pmol/kg), at 0.05 pmol/kg in CFM 12 the ratio error exceeds ±20%.

The data were screened as follows. Firstly, those data were removed for which samples or handling were considered faulty (e.g. samples from contaminated Niskins, see above). Secondly, CFM station profiles were inspected and compared to those of other properties, which led to rejection of just a few data considered as clearly unreasonable judging from the hydrographic structure. Thirdly, measurements were checked for CFM 11/12 ratio consistency. Those data that have ratios that differ significantly from a reasonable value (estimated from the general distribution of ratios), have been flagged in the data tables; the flag means that we believe one of the two CFM numbers to be faulty.

The CFM data of Stas. 122 to 139 have larger uncertainties and contain more outliers. The suspected cause of this is a leak in the 2 x 8 multiposition valve. It looks as if some sample degassing in the water sample containers may have occurred, effected by a small amount of carrier gas leaking through. If this interpretation is correct, measured concentrations should be on the low side for these stations, and, due to different solubility, more so for CFM 12 than for CFM 11. Such interpretation is supported by a comparison of surface water concentrations with values corresponding to solubility equilibrium with atmospheric concentrations, as wen as by profile information (i.e., high-ratio values tend to be low in the profiles). The flagged data for these stations may be low in CFM 12 by up to about 25% (10% for CFM 11), and there may be a general bias towards low values believed to be at most about 10% in CFM 12 (5% in CFM 11).

Tables:

The data are given on diskette, only sample tables being included below. The data are organized as follows: The main data table (files: station#.dat; directory \meteor11\btldat) is largely self-explanatory and contains all data except the CFMs. Additionally CTD corrections are listed, and comment on specific data is given were appropriate (see sample table 118.dat for Sta. 118). The CFM data are contained in a second table (file: station#.hyf; directory \meteor11\btlcfm) that lists the basic measurements without a heading, the last three additional columns being CFM 11, CFM 12, and CFM 11/12 ratio; flagged CFM data (see above) are indicated by a negative ratio. Missing data are indicated by "-1.00000E+10". For identification of the different parameters see enclosed sample table "station I 18.hyf".

118.dat

Hydro Data Report 09-Mar-90 06:47

METEOR-11/5 F/S METEOR 2

LEG 01 STATION 118

CAST 01 62 17.0 S LAT 65 13.0 W LON 30-Jan-90 13:00 DEPTH: 3860 ROS AWI CTD #1 24 bottles

SAMP NUM	DEPTH (M)	PRESS (db)	TEMP (DEG C)	SALT (PSU)	POT TEMP (DEG C)	SIGMA0	SIGMA2	SIGMA4	DISS O_2 (UM/KG)	NO_2 (UM/KG)	NO_3 (UM/KG)	PO_4 (UM/KG)	SiO_3 (UM/KG)
114	5	4.6	3.614	33.875	3.613	26.930	36.058	44.780	325	0.30	23.1	1.60	18.9
113	42	42.4	2.261	33.825D	2.259	27.010	36.212	45.003	350	0.21	25.1	1.82	24.1
112	111	112.1	-1.121	33.991	-1.123	27.340	36.736	45.709	345	0.19	27.6	1.99	33.8
111	171	173.0	0.619	34.231D	0.611	27.451	36.740	45.611	254	0.01	33.1	2.27	55.8
110	220	222.3	1.582	34.393	1.571	27.518	36.749	45.567	213	0.00	34.8	2.38	67.3
109	289	291.5	1.909	34.478	1.894	27.562	36.773	45.573	192	0.00	35.1	2.40	74.1
108	397	400.9	1.912	34.542	1.890	27.614	36.824	45.623	185	0.00	34.9	2.39	79.1
107	486	491.0	2.019	34.613	1.992	27.662	36.866	45.658	178	0.00	34.5	2.34	83.4
106	486	491.0	2.019	34.613D	1.992	27.662	36.866	45.659					
105	486	491.0	2.019	34.613D	1.992	27.662	36.866	45.659					
104	584	590.2	2.018	34.651D	1.984	27.694	36.897	45.690					
103	584	590.2	2.018	34.651D	1.984	27.694	36.897	45.690					
102	588	594.2	2.018	34.652D	1.984	27.694	36.897	45.690					
101	588	594.2	2.018	34.652D	1.984	27.694	36.897	45.690					
124	588	594.2	2.018	34.652D	1.984	27.694	36.897	45.690		0.00	33.4	2.30	87.0
123	589	595.2	2.018	34.651	1.984	27.693	36.897	45.689	178	0.00	33.4	2.29	86.7
122	693	700.3	1.978	34.684	1.938	27.723	36.929	45.723	179	0.00	32.8	2.24	89.0
121	833	842.9	1.919	34.708	1.870	27.748	36.957	45.755	183	0.00	32.4	2.21	91.9
120	1036	1048.4	1.768	34.727	1.707	27.776	36.994	45.799	189	0.00	31.9	2.18	96.4

Cast 1 CTD corrections:

```
p = p + (                 0)*p*p*p
      + (                 0)*p*p + (                0)*p
      + (                 0)* t* t + (              0)*t + (          0)
 t = t + (                0)*p*p
      + (                 0)*p
      + (  0.000019648)* t* t + (      -0.0011801)*t + (     -2.9894)
c = c + (                 0)*p*p + (   -8.35795e-07)*p
      + (                 0)* t* t + (              0)*t
      + (                 0)*c*c + (  -0.0000807591)*c+ (  0.0262089)
s = s + (                 0)*p*p + (                0)*p
      + (                 0)* t* t + (              0)*t
      + (                 0)*s*s + (                0)*s+ (          0)
```

Preliminary data -- not for publication.

End of Report.

==

111   salt deleted because of CTD difference

113   salt deleted because of CTD difference

118.hyf

Depth [m]	T in situ [°C]	Sal [psu]	O_2 [μmol/kg]	NO_3 [μmol/kg]	PO_4 [μmol/kg]	SiO_3 [μmol/kg]	CFM-11 [pmol/kg]	CFM-12 [pmol/kg]	CFM11/CFM12 Ratio
5.00000E+00	3.61400E+00	3.38750E+01	3.25000E+02	2.31000E+01	1.60000E+00	1.89000E+01	5.53640E+00	2.44050E+00	2.26855E+00
4.20000E+01	2.26100E+00	3.38250E+01	3.50000E+02	2.51000E+01	1.82000E+00	2.41000E+01	6.62740E+00	2.73100E+00	2.42673E+00
1.11000E+02	-1.12100E+00	3.39910E+01	3.45000E+02	2.76000E+01	1.99000E+00	3.38000E+01	6.44310E+00	2.66410E+00	2.41849E+00
1.71000E+02	6.19000E-01	3.42310E+01	2.54000E+02	3.31000E+01	2.27000E+00	5.58000E+01	3.09110E+00	1.35070E+00	2.28852E+00
2.20000E+02	1.58200E+00	3.43930E+01	2.13000E+02	3.48000E+01	2.18000E+00	6.73000E+01	1.65630E+00	7.42500E-01	2.23071E+00
2.89000E+02	1.90900E+00	3.44780E+01	1.92000E+02	3.51000E+01	2.40000E+00	7.41000E+01	9.77100E-01	4.43300E-01	2.20415E+00
3.97000E+02	1.91200E+00	3.45420E+01	1.85000E+02	3.49000E+01	2.39000E+00	7.91000E+01	7.18100E-01	3.23100E-01	2.22253E+00
4.86000E+02	2.01900E+00	3.46130E+01	1.78000E+02	3.45000E+01	2.34000E+00	8.34000E+01	3.69900E-01	1.67600E-01	2.20704E+00
4.86000E+02	2.01900E+00	3.46130E+01	-1.00000E+10	-1.00000E+10	-1.00000E+10	-1.00000E+10	2.51300E-01	1.08000E-01	2.32685E+00
4.86000E+02	2.01900E+00	3.46130E+01	-1.00000E+10	-1.00000E+10	-1.00000E+10	-1.00000E+10	2.41600E-01	1.12600E-01	2.14565E+00
5.84000E+02	2.01800E+00	3.46510E+01	-1.00000E+10	-1.00000E+10	-1.00000E+10	-1.00000E+10	2.42700E-01	1.19700E-01	2.02757E+00
5.84000E+02	2.01800E+00	3.46510E+01	-1.00000E+10	-1.00000E+10	-1.00000E+10	-1.00000E+10	2.47100E-01	1.12300E-01	2.20036E+00
5.88000E+02	2.01800E+00	3.46520E+01	-1.00000E+10	-1.00000E+10	-1.00000E+10	-1-00000E+10	2.43500E-01	1.22500E-01	1.98776E+00
5.88000E+02	2.01800E+00	3.46520E+01	-1.00000E+10	-1-00000E+10	-1.00000E+10	-1.00000E+10	2.41700E-01	1.06700E-01	2.26523E+00
5.88000E+02	2.01800E+00	3.46520E+01	-1.00000E+10	3.34000E+01	2.30000E+00	8.70000E+01	2.44800E-01	1.08100E-01	2.26457E+00
5.89000E+02	2.01800E+00	3.46510E+01	1.78000E+02	3.34000E+01	2.29000E+00	8.67000E+01	2.51900E-01	1.17300E-01	2.14749E+00
6.93000E+02	1.97800E+00	3.46840E+01	1.79000E+02	3.28000E+01	2.24000E+00	8.90000E+01	1.58900E-01	7.15000E-02	2.22238E+00
8.33000E+02	1.91900E+00	3.47080E+01	1.83000E+02	3.24000E+01	2.21000E+00	9.19000E+01	9.60000E-02	5-50000E-02	1.74545E+00
1.03600E+03	1.76800E+00	3.47270E+01	1.89000E+02	3.19000E+01	2.18000E+00	9.64000E+01	5.87000E-02	4.32000E-02	1.35880E+00

From: Birgit Klein
Cruise M11/5: Expocode 06MT11/5
The cruise covers partly the sections A21 (101-120), S4 (121-148) and SR02 (149-179).

CFCs:

CFCs are measured directly on the ship using a electron capture detector (ECD) packed column gas chromatograph. The column was filled with Porasil C and Porapak T.

Only f11 and f12 have been measured during the cruise. Part of the original documentation as been lost, information on system blanks and air measurements is unfortunately not available. The original measurements have been recorded on the sio86 scale and have latter been converted to sio93. Contamination problems and calibration problems are reflected in the relatively high errors. Quality flag for CFCs follow woce standards:

* 2 good measurement
* 3 questionable measurement
* 4 bad measurement
* 5 not reported
* 6 replicate sample
* 9 no sample drawn

errors:

sta.	f11	f12
102-117	2% or 0.01 pmol/kg	2% or 0.01 pmol/kg
118-161	3% or 0.01 pmol/kg	2% or 0.01 pmol/kg
166-179	2% or 0.01 pmol/kg	2% or 0.01 pmol/kg

Tritium:

Tritium is sampled in 1 l glas bottles which are analyzed after the cruise in the laboratory at Bremen. Tritium is measured through the in-growth of helium3 from the radioactive decay. For the procedure the water samples are degassed and transferred to special glas containers which are sealed off and placed into freezers. After a storage time of 6 month to about a year to allow the in-growth of sufficient amounts of helium3 the samples are measured with the noble gas spectrometer described below.

A large number of tritium samples have been contaminated on the ship and could not be recovered. They have been identified by quality flag 5. A smaller number of samples had been contaminated during measurement procedures in the lab and has been retrieved through a second extraction. These samples have been assigned quality flag 6 although they are not strictly replicate samples. Each measurement has been assigned an individual error.

Tritium concentrations are scaled to 15 February 1990.

Helium and Neon:

40 ml water samples are filled into copper tubes at sea which are pinched off. In the laboratory the gas amount is vacuum extracted from the sample and transferred to a specialized helium/ neon isotope mass spectrometer.

The noble gas mass spectrometer is no commercial unit but has been specially designed at the University of Bremen. It contains two commercial units: a quadro-pole mass spectrometer (Balzer QMG 112) and a sector field (Mass Analyzer Products, type 215).

Two helium isotopes 3He, 4He and two Neon isotopes 20Ne, 22Ne are measured. Air aliquots provide the instrument calibration and monitor sensitivity changes. An internal standard filled with regular air has been used for the helium isotope and neon measurements at the lab in Bremen to make all measurements internally self-consistent. An external standard does not exist.

Helium data have been corrected for tritium decay during storage although the correction is very small due to the low tritium concentrations in the southern ocean. It is at maximum 0.5% and effects mostly upper waters.

Helium and neon measurements have been assigned individual errors.

*** THIS IS ONLY A README FILE! ***

WOCE Sections Covered A21, S4, SR2

This cruise so far does not have any documentation associated with the data.

Note the different Temperature scales in the .ctd(ITS-68) and .hyd(ITS-90) files.

KJ 5 Dec 1994

The cruise ID was changed from 06MT011-5 to 06MT11-5.
Added TCARBN and PCO2 in .hyd file.

KJ 23 Feb 95