German Research Vessel "Meteor"

Cruise Leg M45/4

St. John's (Canada) to Rendsburg (Germany)

13. to 31. August 1999

Chief Scientist: Prof. Dr. J. Meincke

Introduction

The cruise leg M45/4 was a contribution to the EC- project VEINS (Variability of exchanges in the Northern Seas). Eighteen countries are contributing to field work and modeling of the transport fluctuations through the major ocean passages between the Arctic Ocean and the Northern North Atlantic. This cruise focussed on the fluxes of water masses in the area from the Denmark Strait to the southern tip of Greenland. It is a repeat of the Meteor-cruise M39/5 in 1997 and the Valdivia-cruise 173 in 1998.

Participants

Name	*Speciality*	*Institute*
Meincke, Jens	Chief scientist	IfM Hamburg
Bassek,Dieter	Meteorology	DWD
Bulsiewicz, Klaus	Tracer	UBU
Classen, Nikolaus	Oceanography	IfM Hamburg
Hargreaves, Geoffrey	Moorings	POL
Holfort, Jürgen	Oceanography	IfM Hamburg
Kahl, Gerhard	Meteorology	DWD
Knuth, Edmund	Meteorology	DWD
Nerger, Wolf-Christian	Oceanography	IfM Hamburg
Plähn, Olaf	Tracer	IOW
Rabe, Berit	Oceanography	IfM Hamburg
Read, John	Moorings	CEFAS

Name	*Speciality*	*Institute*
Rinas, Knud	Oceanography	IfM Hamburg
Rudels, Bert	Oceanography	FIMR
Schlimme, Ingo	Tracer	IfM Kiel
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Verch, Norbert	Oceanography	IfM Hamburg
Wüllner, Helmut	Moorings	IfM Hamburg

Research program

The ideas on the source waters for the Denmark Strait overflow have undergone continuous change. Starting out with being solely Arctic Intermediate Waters from the convective centers in the Iceland and Greenland Seas, the strongly intensified investigations on the circulation and water mass transformations have related the overflow to the waters of the western boundary currents in the Nordic Seas. This results in arctic, polar and atlantic contributions to the Denmark Strait Overflow. The present concept consists of equal contributions from Arctic Intermediate Waters, Arctic Ocean Deep Water and recirculated Atlantic Water.

With this composition it is to be expected, that variations in the source water characteristics show up as variations in the Denmark Strait Overflow characteristics. This has recently been found: There is a significant coherence between interannual temperature changes of the DSOW at 64°N and temperature changes in the Atlantic Water of the Westspitsbergen Current, with the latter three years preceding. The causes for the variability are presently seen in the longer-term variability of the atmospheric forcing. These data constitute one of the first examples of a direct effect of low frequency atmospheric variability on the formation of North Atlantic Deep Water.

The field work for the VEINS project south of Denmark Strait is a cooperative effort between institutions from Germany, Iceland, Finland and Great Britain. The leg M45/4 aims at a repeat description of the large scale distribution of the Denmark Strait overflow waters along 6 sections across the continental slope east of Greenland using CTD/Rosette measurements. In addition to CFC´s measurements, SF6 will be measured has part of a deliberate tracer release experiment in the central Greenland seas. An moored array of recording instruments over the east Greenland slope near 64°N will be recovered and deployed again. This array consists of 6 currents meters moorings, 2 inverted echo sounders and 1 bottom mounted ADCP. The are all near bottom-mounted systems designed to monitor the speed and the thickness of the dense overflow layer.

Short Cruise Report

The RV Meteor left St. John's on Aug. 13, 08.00 LT and headed to the southern tip of Greenland. The hydrographic work comprising of vertical profiling of temperature and salinity and water sampling at 10 to 20 levels for analysis of CFC's along section 6 (see

Figure D1) was started with station #512 on Aug. 17, 00.52 UTC. When the section was finished (station #521) the vessel moved on to the area of section 3 to recover the 8 moored instrument arrays that were deployed in 1998 by RV "Valdivia". This activity took all day Aug. 19 and was successful except for one inverted echo sounder on position 63°21.9N 036°03.4W, which could neither be contacted acoustically nor released. In the following period until Aug. 22 the hydrographic work along section 3 (stations #530-#536) and section 4 (stations #537-#545) was completed. Late on Aug. 22 the redeployment of the 8 moored arrays of current meters, inverted echo sounder and acoustic doppler current profiler was started and took until Aug. 23, 16.25 UTC. During the night Aug. 22/23 an hydrosweep survey was made along the mooring line. The last part of the scientific program consisted of hydrographic work along section 2 (stations #554-#560) and section 1 (stations #561-#571). When completed on Aug. 26, 08.00 UTC at position 64°45.1N 027°14.6W the vessel took course for Rendsburg, where it was berthed on Aug 31, 16.00 LT. In addition to to the work done when the ship was stopped during stations there was continuous recording of atmospheric data, sea surface temperature and salinity and the current profile from the surface to 400m depth throughout the cruise leg.

The weather conditions during the period of station work were fine, all instrumentation worked up to expectation. The resulting data sets are of high quality.

Preliminary results

Hydrography

The hydrographic measurements were done with 2 Seabird CTD´s. At station 557, an instrument was attached to the rosette for testing purposes. At a pressure of about 1900 dbar this instrument imploded and damaged the CTD (SB3). After several short test profiles at the following station it was concluded, that the CTD could not be repaired on board and following stations were done with the second CTD (SB1). Apart from a pressure offset in air of 1.14 dbar (SB3) respective 1.33 dbar (SB3), a comparison with the reversing thermometers showed that no additional in situ calibration of temperature and pressure were necessary. Bottle salinities were determined with an AUTOSAL salinometer, which was calibrated using standard seawater. The conductivity showed a time independent offset**,** after calibration the accuracy for conductivity (respective salinity) is better then 0.003 (see Figure D2).

At section 1 (see Figure D3) the Denmark Strait Overflow water can be clearly seen as a layer of low salinity and temperature sitting on the Greenland slope. This layer can be traced till the southernmost section 6, although with increasing temperature and salinity due to mixing with ambient water. In comparison with previous cruises (Meteor 39/5 and Valdivia 173, see Figure D4) it can be noted: There was more overflow water than in 1997 and 1998, it was fresher and colder and its CFC-concentration (see below) was higher than seen before. It is concluded that the overflow was composed of more water from shallower levels in the source area north of Denmark Strait. The amount of deep water from the Labrador Sea was found to be less and with slightly higher temperature and salinity than in the preceding years. This result is consistent with the reduced convective formation of Labrador Sea Water observed in recent years. The preliminary analysis has also revealed a reduced fraction of high salinity components in the Atlantic Irminger Water. This corresponds to the recently observed eastward expansion of the subpolar waters in the Northwestern North Atlantic, which has terminated an increased influx of saline waters to the north of Denmark Strait found in 1997 and 1998.

Table D1: Coefficients of the in situ conductivity calibration :

Conductivity = Conductivity(raw) + a0 + a1*Pressure

CTD	***a0***	***a1***
SB3	+9.70443784e-3	-2.91765989e-7
SBE	+3.02555052e-3	-1.55125204e-7

Moorings

The current and temperature data from the recovered Aandera meters was available short after recovery. Data from the inverted echo sounders needs more processing and is still not available. The mooring array also included for the first time a SeaCat instrument so that high quality salinity time record is available. Surprisingly very low salinity values (Figure D5) were found for a period of approximately 90 days, the respective T/S characteristics were not found in any of the corresponding hydrographic sections. Corresponding characteristics were just found in one station of the northernmost section 1 during the Valdivia 173 cruise in 1998.

Tracer measurements (CFC-11 and CFC-12)

(O. Plähn, K. Bulsiewicz, I. Schlimme)

Two Chlorofluorocarbons (CFC) components, CFC-11 and CFC-12, were analyzed during the cruise M45/4. After sampling, 20 mL of water were transferred from precleaned 10 L Niskin bottles to a purge and trap unit. The gases were then separated on a gaschromatographic column and detected with an Electron Capture Detector (ECD). A standard gas was used to convert the ECD signals in concentrations. The efficiency of the ECD was very stable in time, the observed temporal variations were about 6% for both components. To correct the temporal drift of the ECD, a calibration curve with six different gas volumes was taken before and after each station assuming that the temporal change between two calibration curves is linear in time.

During the cruise, the CFC system worked continuously, thus 560 water samples from 38 CTD stations were analyzed. The CFC samples were collected from different depths covering the whole water column, but the survey was focused on the deep water masses. The blanks or CFC-11 and CFC-12 were negligible. Accuracy was checked by analyzing about 70 water samples at least twice. It was found to be +/-0.45% for CFC-12 and +/-0.53% for CFC-11. The saturation at the surface of both components was about 100% +/-5%. The CFC-11/CFC-12 ratio was between 1.9 and 2.1.

The aims of the CFC analysis were to study the circulation and to analyze the variability of the deep water masses Labrador Sea Water (LSW), Gibbs Fracture Zone Water (GFZW), and Denmark Strait Overflow Water (DSOW) east of Greenland. Along five different sections south of the Denmark Strait CFC measurements were carried out.

Two years ago, CFC's were measured at the same sections during the cruise Meteor 39/5 (Aug./ Sep. 1997). The comparison of the recently collected data with the older measurements shows new interesting results. It is known from former studies that LSW and DSOW are marked by high CFC concentration, whereas the GFZW is characterized by a CFC minimum (Figure D6). During this cruise, the measured concentration in the DSOW were much higher than observed two years ago (Figure D7). The mean CFC-12 values increased from 1.7 pmol/kg (1997) to about 2.3 pmol/kg and the CFC-11 concentration rised from about 3.7 pmol/kg to 4.5 pmol/kg. Whereas in the density level of the LSW (27.74-27.8) the CFC values stagnated in the last two years or even decreased some percents.

The increase of freon concentration in the DSOW correlates with a decrease in salinity, but the temperature did not change significantly. The stagnation in the LSW might be caused by the absence of deep convection in the Labrador Sea in the last years. The largest concentration in the LSW were observed at the eastern edge of each section. As we did not measured in the eastern Irminger Sea, it cannot be excluded that the core of the LSW moved eastward. During the cruise Meteor 45/2 in the eastern North-Atlantic, it was observed that the CFC concentration in the LSW increased in the last two years.

Ship's meteorological station

When the „Meteor“ left St. John’s, Nfld, on 13.08.1999, a migrating high had just passed the city, heading away northeastwards. A trough of low pressure extended from the Foxe Basin over North Quebec to New Brunswick. In consequence, light southerly winds were accompanying the research vessel out to sea. Another flat low, situated over the Great Lakes, was moving east, thereby developing into a gale center by 14.08. when over the Gulf of St. Lawrence. It turned northward and moved up the west coast of Greenland . Its secondary low, however, continued to move east. During 16.08., it was a gale center near Southeastern Greenland. The air masses north of the gale center moved against the mountainous coast and were diverted to the south where the „Meteor“ was experiencing northeasterly gales of 9 Bft and storm force gusts up to 11 Bft. These conditions reduced her speed severely. Half a day was lost before the position where work was to begin was reached on 17.08., winds being light and variable by then. Conditions kept being favorable while a high was building east of Greenland and the next low moved due east from Newfoundland. By 20.08. another low had been swinging northeast from Labrador, its movements being influenced by a trough in the upper air that had reached eastern Greenland. As it made its way into Denmark Strait, southerly winds 7 Bft were felt shortly on the ship's position. Winds continued to be blowing from southerly directions, speeds being light to 5 Bft, in the days to follow so that oceanographic work was not impeded. On 26.08., however, a low in the upper atmosphere had moved to southeastern Greenland, a gale center denoting its position at surface level. As the „Meteor“ began heading for the Pentland firth, southeasterly gales 8 Bft hampered her for a few hours. The last days of the voyage continued to be under the influence of the upper air low migrating east as our ship was proceeding in the same direction. In consequence, several lows and their associated frontal troughs made themselves being felt by strong southerly winds up to 7 Bft. Winds abated in the North Sea so that Rendsburg was reached by 31.08.1999.

Acknowledgment

Sincere thanks goes to the crew of the RV Meteor for highly professional assistance . The cruise was funded by the Deutsche Forschungsgemeinschaft and by the European Commission under the MAST III -program.

Figures

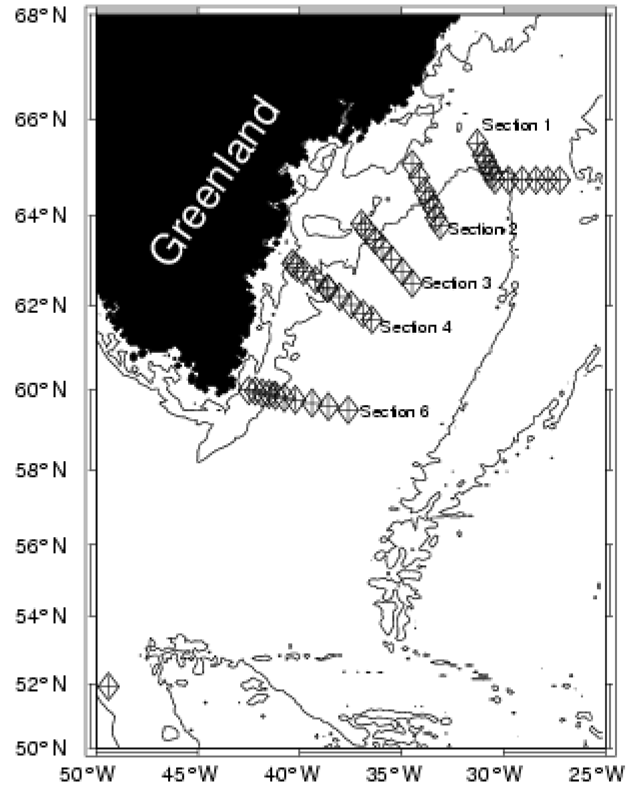
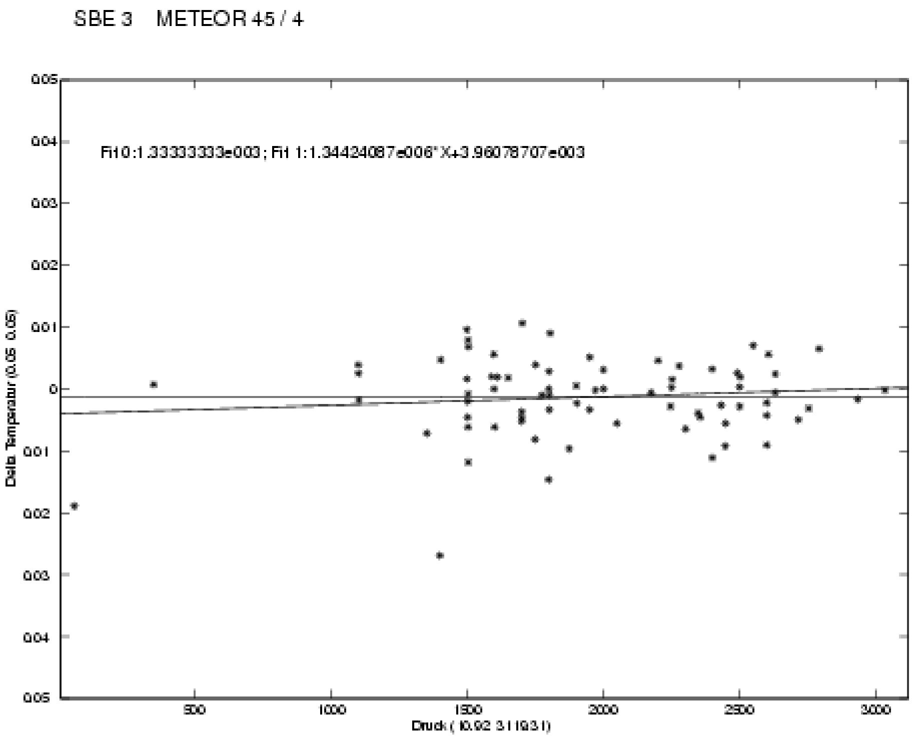


Figure D1: Positions of the CTD profiles acquired during M45/4 and hydrographic sections. The mooring array is located along section 3.



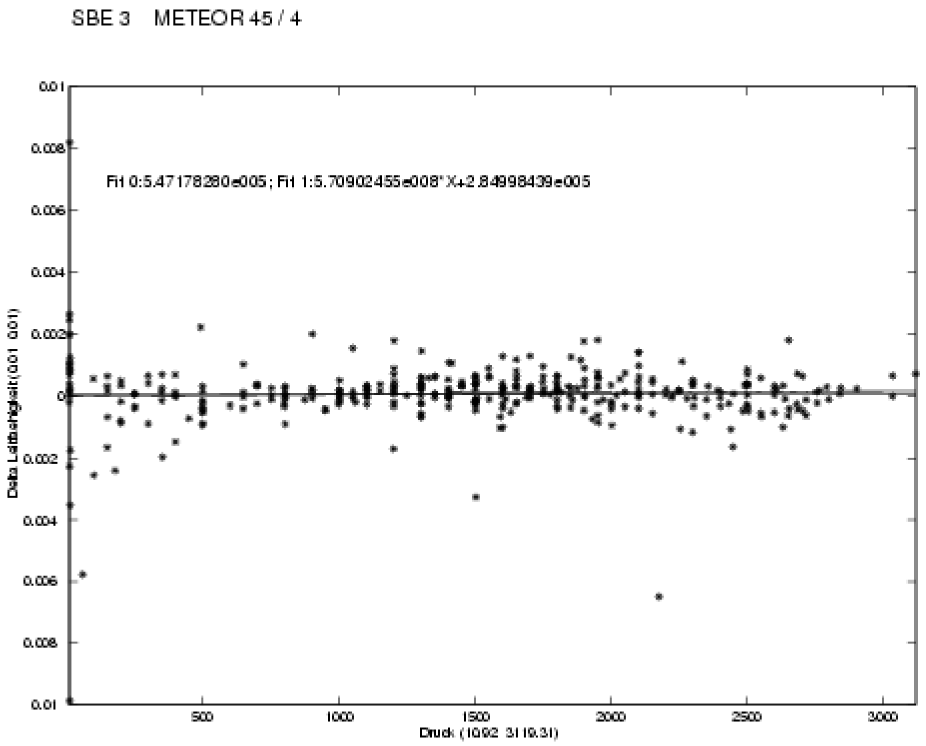
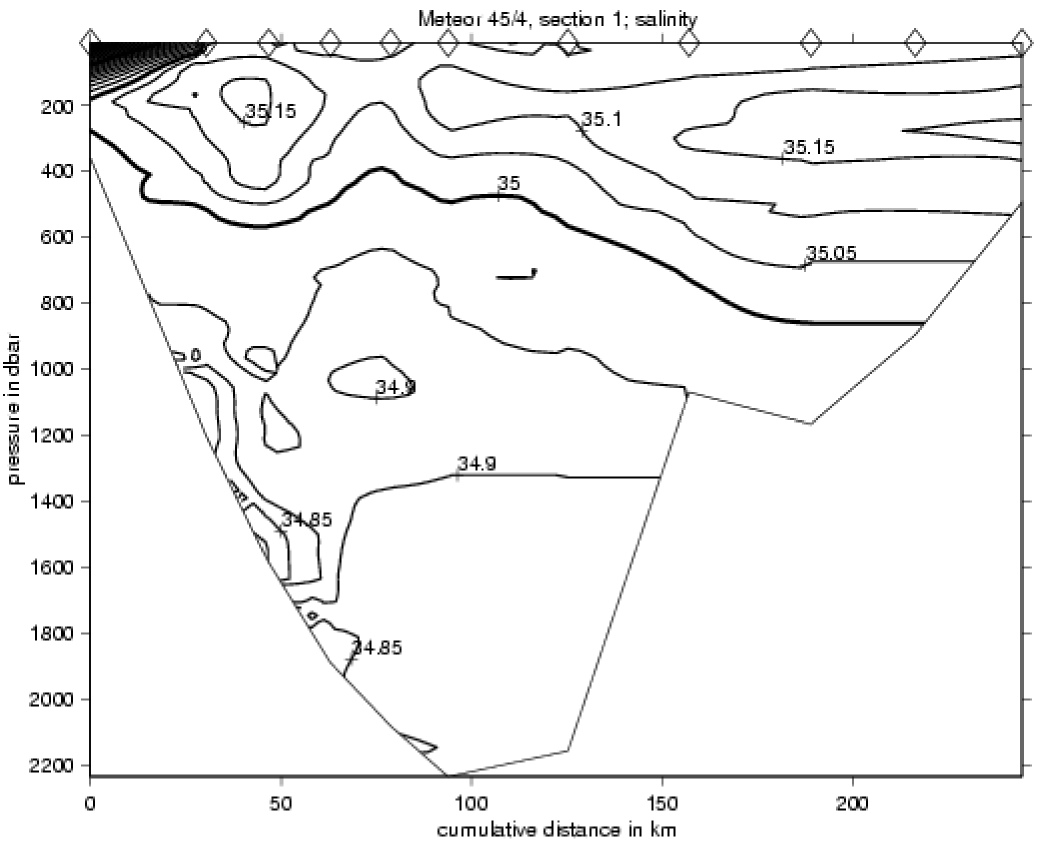


Figure D2: Difference in temperature (a) and conductivity (b) between CTD (SB3) and bottle data after calibration.



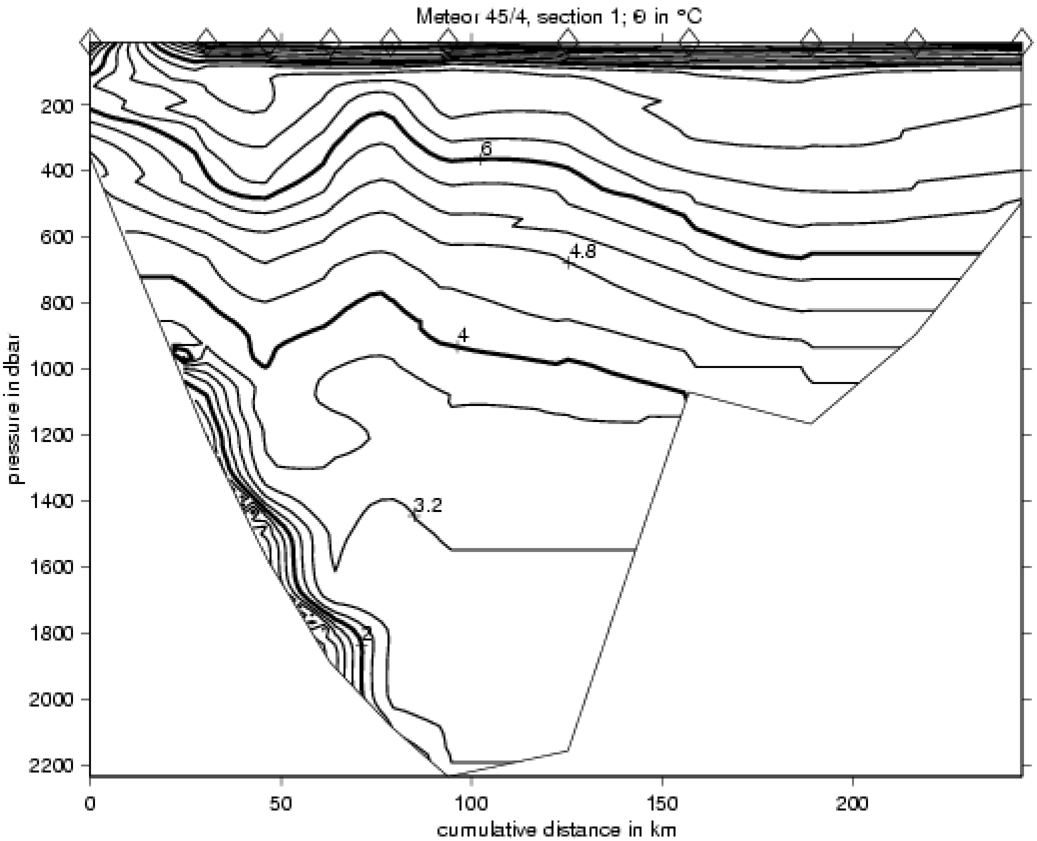


Figure D3: Salinity (a) and potential temperature (b) along section 1.

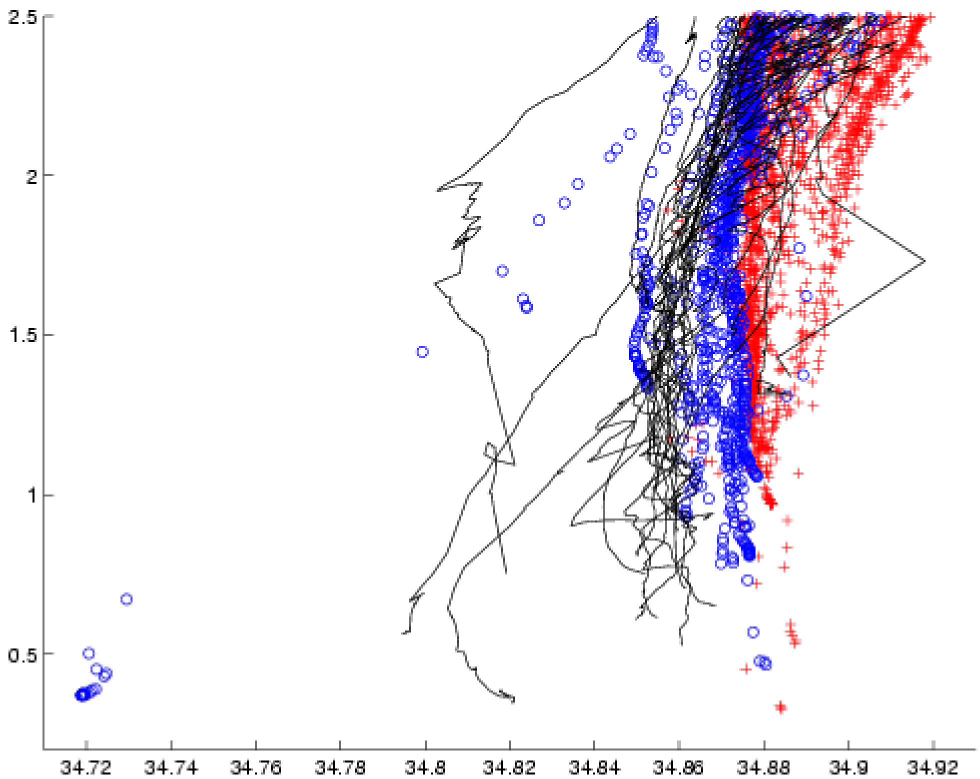
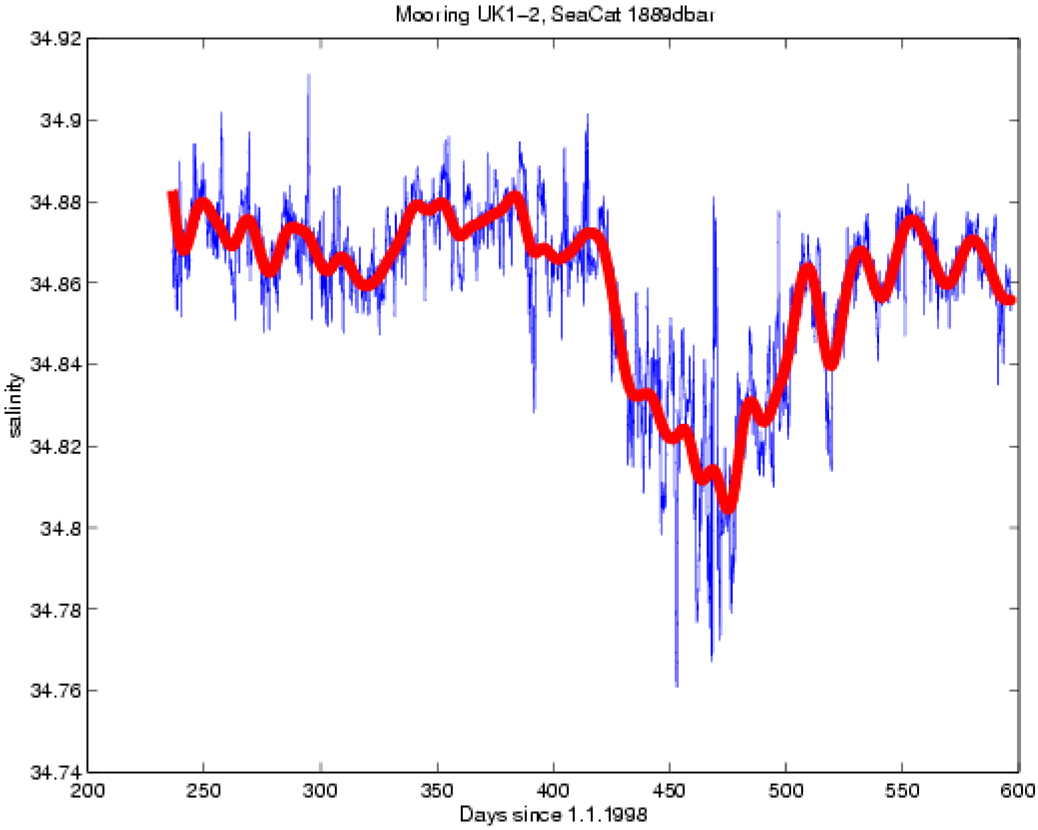


Figure D4: Composite È/S diagrams of cruise M45/4 (lines) compared to M39/5 (+) and Valdivia 173 (o).



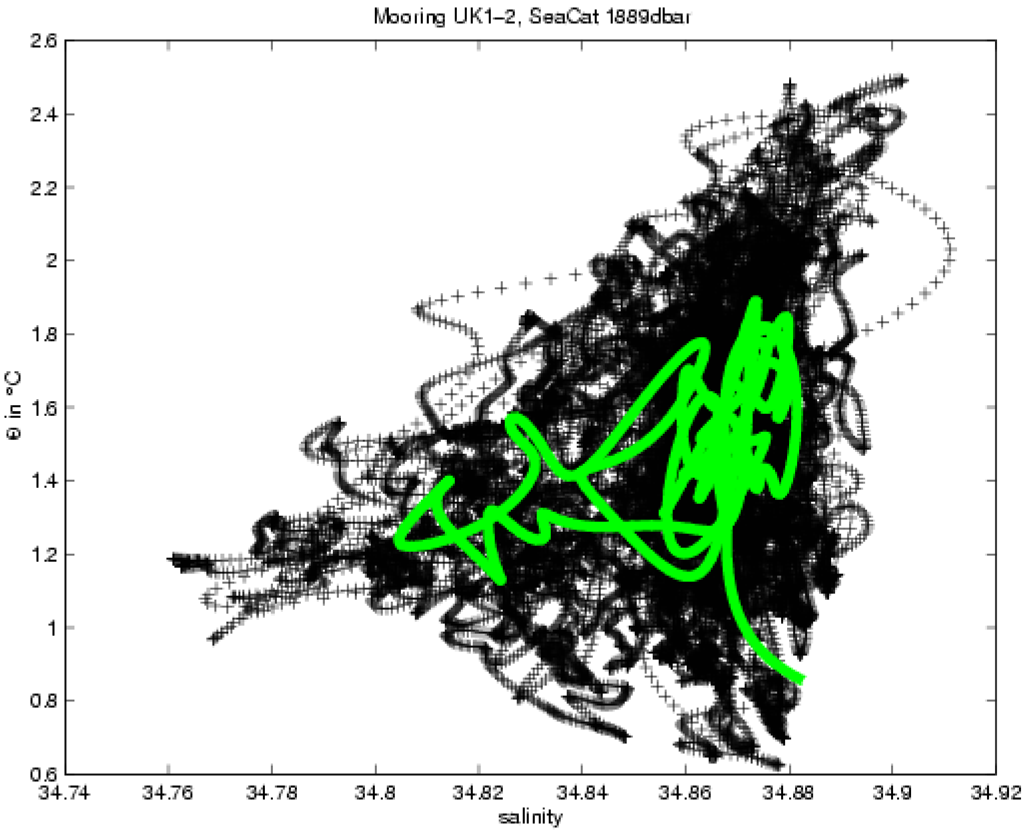


Figure D5: Data from the SeaCat instrument located in the Denmark Strait Overflow Water at section 3. a) Salinity as a function of time (the thick line is is low-pass filtered data) b) θ/S diagram (the line being the low-pass filtered data).

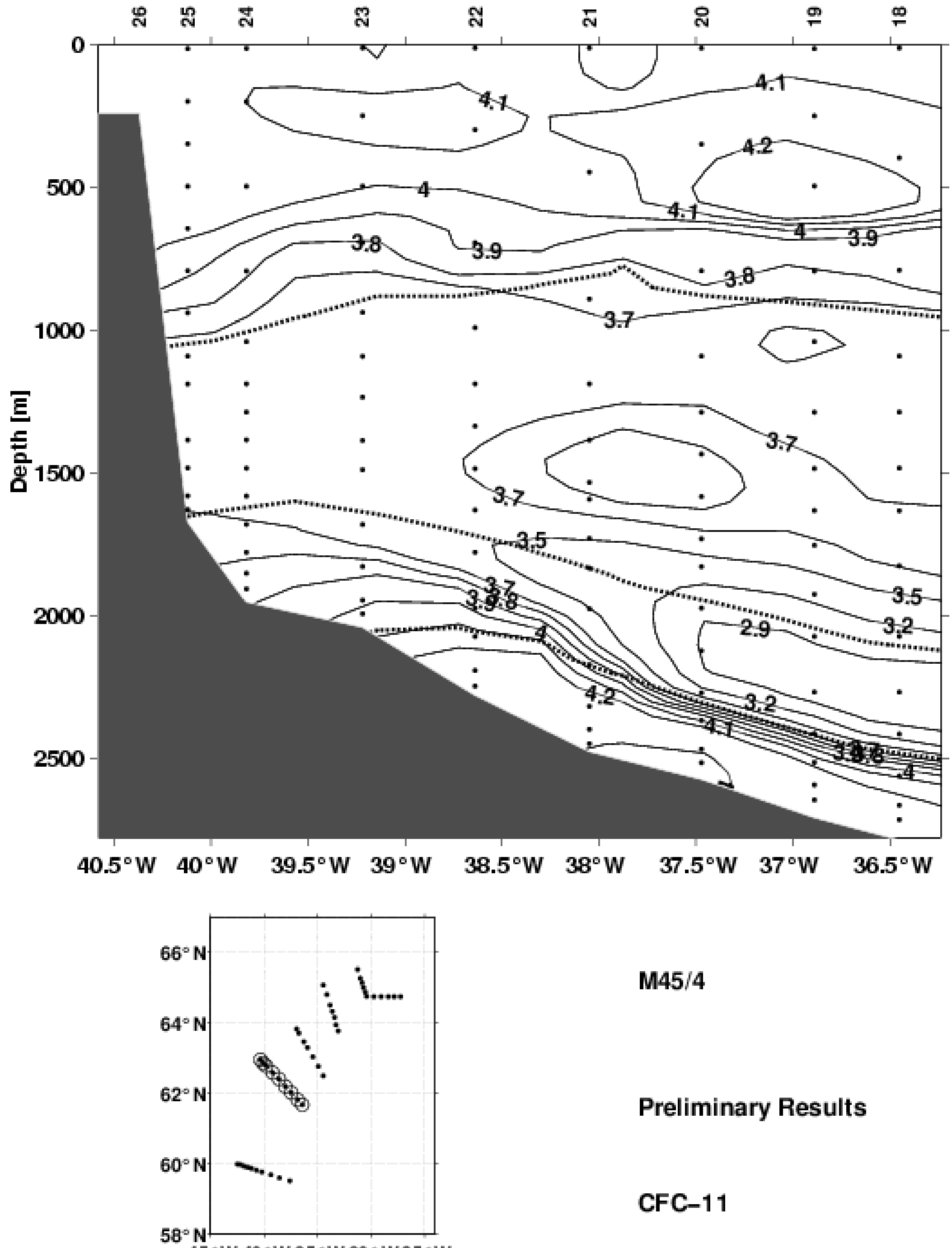


Figure D6: CFC concentration along section 4.

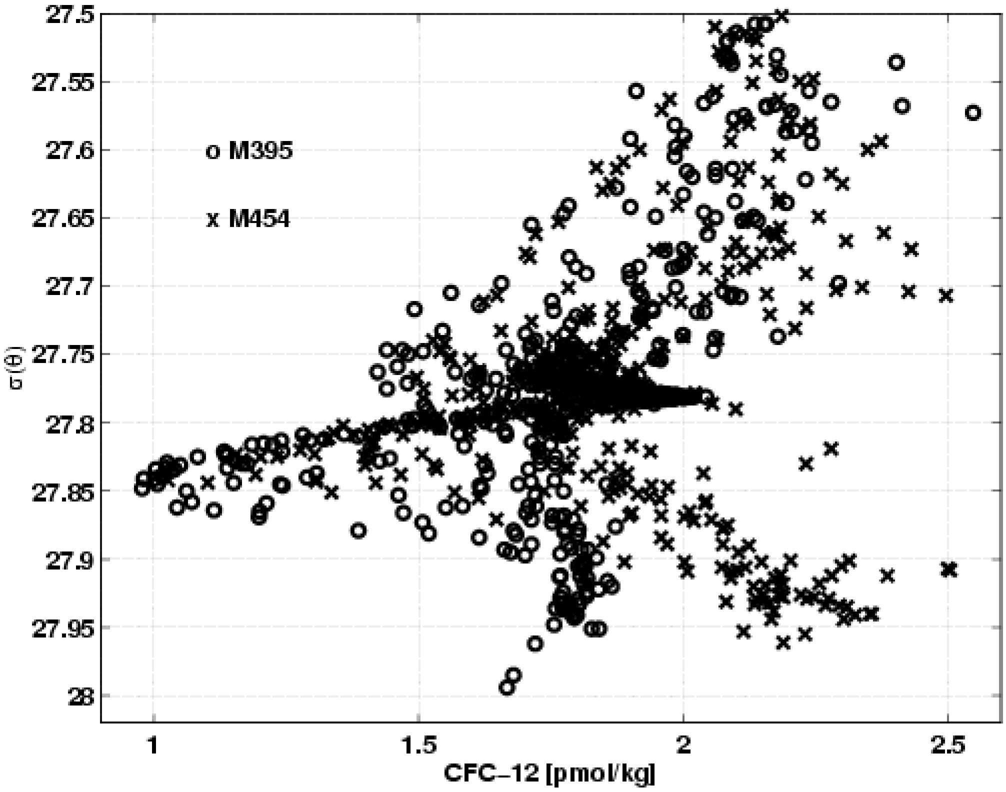


Figure D7: Comparison of the CFC concentration between Meteor cruises M39/5 and M45/4

List of Stations

EXPO-CODE	Section Name	Stat. No.	Cast No.	Cast Type	Date mmddyy	Time UTC	Code	Position Latitude	Longitude	Code	Bottom depth	Meter Wheel	Max Press.	Bottom Dist.	Comments
06ME45/4	VEINS	511	01	ROS/CTD	081499	1138	BE	51 54.77 N	49 22.91 W	GPS	3033				
06ME45/4	VEINS	511	01	ROS/CTD	081499	1208	BO	51 54.55 N	49 23.06 W	GPS	3001	1490	1500		Test Station
06ME45/4	VEINS	511	01	ROS/CTD	081499	1249	EN	51 54.24 N	49 23.30 W	GPS	2999				
06ME45/4	VEINS-6	512	01	ROS/CTD	081799	0053	BE	59 59.61 N	42 30.30 W	GPS	191				
06ME45/4	VEINS-6	512	01	ROS/CTD	081799	0102	BO	59 59.61 N	42 30.47 W	GPS	193	177	180	8	
06ME45/4	VEINS-6	512	01	ROS/CTD	081799	0113	EN	59 59.65 N	42 30.56 W	GPS	192				
06ME45/4	VEINS-6	513	01	ROS/CTD	081799	0235	BE	59 58.77 N	42 10.73 W	GPS	563				
06ME45/4	VEINS-6	513	01	ROS/CTD	081799	0252	BO	59 58.68 N	42 10.96 W	GPS	510	486	494	8	
06ME45/4	VEINS-6	513	01	ROS/CTD	081799	0311	EN	59 58.56 N	42 11.06 W	GPS	492				
06ME45/4	VEINS-6	514	01	ROS/CTD	081799	0424	BE	59 55.73 N	41 51.15 W	GPS	1825				
06ME45/4	VEINS-6	514	01	ROS/CTD	081799	0459	BO	59 55.76 N	41 51.56 W	GPS	1823	1801	1818	8	
06ME45/4	VEINS-6	514	01	ROS/CTD	081799	0555	EN	59 55.77 N	41 51.97 W	GPS	1822				
06ME45/4	VEINS-6	515	01	ROS/CTD	081799	0711	BE	59 54.00 N	41 30.78 W	GPS	1903				
06ME45/4	VEINS-6	515	01	ROS/CTD	081799	0749	BO	59 54.00 N	41 30.78 W	GPS	1903	1868	1890	11	
06ME45/4	VEINS-6	515	01	ROS/CTD	081799	0834	EN	59 54.02 N	41 30.75 W	GPS	1904				
06ME45/4	VEINS-6	516	01	ROS/CTD	081799	0947	BE	59 52.07 N	41 12.21 W	GPS	2037				
06ME45/4	VEINS-6	516	01	ROS/CTD	081799	1024	BO	59 52.21 N	41 12.16 W	GPS	2037	1972	2033	4	
06ME45/4	VEINS-6	516	01	ROS/CTD	081799	1123	EN	59 52.28 N	41 11.78 W	GPS	2041				
06ME45/4	VEINS-6	517	01	ROS/CTD	081799	1255	BE	59 48.96 N	40 45.74 W	GPS	2600				
06ME45/4	VEINS-6	517	01	ROS/CTD	081799	1343	BO	59 48.92 N	40 45.71 W	GPS	2601	2581	2610	7	
06ME45/4	VEINS-6	517	01	ROS/CTD	081799	1449	EN	59 48.97 N	40 45.49 W	GPS	2596				
06ME45/4	VEINS-6	518	01	ROS/CTD	081799	1634	BE	59 46.00 N	40 12.81 W	GPS	2644				
06ME45/4	VEINS-6	518	01	ROS/CTD	081799	1722	BO	59 46.08 N	40 12.92 W	GPS	2644	2628	2641	15	
06ME45/4	VEINS-6	518	01	ROS/CTD	081799	1849	EN	59 46.14 N	40 13.11 W	GPS	2643				
06ME45/4	VEINS-6	519	01	ROS/CTD	081799	2124	BE	59 41.07 N	39 23.91 W	GPS	2854				
06ME45/4	VEINS-6	519	01	ROS/CTD	081799	2214	BO	59 41.24 N	39 23.42 W	GPS	2856	2816	2842	25	
06ME45/4	VEINS-6	519	01	ROS/CTD	081799	2345	EN	59 41.40 N	39 23.11 W	GPS	2856				
06ME45/4	VEINS-6	520	01	ROS/CTD	081899	0204	BE	59 36.05 N	38 35.85 W	GPS	3013				
06ME45/4	VEINS-6	520	01	ROS/CTD	081899	0305	BO	59 36.04 N	38 35.55 W	GPS	3012	3004	3033	10	
06ME45/4	VEINS-6	520	01	ROS/CTD	081899	0426	EN	59 36.13 N	38 35.33 W	GPS	3013				
06ME45/4	VEINS-6	521	01	ROS/CTD	081899	0721	BE	59 31.03 N	37 37.23 W	GPS	3128				
06ME45/4	VEINS-6	521	01	ROS/CTD	081899	0817	BO	59 31.16 N	37 36.41 W	GPS	3127	3087	3119	30	

06ME45/4	VEINS-6	521	01	ROS/CTD	081899	0943	EN	59 31.34 N	37 35.29 W	GPS	3128				
06ME45/4	VEINS-3	522	01	MOR	081999	0729	EN	63 06.5 N	35 32.3 W	GPS					Recovery of mooring G2
06ME45/4	VEINS-3	523	01	MOR	081999	0940	EN	63 17.0 N	35 52.2 W	GPS					Recovery of mooring UK2
06ME45/4	VEINS-3	524	01	MOR	081999	1132	EN	63 21.8 N	36 04.9 W	GPS					Recovery of mooring G1(Fi)
06ME45/4	VEINS-3	525	01	MOR	081999	1410	EN	63 21.0 N	36 04.1 W	GPS					Recovery of mooring G1/IES (failed)
06ME45/4	VEINS-3	526	01	MOR	081999	1600	EN	63 28.7 N	36 18.7 W	GPS					Recovery of mooring UK1
06ME45/4	VEINS-3	527	01	MOR	081999	1800	EN	63 28.4 N	36 18.9 W	GPS					Recovery of mooring UK1/IES
06ME45/4	VEINS-3	528	01	MOR	081999	1912	EN	63 33.0 N	36 30.4 W	GPS					Recovery of mooring F2
06ME45/4	VEINS-3	529	01	MOR	081999	2048	EN	63 37.4 N	36 47.8 W	GPS					Recovery of mooring F1(G)
06ME45/4	VEINS-3	530	01	ROS/CTD	081999	2137	BE	63 42.49 N	36 45.36 W	GPS	1548				
06ME45/4	VEINS-3	530	01	ROS/CTD	081999	2206	BO	63 42.19 N	36 46.27 W	GPS	1650	1632	1629	8	
06ME45/4	VEINS-3	530	01	ROS/CTD	081999	2259	EN	63 41.68 N	36 48.48 W	GPS	1629				
06ME45/4	VEINS-3	531	01	ROS/CTD	082099	0009	BE	63 49.81 N	36 58.17 W	GPS	357				
06ME45/4	VEINS-3	531	01	ROS/CTD	082099	0020	BO	63 49.79 N	36 58.16 W	GPS	357	342	346	8	
06ME45/4	VEINS-3	531	01	ROS/CTD	082099	0029	EN	63 49.77 N	36 58.19 W	GPS	360				
06ME45/4	VEINS-3	532	01	ROS/CTD	082099	0316	BE	63 27.91 N	36 17.91 W	GPS	2011				
06ME45/4	VEINS-3	532	01	ROS/CTD	082099	0354	BO	63 27.91 N	36 17.97 W	GPS	2013	2003	2004	7	
06ME45/4	VEINS-3	532	01	ROS/CTD	082099	0453	EN	63 27.88 N	36 18.06 W	GPS	2012				
06ME45/4	VEINS-3	533	01	ROS/CTD	082099	0622	BE	63 17.98 N	35 56.91 W	GPS	2312				
06ME45/4	VEINS-3	533	01	ROS/CTD	082099	0705	BO	63 18.00 N	35 56.91 W	GPS	2312	2306	2306	8	
06ME45/4	VEINS-3	533	01	ROS/CTD	082099	0812	EN	63 18.02 N	35 56.94 W	GPS	2312				
06ME45/4	VEINS-3	534	01	ROS/CTD	082099	1027	BE	63 02.16 N	35 27.74 W	GPS	2655				
06ME45/4	VEINS-3	534	01	ROS/CTD	082099	1114	BO	63 02.18 N	35 27.14 W	GPS	2654	2639	2655	12	
06ME45/4	VEINS-3	534	01	ROS/CTD	082099	1225	EN	63 02.25 N	35 26.75 W	GPS	2654				
06ME45/4	VEINS-3	535	01	ROS/CTD	082099	1512	BE	62 46.10 N	34 57.36 W	GPS	2777				
06ME45/4	VEINS-3	535	01	ROS/CTD	082099	1603	BO	62 45.96 N	34 57.31 W	GPS	2778	2728	2766	20	
06ME45/4	VEINS-3	535	01	ROS/CTD	082099	1719	EN	62 45.92 N	34 57.14 W	GPS	2775				
06ME45/4	VEINS-3	536	01	ROS/CTD	082099	1954	BE	62 30.22 N	34 27.94 W	GPS	2839				
06ME45/4	VEINS-3	536	01	ROS/CTD	082099	2045	BO	62 30.26 N	34 27.71 W	GPS	2841	2804	2844	20	
06ME45/4	VEINS-3	536	01	ROS/CTD	082099	2159	EN	62 30.25 N	34 27.45 W	GPS	2841				
06ME45/4	VEINS-4	537	01	ROS/CTD	082199	0526	BE	61 40.64 N	36 26.82 W	GPS	2768				
06ME45/4	VEINS-4	537	01	ROS/CTD	082199	0616	BO	61 40.50 N	36 26.83 W	GPS	2766	2721	2758	25	
06ME45/4	VEINS-4	537	01	ROS/CTD	082199	0728	EN	61 40.35 N	36 26.68 W	GPS	2767				

06ME45/4	VEINS-4	538	01	ROS/CTD	082199	0906	BE	61 48.94 N	36 53.60 W	GPS	2687				
06ME45/4	VEINS-4	538	01	ROS/CTD	082199	0959	BO	61 48.97 N	36 53.76 W	GPS	2686	2652	2687	10	
06ME45/4	VEINS-4	538	01	ROS/CTD	082199	1110	EN	61 48.65 N	36 53.09 W	GPS	2690				
06ME45/4	VEINS-4	539	01	ROS/CTD	082199	1310	BE	62 01.31 N	37 27.99 W	GPS	2567				
06ME45/4	VEINS-4	539	01	ROS/CTD	082199	1357	BO	62 01.30 N	37 28.01 W	GPS	2563	2527	2554	12	
06ME45/4	VEINS-4	539	01	ROS/CTD	082199	1508	EN	62 01.22 N	37 27.90 W	GPS	2564				
06ME45/4	VEINS-4	540	01	ROS/CTD	082199	1709	BE	62 12.00 N	38 02.98 W	GPS	2491				
06ME45/4	VEINS-4	540	01	ROS/CTD	082199	1753	BO	62 11.97 N	38 03.02 W	GPS	2491	2457	2486	20	
06ME45/4	VEINS-4	540	01	ROS/CTD	082199	1908	EN	62 11.99 N	38 03.04 W	GPS	2489				
06ME45/4	VEINS-4	541	01	ROS/CTD	082199	2110	BE	62 24.22 N	38 38.48 W	GPS	2271				
06ME45/4	VEINS-4	541	01	ROS/CTD	082199	2154	BO	62 23.98 N	38 38.13 W	GPS	2285	2257	2267	10	
06ME45/4	VEINS-4	541	01	ROS/CTD	082199	2301	EN	62 23.58 N	38 36.81 W	GPS	2283				
06ME45/4	VEINS-4	541	02	ROS/CTD	082199	2318	BE	62 23.44 N	38 36.46 W	GPS	2283				
06ME45/4	VEINS-4	541	02	ROS/CTD	082199	2359	BO	62 23.24 N	38 35.77 W	GPS	2281	2257	2280	8	
06ME45/4	VEINS-4	541	02	ROS/CTD	082299	0054	EN	62 23.23 N	38 35.88 W	GPS	2281				
06ME45/4	VEINS-4	542	01	ROS/CTD	082299	0300	BE	62 35.22 N	39 13.36 W	GPS	2027				
06ME45/4	VEINS-4	542	01	ROS/CTD	082299	0336	BO	62 35.23 N	39 13.30 W	GPS	2027	2000	2020	7	
06ME45/4	VEINS-4	542	01	ROS/CTD	082299	0436	EN	62 35.19 N	39 13.34 W	GPS	2025				
06ME45/4	VEINS-4	543	01	ROS/CTD	082299	0632	BE	62 46.68 N	39 49.23 W	GPS	1938				
06ME45/4	VEINS-4	543	01	ROS/CTD	082299	0700	BO	62 46.59 N	39 49.39 W	GPS	1939	1911	1931	9	
06ME45/4	VEINS-4	543	01	ROS/CTD	082299	0803	EN	62 46.45 N	39 49.58 W	GPS	1944				
06ME45/4	VEINS-4	544	01	ROS/CTD	082299	0911	BE	62 51.29 N	40 07.29 W	GPS	1664				
06ME45/4	VEINS-4	544	01	ROS/CTD	082299	0940	BO	62 51.09 N	40 07.73 W	GPS	1657	1635	1650	4	
06ME45/4	VEINS-4	544	01	ROS/CTD	082299	1024	EN	62 50.78 N	40 07.93 W	GPS	1666				
06ME45/4	VEINS-4	545	01	ROS/CTD	082299	1131	BE	62 57.33 N	40 21.94 W	GPS	265				
06ME45/4	VEINS-4	545	01	ROS/CTD	082299	1137	BO	62 57.32 N	40 21.95 W	GPS	269	253	258	7	
06ME45/4	VEINS-4	545	01	ROS/CTD	082299	1143	EN	62 57.27 N	40 21.92 W	GPS	265				
06ME45/4	VEINS-3	546	01	MOR	082299	2208	EN	63 32.17 N	36 27.94 W	GPS					Deployment of mooring F2/ADCP
06ME45/4	VEINS-3	547	01	MOR	082299	2332	EN	63 28.58 N	36 17.31 W	GPS					Deployment of mooring UK1/IES-99
06ME45/4	VEINS-3	548	01	MOR	082399	0732	EN	63 06.94 N	35 31.94 W	GPS					Deployment of mooring G2-99
06ME45/4	VEINS-3	549	01	MOR	082399	0944	EN	63 16.91 N	35 53.02 W	GPS					Deployment of mooring UK2-99
06ME45/4	VEINS-3	550	01	MOR	082399	1122	EN	63 21.82 N	36 04.25 W	GPS					Deployment of mooring G1(FI)-99
06ME45/4	VEINS-3	551	01	MOR	082399	1303	EN	63 28.82 N	36 18.26 W	GPS					Deployment of mooring UK1-99
06ME45/4	VEINS-3	552	01	MOR	082399	1430	EN	63 33.38 N	36 30.22 W	GPS					Deployment of mooring F2-99

06ME45/4	VEINS-3	553	01	MOR	082399	1625	EN	63 38.30 N	36 48.00 W	GPS					Deployment of mooring F1(G)-99
06ME45/4	VEINS-2	554	01	ROS/CTD	082499	0106	BE	63 46.95 N	33 06.03 W	GPS	2680				
06ME45/4	VEINS-2	554	01	ROS/CTD	082499	0156	BO	63 47.01 N	33 06.11 W	GPS	2677	2662	2685	6	
06ME45/4	VEINS-2	554	01	ROS/CTD	082499	0306	EN	63 47.03 N	33 06.07 W	GPS	2677				
06ME45/4	VEINS-2	555	01	ROS/CTD	082499	0419	BE	63 57.04 N	33 18.22 W	GPS	2492				
06ME45/4	VEINS-2	555	01	ROS/CTD	082499	0504	BO	63 56.98 N	33 18.23 W	GPS	2493	2461	2493	10	
06ME45/4	VEINS-2	555	01	ROS/CTD	082499	0608	EN	63 57.00 N	33 18.23 W	GPS	2491				
06ME45/4	VEINS-2	556	01	ROS/CTD	082499	0729	BE	64 09.73 N	33 26.23 W	GPS	2232				
06ME45/4	VEINS-2	556	01	ROS/CTD	082499	0809	BO	64 09.68 N	33 26.29 W	GPS	2231	2220	2227	8	
06ME45/4	VEINS-2	556	01	ROS/CTD	082499	0906	EN	64 09.53 N	33 26.27 W	GPS	2234				
06ME45/4	VEINS-2	557	01	ROS/CTD	082499	1023	BE	64 19.65 N	33 39.83 W	GPS	1941				
06ME45/4	VEINS-2	557	01	ROS/CTD	082499	1057	BO	64 19.62 N	33 40.27 W	GPS	1942	1911	1904		
06ME45/4	VEINS-2	557	01	ROS/CTD	082499	1146	EN	64 19.48 N	33 40.84 W	GPS	1943				
06ME45/4	VEINS-2	558	01	ROS/CTD	082499	1510	BE	64 30.52 N	33 50.85 W	GPS	1615				
06ME45/4	VEINS-2	558	01	ROS/CTD	082499	1539	BO	64 30.54 N	33 50.81 W	GPS	1615	1599	1610	5	
06ME45/4	VEINS-2	558	01	ROS/CTD	082499	1630	EN	64 30.53 N	33 50.76 W	GPS	1617				
06ME45/4	VEINS-2	559	01	ROS/CTD	082499	1826	BE	64 48.80 N	34 08.69 W	GPS	1031				
06ME45/4	VEINS-2	559	01	ROS/CTD	082499	1847	BO	64 48.73 N	34 08.42 W	GPS	1033	1013	1018	9	
06ME45/4	VEINS-2	559	01	ROS/CTD	082499	1925	EN	64 48.54 N	34 07.87 W	GPS	1039				
06ME45/4	VEINS-2	560	01	ROS/CTD	082499	2116	BE	65 04.90 N	34 28.11 W	GPS	311				
06ME45/4	VEINS-2	560	01	ROS/CTD	082499	2123	BO	65 04.89 N	34 28.10 W	GPS	308	291	297	9	
06ME45/4	VEINS-2	560	01	ROS/CTD	082499	2131	EN	65 04.83 N	34 28.07 W	GPS	310				
06ME45/4	VEINS-1	561	01	ROS/CTD	082599	0513	BE	65 31.19 N	31 16.21 W	GPS	360				
06ME45/4	VEINS-1	561	01	ROS/CTD	082599	0525	BO	65 31.14 N	31 16.52 W	GPS	368	361	357	7	
06ME45/4	VEINS-1	561	01	ROS/CTD	082599	0534	EN	65 31.07 N	31 16.88 W	GPS	371				
06ME45/4	VEINS-1	562	01	ROS/CTD	082599	0720	BE	65 16.12 N	31 00.38 W	GPS	1203				
06ME45/4	VEINS-1	562	01	ROS/CTD	082599	0745	BO	65 16.13 N	31 00.20 W	GPS	1201	1174	1187	10	
06ME45/4	VEINS-1	562	01	ROS/CTD	082599	0823	EN	65 16.01 N	31 00.06 W	GPS	1211				
06ME45/4	VEINS-1	563	01	ROS/CTD	082599	0926	BE	65 08.24 N	30 51.26 W	GPS	1585				
06ME45/4	VEINS-1	563	01	ROS/CTD	082599	0954	BO	65 08.11 N	30 51.33 W	GPS	1591	1563	1581	7	
06ME45/4	VEINS-1	563	01	ROS/CTD	082599	1039	EN	65 07.97 N	30 51.61 W	GPS	1595				
06ME45/4	VEINS-1	564	01	ROS/CTD	082599	1137	BE	65 00.29 N	30 42.57 W	GPS	1888				
06ME45/4	VEINS-1	564	01	ROS/CTD	082599	1210	BO	65 00.24 N	30 42.71 W	GPS	1890	1863	1889	5	
06ME45/4	VEINS-1	564	01	ROS/CTD	082599	1304	EN	65 00.21 N	30 42.91 W	GPS	1890				
06ME45/4	VEINS-1	565	01	ROS/CTD	082599	1408	BE	64 52.70 N	30 33.38 W	GPS	2081				
06ME45/4	VEINS-1	565	01	ROS/CTD	082599	1445	BO	64 52.73 N	30 33.45 W	GPS	2082	2059	2081	4	
06ME45/4	VEINS-1	565	01	ROS/CTD	082599	1542	EN	64 52.70 N	30 33.38 W	GPS	2082				

06ME45/4	VEINS-1	566	01	ROS/CTD	082599	1637	BE	64	45.31	N	30	25.28	W	GPS	2233			
06ME45/4	VEINS-1	566	01	ROS/CTD	082599	1719	BO	64	45.26	N	30	24.91	W	GPS	2238	2207	2235	8
06ME45/4	VEINS-1	566	01	ROS/CTD	082599	1822	EN	64	45.20	N	30	24.57	W	GPS	2229			
06ME45/4	VEINS-1	567	01	ROS/CTD	082599	2001	BE	64	45.26	N	29	45.44	W	GPS	2157			
06ME45/4	VEINS-1	567	01	ROS/CTD	082599	2038	BO	64	45.30	N	29	45.25	W	GPS	2131	2107	2134	7
06ME45/4	VEINS-1	567	01	ROS/CTD	082599	2134	EN	64	45.38	N	29	45.16	W	GPS	2116			
06ME45/4	VEINS-1	568	01	ROS/CTD	082599	2330	BE	64	45.14	N	29	05.16	W	GPS	1070			
06ME45/4	VEINS-1	568	01	ROS/CTD	082599	2351	BO	64	45.20	N	29	05.04	W	GPS	1070	1053	1064	4
06ME45/4	VEINS-1	568	01	ROS/CTD	082699	0031	EN	64	45.20	N	29	04.99	W	GPS	1070			
06ME45/4	VEINS-1	569	01	ROS/CTD	082699	0217	BE	64	45.14	N	28	24.80	W	GPS	1166			
06ME45/4	VEINS-1	569	01	ROS/CTD	082699	0245	BO	64	45.17	N	28	24.69	W	GPS	1165	1153	1164	2
06ME45/4	VEINS-1	569	01	ROS/CTD	082699	0323	EN	64	45.14	N	28	24.76	W	GPS	1166			
06ME45/4	VEINS-1	570	01	ROS/CTD	082699	0501	BE	64	45.03	N	27	50.10	W	GPS	896			
06ME45/4	VEINS-1	570	01	ROS/CTD	082699	0521	BO	64	45.09	N	27	50.01	W	GPS	891	873	883	9
06ME45/4	VEINS-1	570	01	ROS/CTD	082699	0552	EN	64	45.12	N	27	49.91	W	GPS	888			
06ME45/4	VEINS-1	571	01	ROS/CTD	082699	0731	BE	64	45.01	N	27	14.59	W	GPS	494			
06ME45/4	VEINS-1	571	01	ROS/CTD	082699	0744	BO	64	45.00	N	27	14.55	W	GPS	494	477	483	9
06ME45/4	VEINS-1	571	01	ROS/CTD	082699	0755	EN	64	45.08	N	27	14.56	W	GPS	494			