5.4 Leg M45/4

5.4.1 Hydrography

The hydrographic measurements were done with 2 Seabird CTD´s (Table 10). 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 (Fig.57).

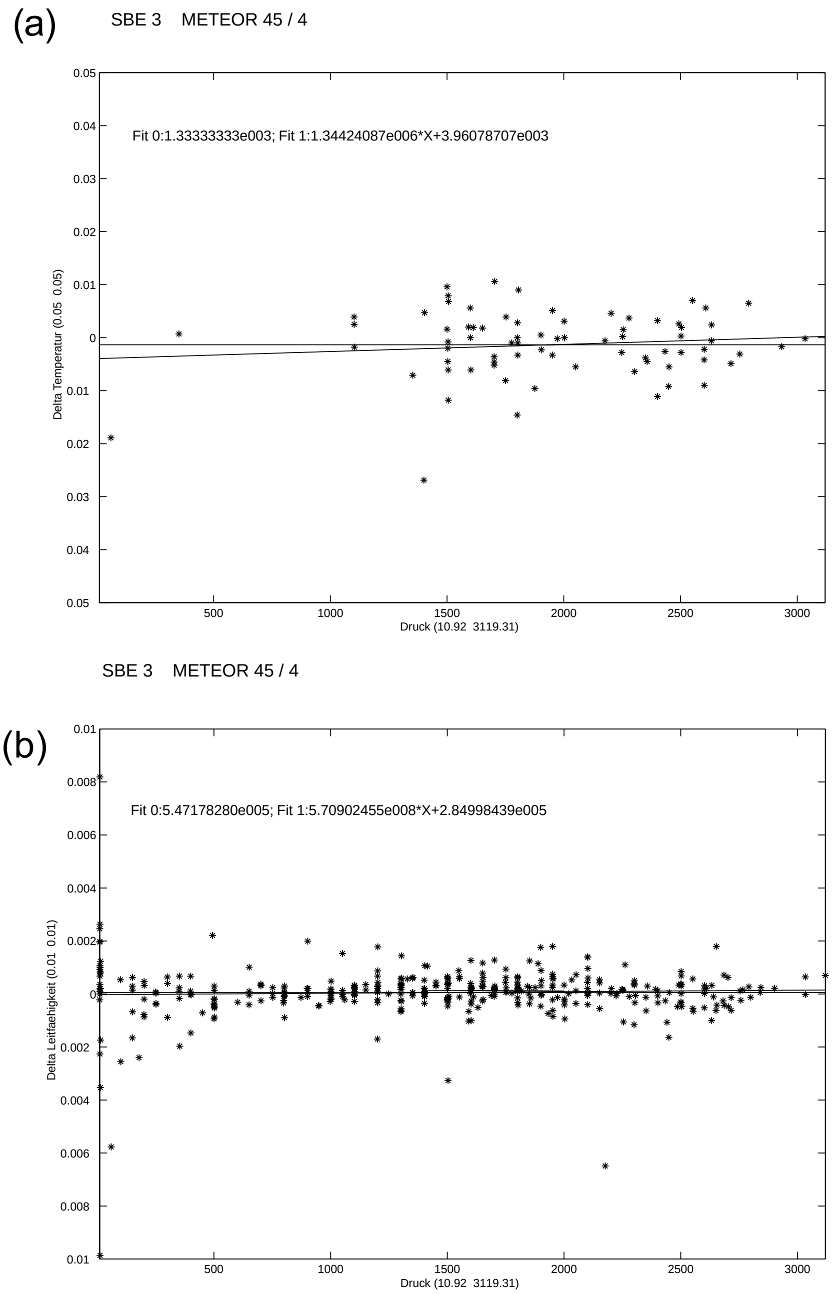

Fig. 57: Difference in temperature (a) and conductivity (b) between CTD (SB3) and bottle data after calibration.

At section 1 (Fig.58) 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, Fig. 59) 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.

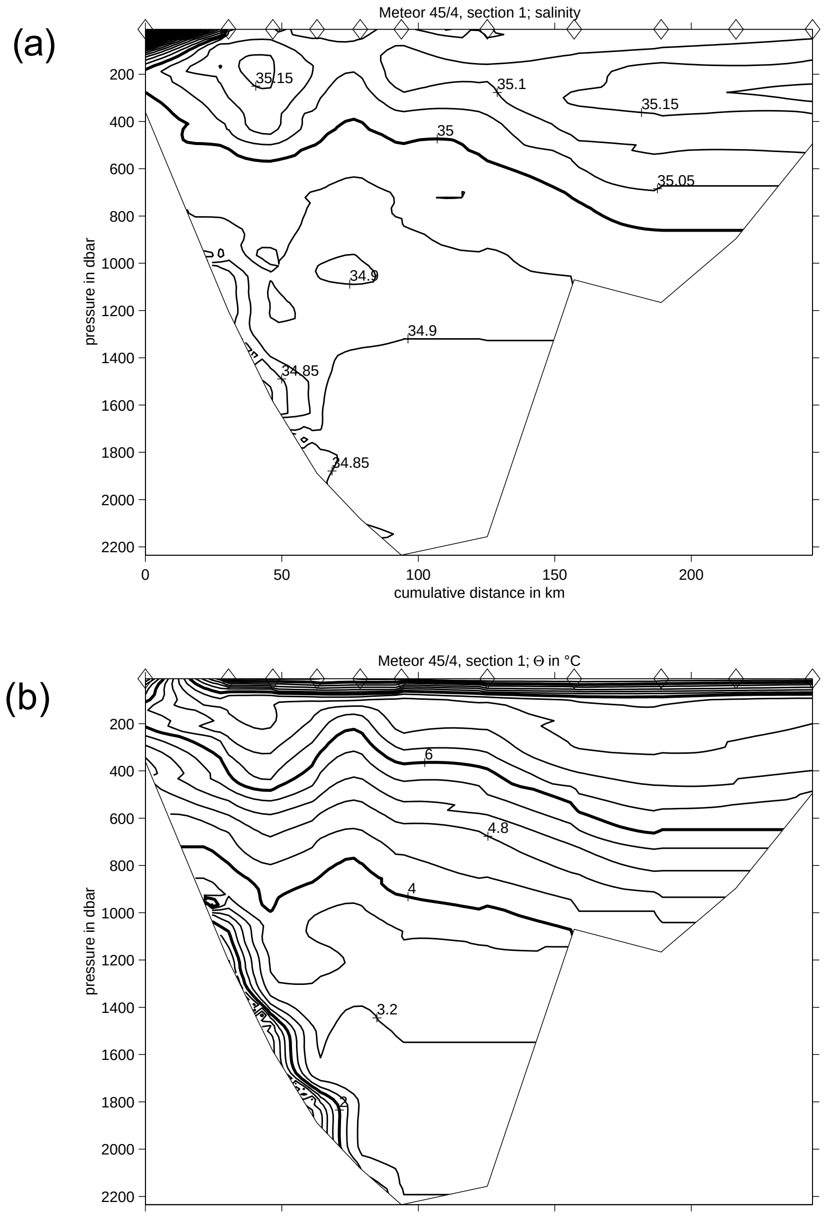

Fig. 58: Salinity (a) and potential temperature (b) along section 1.

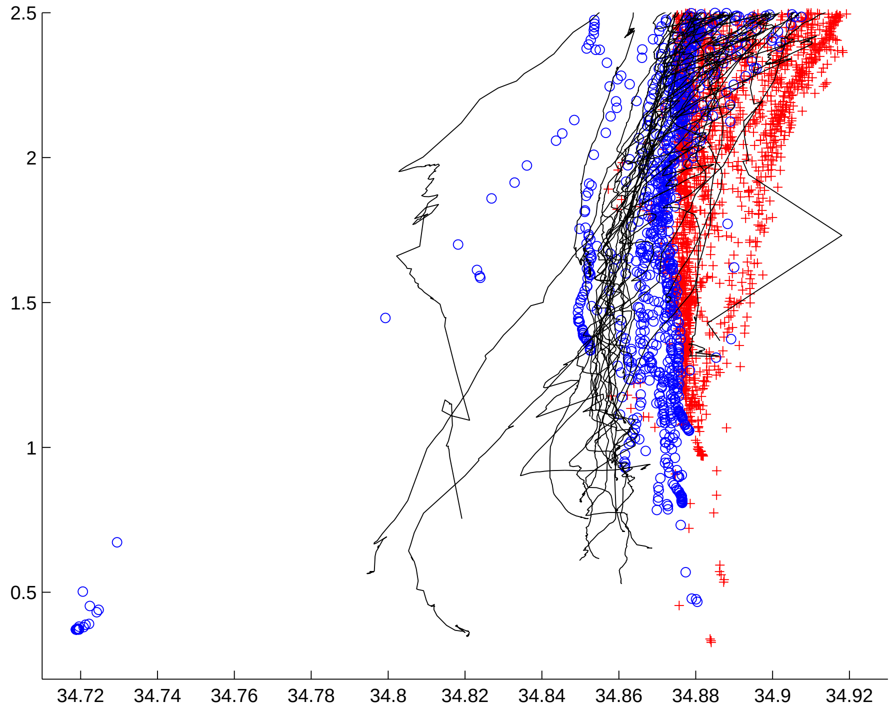

Fig. 59: Composite θ/S diagrams of cruise M45/4 (lines) compared to M39/5 (+) and VALDIVIA 173 (o).

Tab. 10: 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

5.4.2 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 (Fig. 60) 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.

5.4.3 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

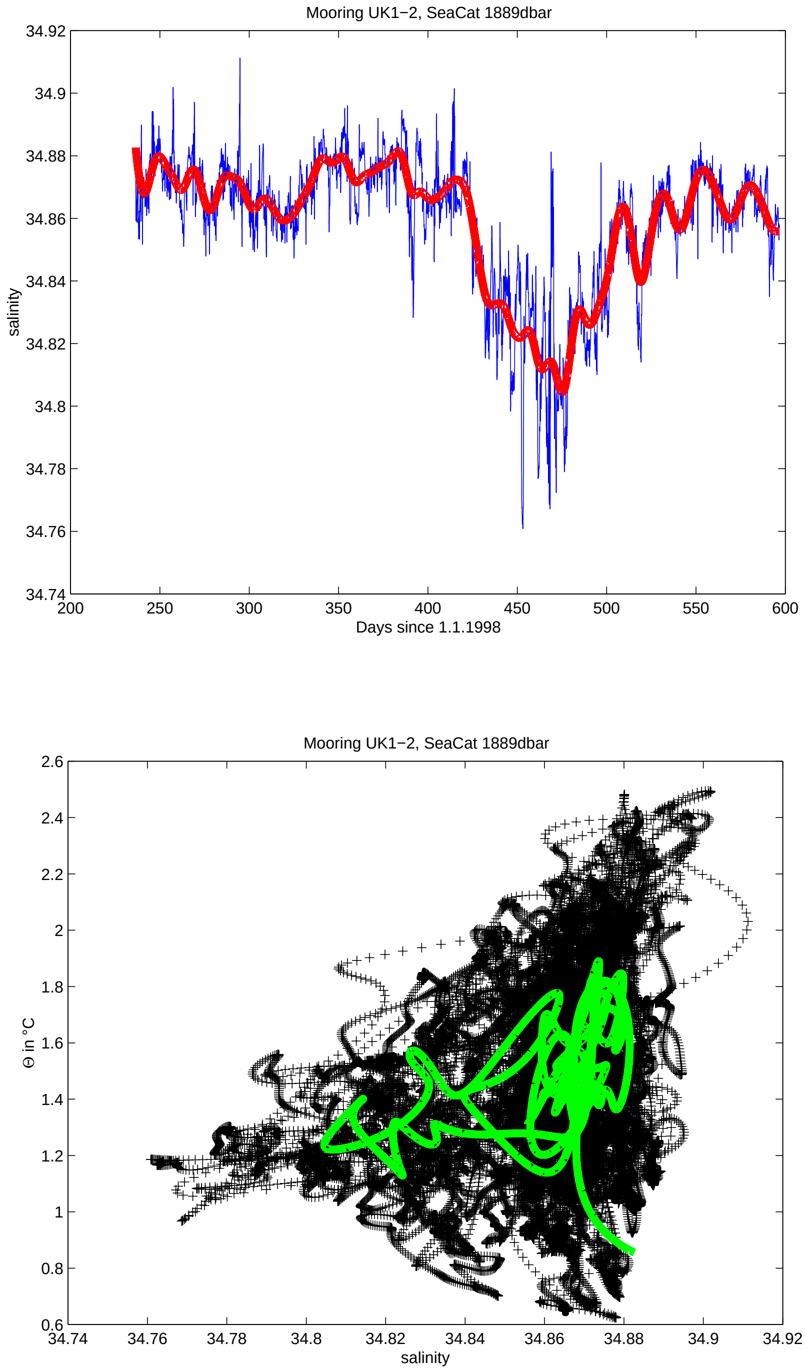

Fig. 60: Data from the SeaCat instrument located in the Denmark Strait Overflow Water at section 3. a) Salinity as a function of time (the thick line is is low-pass filtered data) b) θ/S diagram (the line being the low-pass filtered data).

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.

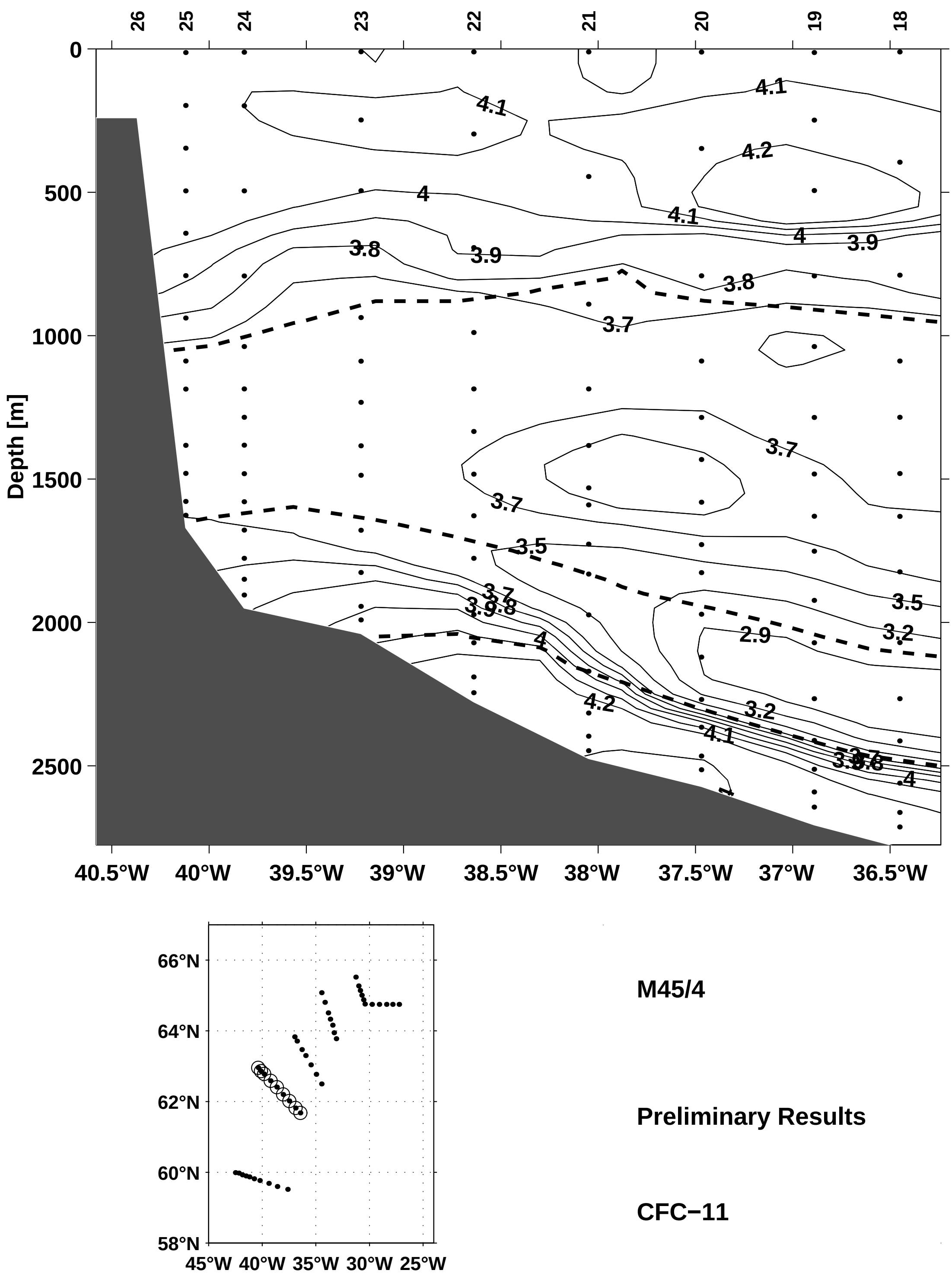

Fig. 61: CFC concentration along section 4.

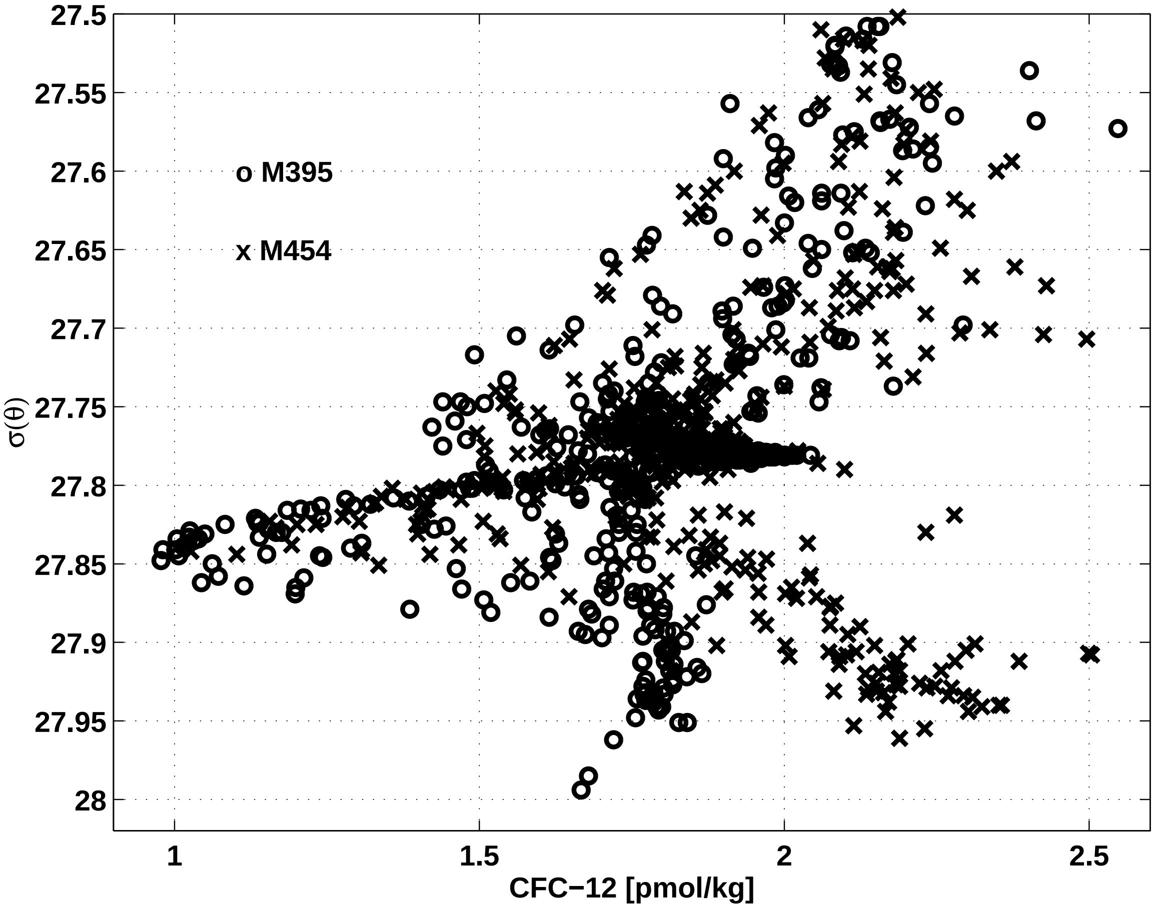

Fig. 62: Comparison of the CFC concentration between Meteor cruises M39/5 and M45/4.

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 (Fig. 61). During this cruise, the measured concentration in the DSOW were much higher than observed two years ago (Fig. 62). 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.