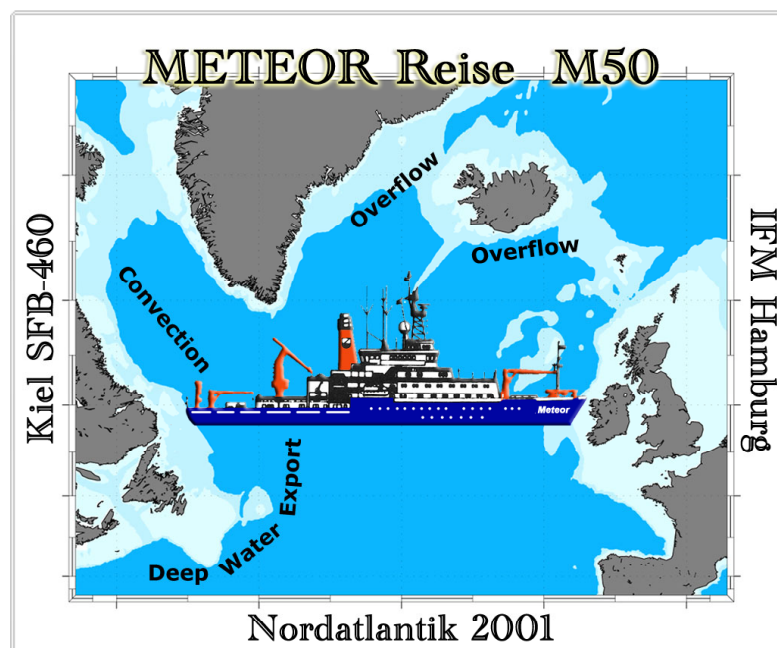


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Cruise No. 50

7 May – 12 August 2001



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Abstract

METEOR-cruise 50 took place in the North Atlantic Ocean with measurements north of 40°N (Figure 1). The cruise began on 7 May 2001 in Halifax and ended on 12 August 2001 at the shipyard in Rendsburg. METEOR-cruise 50 consisted of four legs with activities in Physical Oceanography and Marine Chemistry.

During the first leg (Halifax - St. John's) the changes of the deep circulation and water mass distribution were investigated in the Irminger Sea within the context of the SFB 460 of IfM Kiel. The southern zonal section was a repeat survey of the western part of the WOCE A2 section. For measuring water mass transports a deep reaching profiling Acoustic Doppler current meter (Ocean Surveyor) was used for the first time. Another ADCP was lowered with the CTD (LADCP). To characterize the water masses, CTD hydrography and tracer measurements (Freon) were carried out. The Deep Water Export Array located within the western boundary current off the Grand Banks as well as moorings at 53°N and the Mid-Atlantic Ridge at about 45°N were recovered and redeployed.

The second leg (St. John's - St. John's), also operated by IfM Kiel, was dedicated to mooring work and hydrographic measurements in the Labrador Sea and at the 53°N mooring array, again within the context of the SFB 460. The hydrographic measurements were a continuation of annual repeat surveys since 1996 to investigate the variability of water mass transformation and its relation to the large scale deep circulation. In the Labrador Sea, a number of tomography and convection moorings were recovered and redeployed.

During the third leg, (St. Johns – Reykjavik) mooring work and hydrographic measurements were carried out by IfM Hamburg along sections normal to the southeastern slope of Greenland. The scientific objectives were the long-term description of the composition of the Denmark Strait Overflow and its temporal variability, in continuation of the work of the EU Project VEINS on the Variability of Exchanges in the Northern Seas.

The return leg (Reykjavik - Germany) took place in the overflow regions around Iceland and particularly in the eastern basin of the subpolar North Atlantic. The investigation concentrated primarily on the spreading and mixing of water masses of the region. The field program was part of research initiatives of IfM Kiel (SFB 460) and BSH Hamburg (repeat of WOCE section A1). Observations of the deep circulation and of mass distributions included measurements of current, nutrients, CO₂ and tracers. In addition, a research group from GEOMAR Kiel investigated methane sources that were detected during an earlier cruise at the Mid-Atlantic Ridge.

Zusammenfassung

Die METEOR-Reise M50 fand im Nordatlantischen Ozean statt, nördlich von 40°N (Abbildung 1). Die Reise begann am 7. Mai 2001 in Halifax und endete am 12. August 2001 in der Werft Rendsburg. Die METEOR-Fahrt 50 setzte sich aus vier Fahrtabschnitten zusammen, die physikalisch-ozeanographische und meereschemische Arbeiten beinhalteten.

Im ersten Abschnitt (Halifax - St. John's) wurden im Rahmen des SFB 460 der Universität Kiel die Änderungen der Tiefenzirkulation und Wassermassenverteilung in der Irminger See untersucht. Dabei stellte der südliche Zonalschnitt eine wiederholte Aufnahme des westlichen WOCE A2-Schnittes dar. Zum Einsatz für die Bestimmung von Wassermassentransporten kamen erstmalig ein neuer tiefreichender Schiffs-ADCP (ocean surveyor) sowie ein an der CTD-

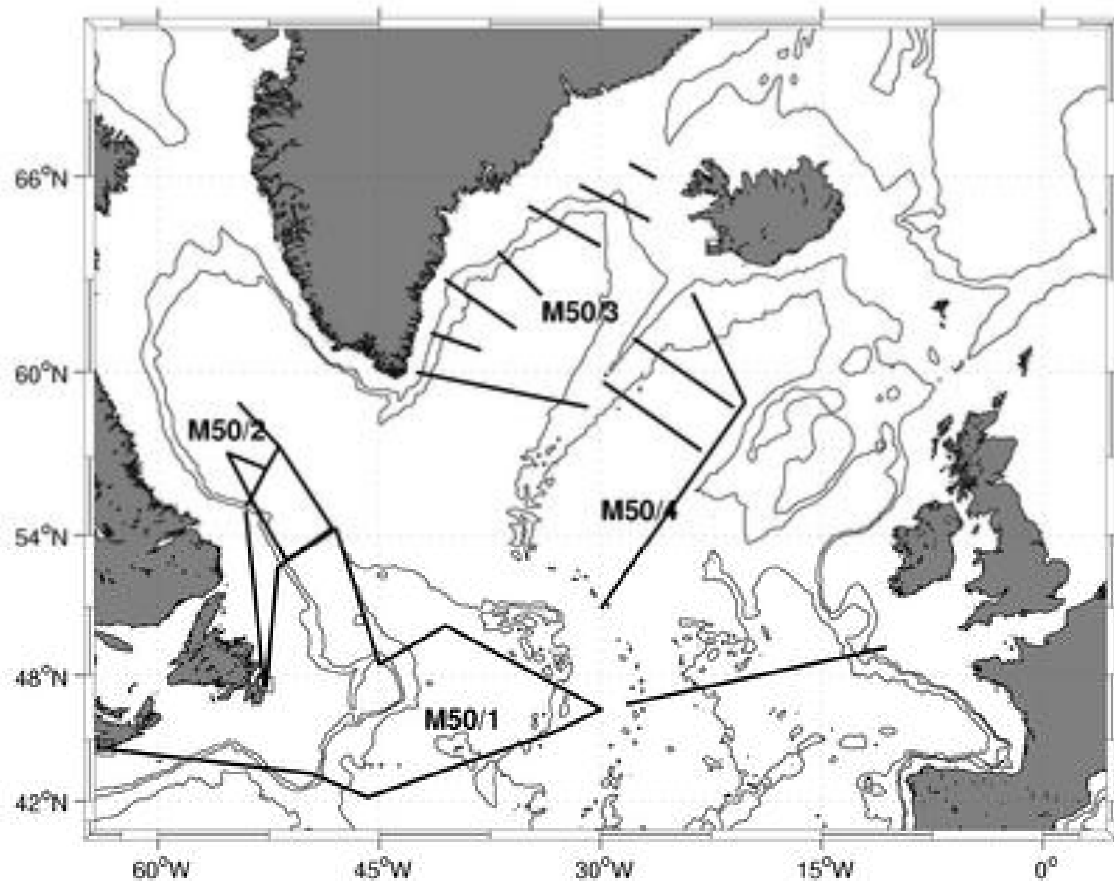


Fig. 1: Cruise track of METEOR cruise M 50.

Sonde mitgefrierter ADCP (LADCP). Zur Charakterisierung der Wassermassen wurden CTD-Hydrographie und Tracermessungen (Freone) durchgeführt. Im tiefen westlichen Randstrom bei den Grand Banks wurde der seit 1997 installierte Tiefenwasserexport-Array ausgetauscht. Ebenfalls aufgenommen und wieder ausgelegt wurden Verankerungen bei 53°N sowie am Mittelatlantischen Rücken bei ca. 45°N.

Im zweiten Abschnitt (St. John's - St. John's) standen Verankerungsarbeiten ergänzt durch hydrographische Messungen in der Labradorsee und beim 53°N Verankerungsarray im Vordergrund. Diese Reise fand ebenfalls im Rahmen des Kieler SFB 460 statt. Die hydrographischen Messungen stellten eine Fortführung von jährlich seit 1996 stattfindenden Messungen dar, um die Variabilität der Wassermassentransformation und ihre Auswirkungen auf die Tiefenzirkulation zu untersuchen. Es wurden eine Reihe von Tomographie- und Konvektionsverankerungen geborgen und wieder neu ausgelegt.

Auf dem dritten Fahrtabschnitt (St. Johns – Reykjavik) wurden Verankerungsarbeiten und hydrographische Messungen entlang der Südostküste Grönlands von Kap Farvel bis zur Dänemarkstraße unter der Leitung des Instituts für Meereskunde der Universität Hamburg durchgeführt. Das wissenschaftliche Ziel hierbei ist die längerfristige Zustandsbeschreibung der Overflow-Komponenten im nordwestlichen Atlantik und die Erfassung ihrer zeitlichen Variabilität und schließt dabei an das EU-Projekt VEINS (Variability of Exchanges in the Northern Seas) an.

Während des letzten Fahrtabschnittes (Reykjavik - Deutschland) bestand das Ziel darin, die Ausbreitung und Vermischung von Wassermassen in den Overflow-Gebieten um Island und speziell im östlichen Becken des subpolaren Nordatlantiks zu untersuchen. Die Arbeiten

gehörten zu den wiederholt durchgeführten Feldprogrammen des Kieler SFB 460 und des Hamburger Bundesamtes für Seeschifffahrt und Hydrographie (WOCE-Schnitt A2). Die Beobachtungen zur Tiefenzirkulation und zu Massenverteilung mit zugehörigen Strömungsmessungen umfassten auch Nährstoff-, CO₂- und Tracermessungen. Ferner wurde den früher entdeckten Spuren von Methanausscheidungen am Mittelatlantischen Rücken von einer GEOMAR-Forschergruppe aus Kiel nachgegangen.

Research Objectives

The research of METEOR cruise M 50 was mainly in the context of the Kiel Sonderforschungsbereich 460 as well as on the VEINS/ASOF projects.

Sonderforschungsbereich SFB 460

The Sonderforschungsbereich SFB 460 „Dynamics of thermohaline circulation variability“ started in 1996 at Kiel University. Main objective of the SFB 460 is to investigate the variability of the watermass formation and transport processes in the subpolar North Atlantic and to gain an understanding of its role in the dynamics of the thermohaline circulation and the ocean uptake of anthropogenic CO₂. The variability of circulation and water mass distribution are closely related with climate changes in northern Europe through the North Atlantic Oscillation (NAO). These connections are a focus of the ongoing research.

The research program of the SFB is based on a combination of physical-oceanographic, marine chemistry and meteorological observation programs, which are operated in close interaction with a continuous series of numerical models with moderate (50 km), high (15 km) and very high resolution (5 km), allowing a simulation of current structures and variability over a wide range of space and time scales. The main interests are, first of all, the water mass formation processes and the circulation of deep water in the subpolar North Atlantic, their interaction and integral effects, especially with regard to the uptake of anthropogenic CO₂. Second, the variability of the ocean - atmosphere interaction is investigated, and modelling investigations of large-scale aspects and causes of this variability are supplemented by the analysis of fluxes from different meteorological standard models in comparison with observations.

The legs M50/1, M50/2 and M50/4 were carried out within the context of the SFB 460. Several cruises had been carried out during the last three years to improve the data basis with a wide range of hydrographic, tracer and current measurement techniques for investigating the variability of the circulation in the North Atlantic. During the three M50-legs the study of the pathways of the deep circulation and variability of water mass distribution were of prime interest. Besides the shipboard measurements, a large part of the work was mooring work and the deployment of floats.

The marine chemistry group took samples on legs 1 and 4 for the analysis of total dissolved inorganic carbon, alkalinity, nutrients and dissolved oxygen. All analyses were carried out on board. Nutrients will be used mainly as indicators for water mass properties, while the other parameters are needed to calculate the uptake of anthropogenic CO₂ into the water column. A significant signal can be expected even at greater water depths in the study area. Transport of anthropogenic CO₂ into the Deep Water is mainly through the thermohaline circulation. Hence,

the investigations carried out during this cruise will serve to detect variations in later studies within the SFB.

VEINS/ASOF

VEINS (Variability of Exchanges in the Northern Seas) was an EU-MAST Project focussing on the variability of oceanic fluxes between the Arctic Ocean and the Northern North Atlantic for a period of three years. It was aimed at developing a cost-efficient array for the long-term monitoring of the polar and subpolar contributions to the decadal climate variability.

VEINS achieves a synoptic coverage of fluxes through Fram Strait, the Western Barents Shelf, the Iceland-Scotland Ridge and the Denmark Strait, including the continental slope of SE-Greenland. The latter was the work area for cruise leg M50/3, where the fluctuations of the Denmark Strait Overflow Water (DSOW)-transports and the entrainment of Atlantic water are major controls of North Atlantic Deep Water formation.

At present a new program "Arctic Subarctic Ocean Fluxes" (ASOF) is being planned in cooperation between several European partners, the US and Canada. The ASOF objective is monitoring of the ice export from and water mass exchange between the Arctic Ocean and the Atlantic and Pacific for the foreseeable future

Acknowledgements

The 50th cruise of RV METEOR served a multi-disciplinary group of projects in the North Atlantic Ocean. All groups and institutions involved helped to support the coordination work. It is our particular pleasure to thank the captains M. Kull and N. Jakobi and crew of all cruise legs for the flexible, friendly and very helpful attitude and professional assistance during the deployments of the complex moored arrays and the various kinds of shipboard measurement programs.

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