

exist some differences in the timing of onsets and terminations. Nevertheless, there is now strong evidence that these geomagnetic events are global features.

## THERMAL EVOLUTION OF NORTH ATLANTIC SURFACE WATER MASSES OVER THE LAST 200 KA- GEOCHEMICAL AND MICROPALAEONTOLOGICAL INDICATIONS

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The geochemical and paleontological investigations of deep sea sediment cores located along a N-S-trending profile in the northernmost North Atlantic and the Norwegian-Greenland Sea indicate new aspects in the paleoceanographic development of the Norwegian Current.

Geochemical analyses on fossil tests of the planktonic foraminifer *Neoglobobulimina pachyderma* sin. reveal that magnesium in foraminiferal tests reflects relative surface water temperature changes. Since the incorporation is uninfluenced by salinity changes of surface waters, magnesium provides an exclusively "thermal" signal. Studies on coccoliths in the Norwegian-Greenland Sea reveal that abundances strongly vary in accordance to climatic changes. Coccoliths are mainly restricted to interglacial core sections, indicating variable oceanographic regimes through time.

The combination of quantitative coccolith data and magnesium in foraminiferal tests makes a differential paleoceanographic reconstruction of the Norwegian Current possible. Significant magnesium variations in *N. pachyderma* sin. during isotopic stages 6 and 3 characterize a more variable surface-water circulation than previously assumed. At the beginning of stage 5, the drastic increase of magnesium concentrations accompanied by a successive appearance of various coccolith species indicates the starting influx of relatively warm North Atlantic surface water masses. In accordance to coccolith data, magnesium data indicate an establishment of the Norwegian current even during substages 5.3 and 5.1, whereas during substages 5.4 and 5.2, a drastic cooling of surface waters and/or a complete reduction of inflowing North Atlantic surface waters occurred. For the glacial stages 4 and 2, the interruption of inflowing surface waters has to be considered due to very low magnesium concentrations. The climatic change to the Holocene is reflected both in a drastic increase in magnesium concentrations and high coccolith abundances indicating a severe influx of relatively warm North Atlantic surface water masses. During Termination I<sub>A</sub>, these surface waters presumably reached Vøring Plateau, but established in Fram Strait not before Termination I<sub>B</sub>.

## SEDIMENTS IN THE ARCTIC SEA ICE

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Due to its exposed position and the unequal relationship between area and mean thickness, the sea-ice cover is expected to react sensitively on even small environmental changes. The importance of sedimentary inclusions in the Arctic ice cover on ablation processes, and on albedo effects related to such changes, is still not sufficiently known. Intensive studies on sediment inclusions in the

Arctic sea-ice cover have been concentrated on the central Arctic Ocean (Arctic '91), on main ablation areas in the Greenland Sea and Fram Strait, and, most recently, on source areas in the Laptev Sea area. Primary research objectives include the quantitative sediment analyses, the documentation of the regional distribution pattern of material-laden ice, the evaluation of processes by which sediment is incorporated into the ice cover, and the identification of transport paths and probable depositional centers for the sediment.

Sea-ice sediments are dominated by fine grain sizes, though coarse sediments and stones up to 5 cm in diameter could be observed. The component analysis reveals quartz and clay minerals to be the dominant terrigenous sediment particles. Therefore, clay mineralogy of ice-rafted sediments provides important indications for ice-drift patterns. The biogenous components point to a shallow marine source area for the sea ice sediments, indicating that terrigenous sediments have already been deposited on shelf areas before being incorporated into the sea ice by suspension freezing.

Observations in the Laptev Sea area (Siberian Arctic) indicate that frazil and anchor ice generating in a large coastal polynya provide the main mechanism to bring sediment into the sea ice. The sediment in Laptev Sea ice is distributed diffusely over the entire ice column (turbid ice), whereas in the Central Arctic Ocean sediments are already concentrated in layers or on ice floe surfaces due to various melting and freezing processes. Consequently, the sediment load in central Arctic multi-year sea ice exceeds by far the amounts observed in one-year sea ice from the Laptev Sea.

#### AN 180,000 YEAR MAGNESIUM RECORD IN *NEOGLOBOQUADRINA PACHYDERMA* SINISTRAL - A TOOL FOR THE THERMAL RECONSTRUCTION OF NORWEGIAN SEA-SURFACE WATERS

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The variations of magnesium in calcitic tests of planktonic foraminifers (*Neogloboquadrina pachyderma* sin.) enables the spatial and temporal reconstruction of the thermal structure of ocean surface water masses even at high northern latitudes. Sediment cores from the Norwegian Sea and Fram Strait were used to systematically investigate these geochemical variations for glacial/interglacial changes during the past approximately 180,000 years.

The quantitative measurement of magnesium was performed by electronmicroprobe analyses in foraminiferal tests. Sample contamination, as well as the influence of early diagenetical processes potentially altering the original element content, can be ruled out at least for the time period considered here.

For the first time, the temperature-related calcium substitution by magnesium is shown in tests of *N. pachyderma* sin. Generally, relatively high magnesium concentrations appear during interglacials, whereas low magnesium concentrations occur during glacial periods. Even short climatic events such as the Younger Dryas cooling are reflected in the magnesium signal. Comparison to oxygen isotope data suggest that the magnesium signal is not influenced by salinity changes, thus providing an alternative tool to reconstruct relative surface water temperature variations.

During oxygen isotope stages 6 and 3 significant magnesium variations reflect a spatially and temporally differentiated surface water circulation. The drastic increase in the magnesium concentration at the beginning of stage 5 points to the onsetting influence of relatively warm North Atlantic surface waters into the Norwegian-Greenland Sea. A significant cooling of surface water