Late Quaternary nannofossil record north of the Faeroe-Iceland Ridge

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Over 60 short sediment cores from the Norwegian and Greenland Seas, the Fram Strait, the Nansen Basin and the continental shelf around Svalbard and Greenland have been analysed for calcareous nannofossils (coccoliths) (Fig. 1). These photosynthetic planktonic algae provide information about the age of the sediment and the sea surface water environment.

Nannofossil biostratigraphy and chronology

Calcareous nannofossils provide a reliable chronological framework in late Quaternary sediments from European Arctic seas as the conventional marker species were present in the subpolar environment. Additional datum levels have been obtained by correlating characteristic and consistent abundance fluctuations of nannofossils to the oxygen isotope stratigraphy (Gard 1986, in press).

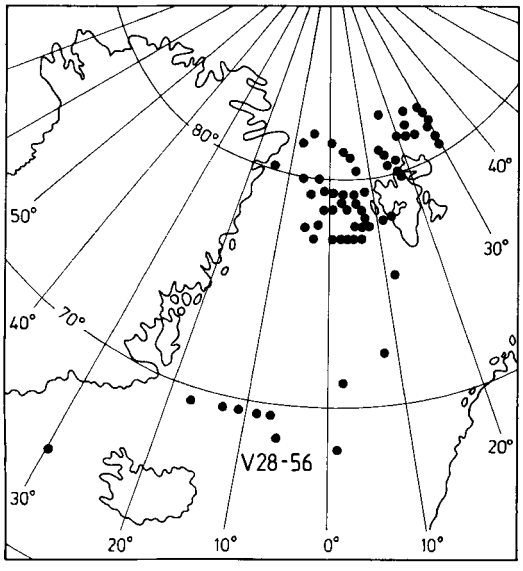

Fig. 1. Location map of cores analysed for calcareous nannofossils.

Core V28–56 from the Norwegian Sea (68°02'N, 06°07'W, water depth 2941 m) (Kellogg et al. 1978) shows the general pattern of nannofossil abundance fluctuations during the last 450 kyrs (oxygen isotope stages 1–12, Fig. 2). The nannofossil assemblage is subpolar and of low species diversity. However, the relative abundance ratio between the different species changes characteristically through time, which is excellent for biostratigraphical purposes and makes the identification of discrete nannofossil layers in cores with no other age information unambiguous.

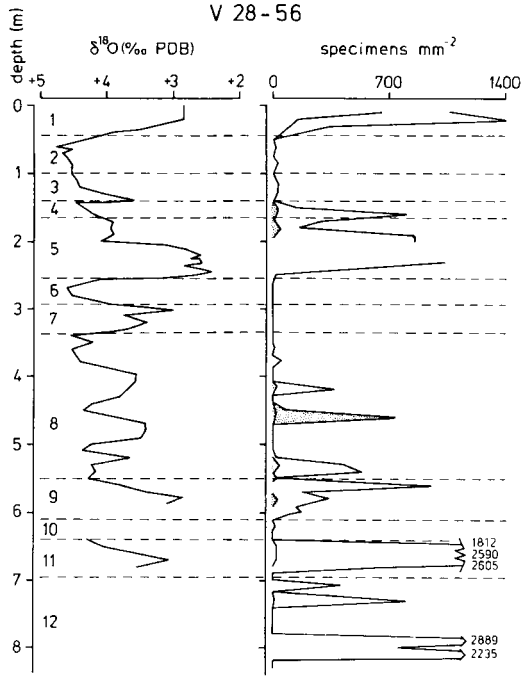

Fig. 2. Oxygen isotope stratigraphy and nannofossil abundances in core V28–56. White area = placoliths <5 μm. Shaded area = *Coccolithus pelagicus*. Oxygen isotope stratigraphy after Kellogg et al. 1978.

The nannofossil assemblage of today (oxygen isotope stage 1) is totally different from any previous time period, being dominated by *Emiliania huxleyi* (Lohmann) Hay & Mohler and *Coccolithus pelagicus* (Wallich) Schiller. *Gephyrocapsa* spp. are rare in the study area today but are the most common taxa during all other time periods studied. Different species, or morphotypes (Samtleben 1980), of this genus dominate during different time periods. During oxygen isotope stages 4 and 5, *G. muellerae* Bréhérét constitutes more than 90% of the *Gephyrocapsa* assemblage, whereas during stages 7–9, very small specimens (<2 μm) which may be assigned to *G. aperta* Kamptner are most common. *Emiliania huxleyi* has its first appearance during stage 8 and is present in low abundances during stages 4–8. During oxygen isotope stage 11, *G. muellerae* is again most common, whereas the nannofossil assemblage from stage 12 is a mixture of three *Gephyrocapsa* variants, with no clear dominance: *G. mullerae*, *G. aperta* and *G. caribbeanica* Boudreaux & Hay. Sediments deposited during oxygen isotope stage 13 can be recognized by the dominance of *G. caribbeanica* and rare occurrences of *Pseudoemiliania lacunosa* (Kamptner) Gartner (extinct in stage 12).

Regional distribution of nannofossils and sedimentation rates

Cores raised from the continental shelves generally contain Holocene sediments only, indicated by common *E. huxleyi* and *C. pelagicus* throughout. Cores raised from the Nansen Basin are low in $CaCO_3$ content and are essentially barren of nannofossils. At more shallow depths on the northern continental slope off Svalbard, nannofossils are preserved and show that the sediments are mainly of Holocene age, although the lower part of the cores usually terminates in a nannofossil barren diamicton. The oldest core recovered from the Yermak Plateau terminates in oxygen isotope stage 5. In the Fram Strait, several cores with well developed sequences from the recent to oxygen isotope stage 5 have been identified, even as far as 81°24'N. However, no cores from the Fram Strait and northwards penetrate any layer containing abundant nannofossils below stage 5 as has been observed in several cores from the Norwegian and Greenland Seas. The absence of older nannofossils from the more northerly cores probably indicates that they are younger, and their maximum age may only be about 250 kyrs.

Linear sedimentation rates in the deep sea environment and in the central Fram Strait are in the order of some cm/kyr. However, in the Fram Strait, sedimentation rates an order of magnitude higher may be encountered. The sediment accumulation on the slopes and shelf is relatively fast due to increased input of terrigenous material.

Paleoceanographic conclusions

Coccolithophorids are photosynthetic algae which are absent in polar waters but which thrive in the subpolar environment. Therefore the presence of these nannofossils (coccoliths) points to at least seasonally ice-free conditions. Their absence in the sediments may be due to: (a) a year-round ice-cover, (b) loss of habitat due to extremely low temperatures and salinities or low nutrient levels in the surface waters, or (c) calcium carbonate dissolution. As the coccoliths in the study area are similar to the assemblages in the northern North Atlantic, it seems probable that the intervals with high amounts of deposited coccoliths reflect periods with inflow of Atlantic waters.

The presence of high amounts of nannofossils deposited during stages 1 and 5 in the northern Fram Strait and on the Yermak Plateau suggests that the West Spitsbergen Current reached this area during stage 5 in a similar pattern to the present one.

Increased abundances of *Calcidiscus leptoporus* (Murray & Blackman) Loeblich & Tappan are observed during oxygen isotope substage 5e, which probably indicates the highest sea surface temperatures during the last 450 kyrs. It is notable that nannofossils prevailed in the study area during most of oxygen isotope stage 5, although, going northwards, the trend is that only substages 5a and 5e contain nannofossils. *Coccolithus pelagicus* is present in low abundances throughout the last 450 kyrs, but it blooms and dominates the assemblage during oxygen isotope stage 1 and during a brief interval during stages 7 or 8. The factors causing these blooms are unknown.

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