Terra Antartica, 1994, **1** (2), 431-432
Special issue

Late Quaternary Glacial/Interglacial Variations in Sedimentary Processes along the East Greenland Continental Margin

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High-latitude areas are very sensitive to paleoenvironmental changes, as shown in the landmark study of the CLIMAP (Climate Long Range Investigation Mapping and Prediction) Group for the latest Pleistocene glacial - Holocene interglacial cycle (CLIMAP 1981). Thus, detailed sedimentological and organic-geochemical studies of marine sediments from the East Greenland Continental Margin (Fig. 1) can yield important information about the glacial/interglacial variations of paleoenvironment. Sedimentary processes, terrigenous sediment supply, and biogenic productivity in the study area are mainly influenced by fluctuations in the extent of the Greenland Ice Sheet, extent of sea ice, rate of drifting icebergs, meltwater input, and/or oceanic circulation, i.e., all factors controlled by climate. Similar mechanisms are also controlling the sedimentation along the Antarctic Continental Margin (see Bonn et al., this vol.). Our East Greenland Continental Margin study is part of the ESF-PONAM (European Science Foundation - Polar North Atlantic Margins) programme in which the reconstruction of this environmental history of the East Greenland Margin and the correlation between terrestrial and marine records are major objectives (Elverhoi and Dowdeswell 1991).

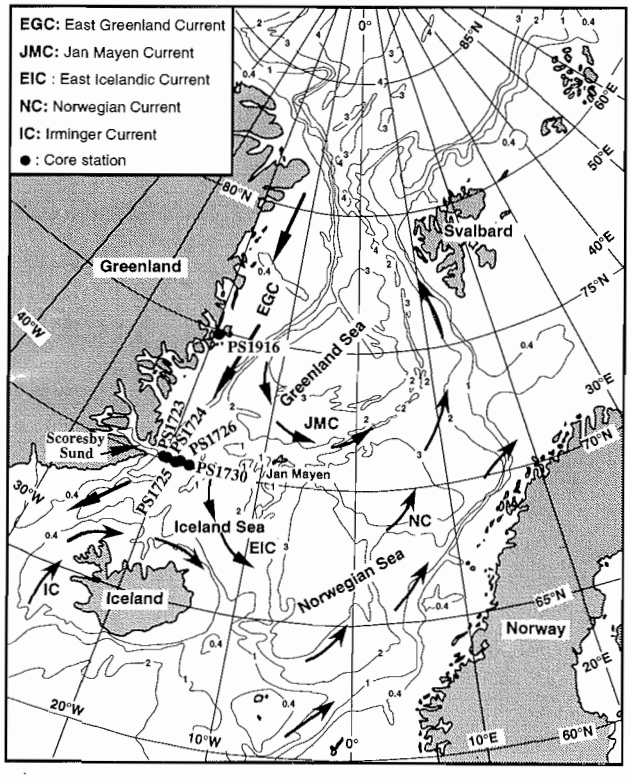

Fig. 1 - Study area, location of sediment cores at the East Greenland Continental Margin, and major surface water currents.

The study is based on sediments recovered by gravity coring on profiles perpendicular to the East Greenland Continental Margin between about 69° and 75°N and in the Scoresby Sund during POLARSTERN expeditions ARK V/3 and ARK VII/3 in 1988 and 1990, respectively (Fig. 1). The following investigations have been performed: detailed description of lithology to identify sediment facies types; separation of clay-silt-sand-gravel fractions; detailed coarse fraction analysis (determination of biogenic and siliciclastic components); oxygen and carbon isotope measurements; determination of carbonate, organic carbon, and nitrogen contents; classification of the organic carbon fraction using Rock-Eval pyrolysis (i.e., hydrogen and oxygen index values) and C/N ratios; absolute age dating using AMS^{14}C method (see Stein et al., 1993; Nam et al., 1994 for further details).

Past climatic glacial-interglacial changes along the East Greenland Continental margin through the last 220 ky BP are well documented in the investigated sediment cores. According to the amount of sand fraction and ice-rafted debris (IRD), several major pulses of glacial activity and supply of terrigenous material by glacio-marine processes were recorded (Fig. 2a). During the last glacial maximum (stage 2 / Weichselian), the supply of IRD at the continental slope off Scoresby Sund was significantly higher than during the maximum stage 6 (Saalian) glaciation. Maximum flux rates of terrigenous (ice-rafted) material were recorded at the continental slope between 15 and 19 ky BP (Nam et al., 1994) which may correspond to the maximum stage 2 extension of glaciers on Greenland (cf., Funder, 1989).

The drastic climatic change from glacial maximum to present interglacial conditions is documented in the sedimentary sequences from upper slope and shelf environments. A facies succession on the shelf from overconsolidated diamicton/lodgement till to alternation of diamictons and varved clay to bioturbated glaciomarine sediments may reflect the gradual retreat of continental ice masses/ glaciers during (? early/) late Weichselian glacial - Holocene interglacial transition (termination)

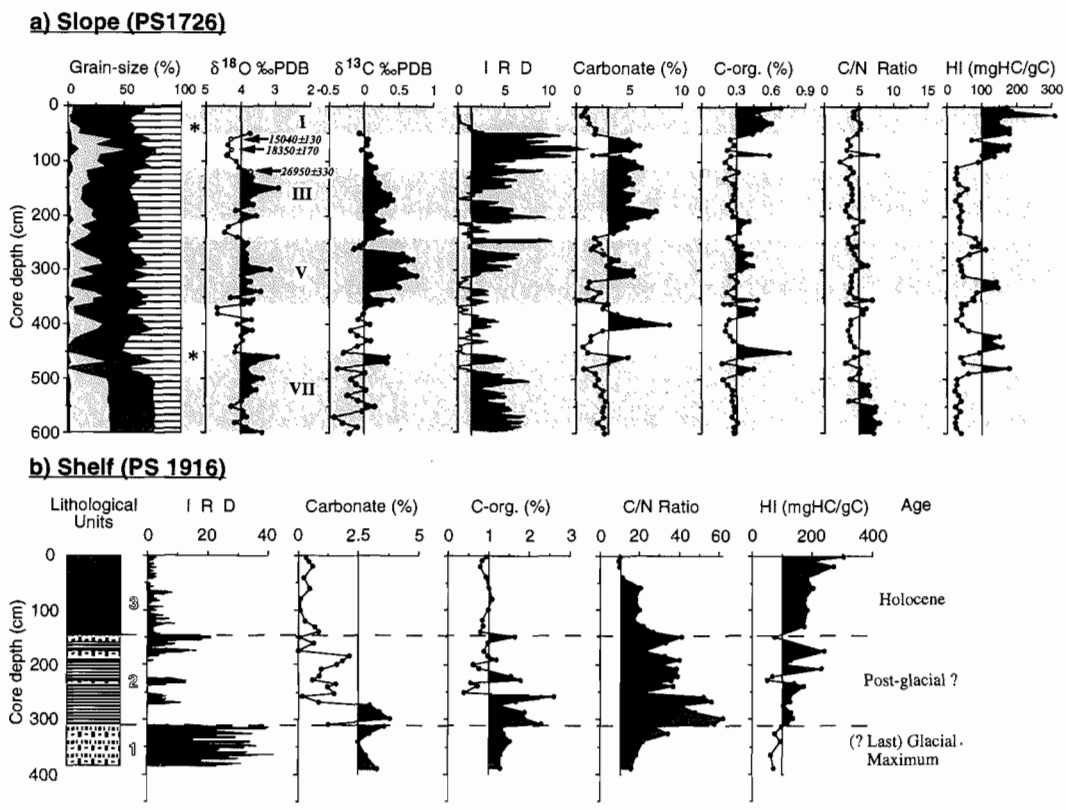

Fig. 2 - Results from the slope core PS1726 (a) and shelf core PS1916-1 (b) (see Fig. 1 for locations): Major lithologies, amount of ice-rafted debris (IRD, i.e., gravel fraction > 2mm, counted in X-radiographs and expressed as numbers per 10 cm^3), contents of carbonate and organic carbon, organic carbon/nitrogen (C/N) ratios, and hydrogen index (HI) values (HI expressed as mg hydrocarbons per gram organic carbon). For core PS1726, stable oxygen and carbon isotopes are also shown. C/N ratios and HI values allow a first characterization of the organic matter, with C/N ratios of < 10 and HI values of >> 100 typical for marine organic matter and C/N ratios > 15 and HI values < 100 typical for terrigenous organic matter (for details see Stein 1991).

(Fig. 2b). This process probably resulted in distinctly decreased flux and deposition of ice-rafted debris in the open shelf / upper slope environment. During this termination, also the sea-ice cover decreased causing an increase in surface-water productivity as suggested from increased organic carbon and biogenic opal deposition. During the last 10,000 years, large amounts of ice-rafted debris were probably already trapped in the Scoresby Sund; only minor amounts reached the open shelf.

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