Stable isotopic compositions of surficial organic matter along a transect across the Labrador Sea

A.N.N. Muzuka

GEOTOP, Université du Québec à Montréal, C.P. 8888, Montréal, Québec, Canada H3C 3P8.

Introduction

The $\delta^{13}C$ and $\delta^{15}N$ compositions of organic matter (OM) have been used to estimate the proportions of allochtonous and autochthonous materials preserved in marine sediments (e.g. Macko, 1983). Apart from the work of Macko (1989) and Rogers *et al.* (1972), which utilized cores recovered at ODP Sites 646 and 647 and DSDP Sites 111 and 112 respectively, no attempts have been made to determine sources of surfical OM in the Labrador Sea. Thus, the present study uses the stable isotopic compositions of carbon and nitrogen for surfical organic material recovered along a transect across the Labrador sea to delineate its sources.

Results

The mean surficial (0–30 cm) $\delta^{13}C$ and $\delta^{15}N$ values on the western side of the Labrador Sea decrease with increasing water depth down to about 2000 m, from −21.7‰ to −24.7‰, and 8.0‰ to 6.1‰ respectively; they then start to increase down to the Labrador basin (3994 m). Off the western Greenland coast, the $\delta^{13}C$ and $\delta^{15}N$ values increase slightly with increasing water depth. These results indicate high input of terrestrial OM at a water depth interval of 1300–2700 m on both sides of the basin. On the Labrador shelf, input of OM is dominated by marine primary productivity with minimal influence of continental OM.

The mean organic carbon content is very low for both sides of the basin, typical of open marine environment, and lacks any variation with increasing water depth. Contrary to organic carbon content, the mean $CaCO_3$ content on the Labrador side increases with increasing water depth reaching a local maxima at about 2000 m water depth followed by a slight decrease. On the Greenland side, the $CaCO_3$ content generally shows a slight increase with increasing water depth. Apart from the shelf sites, the $CaCO_3$ content on the Labrador continental margin is higher than on the Greenland side.

Discussion

Worldwide studies conducted to document influences of terrestrial OM in the marine environment have indicated a decrease in the proportion of terrestrial OM with increasing distance offshore (e.g. Macko, 1983; Schultz and Calder, 1976). The observed high input of terrestrial material between water depths 1300 and 2700 m is contrary to the above general trend, and the possible causes include sedimentation features and circulation processes specific to the Labrador Sea.

Isotope fractionation due to temperature effect as well as primary productivity can be ruled out due to lack of major changes in species diversity, low temperature difference between sites and relatively similar concentrations of dynocyst (de Vernal *et al.*, 1994). Deposition by turbidity currents into tributaries and satellite channels of the North Atlantic Mid-Ocean Channel is the most probable process responsible for the observed trend. Since turbidity currents are inferred to have been very active during the glacial times (e.g. Myers and Piper, 1988), sedimentary material found between 1300 and 2700 m water depth may be turbidite of the late Pleistocene, covered by a thin layer of marine OM due to strong western boundary undercurrent (WBUC). High content of $CaCO_3$ at all sites within this depth interval may be an indication of deposition of carbonate fine particles resulting from turbidity current.

High proportion of terrestrial material in the deeper waters may be a relic of sediments eroded from exposed shelves during low sea level stand (last glacial maximum) and deposited on the continental slope. Owing to strong WBUC, which currently sweeps the Labrador slope and rise, recent sediments may have been eroded and/or not deposited, leaving behind shelf derived older sediments. Furthermore, the material may be a recent continental refractory material (wind transported) or Cretaceous material derived from Baffin Bay and deposited there by the WBUC and/or icebergs. Widespread presence of reworked Arctic palynomorhs and increase in *Pinus*,

Sphagnum and *Lycopodium* palynomorph contents with distance offshore in many analyzed cores from the Labrador Sea (de Vernal *et al.*, 1994; Rochon and de Vernal, 1994) are further evidence of these sources.

Conclusion

There is a measurable input of terrestrial OM between 1300 and 2700 m water depth on both sides of the basin caused by turbidity current, iceberg or wind. Turbidite deposits have been covered by a thin layer of recent pelagic sediments due to strong bottom current WBUC. Apart from turbidity currents, other agents responsible for transporting sediments include wind and icebergs. The present study has demonstrated that distribution of OM in the marine environment may vary depending on the sedimentation processes.

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