Evolution of the depleted asthenosphere beneath the Atlantic: Evidence from εHf in N-MORB from 80°N to 55°S

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εHf in N-MORB with $(La/Sm)_n < 0.65$ from 12 different “normal” ridge segments remote from plume/ridge interactions, exhibit a striking linear gradient along the entire 15,000 km long Mid-Atlantic Ridge (MAR) from 80°N to 55°S. εHf decreases from +23.9 in the Arctic to +13.4 near the Bouvet Triple junction in the South Atlantic. Similar gradients are also apparent in $^{207}Pb/^{204}Pb$ and to a lesser extent εNd. εHf correlates negatively with MAR spreading rate and with distance between the MAR and the continents. There is no correlation between εHf and ridge depth, age of Atlantic opening or Lu/Hf. The inverse relationship between spreading rate and εHf indicates that the observed Atlantic isotope gradients are not caused by differences in efficiency of melt collection from the "wings" of the melt zone in a mantle containing enriched veins or blobs. The isotope gradients may be caused by pollution from continental lithosphere delaminated during Atlantic opening. However, the negative correlation of εHf with MAR-continent distance indicates that such a lithosphere pollutant has been incompatible element depleted for a long time. It is also possible that the Atlantic mantle is polluted by residues of fractional melting associated with plume dispersal. Finally, it is possible that the gradients are not related to any pollutant (veins/blobs, continental lithosphere or plume residues) but are due to longstanding variations related to the evolution of the depleted upper mantle. In this case, the mantle underlying the Atlantic has been more incompatible element depleted toward the north due to a greater extent of melt/fluid removal through time in forming continents. Alternatively, the depletion of the upper mantle by melt removal and continent formation may have begun earlier in the north than in the south resulting in an older mean age for the northern upper mantle. However, any of these inherent upper mantle variations must be ancient to allow for radiogenic ingrowth. Thus they predate the opening of the Atlantic and must have developed during the formations and breakups of earlier continents.

High-resolution, Southern-Hemisphere record of rapid climate change at Termination I and subsequent cold reversal: Great Australian Bight, ODP Leg 182

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The transition from the last glacial maximum to the Holocene was by no means smooth and continuous but was marked by several rapid climate fluctuations, as indicated by a stepwise rise in sea-level. High-resolution and well-dated marine records from the Southern Hemisphere are rare, yet they would be important for our understanding of the last glacial cycle on a global scale. We used a marine sediment core recovered during ODP Leg 182 on the Great Australian Bight to reconstruct the deglaciation history of this geographic realm.

Site 1127 is situated on the continental shelf facing the open ocean in a mid-latitude Southern-Hemisphere location. The simultaneous deposition of surface-dwelling planktonic foraminifera together with the benthic shelf community makes the sedimentary record deposited in this region sensitive not only to paleoceanographic but also to environmental changes affecting the shelf. Study of this combined record permits us to link changes in the open-ocean with those occurring in the continental-margin setting. High sedimentation rates and well-preserved foraminifera enabled us to develop a high-resolution oxygen isotope stratigraphy for the evaluation of the paleoceanographic changes. A detailed AMS C-14 chronology is used to determine the relative timing of sea-level rise and climatic fluctuations and compare these with other paleoclimatic records.

Our isotope data indicate abrupt warmings at 16.5 and 14 cal yr B.P. that can be associated with large sea-level rises observed in regional and global records. A rapid return to cooler sea-surface temperatures, dated between 12.3 and 11 cal yr B.P., points to an abrupt end to the deglaciation. Overall, mass accumulation rates increase from the Late Glacial to the Holocene as sea-level rises, flooding the shelf and reinitiating cool-water carbonate production.

We compare the relative timing of Termination I and subsequent rapid cold reversal with regional climatic records, as well as Greenland and Antarctic ice-core data. The rapid cold reversal observed in the Great Australian Bight between 12.3 and 11 cal yr B.P. supports the Oceanic Cold Reversal hypothesized by Stenni et al., 2002. Interestingly, this cooling is quasi-synchronous with the “Younger Dryas Event” in Europe (12.6-11.5 cal yr B.P.)

Reference

Stenni B. et al., (2002), *Science* **293**, 2074-2077.