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Atlantic Ocean Circulation during the Latest Cretaceous and Early Paleogene: Progressive Deep Water Exchange

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The Atlantic deep ocean circulation in the Latest Cretaceous (75-66 Ma) was dominated by regional processes, as indicated by the presence of distinct deep water masses. Due to the opening of the Atlantic Ocean, its different sub-basins became progressively connected and a global mode of ocean circulation commenced in the early Paleogene, $\sim$60 Ma. To understand the evolution of deep water formation and exchange, Nd-isotope data and δ13C stratigraphies are generated for a range of sites in the North and South Atlantic. These permit to identify different intermediate and deep-water masses, to recognize their potential source regions and to determine the exact timing of deep water connection.

The carbonate-rich pelagic sediments of Site U1403 near Newfoundland can be astronomically tuned and correlated to the global δ13C framework.
Relatively negative seawater εNd(t) signatures in the 67-62 Ma interval at Site U1403 of $\sim$-10 are distinct from those recorded further south in the North Atlantic. Possible explanations could include elevated non-radiogenic weathering inputs from the North American craton.
In the latest Maastrichtian, the Site U1403 εNd(t) record displays a short-term positive excursion before the K/Pg boundary (67-66 Ma) followed by a sudden drop to unradiogenic values at the boundary. Changes in ocean circulation might be related to climatic changes in the pre-extinction interval and the impact itself.

The εNd(t) records at Sites 1267 and 525 at Walvis Ridge show that an early Maastrichtian excursion to highly radiogenic values reflects a brief interval at 72-70 Ma, related to a period of increased hot-spot volcanism. Concomitant measurements of εNd(t) values in three different archives, fish teeth, ferromanganese coatings of bulk sediments and of foraminifera, provide a test for the partial influence of detrital particles on the isotopic composition of coatings.

The first data of Sites U1403, 1267 and 525 indicate the occurrence of a common deep-water neodymium isotope signature (εNd(t) -8) in the North and South Atlantic since 60 Ma. At this time, the sub-basins of the deep Atlantic became fully connected. A deep-water mass with a common εNd(t) signature, likely originating in the high southern latitudes, prevailed over a broad range of water depths, indicating vigorous deep ocean circulation.