Reconstruction of the North Atlantic end-member of the Atlantic Meridional Overturning Circulation over the last 1.5 Myr

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North Atlantic Deep Water (NADW) represents the major water mass that drives the Atlantic Meridional Ocean Circulation (AMOC). In order to understand its impact on ocean circulation and climate through time, it is necessary to constrain its composition. We report Nd isotope ratios of Fe-Mn oxide encrusted foraminifera and fish debris from DSDP Site 607 (41.00N 32.96W, 3427m), in the present-day core of NADW, and ODP 1063 (33.68N 57.62W, 4585m), on the deep abyssal plain at the interface between NADW and Antarctic Bottom Water. We provide a new North Atlantic paleocirculation record covering 1.5 Ma.

Site 607 interglacial ε_{Nd}-values are consistently similar to present-day NADW (~-13.5), with median values of -14.3 and -13.8 in the Early and Late Pleistocene. Glacial ε_{Nd}-values are higher by ~1 ε_{Nd}-unit in the Early Pleistocene, and ~1.5-2 in the Late Pleistocene. Site 1063 shows much greater variability, with ε_{Nd} ranging from -10 to -26.

We interpret the North Atlantic AMOC source as represented by the Site 607 interglacial ε_{Nd}-values, which has remained nearly stable throughout the entire period. Glacial ε_{Nd}-values reflect incursions of southern-sourced waters to Site 607, which is supported by coeval shifts to lower benthic $\delta^{13}C$. In contrast, Site 1063 ε_{Nd}-values reflect local effects from a bottom source.

A period of greatly disrupted ocean circulation marks ~950-850 Ma, which may have been triggered by enhanced ice growth in the Northern Hemisphere that began around ~1.2 Ma, as suggested by possible input events of Nd from the surrounding cratons into the North Atlantic observed in Site 607. Interglacial AMOC only recovers to the previously observed vigor over 200 ka following the disruption, whereas further intensified SSW incursion into the deep North Atlantic come to characterize the mid-late Pleistocene glacial intervals.