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Glacial-to-interglacial variations in the deep water at the Bermuda Rise inferred from a Nd isotope record covering the last million years

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The formation of North Atlantic Deep Water (NADW) in the North Atlantic is an important modulator of the climate system, as it drives the global termohaline circulation, responsible for the distribution of heat, salts and nutrients across the oceans. ODP Site 1063 (4584 m), on the deep Bermuda Rise, is located in the mixing zone between NADW and Antarctic Bottom Water (AABW) and appears to be a good location to study how ocean circulation and climate interconnect. Here we present a new record based on Nd isotope ratios that covers ~1 Ma at that Site. Our data shows Nd isotope ratios during parts of interglacials that are much lower than present day NADW. These results are coherent with recent published studies on the last interglacial–glacial cycle that show that the deep North Atlantic Nd isotope ratios are also lower than NADW during the early interglacial. However, Nd isotope values from the shallower DSDP Site 607 (3427 m), within the core of NADW, have remained similar to modern NADW during interglacials over the same time interval. Site 607 is thought to represent the deep North Atlantic, as shown by an Atlantic meriodional transect that displays Nd isotopes ratios for glacial and interglacial maxima over the last ~1 Ma. We suggest that Nd isotope ratios at Site 1063 do not fully represent the North Atlantic endmember of the AMOC during interglacials, but regional or local processes. However, glacial values at Site 1063 fitting those of Site 607 suggest that Nd isotope ratios represent, indeed, water mass mixing during glacial periods. The low Nd-isotope ratios in the deep Bermuda Rise during interglacials would be the result of particle-seawater exchange derived from the arrival of freshly ground, poorly weathered bedrock from the Canadian shield to the North Atlantic during major ice sheet retreats, such as deglaciations as well as stadial-to-interstadial transitions. Consequently, a deep, regionally constrained layer of seawater is tagged with this extreme Nd isotope signature that is not representative of the AMOC. We suggest that a benthic nepheloid layer, whose development is driven by a deep-recirculating gyre system regulated by the interaction between the northward flowing Gulf Stream and the southward flowing deep western boundary current, facilitates the periodical masking of the deep Atlantic Nd isotope signature at Site 1063. The intermittence of the masking allows for a speculation on how the deep-recirculating gyre system

might have changed over the last ~1 Ma glacial-to-interglacial cycles.