Reconstructing deep ocean circulation pathway and strength with grainsize-specific Nd isotopes

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Geochemical proxies measured on the biogenic and authigenic phases of marine sediment cores are powerful tools for reconstructing past water mass source and chemical composition. However, these proxies are often ambiguous for reconstructing physical oceanographic parameters such as deep water advection speed and direction. The dispersion of fine detrital sediment passively traces deep water advection. Circulation pathways can be reconstructed through time if the sources of marine sediments are geochemically constrained. Furthermore, integrated current strength may also be deduced from the distance a given grain size was advected from its source. We will present initial results of a new approach to constrain past deep ocean circulation based on the advection of detrital sediment particles of different grain sizes whose source is constrained by Nd isotopes.

We have initially worked in the North Atlantic because it hosts a strong geostrophic Deep Western Boundary Current (DWBC) that transports terrigenous sediments from sources with distinct and well-constrained geochemistry. We have separated marine sediment into discrete grain size fractions, which are confirmed using granulometry and scanning-electron microscopy. We have measured Nd isotopes and magnetic mineralogy on these grain size fractions, and used them to "unmix" Atlantic bulk sediment into distinct sediment sources which contributed sediment to each core location. For the Holocene samples, the finest grainsizes are derived from Iceland and are transported great distances along the DWBC, while the coarser fractions are locally derived. Preliminary reconstructions for the Last Glacial Maximum and deglacial time-slices places new constraints on changes in sediment sources through time, as well as the circulation pathways of deep ocean currents during critical climate intervals.