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Grain size specific authigenic Nd isotope compositions in the Northwest Atlantic Ocean – Ubiquity of authigenic phases and impacts of boundary exchange processes

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The isotope composition of authigenic neodymium, leached from marine sediments, is extensively used to reconstruct changes in past ocean circulation. The proxy relies on two fundamental assumptions, namely (i) a quasi-conservative behavior of Nd in the water column and (ii) an undisturbed record of past seawater represented by authigenic sedimentary phases. Both assumptions are increasingly questioned. On the one hand, benthic fluxes may have a significant impact on deep-water compositions. On the other hand, authigenic minerals can form in porewaters, where the impact of silicate-derived Nd additions could overprint a water column signature.

We present authigenic and silicate-hosted Nd isotope compositions for bulk sediments and different grain size fractions from the Northwest Atlantic margin. Bulk silicate Nd isotopes show clear changes in sediment sources from shallow to deep sites offshore Cape Cod, with the lowest signatures at 3100 m depth relating to the advection of fine-grained sediment with the Deep Western Boundary Current. At all but the shallowest site (1150 m), there is sediment-sorting related variability between grain size fractions, exceeding 1.5 epsilon-units. Such variability is also observed in sediments collected offshore Cape Hatteras. In contrast, reductively leached authigenic Nd fractions show no resolvable variability in Nd isotope composition between different grain sizes at each site. Authigenic signatures do, however, vary between sites, although some of the studied cores are located in waters of near-identical hydrographic properties.

These findings suggest that there are ubiquitous authigenic nanoparticulate FeMn phases hosting a Nd pool with no clear affinity to a specific sediment grain size. This precludes significant early diagenetic clay dissolution, which has been hypothesized to explain high porewater REE concentrations [1]. Authigenic Nd is, however, not dominated by advected water masses and appears to be affected by exchange processes along the margin. The influence of local processes, which may also be affected by changes in sediment compositions through time [2], have been documented previously in this area [e.g. 3].

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[2] Abbott et al. (2021). Geochim Cosmochim Acta 319

[3] Pöppelmeier et al. (2019). Geochem Geophy Geosy 20