An experimental investigation of the acquisition of Nd by authigenic phases in marine sediment

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The Nd isotope composition (εNd) of authigenic phases in marine sediment is widely used to reconstruct the origin and mixing of water masses of overlying seawater through time. However, at some locations in the modern ocean, the εNd of authigenic phases in surface sediment is not consistent with that of local seawater. We conducted a laboratory-based incubation experiment with a Mn-oxide phase placed at the sediment-water interface of multicores to determine the extent to which the authigenic phase records seawater εNd.

Sediment cores were collected from the deep Strait of Georgia, a high sedimentation rate environment with oxygenated surface sediments and active macrofauna. The detrital fraction of the sediments is deposited predominantly by the Fraser River, which transports material from ancient cratonic rocks at the headwaters (εNd -23) as well as sediment from younger, more radiogenic orogenic belts (εNd +6) closer to the coast.

The multicores, seawater and synthetic authigenic phase were incubated for 6 months in a tank in which the seawater had been spiked with ^{150}Nd, thus increasing its $^{150}Nd/^{144}Nd$. Before the incubation, the naturally occuring εNd and $^{150}Nd/^{144}Nd$ of the pore water and seawater were measured. The $^{150}Nd/^{144}Nd$ of the Mn-oxide phase measured after the incubation indicates that a minimum of 80% of the Nd associated with the Mn-oxide phase is not sourced from seawater, but from pore waters, suggesting that at the sediment-water interface of this marine environment, authigenic phases largely reflect the Nd isotope composition of pore waters.

In addition, the incubation setup allowed us to calculate the flux of Nd from the sediment by exploiting the decrease of $^{150}Nd/^{144}Nd$ in seawater through the incubation. The maximum possible flux calculated in this way is 17.4 ng/cm^{2}yr, 3-4 times that of previous estimates from Pacific Northwest sediments (Abbott et al. 2015b). While this flux is quite high, renewal events of Strait of Georgia deep water prevent this Nd flux from being the dominant control of dissolved εNd in Strait of Georgia deep water.