Barium-Isotopic Signatures of Barite Diagenesis

JULIA E. MIDDLETON[1]*, ADINA PAYTAN[2], & TRISTAN J. HORNER[1]

[1]Woods Hole Oceanographic Institution, MA 02543, USA; *jemiddle@mit.edu

[2]University of California Santa Cruz, CA 95064, USA

Sedimentary barite abundances are widely used to reconstruct variations in past export productivity. The isotopic composition of Ba (barium) in barite is similarly emerging as a tracer of past variations in ocean circulation and carbon export. However, little is known about the Ba-isotopic fidelity of barite during early diagenesis. Likewise, the timescales over which diagenetic processes may affect primary Ba-isotopic trends is poorly constrained. Here we address these issues by presenting Ba-isotopic results for field samples, which we complement with laboratory incubations of natural and synthetic barites.

First, we surveyed Ba-isotopic compositions of seafloor and water column samples from the Equatorial Pacific, collected during JGOFS and ProteOMZ, respectively. Core-top barites exhibit Ba-isotopic compositions consistent with an upper water column origin. In contrast, porewaters exhibit isotopic compositions similar to bottom seawater, slightly heavier than co-occurring barite. Both are isotopically-invariant over the upper 30 cm. However, the offset beteen porewaters and barite may indicate additional processes (e.g., isotopic exchange) or sources of Ba to porewaters other than barite (e.g., organic matter).

Second, we assessed rates of isotopic exchange in the laboratory. We incubated naturally-occurring and synthetic barites in solutions of labeled artificial and coastal seawater (filtered to 0.4 μm). Exchange is evident under all conditions and for all samples, though the apparent rate is strongly dependent on the initial barite:fluid ratio.

We discuss our results in the context of using barites to reconstruct the Ba-isotopic evolution of seawater and explore new applications of the incubation method to probe the pathways, rates, and mechanisms of pelagic barite precipitation.