Calcium phosphates in Pacific deep-sea sediments as proxies for the REY distribution in pore waters

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Rare earth elements and yttrium (REY) are often used as proxies to describe past enviromental conditions or to track element sources. Calcium phosphates are commonly used as archives for REY, but our study of the upper 10 m of deep-sea sediments from the equatorial Pacific, where REY are controlled by Ca phosphates, show that the shale-normalized (SN) REY patterns are heavily impacted by early diagenesis. The Ca phosphates incorporate REY from ambient pore waters without major fractionation, and thus, their REY_{SN} patterns are similar to the pore-water REY_{SN} pattern [1].

Our data from the Clarion Clipperton Zone (CCZ) and from the Peru Basin reveal such incorporation of pore-water REY into the Ca phosphates over long geographical distances and over a rather wide range of oxic to suboxic pore-water conditions. The pore-water REY_{SN} patterns from the Peru Basin show similar features as seawater (e.g., heavy REY enrichment, negative Ce_{SN} and positive Y_{SN} anomalies), whereas the pore-water REY_{SN} patterns from the CCZ display middle REY enrichment, the development of a negative Ce_{SN}-anomaly with depth, and either no or a slightly negative Y_{SN}-anomaly [1]. The differing pore-water REY_{SN} patterns are possibly due to different REY sources to the pore water.

These results cast doubt on the approach of using marine Ca phosphates as archives for the REY distribution or the Nd isotope composition of seawater, because the REY are derived from pore water and the Ca phosphates therefore do *not* preserve a primary seawater REY signal.

[1] Paul *et al*. (2019) *Geochim. Cosmochim. Acta* **251**, 56-72.