The rare earth element distribution of *Porites* corals

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The rare earth elements (REE) are an orderly group of elements with similar but systematically varying chemical behavior. In seawater their relative concentrations reflect input from continents, particle exchange and scavenging processes, and water mass mixing. The annually banded aragonite skeletons of massive corals such as the widespread *Porites* genus record seasonal changes in seawater composition over hundreds of years and fossil specimens can be accurately dated with U-series techniques. They have great potential as proxies of seawater REE.

Here we investigate the incorporation of REE into *Porites* coral skeletons based on laboratory culture experiments, corals collected in the field, and seawater samples to directly determine partitioning from seawater into coral aragonite. The culture seawater has a distinctly non-natural REE pattern, most likely resulting from the artificial salts used to maintain the major element chemistry. The culturing experiments conducted at different pCO_2 conditions [1] also hint to a secondary influence of seawater carbonate chemistry on REE incorporation. Experiments with different grain sizes of field collected *Porites* powders dissolved in acids of different strength reveal a clear influence of different phases in the coral releasing distinct REE concentrations. This strongly suggests that the REE are not only present in the aragonite lattice but inclusions and organics also contain elevated levels of REE, and a consistent chemical treatment before measurement is essential if data are to be compared between different labs. Finally, we examine the seasonal variability of REE in young fossil corals from the Bay of Bengal where seasonal variations in the REE distribution of seawater are expected to result from monsoonal river discharge. Comparison of the coral REE distribution with a seawater time-series collected nearby reveals both the potential and complexity of this proxy.

References:

[1] Cole et al., Scientific Reports, DOI: 10.1038/srep26888, 2016.