# Understanding Paleoceanographic Tracers in Deep-Sea Corals from a Biomineralization Perspective

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Deep-sea corals are a useful archive of intermediate and deep waters in past oceans. However, application of traditional oceanographic tracers to deep-sea corals remains a challenge due to our insufficient understanding of their "vital effects". Deep-sea corals are ideal test organisms to study the mechanism underlying vital effects generally, due to the large tracer gradients in individual corals living under relatively constant environmental conditions. Here we present stable isotope, minor element, and trace metal (Me/Ca ratios) data in a suite of modern *D. dianthus* that span a wide range of environmental conditions. The data were collected over four different spatial scales in individual corals (bulk, micromill, SIMS, nanoSIMS), to build both empirical tracer calibrations and a mechanistic model of coral calcification.

At the bulk sample scale, some relatively strong correlations were found between skeletal Me/Ca and environmental conditions. The Li/Mg ratio is correlated with temperature with the same relation found in other corals. Sr/Ca is also correlated with temperature with the same temperature sensitivity as inorganic aragonite. Both B/Ca and U/Ca are related to [$CO_3^{2-}$], but the sensitivities are saturated at high [$CO_3^{2-}$]. Ba/Ca is correlated with alkalinity.

At the tens of microns to smaller scales, we observe positive correlations between Mg/Ca and Li/Ca, as well as Mg/Ca and B/Ca in the fibrous aragonite of the skeletons. Mg/Ca and Sr/Ca are general negatively correlated in the fibrous aragonite. Different tracer correlations are found for the centers of calcification (COCs). Coupled with oxygen and carbon isotopes, we propose a model that relates the pH up-regulation in the calcifying fluid of the corals to the calcification dynamics, in an effort to explain the observed tracer correlations and improve paleo-proxy calibrations in biogenic carbonates.