Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37591

Non-Traditional Stable Isotopes as In-Situ Tracers of Aragonite to Calcite Transitions in Coral Skeletons

KYLEE D. GRAHAM AND ISAIAH W. BOLDEN
Georgia Institute of Technology

Geochemical variability within terrestrial and marine carbonates, such as speleothems and corals, serve as essential archives for reconstruction of past environmental conditions. However, calibrations and interpretations of this variability are often complicated by mineralogical diagenesis, a process by which secondary remobilization and recrystallization of the carbonate lattice result in post-depositional removal and/or concentration of elemental impurities. This is particularly true for fossilized, subaerial coral skeletons in tropical regions where intense heat and exposure to meteoric waters facilitate the chemical alteration of primary aragonite to calcite and scavenges trace elements often used for fingerprinting past climatic variability. Fortunately, screening techniques such as x-ray diffraction (XRD) and scanning electron microscopy (SEM) exist for evaluating the degree of diagenesis within contemporary and fossilized carbonates and greatly assist with excluding samples that are heavily altered from further analyses. A drawback to these techniques, however, is that they often require destructive bulk sampling (XRD) or lack the ability to provide simultaneous geochemical and mineralogical data at the micron scale (SEM), making it difficult to precisely mask altered regions from primary environmental signals.

Here, we investigate non-traditional stable isotopes as high-resolution, in-situ proxies for carbonate diagenesis. By leveraging the distinct kinetic and equilibrium fractionation effects of calcium, magnesium, and strontium during mineral phase transitions, we aim to quantify the geochemical offset between primary aragonite and secondary calcite through inorganic precipitation experiments. Using tandem MC-ICP-MS and LA-ICP-MS, we map $\delta^{44}Ca$, $\delta^{26}Mg$, and $\delta^{88}Sr$ alongside analytical transects for Sr/Ca and Mg/Ca ratios in these farmed calcites as well as fossilized Caribbean coral skeletons. This approach allows for the simultaneous characterization of mineralogical integrity and climate-sensitive trace elements at the micron scale. Ultimately, this research provides a framework for creating diagenetic masks that can refine paleoclimate reconstructions by isolating primary biomineralization signals from post-depositional overprinting.