

Multi-proxy reconstructions of the Eastern Equatorial Pacific: measuring Sr/Ca, Ba/Ca, and Li/Mg in modern corals using ICP-OES

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Sea surface temperature (SST) in the Eastern Equatorial Pacific (EEP) exhibits large variability on multiple timescales. These variations are often related to modes of climate variability that strongly affect global climate, such as the El Niño Southern Oscillation. However, the short length and sparsity of instrumental data in the EEP limits our ability to discern changes in this region. Geochemical signals in corals can help extend instrumental data further back in time. Although $\delta^{18}\text{O}$ and Sr/Ca are the most commonly analyzed geochemical tracers of SST in corals, they may have site-specific complications. Several alternatives (e.g., Li/Mg) have been proposed to overcome these challenges, but have yet to be applied to long climate records, in part due to the cost and time required to measure these elements.

Here, we develop a new method that uses Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES) to analyze Li/Mg, Sr/Ca, and Ba/Ca ratios in coral aragonite. We apply this method to two subannually resolved *Porites* spp. corals collected from the northern Galapagos archipelago (Wolf and Darwin Islands). We assess the fidelity of Li/Mg and Sr/Ca to reconstruct SST, and the ability of Ba/Ca to reconstruct upwelling conditions over a 25-year (Wolf) and a 28-year (Darwin) window. Our results from both sites confirm that Sr/Ca is a robust and reliable temperature proxy. Our Li/Mg data, on the other hand, exhibit a complex relationship with SST, possibly due to the precision of the ICP-OES methodology. Similarly, skeletal Ba/Ca shows little relationship with upwelling, probably because our analytical uncertainty exceeds the expected upwelling signal, thus preventing useful inferences. Under these circumstances (a low signal-noise ratio), combining multiple tracers from the same coral does not improve the quality of SST reconstruction. These results show that simultaneously analyzing Sr, Li, Ba, and Mg in corals can be a cost- and time- efficient method, if environmental signals are large relative to analytical precision.