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$\delta^{88}Sr$ Seawater reconstruction from well-preserved Fossil Coral over the last 161 Myr

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Stable strontium isotopes ($\delta^{88}Sr$) are a novel tool for constraining the isotopic mass balance of Sr in the global ocean (i.e., the sources and sinks of Sr to the ocean). These sources and sinks of Sr are tied to the global carbon cycle and are important to our understanding of changes to the climate system. The $\delta^{88}Sr$ composition of seawater ($\delta^{88}Sr_{SW}$), on timescales longer than the 2.5 Myr residence time of Sr in the ocean, depends on the burial of calcium carbonate to the deep ocean and alteration of ocean crust, both major sinks of marine Sr. Radiogenic Sr ($^{87}Sr/^{86}Sr$) is sensitive to changes in source fluxes of marine Sr, through hydrothermal input and continental weathering, therefore utilizing these proxies in tandem allows for paleoenvironmental assessment.

Scleractinia coral have a unique potential as paleoclimate archives because of their large temporal range (approx. 237 Myr to modern) and their tendency to precipitate majority-aragonite skeletons throughout their evolutionary history. Recent $\delta^{88}Sr$ studies in both cold and warm-shallow water corals show that there is no significant relationship between $^{88}Sr/^{86}Sr$ fractionation and temperature or $[CO_3^{2-}]_{seawater}$, and that inorganic- and coral-derived aragonite have a $\delta^{88}Sr$ offset from sea water of approximately -0.2‰ (Raddatz et al. 2013; Fruchter et al. 2016; Wei et al. 2022). This consistent isotopic offset implies that coral aragonite can be used as a faithful archive of $\delta^{88}Sr_{SW}$.

We have analyzed $\delta^{88}Sr$ from a suite of 38 fossil coral samples that span ~161 Myr to reconstruct $\delta^{88}Sr_{SW}$. These fossil coral have been well-screened for diagenesis (Gothmann et al. 2015) and well-studied for other geochemical systems, namely Sr/Ca, Mg/Ca, U/Ca, $\delta^{44/40}Ca$, $\delta^{26}Mg$, $^{234}U/^{238}U$, and $^{238}U/^{235}U$ (Gothmann et al. 2016; 2017; 2019). Comparing the $\delta^{88}Sr_{SW}$ and other geochemical data from this fossil coral record to other archival records of $\delta^{88}Sr_{SW}$ (Vollstaedt et al. 2014; Paytan et al. 2021) can (1) tell us whether the coral-$\delta^{88}Sr_{SW}$ record agrees with other $\delta^{88}Sr_{SW}$ records derived from belemnites and brachiopods (records also derived from biogenic minerals and have limited temporal resolution) and (2) help shed light on the global Sr-cycle since the Mesozoic.