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Controls on Sr partitioning in aragonite under simulated biogenic conditions

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Coral aragonite Sr/Ca is a common palaeothermometer, used to reconstruct past surface seawater temperatures in the tropics and sub-tropics. Coral aragonite Sr/Ca may be influenced by temperature, seawater pCO_2 and by skeletal extension rate/calcification rate. Resolving how different factors influence strontium partitioning is essential to the effective development of this palaeoproxy.

Here we precipitated aragonite from seawater *in vitro* under tightly controlled conditions that simulate the compositions of the calcification fluids used to build coral skeletons and identify potential controls on aragonite Sr/Ca. During the precipitations we varied pH (8.337, 8.545 and 8.727), seawater pCO_2 and dissolved inorganic carbon (DIC, 850-7800 μmol kg-1) to generate a range of aragonite saturation states (Ω = 4, 7, 10, 13 or 18). We tested multiple pH/DIC conditions within each Ω condition. All experiments were conducted at T = 25±0.1°C, salinity = 34 and aragonite was precipitated *in vitro* onto a seed produced from a ground up coral skeleton. The same mass of aragonite was precipitated *in vitro* in each experiment. We observed a broad range of aragonite precipitation rates (from 130 to 3400 μm m^{-2} h^{-1}) which were positively related to Ω.

Sr/Ca K_D of the precipitated aragonites were inversely correlated with aragonite precipitation rates (and Ω) but were unaffected by seawater pH. Aragonite Sr/Ca was inversely related to Mg/Ca. Aragonite Sr/Ca varied by >7% over the tested Ω range. The temperature dependence of coral aragonite is up to ~1% °C. Variations in the aragonite precipitation rate between coral skeletons could generate significant errors in estimates of past seawater temperatures.