



Significance of fluid chemistry revealed by experimental hydrothermal diagenesis of aragonitic Porites coral

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In both modern and past environments, marine carbonates are among the most important archives of environmental information. However, due to the metastable nature of some common carbonate minerals, these archives are often affected by diagenetic alteration driven by a multitude of chemical, mineralogical, and (micro)biological processes. Widely used but particularly sensitive archives are the aragonitic skeletons of scleractinian corals. Here, hydrothermal alteration experiments were performed to create a better understanding of the diagenesis of an often-utilized species, *Porites*. The use of varying experimental conditions (temperature, time, and fluid chemistry) allowed insight to the mechanisms and drivers of diagenesis and resulting alteration features. Experiments with fluid temperatures of 130°C induced remobilization and darkening of organic matrices, with little other evidence for alteration. In contrast, specimens altered at 160°C underwent significant diagenetic alteration independent of fluid type. Fluid chemistry, particularly Mg:Ca ratios, was found to determine the type of alteration (e.g. neomorphism or cementation). Alteration with meteoric waters resulted in almost complete neomorphism of the aragonite skeleton to blocky calcite, as well as significant isotopic exchange with the experimental fluid. In comparison, samples altered in the experimental burial fluids record no major mineralogic change or significant isotopic exchange, but instead, the precipitation of pore-filling aragonitic needle cements was observed. The $\delta^{18}\text{O}(\text{carbonate})$ signatures of altered subsamples indicate transformation via dissolution and reprecipitation depending on the degree of diagenesis and driven by the fluid chemistry. The outcome of this work documents that a multi-proxy approach has the best potential to shed light on the interpretation of processes and pathways of aragonitic coral alteration, with implications for other carbonate archives.