



## **Experimental alteration and diagenetic susceptibility of carbonate bivalves**

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Carbonate biominerals are important environmental archives in the geologic record, and can record conditions during both deposition and subsequent diagenesis. Alteration of these paleoenvironmental proxies are important to understand if one wishes to use the petrographic and geochemical signatures to make conclusions about past environmental conditions. This study uses an experimental approach to best indicate the controls and effects of the diagenesis of various carbonate archives. Samples are hydrothermally altered at known pore water chemistry (meteoric and brine fluids), and temperature conditions (100-200C), and are directly compared to unaltered subsamples for petrographic and geochemical alteration. This comparison allows for reduced heterogeneity, and a quantitative and systematic approach to determine the type, extent, and controls of diagenesis.

Results indicate little to no alteration at the lower temperature experiments (100C), and almost complete alteration observed at higher temperatures (175-200C). Intermediate temperature ranges (130-160C) allow the evaluation of both diagenetic processes, as well as possibly indicating factors controlling or driving alteration. Initial results indicate partial recrystallization of the bivalve *A. Islandica*, as well as other carbonates (corals, bivalves, gastropods, ammonites, and speleothems), with a visually distinct recrystallization front for select specimens. Results indicate that the diagenetic pathway preferentially follows organic distribution, and internal structures within the organo-sediments and minerals, possibly formed during initial formation. Alteration also suggests preferential movement of intercrystalline organics in some sample types, where they appear to be pushed away from the diagenetic front, causing concentration of the water insoluble organics, and the production of visually darker areas surrounding diagenetic fluid pathways.

In addition to petrographic analyses, geochemical comparisons were made using light stable isotopes ( $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$ ), carbonate clumped isotopes, and elemental analysis, providing additional information on the transformation process from pristine Aragonite to secondary carbonate minerals. When comparing the unaltered to experimental diagenetic samples, a clear trend is seen in the lightening of the recrystallized carbonate, with depleted  $\delta^{18}\text{O}$  values up to 40 ppt more negative due to the use of isotopically light alteration fluids. A possible second phase of alteration may also be seen within the diagenetic calcite. Replacement of  $\text{Sr}^{2+}$  ions with  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ , and other divalent ions, as the carbonate sediments (particularly apparent in the corals and bivalves) move from the less stable aragonitic structure, to more stable carbonate minerals such as low-Mg calcite. These results have implications for the stabilization and diagenetic susceptibility of biogenic carbonates in the geologic record, and can be used to systematically track the alteration process using known diagenetic regimes.