Alteration features of aragonite archives

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Carbonate minerals are widely used as archives in paleoenvironmental research, providing substantial information for past depositional and diagenetic regimes. However, nearly all carbonates undergo diagenetic alteration to variable degrees. Diagenetic features are essentially caused by complex fluid-solid interaction including recrystallization and neomorphosis of carbonate crystals and related geochemical resetting. A common conception is that a given primary texture is replaced by a secondary fabric via micro-scale dissolution-reprecipitation reactions that may reach geochemical and/or isotopic equilibrium with the diagenetic fluid. Here we document the alteration of biogenic and abiogenic carbonate archives and the influence of organics and internal fluids within a system. More specifically, attached and bound aqueous fluids within a mineral composite such as shell organic matter and fluid inclusions likely play a crucial role in the early stages of alteration within a relatively rock-buffered system. Degradation of organics can be observed via decreased organic elemental such as sulfur concentration and fluorescence. During alteration, the conversion of micro-scale aragonite minerals to larger stable diagenetic calcite is observed via hydrothermal alteration experiments. The role of internal fluids was further examined via experimenal alteration in the absence of external fluids. To decipher the impact of fluid availability and transfer behavior, i.e. carbonate-buffered *versus* diagenetic-fluid buffered systems, textural and geochemical alteration was determined between different aragonite archives. Results for organic-rich biominerals such as mollusc shells and abiogenic, organic-lean speleothems were compared to examine the two ends of the spectrum with regards to internal fluids. Data suggests that the degree of diagenetic alteration of aragonite minerals at a given exposure to physicochemical alteration conditions is strongly controlled by the micro- to nano-scale internal architecture governing the availability and transfer of aqueous fluids. Results shown here have significance for those concerned with carbonate archives and have wider implications for a mechanistic understanding of carbonate diagenesis.