Microstructural and microchemical signatures derived from hydrothermal alteration of *Arctica islandica* aragonite, *Terebratalia transversa* calcite

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Living systems are far from thermodynamic equilibrium and create local chemical environments in which physiologic processes such as biomineralization takes place. Disequilibrium is not sustained after death and all tissues will be altered by equilibration during diagenesis. Metastable carbonates such as aragonite and high-Mg calcite are subject to strong chemical driving forces and transform to stable low-Mg calcite. With increasing diagenesis, the signature of the biogenic structure gradually fades and is replaced by inorganic alteration features.

To understand transformation processes during diagenesis we subjected *Arctica islandica* aragonite and *Terebratalia transversa* low-Mg calcite, to hydrothermal targeted alteration. Alteration is performed in the presence of three chemically different fluids, two distinct experiment times and temperatures. We investigate, relative to unaltered shell material, microchemical and micro- and nanostructural characteristics of the altered shells with micro-Raman, EPMA and electron backscattered diffraction (EBSD).

An increase in temperature from 100 °C to 175 °C exerts the most dominant influence on shell phase and shell microstructure transformation. Irrespective of fluid chemistry and duration of experiment, at 100 °C, we still observe large portions of pristine shell material, with only some newly formed non-biological calcite and aragonite at the two peripheries of the shell. At 175°C the original shell microstructure is almost completely overprinted, especially that of *Arctica islandica*. Aragonite is completely transformed to irregularly oriented large calcite units and shell patches where an EBSD signal indicating a crystalline mineral is absent. In *Terebratalia transversa* the overall microstructure of the shell is distorted but still preserved to some degree, e.g. the outline of calcite fibres. However, the pristine biogenic calcite nanoparticles are replaced by recrystallized calcite single crystals.