

Controls on CaCO₃ precipitation and diagenesis in terrestrial hot springs

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Carbonate precipitates at continental springs are regarded as interesting archives of terrestrial, environmental changes. These settings received an increased global scientific interest as industrial consortia discovered important reservoirs in deposits with similar fabrics, provoking questions on their formation conditions. As travertine precipitation results from the interplay of physico-chemical processes (CO₂ degassing, heat dispersion, flow turbulence) and the presence and activity of (micro)biota, they may contain “biomarkers” of interest for reconstructing early life.

This study focuses on changes in CaCO₃ fabrics and mineralogy that result in typical travertine layering in recent and ancient deposits. The layered nature has been linked to changes in precipitation rate or the abundance, nature and activity of organisms inhabiting the springs. These parameters, on their turn, reflect environmental changes, though, the exact conditions, their magnitude and how they impact fabrics, is less clear. In addition, detailed isotopic and trace elemental transects have been used to address this, but the impact of early diagenesis on crystal texture and preservation of geochemical signals remains poorly addressed.

At first, field, microscopic and micro-CT observations of modern to Pleistocene travertine deposits from different locations (Turkey, Greece, Hungary and Yellowstone NP, USA) reveal the nature of lamination and 3D fabrics at micron- to centimeter-scale along the spring outflow paths. These observations will be confronted with field carbonate precipitation experiments over the course of days, in active streams to understand and quantify the impact of biotic-abiotic parameters on layering and precipitation rates along downstream facies and within different climatic contexts.

Secondly, unique recent to Holocene travertine core transect at Mammoth Hot Springs (Yellowstone NP, USA) permits to observe in detail changes in CaCO₃ fabrics and aragonite to calcite mineralogy during early diagenesis. They are compared with alteration experiments of pristine CaCO₃ precipitates in the lab, under controlled temperature and water chemistry conditions. Bulk and high-resolution isotope analyses help to capture the impact of recrystallisation on the primary δ¹³C and δ¹⁸O trends.