Calcite Precipitation and Dissolution Under Hydrodynamic and Chemical Kinetic Control

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Overview of Current Investigations

This work addresses some of the fundamental unanswered questions concerning the physics and chemistry of rimstone formation. Rimstone (travertine) dams and flowstone formations are mineral deposits that are found on the land surface, in caves, and in other settings. These formations appear to evolve under geochemical and hydrodynamic control. Mathematical modeling of this solid-aqueous system is carried out, in order to explain the system scale (cm-meter) patterns of rimstone dams in these deposits. The mathematical model consists of a system of equations to describe the combined behavior of a thin fluid film, reactive chemical species, and moving interfaces (air-fluid and fluid-mineral). Comparison of field study measurements and geochemical analyses (pH and ion concentrations) in the literature with model predictions are used to identify the relationships between the spatial features of the dams and their surroundings, such as the slope of the underlying substrate. Furthermore, this modeling investigation extends previous models through formulation and solution strategies to determine the locations and spatial features of the fluid-atmosphere and fluid-mineral surfaces, and more generally quantifies free surfaces in precipitative pattern formations.