

Interaction of Eu(III) with Biogenic CaCO₃ characterized by TRLFS

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Biomineralization is the process in which minerals are produced by organisms. Microbial induced carbonate precipitation (MICP) is a fundamental example of biologically induced mineralization [1] MICP has gained recent interest for use in many applications, one being groundwater and soil remediation of heavy metals and radionuclides [2] [3]. Americium and curium are long-lived, radiotoxic elements of particular concern in the field of nuclear waste disposal, and understanding how they behave in geological repositories is important. Previous studies using Time-Resolved Laser Fluorescence Spectroscopy (TRLFS) have shown that Ca²⁺-containing mineral phases, e.g., CaCO₃, often present at disposal sites, are ideal for incorporation of trivalent Am/Cm and homologous trivalent lanthanides (Ln), i.e. europium, into the host material, and thus retarding their environmental mobility [4]. Further investigations have also demonstrated that physicochemical differences between inorganic versus biogenically derived minerals may yield different interactions with these elements, which has significant implications regarding their disposal and behavior in the biosphere [5].

In this work, the archetypal ureolyzing bacteria *Sporosarcina pasteurii* was used for precipitation of CaCO₃ in the presence of trivalent europium under varying conditions to investigate the effect of biological components on the chemical interactions with the mineral and Eu. The reactions were monitored over time and the solution chemistry and resulting minerals were characterized by a variety of chemical and biochemical techniques showing the formation of a notably stable vaterite phase and calcite coincided with the sequestration of Eu. TRLFS results determining the chemical environment and structural localization of Eu(III) with the biominerals, e.g., incorporated Eu in the host lattice, are consistent with these findings, and are compared to results from pure inorganic CaCO₃ systems. Ultimately, this allows for the better understanding on how these elements interact with CaCO₃ originating from biomineralization and their fate within the biosphere.

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