Defense Announcement

THE ROLES OF ORGANICS IN NUCLEATION AND GROWTH OF SOLID SOLUTIONS

Degree: PhD, Environmental Engineering

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Time: 4:00 PM- 6:00 PM

Location: Zoom meeting ID: 930 8699 6187

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Abstract: Solid solutions are likely to form when two isostructural minerals crystallize simultaneously from multicomponent solutions. The crystallization of solid solutions is essential to many geological, biological, and environmental processes. Under the environmentally relevant conditions, the formation of solid solutions is expected to be dramatically affected by organics, however, the mechanistic bases of the roles of organics in crystallization behaviors of solid solutions are still limited.

Nucleation and growth processes of barium-strontium sulfate solid solutions at organic-water interfaces were investigated. Results showed that Sr-bearing barite nucleation was significantly promoted even when the bulk solution was undersaturated, due to the enrichment of cations at organic-water interfaces. In supersaturated solutions, this enrichment generates nanometer-sized Sr-rich nuclei on organic films, while Sr-poor barite grows quickly to micrometer-sized crystals in bulk solutions. Theoretical solid-solution calculations explain the distinct Sr incorporation in barites on organic films and in bulk solutions. The findings resolve a marine Sr-bearing barite paradox and provide insights into manipulating solid-solution nucleation and growth through the unique chemical environment near organic–mineral interfaces.

Iron hydroxides are important scavengers for dissolved chromium (Cr) via coprecipitation processes; however, the influences of organic matter (OM) on Cr sequestration in Fe-Cr-OM ternary systems and the stability of the coprecipitates are not well understood. The complexation capabilities of varied OM with Fe^{3+}/Cr^{3+} ions, hydrolyzed Fe/Cr species, and newly formed Fe/Cr hydroxides are found to control Cr sequestration, re-dissolution, and transportation. This study provides new mechanistic insights of OM in controlling $(Fe, Cr)(OH)_3$ solid solutions, which are essential for Cr remediation and removal in both natural and engineered settings.