

Complexity in Metal-Carbonate Interactions

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The interaction of aqueous metal ions with mineral surfaces exerts a strong influence on the mobility of metals in natural environments. Multiple processes are known to take place at the mineral-water interface, including metal incorporation, metal adsorption, and the secondary nucleation of mineral phases. This presentation will describe our recent results on the interaction of dissolved Cd and Pb with carbonate mineral surfaces (including calcite and dolomite). The results reveal a range of behavior, ranging from the growth of otavite films on calcite and dolomite substrates, the incorporation of Pb into calcite surfaces, dramatic changes to the morphological evolution of dissolving calcite surfaces in the presence of Pb, the nucleation and growth of cerussite at the calcite surface, and the eventual replacement of calcite by cerussite. This wide diversity of behavior (observed with a range of interface-sensitive tools including X-ray scattering, transmission X-ray microscopy and atomic force microscopy) is attributed to the dynamic reactivity of carbonate minerals so that these reactions depend not only on the nominal solution conditions but also on the local dynamics including the dissolution of the mineral substrate, the local metal concentration as controlled by transport from the solution, and even the shape and size of the substrate.

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