

Role of submicron channels on calcite (104) surface reactivity

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Reactions at the mineral – water interface play a central role in environmental processes. They control mobility and transport of dissolved ions and molecules and microbial life. Calcite regulates the pH of natural waters, and is a major CO₂ sink. Studies on the reactivity of calcite have been conducted on the freshly cleaved calcite (104) surface, which has net zero charge due to its arrangement of calcium and carbonate ions. The mineral-water interface is complicated by chemical and physical alteration that may add complexity due to the emergence of extrinsic properties. Here we present preliminary results of ongoing investigations of the effects of defects and submicron channels on calcite-water interfacial processes. Experiments are being performed to assess the effects of solution composition, channel width, depth, and crystallographic orientation on the evolution of surface topography, as well as secondary mineral nucleation and growth morphology. Dissolution of calcite in 5 mM Pb(NO₃)₂ solution indicates preferential nucleation of cerussite along etched surfaces (Figure 1b). A significant role of extrinsic properties is evident, and is being further analyzed.

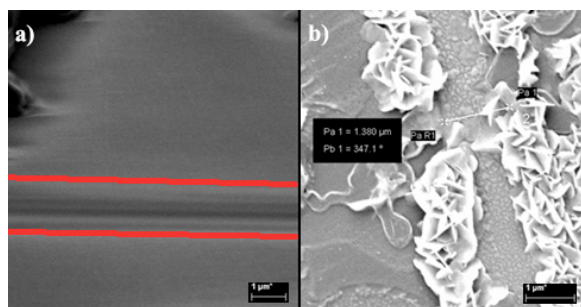


Figure 1: a) Electron micrograph of calcite cleavage surface, with FIB-etched channel (~1 μm wide, ~0.5 μm deep, between red lines); b) Preferential arrangement of cerussite nucleation sites along etched channel during far from equilibrium dissolution of calcite in 5 mM Pb(NO₃)₂ solution, reaction time 90s.