

The effect of Cadmium on calcium carbonate growth and dissolution

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Calcium carbonates are ubiquitous minerals in nature and have been thoroughly studied for potential environmental remediation as a toxic element retainer following reaction with contaminated water. This work aimed to study the effect of cadmium ions on calcium carbonate dissolution and growth using different analytical methods. Firstly, calcite growth and dissolution in the presence of different Cd^{2+} concentrations have been observed with in situ atomic force microscopy (AFM). Then hydrothermal experiments have been conducted to compare calcite and Carrara marble samples, to study the effect of grain boundaries on calcium carbonate dissolution in the presence of Cd^{2+} . Results indicate that a new CdCO_3 phase is formed on the calcite surfaces that become increasingly covered and possibly passivated by the presence of the new CdCO_3 layer. This is observed in both the AFM experiments as well as hydrothermal experiments using calcite crystals. However the grain boundaries within Carrara marble act as fluid pathways within the rock allowing access for the Cd – rich solution to penetrate within the sample. Surface passivation compared with coupled dissolution-precipitation replacement reactions are investigated in terms of molar volume changes and solubility differences between parent (CaCO_3) and product (CdCO_3) phases as well as reaction kinetic considerations.