

The effect of cadmium on the growth and dissolution of calcium carbonate

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Water and soil contamination have become an issue of concern in a lot of areas due to anthropogenic activities. In recent years research has focused on finding efficient and low-cost methods and material for environmental remediation. Calcium carbonate rocks are ubiquitous in the Earth and have shown good properties as heavy metal retainers. In this study we focused on observations and analysis of the effect of cadmium on calcium carbonate during growth and dissolution using different analytical methods. First, cadmium-calcite interactions have been observed and measured with in-situ atomic force microscopy (AFM). Then hydrothermal experiments have been conducted on calcite, Carrara marble and aragonite to compare the effect of cadmium on the dissolution of different calcium carbonate rocks and to investigate the effect of grain boundaries and different crystallographic structures on this reaction. The formation of a (Ca,Cd)CO₃ phase on the calcium carbonate surface has been observed during growth and dissolution for both AFM and hydrothermal experiments. This new layer could potentially lead to the passivation of the calcium carbonate surface, however the grain boundaries in Carrara marble act as fluid pathways in the rock and allow access to the cadmium solution 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 (CaCO₃) and product ((Ca,Cd)CO₃) phases as well as reaction kinetic considerations.