EGU23-6221, updated on 28 Mar 2024
https://doi.org/10.5194/egusphere-egu23-6221
EGU General Assembly 2023

Removal of cadmium from solution during the replacement of calcium carbonate by hydroxyapatite in the presence of phosphate.

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Water contamination caused by the overuse of fertilizers has become a concern in many areas throughout the last decades. The intensive use of phosphate fertilizers has led to high concentrations of phosphates in ground waters and effluents, but also to high levels of other toxic elements, especially cadmium. Cadmium can be found in high concentrations in phosphate rocks which are used to synthesize fertilizers, resulting in high concentrations of cadmium in some fertilizers that are then used on fields. Various materials have been studied for cadmium capture in solution and both calcium carbonate and apatite have shown good uptake capacities toward this element. Furthermore, calcium carbonate minerals can be replaced by apatite through a pseudomorphic dissolution-precipitation mechanism when immersed in a solution containing phosphate (Jonas et al., 2014; Klasa et al., 2013; Pedrosa et al., 2016; Wang et al., 2012). Here, we report on the capture of cadmium from solution during the replacement reaction of Carrara marble by hydroxyapatite (Wang et al., 2019). Cubes of Carrara marble have been reacted in sealed hydrothermal reactors at 200°C in solutions containing various concentrations of phosphate and cadmium for times between 4 and 60 days. The samples were then sectioned and analysed by Scanning Electron Microscopy (SEM), BackScattered Electron (BSE) imaging, Electron Dispersive X-ray Spectroscopy (EDS) and Raman Spectroscopy. The nanoscale reaction on the sample surface has been observed with in-situ Atomic Force Microscopy (AFM) in fluid flow and static solutions. The coupled dissolution-precipitation reaction observed and the capture of cadmium by the newly formed phase will be presented.

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