

IMMOBILIZATION OF LEAD – AN EXAMPLE OF AFM APPLICATION TO ENVIRONMENTAL MINERALOGY

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Apatite has been used to remediate Pb contamination. Apatite dissolution releases phosphate, which combines with Pb to form highly insoluble Pb phosphate mineral pyromorphite $Pb_5(PO_4)_3Cl$ (PY). A combination of atomic force microscopy (AFM) with scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDX), X-ray diffraction (XRD), and atomic absorption spectroscopy (AAS) were used for *in situ* and *ex situ* examinations of the interface and the reaction products. Experiments were performed with natural chlorapatite (CAP) and fluorapatite (FAP), and with synthetic hydroxylapatite (HAP).

Heterogeneous and homogeneous precipitation of PY was observed. Heterogeneously grown PY crystals form by epitaxy, exhibiting spiral growth patterns on AFM images. For a better understanding of possible epitaxial relationships between the atomic structures of Ca- and Pb-apatites, atomic models for different crystallographic planes were computed using the program ATOMSTM.

In situ Tapping Mode AFM imaging with the aid of fluid cell attachment coupled with *ex situ* SEM/EDX revealed that heterogeneous PY precipitation did not prevent the continuation of apatite dissolution. The presence of Pb_{aq} increased apatite dissolution rates, most probably because formation of PY acted as a sink for dissolved phosphate hence increasing the thermodynamic drive for dissolution. The results indicate that *in situ* immobilization of Pb_{aq} by apatite amendments to contaminated soils may take place both on the apatite surface in contact with Pb_{aq} (mostly heterogeneous precipitation) as well as in the soil profile as a result of a reaction between Pb^{2+} and dissolved phosphates released from leaching apatite (mostly homogeneous precipitation).