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Pseudomorphic replacement of single cerussite $PbCO_3$ crystals by hydroxylpyromorphite $Pb_5(PO_4)_3OH$ in phosphate solutions

M. Kwaśniak-Kominek (1), M. Manecki (1), T. Bajda (1), and J. Rakovan (2)

(1) AGH – University of Science and Technology, Krakow, Poland (monika.kwasniak@gmail.com), (2) Miami University, Oxford, OHIO, USA (rakovajf@muohio.edu)

Lead apatite, pyromorphite, can form by replacing lead carbonate, cerussite, under conditions similar to those found in earth surface environments. This occurs by a process analogous to the calcium carbonate - calcium apatite system, where during chemical weathering and natural hydrothermal reactions hydroxylapatite can form by replacing calcium carbonates. The aim of this study is to experimentally investigate reactions of cerussite with phosphate solutions to determine the conditions under which pyromorphite can form and the mechanism of the transformation.

Cerussite can be readily transformed into hydroxylpyromorphite by hydrothermal treatment in a 2M $(NH_4)H_2PO_4$ solution. The product of reactions is independent of the presence of Cl in the solution. Hydrothermal experiments were carried out in order to produce partially reacted crystals. In both cases, with the presence or absence of Cl, the cerussite is pseudomorphologically replaced by hydroxylpyromorphite.

The reaction products were studied by scanning electron microscopy (SEM) to determine the microstructural relationship between the parent and the product phases. X-Ray powder diffraction (XRD) and infra-red spectroscopy (FTIR) were used for phase determination. The results show that the new phase was only hydroxylpyromorphite even in the presence of Cl. Observations of broken crystals show partial replacement of cerussite by polycrystalline hydroxylpyromorphite, preventing even fine scale surface micromorphology. The features of replacement of cerussite crystals by hydroxylpyromorphite are similar to pseudomorphic reactions in a wide range of materials and are consistent with a mechanism described as interface-coupled dissolution-precipitation.

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