European Mineralogical Conference
Vol. 1, EMC2012-346, 2012
European Mineralogical Conference 2012

The effect of gluconic acid on solubility of pyromorphite Pb5(PO4)3Cl

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Due to symbiosis with plants, certain kinds of the soil bacteria are supplied with glucose which supports the culture growth and development. In the bacterial metabolic pathways, glucose is converted into gluconic acid which is expelled to the environment. The organic acid greatly enhances solubility of several soil minerals, in particular apatites, dissolution of which releases phosphate ions to the environment making them available to plants.

It was recently suggested to use the solubilization capability of the microbes to optimize the remediation treatment applied in lead contaminated sites [1]. The concept is based on the idea, that the bacteria expel organic acids (mainly gluconic) and solubilize mineral forms of phosphate (e.g. phosphate rock or fish meal) which along with the microbes are introduced to the environment. The phosphate ions bind in - situ with lead in form of pyromorphite Pb-5(PO4)3Cl, which is one of the most stable minerals in the environment [2].

In this study, the solubility of pyromorphite in presence of gluconic acid was investigated. The effect of the gluconic acid on pyromorphite has not been studied, so far. There are evidence that in certain conditions, the gluconic acid forms complexes with Pb ions, however [3]. This raises a concern that the microbial metabolite might affect the stability of pyromorphite as it does that of other phosphate minerals. It might be particularly essential at Pb contaminated sites which have already undergone the abiotic, phosphate-induced in-situ treatment. One set of experiments was carried out at constant pH and in several concentrations of acid, and a second set at 5, 25 and 35 oC and broad pH range.

The presence of gluconic acid enhances the solubility of pyromorphite. Both acidification and complexing capabilities of the metabolite play the role in the process. The mineral dissolves more with temperature. The dissolution rate was calculated and compared with this of Ca-apatite, and the explanation of the dissolution-precipitation mechanisms of the reaction in presence of gluconic acid is proposed. The obtained data indicate a need of detail studies on the mechanisms of the microbial modification of the phosphate-induced method. The bacterial metabolites affect stability of pyromorphite, so as they do in the case of any other phosphate minerals. Introduction of phosphate solubilizing bacteria into contaminated sites might have negative effect in the long run and, in this terms, going into raptures might be very pernicious.

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