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Pyromorphite formation from lead adsorbed on bacteria cells of Bacillus subtilis

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Bioavailability of Pb in soils is mostly controlled by the dissolution and precipitation of discrete mineral phases and by sorption/desorption processes. In-situ Pb immobilization, now routinely applied technology for reclamation of lead contaminated soils, is based on the formation of highly insoluble mineral pyromorphite Pb5(PO4)3Cl. As a result, more bioavailable lead species are converted into highly immobile crystalline form resulting in neutralization of the toxicity without removal. To date, research regarding the reactions between Pb ions in the solution and soil particles does not explain all the mechanisms of reactions taking place in environment. The least is known on the role of microorganisms in the system. Bacillus subtilis is a relatively well characterized Gram-positive aerobic species commonly found in ground water and soil systems. The cell walls of Gram-positive bacteria are highly porous. The adsorption of lead ion onto surface of metabolizing and non-metabolizing bacteria is partly reversible. The adsorption of lead onto Bacillus subtilis are controlled by pH (effectiveness of adsorption increase with increasing pH) and ionic strength. The objective of this study was to explicate the mechanisms of the reaction between solution containing PO43- ions and non-metabolizing bacteria Bacillus subtilis surface saturated with adsorbed Pb2+. The reaction, in the presence of Cl-, results in rapid crystallization of pyromorphite crystals on the surface of bacteria cells (heterogeneous precipitation) as well as in the space between them (homogeneous precipitation). The mechanism of nucleation and

precipitation depends on relative kinetics of two processes: Pb^{2+} desorption and pyromorphite precipitation. Heterogeneous precipitation and formation of pyromophite incrustations on bacterial cells indicate that desorption of lead from gram-positive bacteria is slower than precipitation of pyromorphite. At the conditions of our experiment, homogeneous crystallization of pyromorphite is a result of reaction between ions in intergranular solution.

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