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Modeling the influence of exopolymeric substances (EPS) extracted from Pseudomonas bacteria on chromium (III) sorption and transport in heterogeneous subsurface soils

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In situ remediation of soils contaminated with Cr(VI) is usually accomplished through microbial reduction of Cr(VI) to Cr(III) by soil microorganisms including Pseudomonas bacteria. Cr(VI) is a toxic substance that may stimulate the production of exopolymeric substances (EPS) by soil bacteria. Natural organic ligands such as EPS may have a pronounced impact on Cr(III) solubility, sorption, transport and bioavailability in subsurface systems. In this study, laboratory sorption and column experiments were performed to investigate the influence of exopolymeric substances (EPS) extracted from Pseudomonas aeruginosa P16, Pseudomonas putida P18 and Pseudomonas stutzeri P40 on chromium (III) sorption and transport in heterogeneous subsurface soils. The results from laboratory experiments indicate that microbial EPS enhanced Cr(III) solubility, which, in turn, led to an increase in Cr(III) transport through columns packed with subsurface soils under slightly acidic to alkaline pH conditions.

A reactive transport code that includes a semi-empirical surface complexation model (SCM) to describe chemical processes e.g., sorption was used to simulate bench-scale column data for Cr(III) transport in the presence of EPS. Our transport simulations suggest that for an accurate simulation of Cr(III) transport in the presence of microbial EPS, the following processes and/or interactions need to be explicitly considered: 1) Cr(III)-EPS interactions; 2) binary soil/Cr and soil/EPS surface complexes; and 3) ternary soil/Cr/EPS complexes.