



Microbial mobilization of cesium from illite: Role of organic acids and siderophores

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Understanding the behavior of cesium (Cs) in soils and geological formations is interesting in the context of nuclear accidents and nuclear waste disposals. Indeed, this radionuclide with a 30-years half-life can contaminate crops and more generally the food chain. Cs with properties similar to potassium is known to be strongly accumulated in the clays of upper soil horizons.

While excavation of contaminated soil cannot be feasible for the whole contaminated surfaces (huge volumes to be cleaned-up), in situ methods could provide a sustainable and low cost solution. Phytoextraction is one of a few solutions for in situ remediation of soils contaminated by trace elements and it preserves the quality of agricultural soils. However, many improvements are still needed to enhance phytoextraction effectiveness.

The combination of bioaugmentation (soil inoculation with exogenous microorganisms) with phytoextraction is likely to increase the bioaccessibility of radionuclides and their accumulation in plants. The role of bacteria on soil-pollutants can be direct (direct metal complexation) and/or indirect (weathering of clays adsorbing Cs).

This study aims to provide more specifically a mechanistic understanding of the bacterial mobilization of Cs from soil with the prospect of soil bioremediation. Bacterial metabolites of *Pseudomonas fluorescens* (ATCC 17400) were supplied to illite spiked with 0.1 and 1 mM of Cs. Purified siderophores including pyoverdine from *P. fluorescens*, or the whole metabolites from the bacterial culture supernatant were compared to low molecular weight organic acids (LMWOA) (citric and oxalic acids) at 0.04 mM, or synthetic chelants, i.e. acetohydroxamic acid (AHA) and desferrioxamine mesylate (DFOM) ranging from 50 μ M up to 250 μ M. The release of Cs and the structural alteration of illite (release of Al, Fe and Si) were monitored. When compared to the control, no release of Cs from illite was observed with LMWOA. On the contrary, a slight release of Cs was shown with AHA and DFOM (9 % and 22 %, respectively). The highest release was shown with the bacterial supernatant and the purified pyoverdine (39 % and 43 %, respectively). The purified pyoverdine and the bacterial metabolites were also able to complex Fe from illite and to a lesser extent Al. These results demonstrated that Cs is likely to be indirectly released from illite by *P. fluorescens* producing chelating agents involved in its alteration.