Immobilization of metals and radionuclides by microbial biomineralization processes

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Microbes are known to transform metals and radionuclides, through a range of mechanisms including redox transformations, the adsorption of metals onto cell surfaces and intracellular uptake. Processes, including redox transformations, which immobilize metals and radionuclides into the solid-phase are particularly desirable as they could be used to remdiate contaminated land. Bacteria can generate a diverse array of biominerals, including carbonates, phosphates and manganese oxides, all of which can immobilise heavy metals and radionuclides into the solid state. During biomineralization, bacterial metabolic processes can shift the thermodynamic equilibrium into a state where the dissolved phase is no longer stable (thus inducing precipitation) and/or they can directly catalyse the conversion, speeding up the kinetics of the precipitation process. As a result, microbially mediated mineral precipitation can occur both in greater quantities and at significantly enhanced rates compared to abiotic processes. Importantly, these processes can be stimulated to occur *in situ*. Hence, all that is required is for the appropriate nutrients to be injected into the system of concern to stimulate the desired microbial response. Such nutrients are found cheaply in urine (C, N) and in plant by-products (C, P).

The aim of this project is to investigate the relative performance in differing geological and geochemical conditions of the calcite formation/carbonate precipitation, phosphate precipitation and manganese oxide formation processes for solid-state capture of problematic metal and radionuclide contaminants. This investigation will be a critical step in the development of novel *in situ* bioremediation technologies exploiting the natural indigenous microbial community and will produce the first ever consistent research database for design of solidstate capture strategies in specific site conditions.