Biomineralization processes for the remediation of radionuclides

J. C. RENSHAW*[1], S. HANDLEY-SIDHU[2] AND L. E. MACASKIE[3]

[1]Dept of Civil & Environmental Engineering, University of Strathclyde, Glasgow, G1 1XJ, UK (*correspondance: joanna.renshaw@strath.ac.uk)

[2]School of Geography, Earth & Environmental Sciences, University of Birmingham, Birmingham, B15 2TT, UK (s.handley-sidhu@bham.ac.uk)

[3]School of Biosciences, University of Birmingham, Birmingham, B15 2TT, UK (l.e.macaskie@bham.ac.uk)

Microbially-mediated biomineralization processes can generate a range of mineral forms including phosphates, carbonates, and oxides [1]. Such biomineralization processes could be used to limit radionuclide migration in contaminated environments either through (a) immobilizing radionuclides or (b) limiting contaminated groundwater flow.

Recent research investigating the potential use of microorganisms for remediation of radionuclide-contaminated land has focussed on microbially stimulated reduction of uranium (VI) [1], but there have been relatively few studies of other biomineralization processes. In this project, bacterial formation of hydroxyapatite was investigated for immobilization of radionuclides. Previous studies had shown that a Serratia sp could biomanufacture nanophase hydroxyapatite [2] [3]. This organism contains high levels of an atypical phosphatase enzyme located in the bacterial periplasmic space and attached to extracellular polymeric substance; this enzyme cleaves glycerol-2-phosphate, liberating inorganic phosphate and providing the nucleation site for the growth of hydroxyapatite (HAP) crystals [2] [4].

Altering the conditions for biomineralization and post-biomineralization heat treatment resulted in nanophase hydroxyapatite with varying physico-chemical properties (e.g. crystallinity, particle size, specific surface area). These biological hydroxyapatite materials have potential application in novel remediation methods, for the sorption and immobilisation of radionuclides such as Sr^{2+}, Co^{2+}, UO_2^{2+} and trivalent actinides [4] [5].

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