

Biominalisation of amorphous calcium phosphate sorbents for waste cleanup

S. HANDLEY-SIDHU^{1*}, T. MULLAN¹, S. KING³,
B. STOLPE¹, Y. SIDHU⁴, J. LEAD⁵, M. O. CUTHBERT² AND
L. E. MACASKIE²

¹School of Geography Earth and Environmental Sciences,

²School of Biosciences, The University of Birmingham, B15

2TT, UK (*correspondence: s.handley-sidhu@bham.ac.uk)

³ISIS Neutron and Muon Source, The Rutherford Appleton
Laboratory, OX11 0QX, U.K.

⁴College of Life and Environmental Sciences, The University
of Exeter, EX4 4SB, UK.

⁵Center for Environmental nanoscience and Risk, University of
South Carolina, SC 29208, USA

Serratia sp. bacterium produces amorphous calcium phosphate (BHAP), with a larger specific surface area and a more reactive surface compared to synthetically produced hydroxyapatite [1]. Previous research has shown that BHAP can remediate up to 10 times more Sr²⁺ and Co²⁺ from groundwaters than commercially available hydroxyapatite [2]. It has also shown promise in remediating radionuclides from saline waters.

Serratia sp. contains high levels of an atypical phosphatase enzyme located in the bacterial periplasmic space, attached to organic extracellular polymeric substance (EPS) and free in solution; this enzyme cleaves glycerol-2-phosphate (G2P), liberating inorganic phosphate for BHAP formation [2-4]. Evidence suggests that the growth of BHAP is controlled within spatial localisation of the biological space and in close proximity to cells [2-4]. Images from transmission electron microscopy and atomic force microscopy show a network around the bacteria, consisting of EPS template and BHAP.

Small angle neutron scattering (SANS) was carried out to examine size, shape, internal structure and spatial arrangement of bio-nanomaterial growth over time. Preliminary data of BHAP saturated bacteria showed fractal cluster models (eg, primary radii <10 Å, fractal dimensions around 2.7-2.8 and final cluster sizes between 150-350 Å).

[1] Oelkers and Montel. (2008) *Elements* **4**, 113-116. [2] Handley-Sidhu et al., (2011) *Environ. Sci. Technol.* **45**, 6985-6990. [3] Askarieh et al., (2000) *Waste Management* **20**, 93-106. [4] Handley-Sidhu et al., (2011) *Biotechnol. Lett.* **33**, 79-87.