Biogeochemical Gradients and Radionuclide Transport: Insights into Radionuclide Behaviour

MORRIS, K.[1], LLOYD, J.R. [1], LAW, G.T.W. [2], LIVENS, F.R.[1,2], SHAW, S. [1], BOTS, P.[1], BROOKSHAW, D. [1], MASTERS-WAAGE, N. [1], RIZOULIS, A. [1], SMALL, J.[1,3], WILLIAMSON, A.J.[1]

[1] Research Centre for Radwaste Disposal and Williamson Research Centre, School of Earth and Environmental Sciences, The University of Manchester.
[2] Centre for Radiochemistry Research, School of Chemistry, University of Manchester.
[3] National Nuclear Laboratory, Warrington, UK.

The NERC BIGRAD Consortium examined the impacts of biogeochemistry in scenarios relevant to the disposal of intermediate level radioactve wastes in a deep geological disposal facility[1]. Here, we highlight the key scientific outcomes of the BIGRAD research with a focus on radionuclide biogeochemistry in systems relevant both to evolved cementitious intermediate level radioactive wastes and under "far field" conditions, away from the immediate vicinity of any radioactive waste repository housed in the deep subsurface.

The model systems we discuss include bioreducing and biocycling sediment microcosm studies bracketing alkaline to circumneutral conditions as well as pure culture and mineral bioreduction experiments. We also discuss the implications of select geochemistry and mineralogy results from BIGRAD in terms of the overall fate of radionuclides in this potentially biogeochemically rich sub-surface environment. Overall, our research on the impact of bio-reduction and bio-cycling processes on radionuclide behaviour, highlights the potential breadth of processes occuring in these wastes which can influence Tc, U, Np and Pu mobility. Indeed, in many cases, microbial processes actually tend to retard the transport of radionuclides in situations relevant to intermediate level radioactive waste management. Overall, BIGRAD has provided underpinning science which supports the concept of a deep sub-surface "bio-barrier" to radionuclide migration occuring in intermediate level waste disposal.

[1] RWM Report, 2016. https://rwm.nda.gov.uk/publication/summary-of-the-bigrad-project-and-its-implications-for-a-geological-disposal-facility/.