Long-term interactions of radionuclides with iron oxyhydroxides in geodisposal and contaminated land environments: A combined abiotic and biological study.

The UK has a substantial legacy of radioactive wastes and their safe management using deep geological disposal is a national priority (Figure 1). Understanding the long-term fate of radionuclides in the environment is key to developing safe management of radioactive wastes and radioactively contaminated land. In radioactive waste disposal, during evolution of the repository, iron oxyhydroxides will be present in wastes and will also form from the corrosion of steel canisters and engineering iron. Recent studies have indicated that iron oxyhydroxides can incorporate a range of radionuclides, including actinides (Marshall et al., 2014a, b; Bots et al., 2015) and Tc (Marshall et al., 2015). These sequestration processes have the potential to act as a secondary barrier to radionuclide migration in waste disposal. However, changes in the abiotic and biologically driven processes that occur over the long-term within the environment will alter the biogeochemistry within and around the repository (e.g. Newsome et al., 2014). In turn, this will influence the stability of the iron oxyhydroxide minerals formed and ultimately these changes will impact on the speciation and fate of the radionuclides with the potential for re-mobilisation to occur. This experimental project will focus on characterising the fate of key risk driving radionuclides such as uranium, technetium and neptunium associated with deep geological disposal relevant iron oxyhydroxides during conditions relevant to the long-term biogeochemical evolution of a repository. The project will examine the influence of both abiotic and biological processes on radionuclide speciation and fate, and utilise advanced geochemical, nanoscale characterisation and microbiological genomic techniques to probe the mechanisms of radionuclide interactions.

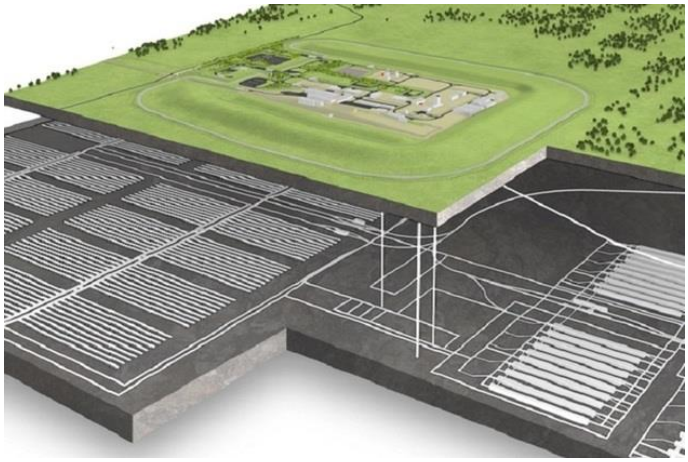

Figure 1. Schematic representing a deep geological disposal facility for higher activity radioactive wastes. (www.gov.uk)

Training: This industrially sponsored PhD projects will be based in the School of Earth & Environmental Sciences at The University of Manchester. The projects will be experimental in scope, and the successful candidates will join a significant ongoing research effort associated with the Next Generation Nuclear Centre for Doctoral Training. The projects will be based at The University of Manchester and run in collaboration the National Nuclear Laboratory. Currently, we have over 20 PhD researchers training across the nuclear environmental area and all of our nuclear PhD graduates have gained employment in academia / industry. The project will also benefit from the excellent facilities within the Williamson Research Centre for Molecular Environmental Science to perform chemical, mineralogical and microbial. Students will also have access to advanced facilities available within The University of Manchester (e.g. electron microscopy, X-ray photo electron spectroscopy, mass spectrometry) as

well as national and international facilities where we routinely analyse radioactive samples such as the Diamond Light Source (http://www.diamond.ac.uk). Finally, the students will work closely with industrial supervisors within the National Nuclear Laboratory.

Candidate Skills: These projects are experimental in scope and the successful candidates should have a strong background in the Chemical Sciences (BSc / Masters in Chemistry, Environmental Chemistry, Environmental Sciences, Geology, Geochemistry or similar). If you are interested in the projects, please contact the supervisors, Prof Sam Shaw (sam.shaw@manchester.ac.uk).

Full details of the project and details of how to apply can be found on the Next Generation Nuclear Centre for Doctoral Training website at http://www.nextgennuclear.manchester.ac.uk/our-research/manchester/

References.

Bots, P., Shaw, S., Law, G.T.W., Marshall, T.A., Mosselmans, J.F.W., Morris, K., 2016. Controls on the Fate and Speciation of Np(V) during Iron (Oxyhydr)oxide Crystallization. Environmental Science and Technology 50, 3382-3390.

Marshall, T.A., Morris, K., Law, G.T.W., Livens, F.R., Mosselmans, J.F.W., Bots, P., Shaw, S., 2014a. Incorporation of uranium into hematite during crystallization from ferrihydrite. Environmental Science and Technology 48, 3724-3731.

Marshall, T.A., Morris, K., Law, G.T.W., Mosselmans, J.F.W., Bots, P., Parry, S.A., Shaw, S., 2014b. Incorporation and retention of 99-Tc(IV) in magnetite under high pH conditions. Environmental Science and Technology 48, 11853-11862.

Newsome, L., Morris, K., Lloyd, J.R., 2014. The biogeochemistry and bioremediation of uranium and other priority radionuclides. Chemical Geology 363, 164-184.