The role of clay and organic colloids in radionuclide mobility in the environment

Institution:	**University of Liverpool**		
Dept/School/Faculty:	Faculty of Science and Engineering		
PhD Supervisor:	Dr J Bridge	Co-Supervisor:	Prof R Doong
Application Deadline:	15 June 2013		
Funding Availability:	Funded PhD Project (Students Worldwide)		

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Dual Phd Programme with University of Liverpool and the National Tsing Hua University:
The PhD student will spend 2 years studying at the University of Liverpool and 2 years at National Tsing Hua University under the bilaterally agreed 2+2 scheme between the two institutions. The expertise developed at National Tsing Hua University and the University of Liverpool will be transferred between them, to the benefit of both institutions.

Aim and Objectives
This PhD will seek to provide a mechanistic understanding of the role of colloid mobilisation and redistribution in migration of radionuclides such as Cs and U within and through soils. The student will address this aim by conducting laboratory experiments, supported by theoretical development, in pursuit of these specific hypotheses: (i) weathering state of mineral or organic colloids significantly affects rates of sorption of radionuclides from solution; (ii) modification of colloid surfaces by radionuclide sorption significantly alters colloid stability (e.g. rates of aggregation, deposition and/or resuspension); (iii) therefore, colloid-facilitated radionuclide migration in soils is a specific function of soil weathering history and environmental radionuclide concentrations.

Funding Notes:

Living costs (£2,500 p.a. @ Liverpool, U.K; $10,000 Taiwanese Dollars p.a. @ Hsinchu, Taiwan to be covered by the dual PhD scholarship scheme.
Full tuition fees covered for the duration of the programme.

Details:

To date there is relatively little direct observation of any contaminant, including radionuclides, *in situ* within intact soils and how the distribution changes in space and time. Hence we have a relatively poor process understanding of the rates and spatial patterns of transport of radionuclides, and hence their biouptake, within the terrestrial environment. Nevertheless, empirical data shows that colloid particles play a key role in the transport of many types of contaminant.

Colloid particles held in soils are sensitive to changes in pore water flow and chemistry. Colloids of any type (mineral, organic matter, biological) are not fixed entities but aggregate, disperse, attach to and detach from solid-liquid and gas-liquid interfaces over time, forming deposits within the pore space that can modify pore flow, disrupt pore connectivity and alter the surface area available for sorption of solutes from the pore water.

Changes in their surface chemistry, size or morphology alter this behaviour. Weathering is one example of a systematic change in particle surface chemistry; accumulation of sorbed species from solution is another. The interactions between these variables, within broader gradients of flow and chemical change within the soil profile, may generate complex transport outcomes which can only be understood in terms of the coupled processes acting at small scale.

This PhD studentship will use a range of techniques including Nanosight particle tracking analysis, gamma imaging, flow-through column studies, high-resolution microscopy, and microchannel flow to quantify the interactions between colloids and key environmental radionuclides in ideal porous media and intact soils, and couple these data to theoretical developments in the understanding of liquid-colloid-solid systems.

At Liverpool, the researcher will collaborate with colleagues in Nuclear Physics and the NiCaL nano-investigation facility with the opportunity to develop work with researchers at the universities of Sheffield and Manchester. At NTHU, there is potential to develop experiments using the Tsing Hua Open-pool Reactor neutron source and the National Centre for Synchrotron Radiation Research, both located on neighbouring campuses in Hsinchu.

Application:

*Closing date for applications to this scheme is **15th June 2013**, with an earliest start date of 1st October 2013.*

- The studentship will be held for 2 years (2013-2015) at Liverpool, UK in the Centre for Engineering Sustainability (lead supervisor Dr Jon Bridge), before transferring to complete a further two years (2015-2017) in the College of Nuclear Science at National Tsing Hua University, Hsinchu, Taiwan (Prof Ruey-an Doong).
- The Dual PhD Scholarship scheme will cover the full fees for both universities and provide a partial stipend equivalent to NTD10,000 per annum to support living expenses.
- **Note that you will need to have additional funds in place to ensure you can cover your full costs of travel to and living in Liverpool and Hsinchu.**
- Some information on additional Scholarships that may be available to you can be found at
    - http://www.liv.ac.uk/study/postgraduate/finance/funding/ or
    - http://www.findaphd.com/student/funding/funding-1.asp.

Please make your application using the University of Liverpool online applications, http://www.liverpool.ac.uk/study/postgraduate/applying/online/. After the 15th June deadline, we will assess the applications according to the University of Liverpool Research Degrees Admissions Policy and contact you in due course.

Please direct enquiries to:

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