Controls on anthropogenic radionuclide distribution in the Sellafield near-shore

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Authorised discharges of effluents from storage ponds and spent fuel reprocessing activities at the Sellafield site have been made to the Irish Sea since 1952 [1]. As a result, actinides and fission products have accumulated in nearby intertidal sediments. To date, the majority of studies conducted with Sellafield-contaminated materials have focused on ascertaining radionuclide distribution profiles and matching these to discharge histories, where available [2, 3]. The importance of biogeochemical controls on actinide transport and fate [4] has not been evaluated.

Here, we have used column separation techniques coupled with radiometric analysis, magnetic sector ICP-MS, and AMS to quantify actinide (Am, U, Np, Pu) and fission product (Cs) distribution at two locations impacted by the Sellafield discharges. Major element and nutrient distribution in the sediment and porewater was also analysed *via* XRF, ICP-MS, and IC.

The results suggest that radionuclide distribution is largely independent of the ambient redox-related processes, despite robust redox stratification with depth. Interestingly, the maximum Pu and Np signal coincides with low Fe concentrations, and indicates a decoupling of the normal geochemical controls suggested to govern the behaviour of these actinides [e.g. 4]. Together, this work provides an insight into the long-term stability of actinide and fission product elements in the environment and has relevance to radioactive waste disposal (e.g. geological disposal) and contaminated land management (e.g. Fukushima).

[1] Gray *et al.* (1995) *J. Rad. Prot* **15**, 99-131. [2] MacKenzie & Scott (1993) *Env. Geochem. Health* **15**, 173-184. [3] Marsden *et al.* (2006) *Sedimentology* **53**, 237-248. [4] Brookshaw *et al.* (2012) *Min. Mag.* **76**, 777-806.