

⁹⁰Sr retardation in sediments at the Sellafield Site, Cumbria, UK - Evidence from field, experimental and modelling studies

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At the Sellafield Site in Cumbria, UK, reprocessing of Magnox Fuel has been undertaken since 1964 within a small (0.65 x 0.45 km) central area of the site known as the Separation Area. Over this period numerous small leaks and spills of radioactive liquors to ground have occurred from waste storage and treatment plants, along with a small number of larger leaks, the latter occurring predominantly during the 1970's. Cumulatively these events have led to the widespread contamination of much of the subsurface of the Separation Area with a number of radionuclides including ¹³⁷Cs, ⁹⁰Sr, ³H, ⁹⁹Tc and a number of actinides. In the case of ⁹⁰Sr, concentrations reach several 100 Bq/L in plumes down hydraulic gradient from the Separation Area and several 100,000 Bq/L local to the most significant leak points.

Despite the significant burden of ⁹⁰Sr contaminated land at Sellafield, and the need to understand its future evolution, very little site specific knowledge of the sorption behaviour of this radionuclide has been determined to date and numerical modelling studies have utilised generic distribution coefficients (K_ds).

In this study Sellafield soil samples have been taken directly from a ⁹⁰Sr plume downgradient of a key source building. Extensive soil characterisation was first undertaken including mineralogical, particle size and electron microscopy. Batch and column sorption experiments were then performed over a range of site groundwater chemistries to derive site specific K_ds. The K_ds obtained were then simulated using geochemical modelling.

The results show that significant differences in ⁹⁰Sr retardation may be expected across the Sellafield site particularly depending on the leak and ambient groundwater chemistry and the soil particle size. The results help to explain the pattern of observed ⁹⁰Sr in Sellafield groundwaters and add confidence to assessments of human health and contaminated land liability.