Interactions between vitrified nuclear wastes and high pH solutions: An experimental and natural analogue approach

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In the UK, the Government have stated their preference for the final disposal of radioactive waste within a geological disposal facility (GDF), several hundred meters below ground. Engineered barrier systems (EBS) will be designed to physically and chemically retard the transport of radionuclides to the biosphere. Groundwater will interact with the EBS which, for UK intermediate-level waste (ILW), will include high pH cement as a waste isolation matrix and in the GDF construction, which will produce alkaline conditions within the GDF. It is not well understood how such solutions will affect the durability of co-located vitrified ILW.

A multidisciplinary experimental approach is described; aimed at developing a mechanistic understanding of how the evolving geochemical conditions associated with a cementitious EBS may affect the dissolution kinetics of vitrified ILW. The results of an experimental study using simulant ILW glass compositions exposed to cementitious pore fluid of different ages, representative of the evolving geochemical conditions of the EBS as a function of time, are discussed. Additionally, a parallel natural analogue study, in which 60-year old glass bottles, discarded in high pH leachate pools (pH~12.5) at a lime-waste site in the UK are being investigated to understand the nature of alteration layers and the evolution of ground water at the site.

It is hoped this study will answer fundamental questions about the passive safety of UK's geological disposal plans.