

USE OF NATURAL ANALOGUES TO DEVELOP AND TEST MODELS OF RADIONUCLIDE RELEASE AND TRANSPORT IN UPLIFT / EROSION SCENARIOS

*Elizaveta Klein¹, Ian McKinley¹, Susie Hardie¹, Yukio Tachi², Masahiro Shibata², Yuki Amano²,
Hiroyasu Takase³*

*¹MCM Consulting, Baden-Dättwil, Switzerland
E-mail: liza.klein@mcm-international.ch*

²JAEA, Tokai, Ibaraki, Japan

³Quintessa Japan, Yokohama, Japan

Unlike other countries where uplift / erosion is treated as a special perturbation scenario, due to the Japanese tectonic setting, the impact of uplift must be considered as part of “likely” repository evolution. In addition, because safety assessments are currently being developed to support comparison of possible sites or alternative disposal concepts, the treatment of uplift / erosion must be as realistic as possible in order to identify any significant differences between options. In an initial study, the perturbation of the EBS and modification of the far-field was assessed for a simple uplift and erosion scenario, with resultant changes in solubility and sorption of key radionuclides considered – assuming reversible sorption for U and Np, but allowing for partial reversibility in the case of Cs. Greatest uncertainties were associated with the behaviour of the altered EBS as it approaches the surface. Although the potential for high doses in the distant future exists, the risk is probably not great for HLW – but could be more problematic for direct disposal of Spent Fuel (SF). A special challenge here is development of models (and associated databases) to quantify the impact of rock mechanical, hydrogeological and bio-geochemical changes on radionuclide migration – both in the EBS and in the geosphere.

Even in Japan, significant impacts will occur only in the far future (after hundreds of ka) and develop very slowly. As such, there are great uncertainties with any laboratory studies to investigate the processes involved and therefore natural analogues have great potential here. The paper will discuss the key safety-relevant processes and radionuclides of interest – with a focus on the relatively simple case of disposal of vitrified waste in an inland setting, but also with consideration of other waste types (TRU, SF) and also coastal environments. From this, potential analogue studies will be listed – considering both data mining of existing knowledge bases and also new projects that are specifically focused on this application. The ideal NA would probably consist of an eroding body of massive iron oxides in a rapid uplift setting with relevant climate conditions. This could either be found in Japan or in other relevant environments around the Pacific Rim.

Currently most interest in this topic is driven by discussions supporting new regulatory guidelines in Japan, but the technical issues may be of wider interest to other tectonically active countries indicating a potential for international collaboration, the pros and cons of which will also be discussed in the paper.