

Multi-scale, multi-criteria evaluation of nuclear waste repositories in different geologic settings

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The isolation of radioactive waste in a deep geological repository depends on engineered and geologic barriers. The geologic barriers depend most on low hydraulic conductivity and geochemical constraints that limit solubility and increase sorption. However, there is a difference between selecting sites of similar geologies vs. sites where the geology is different. In the former case, the same geochemical factors can be used to analyze the performance of different sites—as in Sweden and Finland [1]. In other countries, the choice can be among sites with very different geologic settings—as may be the case in the U.S. and Germany. Yet, sites that are in different host rocks will not necessarily rely on the same retardation concepts. The difficulty is that host-rock-specific criteria do not allow the direct comparison of the technical suitability of sites with different geologic settings.

We present an approach for the multi-scale, multi-criteria evaluation of sites by focusing on the geochemical factors contributing to retardation. A multi-scale representation of disposal systems allows the comparison of host-rock-specific repository designs at the level of their main components and processes (*e.g.*, geological barriers, geochemical processes); whereas, their technical suitability is determined for a specific set of indicators and criteria [2]. The multi-criteria evaluation seeks to rank all potential sites according to their level of fulfilment of safety functions [3]. This approach does not search for a technically optimal solution because the selected site will necessarily be a combination of technical suitability and social acceptance.

[1] Sellin & Leupin (2013) *Clays and Clay Minerals* **61**(6), 477-498(22). [2] Diaz-Maurin & Ewing (2018) *Sustainability* **10**(12), 4390. [3] Munda (2008) *Social Multi-Criteria Evaluation for a Sustainable Economy*. Springer, Berlin.