Behavior of Eu in fractured aquifers with different petrogenesis

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An understanding of the geochemistry of potential host rocks is very important for the evaluation of a site for construction of an underground geologic repository. Because of similar valence and ionic radii and high similarity in electronic structure with trivalent actinides (such as Am3+ and Cm3+), the rare earth elements (REEs) have been used to predict the behavior of actinide-series elements in solution [1]. For Am and Cm, which occur only in the trivalent states in most waste-disposal repository environments, the analogy with the REEs is particularly relevant. Because the transuranic actinides do not occur naturally in appreciable quantities, their behaviors in repository environments cannot be predicted from evidence of their movement in geologic environments (mainly in groundwater) over geologic timespans. Predictions about long-term future behavior of transuranic actinides have therefore been made by extrapolation from short-term observations of their chemical properties in laboratory experiments or in field tests, but such extrapolation is fraught with uncertainty [2].

In order to verify the behavior of Eu in various geological environments, we estimated the abundance of rare earth elements in three gneisses originated from different geological environments, and in fracture-filling calcite precipitated as a fracture-filling material due to changes of geochemical environment in paleo-groundwater. Of the three gneisses, two gneisses are granitic-granodioritic origin and the other is tonaltic-trondjemitic origin. As a result, we observed that a sorption process of Eu occurred with fracture-filling calcite precipitation due to water-rock interaction. Our results confirm that Eu is the most variable element of REEs for the geological and hydrogeological environment such as petrogenetic difference and change of oxidation-reduction in grounwater. Our results suggest that behavior of Eu in fracture-filling calcite is very helpful in understanding the behavior of Am in geological conditions.

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