Mobility of U and REE on colloids in groundwater and its quality-controlled sampling at the Mizunami Underground Research Laboratory

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The mobility of colloids and their association with analogue elements (U and rare earth elements: REEs) in deep granitic groundwater were investigated at the Mizunami Underground Research Laboratory. From the perspective of the mobility of colloids, this study proposed technical methods for the quality control of groundwater and colloids sampling. The groundwater and colloids were sampled from boreholes (located at -300 and -400 meters below ground level: mbgl) and fractures in the drift wall (-300 mbgl). With respect to groundwater sampling from boreholes, anthropogenic colloids formed on the borehole wall randomly contaminate groundwater. In contrast, groundwater sampled from drift wall are expected to consist mainly of natural colloids originating from deep granitic groundwater.

The concentrations of colloid-forming elements (Al, Fe and TOC) changed as groundwater was removed from the borehole, becoming constant after five sampling interval volumes had been replaced. For quality control of groundwater sampling from borehole, the mobile anthropogenic colloids can be removed by replacing contaminated groundwater in the borehole. For the groundwater sampled from fractures in the drift wall, the size-fractionated concentrations of the colloid-forming elements were almost constant, suggesting the effects of natural occurring colloids on the groundwater chemistry were almost negligible.

Changes in the concentrations of U in the groundwater sampled from boreholes were associated with the colloid-forming elements. The mobility of U was facilitated by mobile anthropogenic colloids as pseudo-colloids. The mobility of REE was barely facilitated by the anthropogenic colloids. The REE was concentrated with >0.2 μm particles in the groundwater sampled from fractures in the drift wall. The mobility of REE was facilitated by the natural REE bearing materials with >0.2μm of the size. Our results suggest the mobility of analogue elements are facilitated by different colloidal materials in the deep granitic groundwater.