Actors in rock-water-systems: microbial radionuclide mobilization

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The mobility of radionuclides (RN) depends on reactive transport with mobilization as well as immobilization processes. The contribution of microorganisms to the migration behavior of RN is not often taken into account. However, microbial processes speed up chemical reactions by several orders of magnitude, and the (im)mobilization of elements is not strictly an abiotic process. Therefore, we investigated the effect of microorganisms on the release of elements and/or RN from rock into groundwater. The sampling site, the former alum mine 'Morassina' is situated in the Thuringian forest near Schmiedefeld, Germany. There, low grade metamorphic Silurian slate with high metal loads (14,113 µg/g Al; 2,805 µg/g Fe; 413 µg/g V; 8.2 µg/g U) is affected by pyrite oxidation resulting in acid seepage waters of low pH (2.6-3.7). Slate samples were with up to 394 ± 26 Bq/kg ^{238}U and 454 ± 24 Bq/kg ^{226}Ra obtained for incubation experiments. The microbes were selected after isolation from secondary Fe-precipitates and drip water to access the active community. Bacterial isolates mainly were of the genus *Arthrobacter*, while a high number of Ascomycota and Zygomycota represented the fungal domain. To show the effect of microorganisms on element mobility, one bacterial and two fungal isolates (*Arthrobacter* sp. MB 109, *Mucor* sp. MF 83, *Cryptococcus* sp. MF 21) were inoculated in microcosm experiments with black slate (solid/liquid 1:10). The supernatants revealed a decrease of U and V concentrations by *Arthrobacter* sp. MB 109. Thus, an active biological effect on the immobilization of U and V could be demonstrated. The inoculation with the fungus *Mucor* sp. MF 83 as well as the bacterial isolate *Arthrobacter* sp. MB 109 led to an increase of Ra activity concentrations in the supernatants within three weeks of incubation, with up to 0.33 ± 0.03 Bq/L ^{226}Ra in comparison to the control without microorganisms (0.10 ± 0.01 Bq/L). *Cryptococcus* sp. MF 21 showed no effect on Ra mobilization. New actors in the rock-water-system mobilizing Ra and immobilizing U and V thus could be shown.