Behavior of colloidal ferrihydrite as radionuclide carrier in the Lake Karachai area

K. TSUKIMURA[1]*, M. SUZUKI[1], Y. SUZUKI[1] AND T. MURAKAMI[2]

[1]AIST, Tsukuba, Ibaraki 305-8567, Japan
[2]University of Tokyo, Tokyo 113-0033, Japan

Actinides such as Pu are transported in groundwater associated with colloidal ferrihydrite ($5Fe_2O_3 \cdot 9H_2O$). We propose a geochemical reaction model to estimate how the concentration of ferrihydrite will change in a disposal site of trans-uranic (TRU) waste, which contains large amounts of radionuclides and NO_3^-. The model considers four processes, input of Fe (II) from rocks to groundwater, oxidation of Fe (II) to Fe (III) by NO_3^- and NO_2^-, formation of colloidal ferrihydrite, and transformation of ferrihydrite to goethite and hematite crystals. The model was applied to the groundwater of the Lake Karachai area, where TRU waste was disposed of. Here, we show that colloidal ferrihydrite persists for more than 60, 000 years in the groundwater as long as Fe (II) is supplied from the surrounding rocks and the oxidizing agent, NO_3^-, exists in the groundwater. Thermodynamic consideration has revealed that Pu is kept sorbed to the colloidal ferrihydrite for long time. Our results suggest that actinides even with low solubility are transported downstream associated with colloidal ferrihydrite for long time in a TRU disposal site.

Biogeochemistry of N and P in a dysoxic/euxinic late Devonian epeiric basin

MICHAEL L. TUITE JR AND STEPHEN A. MACKO

Department of Environmental Sciences, University of Virginia (*correspondence: mtuite@virginia.edu)

The biogeochemistry of N and P in the Late Devonian Appalachian Basin was determined in large measure by the persistently dysoxic to euxinic state of the water column beneath the surface mixed layer. In this study the C, N, P, and S elemental and isotopic composition of sediments is examined along a three-site, 70 km transect of the Appalachian Basin in western New York at the Frasnian/Famennian (Late Devonian) boundary. The $\delta^{34}S$ of sulfides at all three sites indicate the existence of euxinic conditions in the water column during deposition of the laminated, high organic carbon (OC) Upper Kellwasser (UKw) interval. The total phosphorus (TP) flux to the sediment diminishes linearly by 50% from the proximal to the distal site whereas the OC flux diminishes by 73%. The high OC:TP and low OC flux at the distal site suggest that despite the high water column residence time of remineralized P, productivity was limited by another nutrient. The ratio of OC to organic nitrogen (ON) during the euxinic interval at the three sites (mean OC:ON = 36) indicates a substantial loss of ON assuming an initial OC:ON approximating the Redfield ratio of 106:16. Preferential consumption of labile organic matter by sulfate reducing bacteria likely accounts for elevated sedimentary OC:ON values. Mean $\delta^{15}N$ values from each site (~0‰) offer no evidence for significant denitrification, suggesting instead the preferential loss of $\delta^{15}N$ enriched, proteins. Nor do the $\delta^{15}N$ values support the assertion that autochthonous N_2 fixation was the sole source of reactive N during the UKw interval. As in the modern Black Sea, recycled N likely accounted for a substantial fraction of the N budget in the Late Devonian Appalachian Basin and allochthonous N, exported from emerging terrestrial forest ecosystems, represented a significant input of new reactive N.