U(VI) reduction by anaerobic microorganisms isolated from the flooding water of the former uranium mine Königstein (Saxony/Germany)

U. GERBER, E. KRAWCZYK-BÄRSCH, A. C. SCHEINOST, T. ARNOLD

Helmholtz-Zentrum Dresden-Rossendorf, Institute of Resource Ecology, P-O-Box 51 01 19, Dreden, Germany

The former uranium mine Königstein (Saxony, Germany) is currently in the process of remediation. The underground is flooded in a controlled way, and the flooding water is cleaned up in a dedicated waste water treatment plant. Despite high U concentrations up to 13 mg/L and a low pH of 2.9, these waters contain a high microbial diversity as detected by culture-independent methods. Microorganisms are known to interact with metals and radionuclides in different ways [1]. Anaerobic bacteria which are able to gain energy from the reduction of several metals, are known to change the redox state of metals and radionuclides. For instance, anaerobic sulfate-reducing bacteria (SRB) reduce U(VI) to U(IV) and thus change the migration behavior from the more soluble U(VI) into the less soluble U(IV) [2]. Genomic sequence analysis of the flooding water revealed the presence of such anaerobic SRB. By culture-dependent methods it was possible to isolate anaerobic microorganisms from the flooding water. They were incubated with 10 mM glycerol using the flooding water as background medium. During an incubation time of six weeks the redox potential decreased from 660 mV to 300 mV. After four and six weeks of incubation, the cells were separated from the incubation medium by centrifugation and than analyzed by U-L_{III} edge EXAFS (extended X-ray absorption fine structure) and XANES (X-ray absorption near edge structure) measurements. By Iterative Target-Factor Analysis (ITFA) we determined that 100 % of U(VI) was reduced to U(IV). Simultaneously, investigations of the supernatant with UV-vis resulted in the same findings. The results show that naturally occurring anaerobic microorganisms within the flooding water of the former uranium mine Königstein are able to reduce U(VI) to U(IV).

1.Lloyd, J.R.M., L. E. , *Interactions of microorganisms with radionuclides*. Elsevier Science. 2002. 2 Lovley, D.R., et al., *Enzymatic Iron and Uranium Reduction by Sulfate-Reducing Bacteria*. Marine Geology, 1993. **113**(1-2): p. 41-53.