Bioaccumulation of Uranium by *Euglena mutabilis* Cells

THURO ARNOLD[1]*, HEINRICH LÜNSDORF[2] AND SINA BROCKMANN[3]

[1]Helmholtz Zentrum Dresden-Rossendorf, Institute of Resource Ecology, P.O.Box 510119, D-01314 Dresden, Germany
[2]Helmholtz Centre for Infection Research (ZEIM), D-38124 Braunschweig, Germany
[3]Verein für Kernverfahrenstechnik und Analytik (VKTA), P.O.Box 510119, D-01314 Dresden, Germany

Bioaccumulation experiments, together with transmission electron microscopy together with electron energy loss spectroscopy (TEM/EELS) and confocal laser scanning microscopy (CLSM) were used to study the uranium uptake by metabolically active *Euglena mutabilis* cells and by dead biomass of *Euglena mutabilis* cells. For the experiments the Euglena cells were separated from the culture medium and placed in 1×10^{-5} M and 5×10^{-4} M uranyl solution (in Na_2SO_4 medium) at pH 3, respectively to relate to uranium contaminated acid mine drainage conditions and the uranium uptake was monitored over time. It was found that the immobilization by living Euglena cells is a slow but metabolically driven active process which takes up to 10 days, before it reaches equilibrium with the surrounding bulk solution. However, this active process leads to higher amounts of immobilized uranium in comparison to the fast immobilization of uranium by comparable amounts of dead biomass, which is completed within 20 to 25 minutes.

The immobilization of uranium by dead biomass is a different process. Here, uranium could only be observed in some instances on the Euglena pellicle by EF-TEM/EELS in concentrations close to the detection limit. This process was interpreted as a passive but very fast biosorption process in which uranium was eventually heterogeneously distributed as adsorbed species on accessible Euglena surfaces coordinated to carboxyl and also possibly to phosphate groups.

CLSM studies showed that uranium was transported into living Euglena cells. The respective fluorescence spectra obtained from the interior of the cell indicated a uranium phosphate or uranium carboxyl speciation. No such signals could be obtained for dead Euglena biomass, neither on *E. mutabilis* surfaces nor in the cells.

The above shown results showed that *Euglena mutabilis* cells do have the capacity to remove very mobile uranium(VI) species under AMD relevant conditions and could be a promising microorganisms for low-maintenance remediation strategies.