Biosorption of U(VI) at highly saline conditions

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For the long-term storage of radioactive waste in host rock formations with highly saline environments it is important to know how indigenous halophilic microorganisms can affect the performance of a repository. An important interaction mechanism is the soprtion of radionuclides like uranium on cell surface of microorganisms, which has an influence on U migration behaviour. Biosorption studies at highly saline conditions are also of interest for saline wastewater treatment.

The sorption of U(VI) on cells of the halophilic archaeum *Halobacterium noricense* DSM 15987 was studied at pH 6.0 and a NaCl concentration of 3.0 M in dependence on uranium concentration, time and temperature. Independent on the added uranium concentration (10 – 120 μM) around 90 % of the added uranium was sorbed by the cells at room temperature. Time-dependent sorption studies indicated a two-step binding process with a fast step within the first hours and a second slower one. A slightly faster sorption of added uranium could be demonstrated at higher temperatures of 50°C.

Interestingly, with increasing time, uranium concentration and temperature the cells began to form agglomerates. Live/Dead staining (LIVE/DEAD® Bac LightTM Bacterial Viabilit Kit, Molecular Probes) of cells after biosorption with uranium showed that nearly all single cells were dead whereas agglomerated cells were alive. The cell agglomeration is a stress response to protect the cells themselves from environmental challenges.

The characterization of the formed cell-uranium-complexes was even at 3M NaCl with Time-resolved Laser-induced Fluorescence Spectroscopy possible and indicated that uranium was bound to cellular carboxylic groups. The bounding of uranium not only to carboxylic groups but also to phosphate groups of the cell could be verified with Infrared Spectroscopy.

This knowledge is important in understanding microbe-radionuclide interactions at highly saline conditions in respect of geological disposal of nuclear waste and is useful for saline wastewater treatment.