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Bacteria–Actinide Interactions: An Environmental Perspective

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Soils, sediments, and waters heavily polluted with radionuclides and other toxic metals, are a reservoir of unusual bacteria well adapted to these extreme environments. These bacteria possess fascinating mechanisms for interaction with and bio-transformation of radionuclides and other heavy metals, thus regulating the mobility of the metals in the environment. Microorganisms can mobilize radionuclides and metals through autotrophic and heterotrophic leaching, chelation by microbial metabolites and siderophores, and methylation, which can result in volatilization. Conversely, immobilization can result from sorption to cell components or exopolymers, intracellular sequestration, or precipitation as insoluble organic and inorganic compounds, e.g. oxalates, sulfides, or phosphates. The present work is intended to give a overview of the key processes implicated in the interaction of uranium with bacterial strains isolated from different extreme environments including uranium mining waste piles as well as groundwater of a radioactive repository. For this purpose, a combination of spectroscopic (EXAFS, XANES, TRLFS), microscopic (TEM), microbiological and wet chemistry techniques is used. Elucidating the interaction mechanisms microbe/metals is helpful for understanding the role which bacteria play in the transport and mobility of toxic metals in the environment as well as their biotechnological application in the bioremediation of heavy metal contaminated waters.