Uranium biomineralization in environmental bacteria

V. CHAPON[1*], N. THEODORAKOPOULOS[1,2], L. PIETTE[1], L. FEVRIER[2], F. COPPIN[2], N. GALLOIS[1], J. ARMENGAUD[3], B. ALPHA-BAZIN[3], M. BARAKAT[4], P. ORTET[4], M. CARRIERE[5], T. VERCOUTER[6], C. BERTHOMIEU[1].

[1] CEA, DRF, BIAM, LIPM, UMR 7265 CEA-CNRS-Aix-Marseille University, Saint-Paul-lez-Durance, France. (virginie.chapon@cea.fr)
[2] IRSN, SERIS, L2BT, Saint-Paul-lez-Durance, France.
[3] CEA, DRF, IBITECs, Li2D, Bagnols-sur-Cèze, France.
[4] CEA, DRF, BIAM, LEMIRE, UMR 7265 CEA-CNRS-Aix-Marseille University, Saint-Paul-lez-Durance, France.
[5] CEA, DRF, INAC, SCIB, LLAN, UMR E3 CEA-Grenoble-Alpes University, Grenoble, France.
[6] CEA, DEN, DPC, SEARS, LANIE, Saclay, France.

Bacterial interactions with uranium include processes such as redox transformation, biosorption at the cell surface or intracellular bioaccumulation. These different mechanisms can lead to the sequestration of uranium by the bacterial cells in uranium-phosphate minerals. We examined the mechanisms of uranium biomineralization in a phylogenetically diverse set of environmental bacteria. By a combination of spectroscopic approaches (FTIR, TRLFS, EXAFS) and microscopic methods (TEM-EDS), we showed that uranium biomineralization occurred either at the cell wall [1] or intracellularly [2], depending on the strain and exposure conditions. When resting cells of *Microbacterium* strains were exposed to bioavailable forms of uranium at 10μM, U(VI) was accumulated as intracellular needle-like structures composed of an autunite type mineral [2]. Uranium intracellular accumulation was observed only in metabolically active cells, suggesting the involvement of an active process. The molecular mechanism involved in intracellular uranium biomineralization is currently being explored by a combination of genomic and proteomic approaches.

[1] Llorens I *et al*. (2012) PLoS One. 2012;7(12):e51783.
[2] Theodorakopoulos N. *et al*. (2015) J Hazard Mat. 285: 285-93.