



	Experiment title: Uranium scavenging by the neutrophilic iron-related bacteria <i>Sphaerotilus natans</i>	Experiment number: EV66
Beamline: BM26A	Date of experiment: from: 16/04/2014 to: 21/04/2014	Date of report: 01/03/2014 19/12/2015
Shifts: 18	Local contact(s): Dipanjan Banerjee	<i>Received at ESRF:</i>
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Report:

The proposed study aimed at determining the mechanisms of uranium scavenging by the iron-related sheath-forming bacteria *Sphaerotilus natans* and its associated BIOS. Abiotic analogues of these iron oxyhydroxides precipitated without bacteria will be tested in order to understand the role of bacterial cells in the iron and uranium scavenging process.

EXAFS data have been successfully recorded in fluorescence detection mode at 20 K, on a set of samples prepared from biotic and abiotic experiments with U concentrations within the 1000 – 5000 ppm range (Figures 1 and 2)

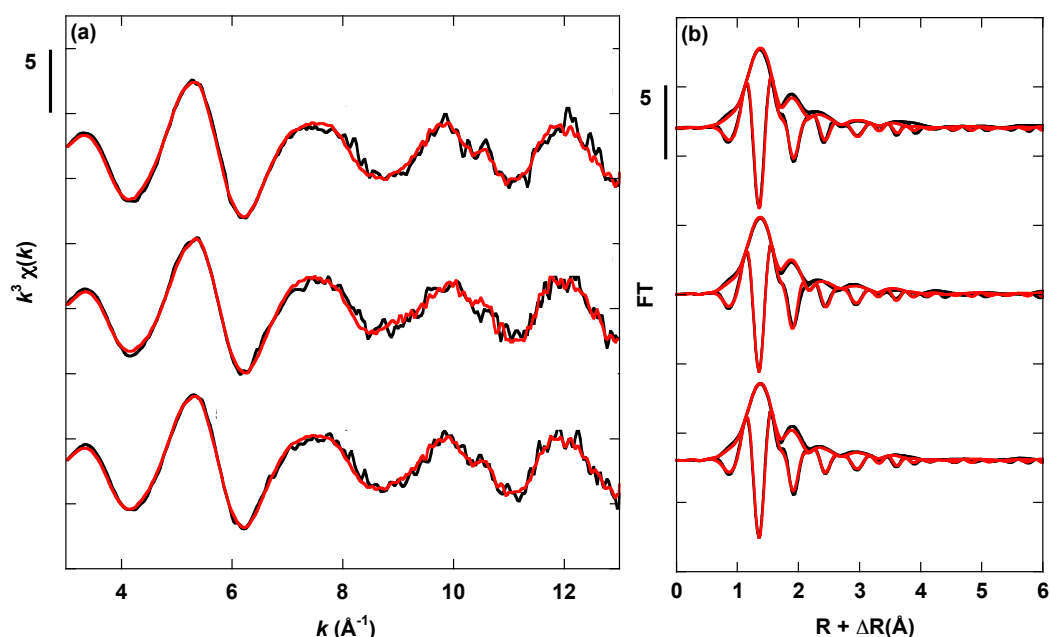


Figure 1. U L_{III} -edge EXAFS spectra of *S. natans* incubated in the presence of U(VI) in various culture media. (a) Results of Linear combination fits using 2 or 3 model compounds spectra from Figure 2. (b) the corresponding Fourier Transforms (FT) magnitude and imaginary part. Experimental data and calculated curves are plotted as black and red solid lines, respectively.

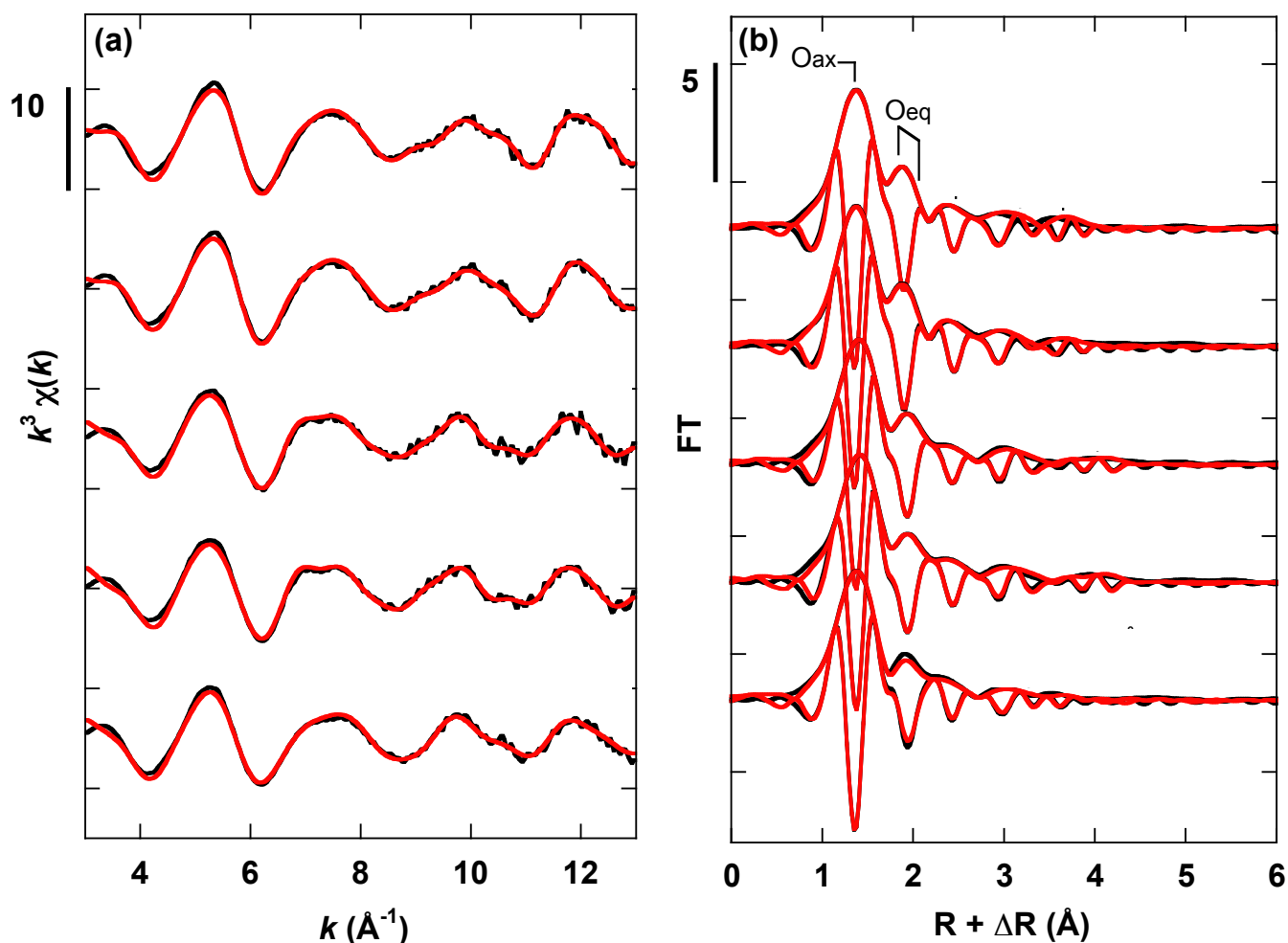


Figure 2. *U* L_{III} -edge EXAFS spectra of *U(VI)* sorption and coprecipitation model compounds on various inorganic and biological substrates. (a) Results of the shell-by-shell fits of unfiltered k^3 -weighted data and (b) the corresponding Fourier Transforms (FT) magnitude and imaginary part. Experimental data and calculated curves are plotted as black and red solid lines, respectively.

Linear Combination fitting (Fig. 1) of the *S. natans* samples completed by and shell-by-shell analysis (Fig. 2) and by Cauchy-wavelet analysis (not shown) of the model compound samples yield a rather molecular-level description of *U* scavenging mechanism by *S. natans*, as a function of the chemical composition of the culture medium and of the growth conditions.

This work was an important part of the PhD of Marina Seder-Colomina at IMPMC in Paris (France) in collaboration with the University of Paris Est (France) and the University of Cassino and Southern Lazio (Italy), in the context of the Erasmus Mundus Joint Doctorate « ETeCoS3 », Environmental Technologies for Contaminated Soils, Solids and Sediments. Dr. Marina Seder Colomina has defended her PhD on Dec 2, 2014.

The following article has been published on the basis of the results obtained from this experiment EV66 on BM26A and from previous experiment EV20 on BM23 :

Seder-Colomina M., **Morin G.**, Brest J., Ona-Nguema G., Gordien N., Pernelle J.J., Banerjee D., Mathon, O., Esposito G., Van Hullebusch E. (2015) Uranium(VI) scavenging by amorphous iron phosphate encrusting *Sphaerotilus natans* filaments. *Environmental Science and Technology* 49, 14065–14075. DOI: 10.1021/acs.est.5b03148