Early diagenetic reduction of mononuclear U(VI) to U(IV) in undisturbed lake sediments

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Former uranium mining sites as well as high geochemical background areas in mining districts may be sources of natural radionuclides release to the environment. However, uranium scavenging in soils and sediments due to sorption and precipitation processes is expected to naturally limit U dispersion in downstream waterways. Geochemical investigation of these sites can serve to identify the processes that control uranium redox and mobility in natural environments, which may help improving the definition of management strategies for U contaminated sites.

Here, we give first direct evidences for the reduction and immobilization of U due to early diagenetic processes in contaminated lake sediments impacted by a former U-mining site in Massif Central, France. Coupling X-ray absorption spectroscopic analysis at the U L_{III}-edge and at the Fe K-edge with geochemical analysis of pore waters indicate that U and Fe reduction are correlated to organic matter mineralization [1]. Shell-by-shell fit and Continuous Cauchy-Wavelet Transform of the EXAFS data reveal that mononuclear U(IV) bound to P, Si and/or C atoms results from the reduction of mononuclear U(VI) below the sediment-water interface. These findings emphasize the need for considering both U(VI) and U(IV) non-crystalline species in the modeling of U mobility in lacustrine environments [1, 2].

[1] Stetten et al. *GCA* under review. [2] Morin et al. (2016) *GPL* 2, 9758-18065.