

Effect of Humic Substances on the Affinity of Ferrihydrite for U(VI)

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Understanding the behaviour of U(VI) in soils and aquifers is crucial for controlling the impact of anthropogenic U contamination. For example, U concentrations up to 1.8 μM persist in the aquifer of the Old Rifle DOE site in Colorado, even after “cleaning” the waste source of contaminations [1]. Direct investigations of U speciation at this site have shown that U is associated with a wide variety of mineral phases as well as with natural organic matter (NOM) [2]. NOM is known to (i) form organo-mineral-metal (ternary) complexes affecting the partitioning of actinides, (ii) catalyze redox transformations, and (iii) enhance mineral dissolution and metal transport [3,4,5].

In order to understand the effect(s) of NOM on the fate of uranium in soils, and to identify the conditions that enhance or retard them, U sorption rates and speciation were investigated in the batch ternary system ferrihydrite-humic acids-U(VI). Nanoparticulate ferrihydrite (Fh) was chosen because it is abundant in the subsurface at the Rifle site and ubiquitous in soils. In addition, it is highly reactive to metal ions and is expected to significantly influence the fate of U.

Our results show that humic acids affect, albeit slightly, the proportion of uranium retained by ferrihydrite, and it increases the proportion of easily exchangeable uranium. These effects depend on the proportion of humic acids and on the sequence in which humics and uranium enter the system. Results from U LIII edge EXAFS spectroscopy suggest the partitioning and exchange reactions are linked to variations in the proportion of uranium associated with ferrihydrite versus humic acids.

[1] Campbell K.M. *et al* (2012) *Applied Geochemistry* **27**, 1499–1511 [2] Maher K. *et al* (2012) *Inorganic Chemistry* **52**, 3510–3532. [3] Means J.L. and Crerar D.A. (1978) *Science* **200**, 1477-1481 [4] Ludwig C. *et al* (1995) *Nature* **375**, 44-47 [5] Gu B. *et al* (2005) **39**, 5268-5275