Geochemistry of uranium in lakes of West Mongolia

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Natural lakes with high concentrations of uranium are widespread, for example, Van in Turkey (110 μgL^{-1}) [1],), Mono in the USA, California (300 μgL^{-1}), Shar Burdiin in Eastern Mongolia (15000 μgL^{-1}) [2]. In Western Mongolia, we have also discovered lakes with concentrations of uranium as high as 3000 μgL^{-1}. In the arid climate of western Mongolia, where evaporation is by 2-3 times higher than the amount of precipitation, evaporation concentration processes contribute to the growth of salinity and content of the U. However, our investigation indicated a significant role in uranium accumulation in the waters of the upper hydrodynamic zone is provided by aquiferous rock catchment lakes. Geologically, granite massifs are widespread on the studied territory, which are known to be possessed of natural radioactivity. But the type of rock is not the main factor. The time of water–rocks interaction which determines the degree of accumulation of U in the lakes is more important. Precisely, the equilibrium-nonequilibrium state of the system water-rock determines the possibility of U concentration in the water during the whole time of its interaction with rocks: the longer interaction time, the more uranium will be concentrated in the water, of course, the other things being equal. Analysis of the lake waters equilibrium with uranium minerals shows that only a few can precipitate out of solution and only three lakes with total salinity more than 300 gL^{-1} equilibrium with the investigated minerals. Water store U by getting into the rocks of any composition and dissolving them. Uranium, in turn, forms complexes with carbonate-ions and migrate to the lakes, and precipitates in lake sediments by influence of evaporation and water-rock interaction time. In this case, the more uranium will be accumulated in the water for the entire migration path to the lake, the greater amount will be precipitated. Consequently, the lakes are a unique geochemical barrier for the migration of uranium which forms oxides, hydroxides, carbonates, phosphates, fluorides and other minerals in lakes sediment.

[1] Mehmet *et al*. (2011) Clean-Soil, Air, Water **39(6)**, 530-536. [2] Linhoff *et al*. (2011) Environ. Earth Sc. **62**, 171-183.

Evaluating the efficiency of a synthetic amorphous manganese oxide for chemical stabilization of Cu in a contaminated soil

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Chemical stabilization techniques aim at rendering less available the metal(loid) fractions that can pose significant environmental and toxicological risks and protecting the functionality of the soil environment [1]. Recently, a synthetic amorphous manganese oxide (AMO) has been proposed as an efficient metal sorbent and stabilizing agent for contaminated soils [2]. This work aims to evaluate AMO (up to 2 wt.%) stabilization efficiency in a soil contaminated predominantly with Cu (400 mg/kg; pH 3.6) using (i) batch experiments with soil solution samplers (rhizons), (ii) small-scale columns and (iii) a novel set-up of a large-scale column experiment together with direct sampling of the soil solution and chemical extraction methods (0.01 M $CaCl_2$, 0.05 M EDTA, BCR sequential extraction procedure).

The results suggest that the application of the AMO increased the soil pH and its high reactivity resulted in increased DOC concentrations originating from dissolved soil organic matter (SOM). The AMO was efficient in stabilizing Cu proved by significant decreases in Cu in soil solution, in the exchangeable fraction and $CaCl_2$/EDTA extracts. When further metals (Cd, Cu, Pb, Zn) were added to the soil columns, the AMO was able to stabilize them in the subsurface layers. However, due to SOM dissolution, metals (especially Cu) bound to the organic soil phase can be released to the soil solution. This preliminary study assess the efficiency of the AMO for metal stabilization in a Cu-contaminated soil and proposes a combination of experimental set-ups evaluating the efficiency of stabilizing amendments in general.

[1] Komárek *et al*. (2013) *Environ. Pollut*. **172**, 9-22. [2] Della Puppa *et al*. (2013) *J. Colloid Interf. Sci*., in press.

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