

Influence of redox interfaces on Arsenic mobility

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Floodplain soils and aquifers are composed of heterogeneous soils and sediment bodies with varying organic matter content, texture, and mineralogy. Thus, redox conditions in floodplain aquifers typically vary dramatically, which has major impacts on mobility and transport of redox active contaminants, including arsenic (As). Being in hydrological contact with the unsaturated zone, these aquifers are also particularly sensitive to climatic or other changes in hydrological patterns, meaning that slight shifts in hydrology can result in large changes in contaminant behavior. However, there is a paucity in knowledge regarding contaminant responses in these heterogeneous systems.

Here we discuss data from a dual domain column experiment, where varying numbers of small sulfidic, organic-rich, fine grained sediment spheres were inserted into a coarse-grained aquifer material with natural abundance of arsenic (<2 ppm). Oxygenated groundwater was pumped through the columns and depth resolved pore-water data was collected from inside sulfidic zones and in-between them. We utilized X-ray absorption spectroscopy (XAS) to reveal solid phase speciation changes in As and IC-ICP-MS for aqueous phase As speciation. Our results show no indication of oxidation inside the reduce spheres, instead, we observed that the reduced conditions spread into the coarse-grained aquifer material. The diffusion of sulfide into groundwater was accompanied by release of DOC and reactive Fe to the aquifer solid phase, and formation of aqueous thiolated As species, resulting into dissolved As concentrations above permissible limits. These results highlight the importance of redox interfaces for controlling contaminant behavior in groundwater and show that slightly sulfidic groundwater can accumulate toxic levels of As even if the sediment As concentrations are low.