Fate of As(V) and As(III) during bacterial iron reduction of ferrihydrite

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Ferrihydrite affects the regulation of element cycling in natural environments by adsorbing trace elements. Iron-reducing bacteria can reduce iron in ferrihydrite, and cause secondary mineralization such as magnetite. Initially adsorbed trace elements are released to the surrounding water or captured in solid phases. Understanding this process is important to reveal the mechanism of contamination in soils. We investigated the fate of arsenic adsorbed on two-line ferrifydrite during bacterial iron reduction.

Ferrihydrite was synthesized by grinding $Fe(NO_3)_3 9H_2O$ and NH_4HCO_3 following the procedure described by Smith et al. [1]. As(V)- and As(III)-adsorbed samples were prepared by soaking the ferrihydrite in Na_2HAsO_4 and $NaAsO_2$ solutions, respectively. Bacteria were isolated from a natural anaerobic mud sample from Fukushima, Japan. The liquid media containing As-ferrihydrite with bacteria were incubated for around 30 days. Solid phases were analyzed using a transmission electron microscope equipped with an energy-dispersive X-ray spectrometer. The amount of Fe and As in the liquid media were measured by ICP-MS.

The most of As(V) was not released from As-ferrihydrite, whereas ~ 50% of As(III) was released into liquid media. Green rust, iron hydroxy carbonate phase, and As-bearing magnetite formed in the both experiments.

[1] Smith et al. (2012) Inorganic Chemistry 51, 6421–6424.