Reduction of As- and Zn-loaded ferrihydrite by iron-reducing bacteria

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Two-line ferrihydrite affects the regulation of element cycling in natural environments by adsorbing trace elements. Iron-reducing bacteria can release these trace elements from the ferrihydrite to the solution or transfer them onto magnetite or other minerals. We investigated the fate of arsenate and zinc adsorbed on two-line ferrifydrite during bacterial-iron reduction.

Ferrihydrite was synthesized by grinding $Fe(NO_3)_3 \cdot 9H_2O$ and NH_4HCO_3 following the procedure described by Stacey *et al*. [1]. As- and Zn-adsorbed samples were prepared by soaking the ferrihydrite in $NaHAsO_4$ and $Zn(NO_3)_2$ solutions, respectively. The degree of adsorption was measured with a transmission electron microscope (TEM) equipped with an energy-dispersive X-ray spectrometer (EDX). Bacteria were isolated from a natural anaerobic mud sample from Fukushima, Japan. The particular species has not yet been identified. The vials containing As- or Zn-ferrihydrite with bacteria were incubated for 26 and 19 days, respectively.

X-ray diffraction and TEM revealed that ~20nm diameter Zn- and As-bearing magnetite particles formed. TEM–EDX and inductively coupled plasma–mass spectroscopy indicate that almost all the Zn and more than half of the As were transferred to magnetite.

We concluded that adsorbed As and Zn were fixed onto more stable magnetite through bacterial iron reduction. Our results suggest that iron-reducing bacteria play a role in keeping contaminants in their environment.

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