Transformation of iron-mineral adsorbed arsenic under natural groundwater conditions

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High arsenic groundwater is widely distributed in inland basins and river deltas, which predominantly occurs in reducing conditions. Reductive dissolution of arsenic-binding iron oxides and reductive desorption, which are dependent on redox conditions, iron oxide mineral phases, chemical compositions and groundwater dynamics, have been widely accepted for arsenic enrichment in those groundwater. However, few attempts have been made to reveal arsenic behavior of arsenic-binding iron-oxide minerals under natural groundwater conditions. In this study, we investigate transformation of iron-mineral adsorbed arsenic and its dependence on iron-oxide mineral phases, organic matter and redox potentials under natural groundwater conditions.

Arsenic-adsorbing iron-oxide minerals were coated on quartz sand and packed in columns (As-IM-S), which were placed in typical wells in the Hetao basin, China. Groundwater was pumped through the columns. Influents and effluents of the columns were sampled at different time intervals.

Results showed that As release and species from/in the As-IM-S-packed columns were dependent on iron mineral phases, groundwater chemicals, and organic matter. Arsenic was released from ferrihydrite via reductive dissolution, reduction of adsorbed-As(V) and desorption, while from geothite via desorption and reduction of adsorbed-As(V). Arsenic was mobilized from hematite via desorption. For both ferrihydrite-adsorbed As and goethite-adsorbed As, desorption firstly occurred, followed by reduction of iron-oxide and/or As(V). Phosphate predominantly led to arsenic desorption. Lower Eh values caused more arsenic released from reductive dissolution of iron-oxides or reduction of adsorbed arsenic. Input of exogenous organic matter enhanced dissimilatory reduction of ferrihydrite and adsorbed As(V), resulting in As(III) as the overwhelming arsenic species in the effluents. In addition, microbes may control arsenic release from iron oxide minerals, with *Pseudomonas* as dominant species in the columns releasing more arsenic.