

Quantification of arsenic species in aquifer solids using micro-XAS

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Western Minnesota, USA, is a regional locus of drinking-water-wells yielding high arsenic (As) groundwater ($As > 10 \mu\text{g L}^{-1}$). The arsenic appears to have a geogenic source or sources derived from Des Moines Lobe glacial tills. The As concentrations vary widely in neighbouring wells with otherwise similar water chemistry [1,2]. Moderate As concentrations in the aquifer sediments (3-10 mg kg⁻¹) and heterogeneous distribution of wells yielding high As groundwater indicate that speciation of As in the solid phase is an important factor in the liberation of As to groundwater.

The goal of the present research is to identify stratigraphic units and hydrogeological parameters that create high As risk in groundwater and well water. Our working hypothesis is that the aquitard-aquifer contact is a geochemically active zone in which reduced As species are liberated to the aquifer from the glacial tills through oxidation processes. To test this hypothesis, a micro-X-ray absorption spectroscopy (μXAS) speciation mapping method was developed to quantify As species in glacial sediments that exhibit high inter-particle heterogeneity at the micron-scale [3].

We applied the speciation mapping approach to aquitard-contact zones at three locations in western Minnesota. When paired with point-XAS measurements of iron (Fe) and As speciation, the data reveal that As is in a reduced chemical state within the aquitard, and is correlated spatially with Fe sulfide minerals at the micron scale. Solid-phase As in aquifer sediments are largely oxidized As(V). At the aquifer-aquitard contact, As is observed in a mixture of reduced and oxidized forms indicating redox processes in this zone.

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[1] Berndt & Soule (1999) Minnesota Arsenic Research Study: Report on Geochemistry. [2] Erickson & Barnes (2005) *Water Research* **39** 4029-4039. [3] Toner *et al* (accepted) *Env. Chem.*