Gas and groundwater dynamics in an As contaminated aquifer

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Arsenic contamination of groundwater remains a problem for many of the river deltaic areas in Asia, where concentrations regularly exceed [1, 2] the 10µ/L currently recommended by the Word Health Organization. The focus of this study, is to determine gas concentrations in groundwaters where arsenic mobilisation is active, revealing information about the site's hydrogeology and gas dynamics in a highly reducing environment. The small village of Van Phuc, Vietnam, presents an ideal opportunity for such a study as is it well documented and accessible, however, arsenic release is still not well understood.

Gas concentrations in 21 wells at varying depths and locations were analysed in field with the miniRUEDI. The miniRUEDI is a portable mass spectrometer capable of measuring noble gases: He, Ar and Kr, in addition to the reactive gases: CO_2, CH_4, N_2 and O_2. Results show a clear depletion, up to ~80%, of atmospheric gases Ar, Kr and N_2, with increased CH_4 concentrations. He, shows the opposite behavior such that it increases in concentration (up to twice that of in air saturated water) as CH_4 concentration increases.

The conceptual picture these results indicate, is that the oversaturation of methane inside the aquifer, depletes the atmospheric gases as a result of their partitioning into the CH_4 gas bubbles. Simultaneously, the CH_4 gas bubbles reduce the hydraulic conductivity of the aquifer, allowing enough time for radiogenic He to accumulate. Groundwater flow thus tends to deviate around the CH_4 producing zone, an important factor to consider when determining As transport in contaminated aquifers.

[1] Science 2010, 328, 5982, 1123-1127
[2] ES&T 2007, 41, 7, 2146-2152