Evaluating arsenic adsorption in a low arsenic aquifer in Bangladesh using *in situ* and laboratory methods

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Deep tube wells tapping low arsenic aquifers are a widely used strategy for reducing exposure to arsenic contained in shallower groundwater in Bangladesh. The Dupi Tila aquifer, characterized by orange-colored sand deposited during the Pleistocene, has been used for arsenic mitigation in Dhaka and the surrounding rural areas. Regional groundwater flow modeling of the Bengal Basin has shown that in some areas deeper aquifer zones are vulnerable to the migration of shallow high arsenic water (Michael *et al*. this session), thus arsenic sorption could be important for resource sustainability. We compare here results from adsorption experiments initiated in the field using freshly collected sands with *in situ* experiments to provide robust estimates of the rate and extent of As adsorption on orange aquifer sands.

The batch adsorption experiments indicate little difference between As (III) and As (V) adsorption, an equilibrium partitioning coefficient (K) of 30 to 70 L/kg, and an adsorption capacity of 40 mg/kg. In parallel, shallow groundwater intrusion, ~200 ppb As (III) or As (V), into the Pleistocene aquifer was simulated in the field using push-pull tests and monitored over time. Both batch and *in situ* experiments show that the rate of As adsorption is limited by the diffusion into smaller pore spaces. Analysis of results from the *in situ* experiments requires an equilibrium partioning coefficient (K) and an estimate of the exposed spaces. Values for K are similar to the batch experiments when small pore spaces, which were nearly unaffected by the experiment, account for 95 to 98% of the total adsorption sites. This is not unreasonable given the rapid flow induced in the *in situ* experiments. Under the most conservative scenario, with rate-limited sorption, the K would be 0.5 to 2 L/kg for As (III) and As (V), respectively. These results demonstrate the ability of orange sands to retard contamination of the Pleistocene aquifer and extends its potential usefulness for at least decades (Michael *et al*. this session).

Trace and rare earth element characteristics of Vindhyan (Neo-Proterozoic) sandstones of Bhopal region, Central India

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The study area, Bhopal (Lat. 23°10' - 23°20'N and Long. 77°17' - 77°30'E) in Madhya Pradesh, India is represented by sandstones intercalated with shales and intra formational conglomerates belonging to Upper Vindhyans of Neo-proterozoic age and basaltic lava flows affiliated to the Deccan trap igneous activity of Cretaceous period.

The observed La/Sc, Th/Sc, Th/Co, Th/Cr, Cr/Th ratios after Cullers [1, 2]; Cullers and Podkovyrov [3]; Cullers *et al*. [4] and Taylor and McLennan [5] and concentration levels of other trace elements like Zr, Ni, V and Sc strongly suggest that these sandstones were derived principally from the felsic source rocks. The Th/Sc versus Sc bivariate and La-Th-Sc triangular plots support this interpretation. The rare earth element (REE) patterns of these rocks further confirm their derivation from felsic source rocks. Interestingly, these rocks exhibit higher LREE/HREE ratios (average 9.19) confirming the felsic igneous rocks as a possible source rocks.

[1] Cullers, R.L. (1994) *Chem. Geol*. **113**, 327-343. [2] Cullers, R.L. (2000) *Lithos*. **51**, 181-203. [3] Cullers and Podkovyrov (2000) *Precambrian Res*. **104**, 77-93. [4] Cullers, Basu and Suttner (1988) *Chem. Geol*. **71**, 335-348. [5] Taylor and McLennan (1985) Blackwell, Oxford, UK, 349 p.