The Geochemistry behind Arsenic Cycling within Riverbank Aquifers in Bangladesh

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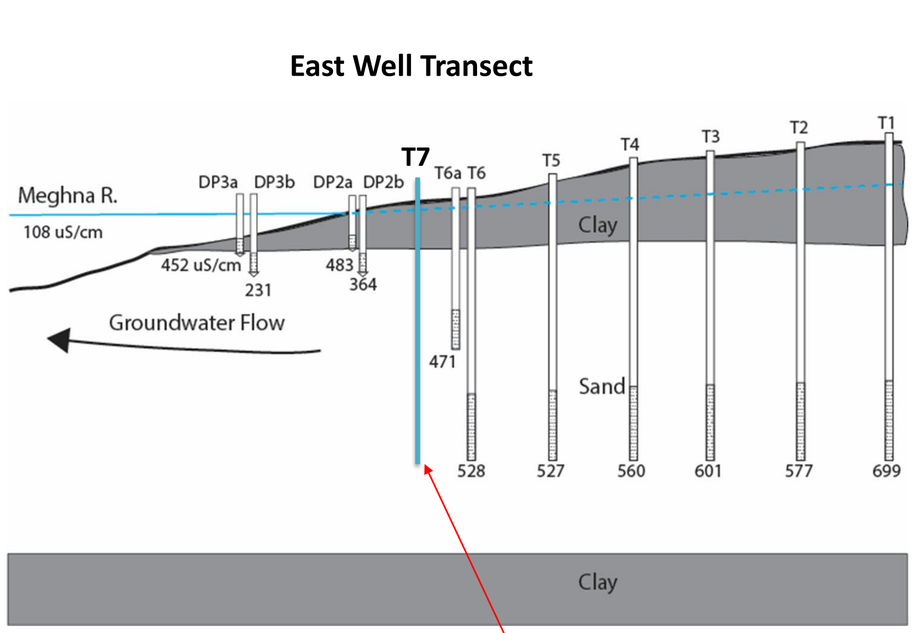
ABSTRACT

Arsenic contamination in drinking water in Bangladesh has been an ongoing problem for decades. This is a critical problem because arsenic poisoning causes health problems and result in premature death. Surface and groundwater interactions may influence aquifer geochemistry in ways that impact the timing and amount of arsenic sequestered and released from iron oxide minerals. My hypothesis is that specific geochemical changes caused by river water movement into shallow aquifers under the influence of both dry season irrigation pumping and early monsoon riverine flooding causes the mobilization of the toxic form of arsenic (arsenite As(III)). I'm approaching the problem from multiple areas of study including solid and aqueous-phase geochemistry, hydrogeology, and microbiology. In the field we used a portable X-ray Florescence (XRF) machine to quantify elements present in sediment. Within the first few meters from the surface we observed a sudden increase in solid-phase arsenic, manganese, and iron concentrations. The increases occur at the same depths at different locations along the river. This 'iron curtain' at these depths are influencing these geochemical reactions. The stability of 'iron curtains' with rising global sea levels and increasing pumping of shallow riverbank aquifers need to be better understood to predict the fate of toxic metals in the subsurface and estuaries where toxic metals have accumulated from geogenic or anthropogenic sources.

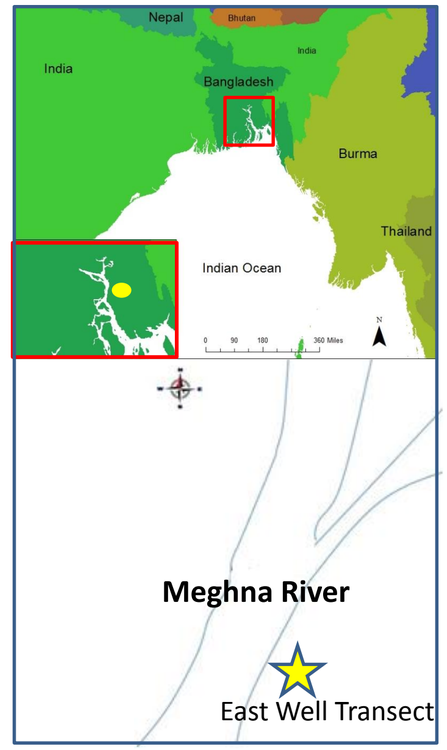
OBJECTIVE

To study the cycling of Arsenic and Iron in groundwater from the tidally fluctuating Meghna River and geochemical reactions.

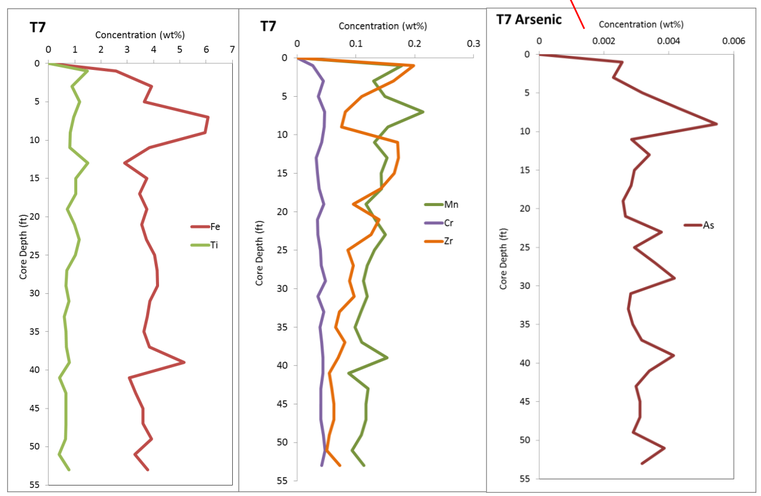
SITE OVERVIEW & RESULTS



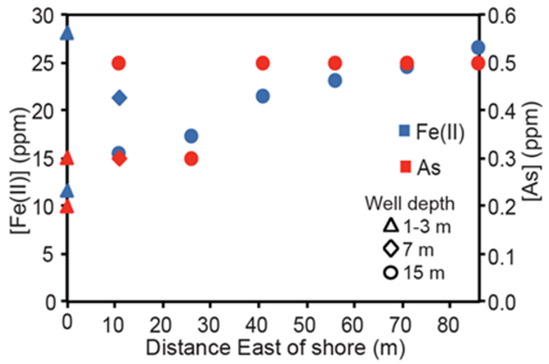
Well transect and dry-point piezometers on the East side of Meghna River and their specific conductance values



Well transect location



XRF Results for well T7



Arsenic and Iron geochemistry results from the East well transect

DISCUSSION

The XRF data shows sudden increases in Arsenic, Iron, and Manganese concentrations as seen in Datta et al., (2009).

Iron oxides act as a passive barrier and catch mobile compounds and elements, these compounds are either oxidized and precipitated or released in their aqueous form.

River tide flooding causes compounds and elements such as Arsenic to oxidize into a toxic mobile form, contaminating the groundwater.

Studying the geochemistry and microbiology under fluctuating flow directions within tidally influenced riverbank aquifers may allow greater Arsenic mobilization across the delta.

FUTURE WORK

Do microbiology analyses and X-Ray Diffraction on sediment samples and interpret results.

Analyze the water samples to be taken in April and compare with the geochemistry results from January.

REFERENCES

Datta, S. et al., (2009), Redox trapping of arsenic during groundwater discharge in sediments from the Meghna riverbank in Bangladesh, *PNAS,* 106, 16930-16935.

Fendorf, S. et al., (2010), Spatial and Temporal Variations of Groundwater Arsenic in South and Southeast Asia, *Science,* 328, 1123-1127.