

Silt layers in sandy riverbanks counteracts the removal of arsenic within hyporheic zones

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Geogenic arsenic in shallow groundwater has poisoned millions of poor rural people across the Bengal Basin. Holocene aged sediments in flat-lying areas of the Ganges-Brahmaputra-Megha Delta contain toxic concentrations of dissolved arsenic exceeding the World Health Organization's drinking water guideline of 10 µg/L by up to 100 times. This mass poisoning has shortened millions of lives through vascular diseases and cancers and reduced economic growth. Mitigation efforts are underway, but the success of these efforts partially rests on our understanding of hydrological and biogeochemical processes which trigger the release of arsenic. Published evidence suggests two sources: 1) iron oxide minerals which sorb arsenic oxyanions to their charged surfaces; and 2) the surfaces of clay minerals and/or pore-waters within clay layers. To understand how subsurface hydrology, geology and geochemical reactions interact to determine the mobility of arsenic, we studied how arsenic behaves at the terminus of groundwater flowpaths: the riverbank aquifer of gaining rivers. I will compare the behavior of dissolved arsenic within the intertidal zone at two riverbank sites along the Meghna River to reveal how river stage fluctuations and the buried geological layers respectively *act* and *counteract* chemical reactions which immobilizes arsenic from groundwater that discharges to the river. At a homogeneous sandy riverbank, mixing with river water maintains an iron oxide layer which acts as an active sink for dissolved arsenic advecting towards the river. At the second site however, the presence of a buried silt layer suppresses the redox state within the mixing zone, thereby preventing iron oxides from forming. Not only is an arsenic sink absent, arsenic is released to sand pore-waters prior to discharging to the river. This is likely because the silt layer expulses both arsenic and mobile dissolved organic carbon (DOC) which lowers the redox state of the overlying sands. This generates and maintains dissolved arsenic. Pore-waters advected from silt can drive the release of dissolved arsenic from sand and keep it in solution within river-aquifer mixing zones. Our observations reveal stark differences in the fate of arsenic in groundwater discharging to gaining rivers owing to differences

in buried geology.

