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Arsenic contamination of groundwater at recharge area in Sonargaon, Bangladesh

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Formation process of arsenic contaminated groundwater at a recharge zone in Sonargaon, Bangladesh

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Arsenic contaminated groundwater had been expanding in Asia. Particularly serious health problems have been reported from various area of Ganges delta, where reductive dissolution of Fe oxyhydroxide via biodegradation is the consensus model to explain the mechanism of dissolution of arsenic into groundwater. However throughout the research work in Sonargaon, Bangladesh, we suspect since highly arsenic contaminated groundwater appears in a recharge area where the groundwater has dissolved oxygen. We can observe the earliest stage of formation of arsenic contaminated groundwater in this area. In this study, groundwaters were collected from household tube wells in September and December 2010. Twelve test Tube wells in a recharge zone were drilled at three different depths (5 ,10 and 15m) in the September, and the groundwaters were collected from those wells.

Total arsenic concentration of groundwater collected from the test tube wells increases with increasing depth. Arsenic concentration exceeds 0.2mg /L at 5m depth, indicating that dissolution of arsenic starts just after groundwater in infiltrated into the aquifer. Arsenic concentrations at depth 10 and 15m are approximately 0.8mg/L. Arsenic concentration of an adjacent tube well exceeds 1mg/L at 30m depth. Therefore, the arsenic is most actively released into the groundwater between 5 to 10 m depth. Arsenite/arsenate ratio changes with depth, As (3):As(5) = 4:6 at 5m depth, 1:9 at 10m depth, 0.5:9.5 at 15m depth, and 0.5:9.5 at 30m depth. Reduction of arsenic seems to be completed at 15m depth.

Reduction of groundwater would not be an important to release arsenic since dissolved oxygen is present in the groundwater at 30m depth. Highly arsenic contaminated groundwater appears in a circled area of 150m radius. Arsenic-free groundwater is present around the arsenic contaminated area.

The previous study documented the three sedimentary layers were present beneath this area, i.e., Holocene sand layer (upper aquifer) including high arsenic groundwater as an aquifard , and Pleistocene sand layer (lower aquifer) . However, the mud layer does not appear beneath the recharge zone where high arsenic contaminated groundwater appears, and the Holocene and Pleistocene sand layers directly contact. Presumably, the uptake of groundwater for irrigation from the Pleistocene aquifer promotes the downgoing flow of groundwater, and such a flow promotes release of the arsenic into the groundwater.

Keywords: Arsenic, groundwater, Bangladesh, Sonargaon, Arsenite/arsenate, oxyhydroxide