Relation between microbiology, hydrogeochemistry and sediment chemistry in explaining occurrences of high groundwater arsenic sites in Matlab, SE Bangladesh

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High arsenic (As) concentrations in the Holocene alluvial aquifers of SE Bangladesh are one of the main obstacles to ensuring safe drinking waters to the rural people. Our study examines variation in microbiology and sediment and water geochemistry with depth along a transect in Matlab, Bangladesh. For our study, we collected two sediment cores, one in North Matlab and one in South Matlab. The cores ranged up to 110m in depth and were collected in the 2013 post-monsoon season. Groundwaters from existing piezometer were Ca–Mg–HCO_3 type in the shallow aquifers, Mg-HCO_3 type in the intermediate depths and Na-K-Cl in the deeper aquifers. Sediment grain size and color were important parameters to consider because those are reflections of microbial community, mineralogical makeup and extent of As contamination. More than 101 bacterial families were present in the 8 sediment samples from South Matlab Core, and less than six families out of them comprised more than 5% of the community. *Comamonadaceae* and *Moraxellaceae* were commonly detected, but their percent abundance differed with depth. Some of the sequences from each sample grouped in families that contain species capable of metal reduction, including *Rodocyclaceae, Enterobacteriaceae, Aeromonadaceae and Acetobacteraceae* were the families capable of Fe and other metal reduction. Operational taxonomic unit (OTU) based beta diversity analyses showed that 92m and 110m samples were in same group which represents medium to coarse grain sand and having light gray color (white). Dissolved As at this depth is less (<10 μg/L, hence a safe aquifer for future drilling). A different group of microbial community was common within by 10m and 27m samples. These two depth sediments are highly micaceous (~5-10%), and are of fine sand size and showing gray color (black). Arsenic concentration in this aquifer was 150-230 μg/L. The last group comprised of 45m, 65m, 81m and 100m depth samples. These are dark gray color (Black, according to Munsell Chart), sediment size was mainly clayey and silt and dissolved As concentrations at these depths were within 350-650 μg/L. We found significant relationships between bacterial community structure, grain size fractionation, dissolved As concentration and sediment C, Mn, and Fe concentrations for these samples from Matlab. A possible explanation can be that total C, Mn and Fe may control the release of aquifer As from sediments to groundwaters, but the process is also dictated by the composition of the bacterial community within those depths of sediments