Sustainable arsenic mitigation below the redox-chemocline by using sediment color as a tool for the local drillers of Bangladesh

M.R.H. MOZUMDER[1]*, M. HOSSAIN[2], P. BHATTACHARYA[2], K.M. AHMED[3], M. A. HASAN[3], M.M. RAHMAN[4], M. VON BRO¨MSSEN[5] AND S. DATTA[6]

[1]Lamont Doherty Earth Observatory of Columbia University, NY 10964, USA (*mozumder@ldeo.columbia.edu)
[2]KTH Royal Institute of Technology, Stockhom, Sweden
[3]University of Dhaka, Dhaka-1000, Bangladesh
[4]Jessore University of Science & Technology, Bangladesh
[5]Rambo¨ll Sweden AB, Stockhome, Sweden
[6]Kansas State University, Manhattan, KS, USA

Groundwater arsenic (As) in high concentrations in shallow aquifers of Bangladesh is well known for more than a decade. Due to the complex fluvio-deltaic geology and spatially variable hydrostratigraphy, safe depths to the low arsenic horizons are not well constrained. Our current study at Matlab, SE Bangladesh shows the existence of a redox-chemocline (RC) at about 40 m b.g.l., which demarcates the reducing (above) and oxidizing (below) aquifer conditions. The RC is a physico-chemical interface where the redox-sensitive parameters display a marked change. We propose that, combining the concept of RC with a rigorously developed sediment color tool will provide the local drillers with an inexpensive, simple As mitigation technique. Analytical results of a total of 155 groundwater samples obtained in 2009 over a depth range of 10-300 m across a ~400 km^2 area at Matlab demonstrate that, the mean groundwater Eh, As_{tot}, Fe_{tot}, NH_4^+-N, and PO_4^{3-}-P above the RC are significantly higher than that measured below the RC. Groundwater Mn^{2+} concentration, however, is low above the RC; reach its peak within the first tens of meters below the RC and remains consistently low thereafter. The dual nature of Mn^{2+} below the RC is attributed to variations in redox status within the different groups of oxidized sediments [1]. Sediment cuttings retrieved from above and below the chemocline are primarily characterized by gray/black and red/off-white/white colours, respectively. These colours are assigned in the field using Munsell soil colour charts. If the local drillers of Matlab and elsewhere in Bangladesh can be trained to recognize the typical oxidized sediments' colours below the RC, this method will stand the test of time as a reliable As mitigation option.

[1] von Bro¨mssen M. *et al* (2007). *Science of The Total Environment* **379** (2–3), 121–132