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Targeting Safer Aquifer At A Highly Arsenic Contaminated Community; South-Western Bangladesh

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The depositional pattern, geochemistry and mineralogy of the Arsenic (As) contaminated sediments along with the chemistry of groundwaters extracted from the Holocene deposit of an As hotspot, Kalaroa, Southwestern Bangladesh have been investigated in this study. These were done to elucidate a unified view that could explain the accumulation and distribution of As on the sediment surface and its subsequent release into the groundwater. Such view of As distribution mainly helped to find out eventually the possible existence of any safer aquifer that could provide adequate potable water to that targeted community.
Two key geochemical parameters, the reaction rate Kr and the partition coefficient, Kd were found to be very promising in explaining the As release mechanism. Showing the realistic natural biotite dissolution process, the in-situ Kr that was derived by applying inverse mass balance model (2.72 $\times$ 10-16 /sec), was found to be slower by only three orders of magnitude than that was determined with the laboratory study (3.19$\times$10-13 /sec).
A parametric predictor equation, that can calculate the partition coefficient Kd based on the aquifer sediment's minerals such as Fe and Al contents along with pore-water pH was developed in this study. Another Kd model based on the diffuse double layer surface complexation theory has also been developed to compare the appropriateness of the parametric Kd model. These two models were compared with the in-situ based field Kd data and were found in a good agreement.
Integrating those two essential geochemical parameters (Kd and Kr), a 1D-Finite Difference numerical model was applied to observe and evaluate the As pollution scenario for the studied Holocene aquifer. The simulation showed very promising results introducing the idea that the deeper aquifer's groundwaters would be remained safe against being contaminated with high As in future, due to the presence of a number of encouraging factors. The most significant among such factors can be mentioned as: i) the absence of any active leaching source that may offer lower possibility of As release within those aquifers; ii) the existence of a silty-clayey aquitard that might hinder further transport of As, which would have released from the overlying aquifers and conveyed later with the downward groundwater movement; iii) abundances of adsorbing minerals like Fe, Al that might trap As, in case of any As which might reach through the fissures and cracks which would have developed in the aquitard with the unplanned randomly tube-well installations by the villagers. As a consequence of these supportive subsurface hydro-geological and geochemical responses, the deeper aquifer would be the potential source in future for providing sustainable, safe, ample and adequate quantity of water in an affordable way for the As affected poor community.