

Oxyanion-forming trace elements and associated geochemical processes in high Arsenic aquifers

Santanu Majumder¹, Michael Vega^{2,3}, Saugata Datta^{1*}

¹ Texas A&M University., College Station, TX 77843, USA
(*correspondence: sdatta1511@exchange.tamu.edu)

² Kansas State Univ., Manhattan 66506, USA

³ WE2ST Center., Colorado School of Mines, USA

A widely reported site (Murshidabad district, south-central part of Bengal Basin), with highly enriched concentrations of As in groundwater, were chosen for this current study. Geochemical studies in the proposed study area are largely focused on As groundwater contamination issues and consequences to population health. However, given the current emergence on trace element co-occurrence and their inter-linked hydrogeochemistry, it is getting imperative to look beyond As and investigate other trace elements (some of which are significantly toxic, and, in cases, could be influential towards As mobilization) in groundwater. Thus, considering the lack of information on these elements and their environmental importance, the purpose of this study was to evaluate the distribution of selected trace elements (As, U, Sb, Fe, Mn, Mo, Se, V) and their inter-relationship in terms of geochemistry and mobilization. Samples were taken from 4 sites on either side of the river Bhagirathi: Nabagram and Kandi (west, Pleistocene aquifers), Hariharpara and Beldanga (east, Holocene aquifers). High As, high Fe and low Mn concentrations were found in groundwaters from the Holocene aquifers, while the Pleistocene aquifer, seemed to contain much lower concentrations of As but higher in Mn. In the eastern sites, total Fe concentrations showed a strong positive correlation with As ($R^2 = 0.82$), whereas poor correlation existed in the groundwaters from west. Similar to As and Fe, other oxyanion forming trace elements such as Mo, Sb and V were found in higher concentrations to the east of the river and lower in the western sites (overall R^2 are 0.76, 0.69 and 0.68 respectively with As and 0.81, 0.65 and 0.73 respectively with Fe). This indicated that their release could principally be controlled by microbe assisted reductive dissolution of Fe. However, U and Se show opposite correlation to As, when all sites are taken under consideration (R^2 are 0.19 and 0.03) and Fe (R^2 are 0.07 and 0.01), showing that these elements are moderately insoluble in Fe-reducing conditions. This showed that oxyanion forming trace elements may behave differently based on given redox conditions which could subsequently affect their mobilization.