Spatial Variations and Role of Dissolved Organic Matter in Arsenic Mobilization in Bengal Basin

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The distribution of arsenic (As) and its release mechanisms in sedimentary aquifers have been studied for several decades. Complex hydrogeology, redox biogeochemistry and presence of dissolved organic matter (DOM) in the aquifers appear to control As oxyanion release. Currently, reductive dissolution of As-bearing iron minerals by the bacteria fueled by labile DOM is considered as the main mechanism of As release from sediments deposited in the Bengal Basin during Holocene and late Pleistocene. Whereas the aquifer geochemistry has been studied widely across the basin, DOM characterization has only begun recently. Here, we describe the spatial distribution of DOM across aquifers of the Bengal basin from fourteen study sites (eleven in India and three in Bangladesh) along an east-west transect crossing the River Ganges[1-6]. The dissolved As concentrations ranged between <1 to 643 μgL^{-1} across these sites and correlated strongly with dissolved organic carbon (DOC), a fraction of DOM, concentrations (R = 0.94) that ranged between 0.65 to 9.6 mgL^{-1}. Fluorescence signatures of groundwater DOM from parallel factor (PARAFAC) models revealed a strong correlation between high As concentrations and humic-like, terrestrially-derived DOM. Further, a negative correlation between dissolved As concentration and the carbon to nitrogen (C:N) ratio was observed. Lastly, the proportion of labile and recalcitrant DOM plays an important role in As mobilization as does bulk DOC and TDN concentrations. Earlier studies indicated that humic-like DOM can enhance As mobilization via aqueous complexation, competitive sorption and electron shuttling[7]. This study offers an overview of DOM distribution across the basin and highlights processes that can help explain the heterogeneous distribution of As concentrations in groundwater.

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