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Chemical weathering and arsenic enrichment in aquifer of Brahmaputra River Basin, India, adjoining Eastern Himalayas

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Arsenic (As) enrichment in the shallow aquifers of Brahmaputra river basin (BRB), mostly located in the Indian state of Assam, has not been known for a long time. So far, very limited number of studies has been done to understand the geological and geochemical processes controlling groundwater chemistry and evolution in the BRB. The present study interprets the groundwater solute chemistry, hydrogeochemical evolution, As enrichment and aquifer characterization in BRB with special reference to two geologically distinct regions in upper Assam, India. These regions consist of the northern (N) region (located along the Eastern Himalayas) and southern (S) region (near Indo-Burma Range) of the Brahmaputra basin which shows distinct tectonic settings and sediments provinces in the Himalayas orogenic belt. Shallow alluvial aquifers of the northern part are mainly composed of grey/brown sand (fine, medium and course) and light grey clay however aquifers of southern part mainly composed of black/dark grey clay and fine grey sands. Aquifers of S-region are severely contaminated with dissolved As (maximum 0.45 mg/L) in comparison to the northern aquifers (maximum: 0.18 mg/L). However, both areas have similar reducing, postoxic environments with high concentrations of total organic carbon (TOC), and saturation index calculations suggest that As is liberated primarily by reductive dissolution of metal oxides. Major mineralogical compositions of the aquifer sediments analysed by FESEM/EDX, XRD and thin section which indicate the major presence of Fe-oxide and oxyhydroxides, mica (muscovite and biotite), feldspar, pyroxene, abundance of quartz and some clay minerals whereas clay highly present in sediments of S-aquifers. The major-ion composition shows that groundwater composition is mainly Ca2+-HCO_3- and Ca2+-Na+-HCO_3 in N-region while S-region part is dominated by Na+-Ca2+-HCO_3- hydrochemical facies. Molar ratios and thermodynamic calculations show that groundwater composition of N and S regions is influenced by monosiallitization and bisiallitization weathering mechanism, which led formation of secondary minerals like kaolinite and smectite. These weathered product might be derived from weathering of K-feldspar, plagioclase, pyroxene and olivine, which are major constitute in Himalayan rocks, eastern Syntaxis (N-region) and gabbroic complex (ophiolite) and basalt (S-region).