Hydrogeochemical and isotopic evidence of groundwater salinization processes in the coastal paleobeach aquifer of Cox's Bazar –Teknaf area, south-east Bangladesh

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To supply fresh water for over 1,000,000 tourists every year, along with for domestic, aquacultural and agricultural demands, the risk of saline water intrusion has increased significantly due to overexploitation of the aquifer of Cox's Bazar-Teknaf area that is facing the Bay of Bengal. In order to document the invasion of seawater into the groundwater system, 73 groundwater samples were collected from different types of tubewells during April 2016 and geochemically analyzed.

Total dissolved solids (TDS) were 135 to 7919mg/l, and high values were found in the groundwaters closer to the coast and few inland wells from the northern and southern part of the study area. The ionic ratios of HCO_3/Cl, SO_4/Cl, Na/Cl and Br/Cl of the groundwater ranged from 0.02 to 164.6, 0.01 to 6.53, 0.20 to 152.09 and 0.0006 to 0.0021 respectively. The relationship between HCO_3/Cl and TDS showed that the groundwaters along the paleobeach and some isolated areas were saline with TDS >1000mg/l, associated with high ratios of Cl/TDS (0.065). Areas affected by marine intrusion had Br/Cl ratios similar to seawater (0.0015) and higher values were found, and also accompanied by low and below the marine ratios of SO_4/Cl (0.05) and Na/Cl (0.86). Groundwaters with Seawater Mixing Index (SMI) > 1.0 and TDS >1000mg/l were about 16% among the studied tubewell waters. Those saline waters had $\delta^{18}O$ and $\delta^{2}H$ values ranged from −6.2 to -2.7‰ and −38.9 to -8.9‰ respectively, and plotted on the mixing line of those values between modern seawater and local fresh groundwaters. Moreover, the shallow depth (<50m) of tubewell water had the relatively high $\delta^{18}O$ (>-4.0‰) values and $\delta^{18}O$ increases at a linear relationship with the concentrations of Cl, SO_4 and, EC. However, having significant positive correlation between TDS, B (0.01 to 5.83mg/l) and Sr (0.03 to 424.95mg/l), and the chemical signature of the saline plumes (e.g., marine SO_4/Cl, Na/Cl and Br/Cl ratios) suggest that the quality of potable water has deteriorated to a large extent due to seawater intrusion along the paleobeach toward inland up to a distance of about 3 km at the heavily groundwater exploited areas from the coast line.