Hydrogeochemical characteristics and assessment of groundwater quality in Cox's Bazar town and its surrounding area, southeast Bangladesh

A. A. SEDDIQUE[1]*, H. MASUDA[2], D. K. KREAMER[3], R. ANMA[4], Y. YOKOO[5]

[1]Dept. of Environmental Science and Engineering, Jatiya Kabi Kazi Nazrul Islam University, Bangladesh (*correspondence: aseddique1975@gmail.com); [2]Dept.of Geosciences, Osaka City Univ., Japan (harue@sci.osaka-cu.ac.jp), [3]Dept.of Geosciences, Univ. of Nevada, Las Vegas, USA (dave.kreamer@unlv.edu), [4]Univ. of Tsukuba, Japan, (ryoanma@me.com), [5]Doshisha University, Japan (yokoo@mail.doshisha.ac.jp)

Cox's Bazar is a rapidly growing modern coastal city located along the eastern shoreline of Bay of Bengal. The city is constructed over 5–250m thick unconsolidated sediments of Quaternary age that form a multi-layer placer-alluvial aquifer system, and has been identified as one of the towns with groundwater quality deterioration in recent times. Furthermore, extensive urbanization, industrial and agricultural activities have resulted in overexploitation of groundwater and are threatening the aquifer. In order to assess the chemical quality of well waters, 115 groundwater samples were randomly collected and analyzed during the pre-monsoon season (June, 2013) in an area of ~7km^2 in Cox's Bazar paleobeach and its vicinity, from different types of tubewells, which included hand pump fitted bore wells (<50m depth), moderately deep energized bore wells (50-100m depth) and deep bore wells (>100m depth).

Results of our geochemical analyses showed that electrical conductivity (EC) and the total dissolved solid (TDS) content of groundwater are highly variable ranging from 202 to 6730µS/cm and 125 to 4509mg/l respectively. The cross plot of HCO_3/Cl and TDS shows that groundwater along the paleobeach and some isolated areas are saline with TDS >1000mg/l, associated with high ratios of Cl/TDS (0.065). Generally the water type is Na^+- Cl to Ca^{2+}-Mg^{2+}-SO_4Cl^- with an intermediate Ca^+-Mg^+-Cl^-, suggesting that the aquifer system interacts with seawater and undergoes cation exchange. Results also reveal that the area affected by marine water intrusion has ionic ratios of Br/Cl (0.0006 to 0.0021) similar to seawater (0.0015) with some higher values. Groundwaters along the paleobeach and some isolated areas, low ionic ratios of SO_4/Cl (0.01 to 6.53) and Na/Cl (0.20 to 152.09), relative to marine ratios (0.05 and 0.86 respectively), are also observed. Groundwaters with Seawater Mixing Index >1.0 and TDS >1000mg/l constitute about 30% of the studied groundwaters and have relatively high $\delta^{18}O$ (>-4.0‰) values. Moreover, 5% of shallow tubewells (<100m depth) are contaminated with radioactive heavy metals (i.e. U, Th), and 80% show high trace element concentrations (i.e. Mn, B, Sr, Fe) that exceed the WHO (2008) drinking water guidelines for certain tubewells. These geochemical variations suggest that the quality of potable water has deteriorated to a large extent due to seawater intrusion along the paleobeach, migrating inland toward the heavily groundwater exploited areas from the coast line and may entail various future health hazards.