IWRM2018-118
8th International Water Resources Management Conference of ICWRS

Fluoride in groundwater: a case study in Precambrian terranes of Ambaji region, North Gujarat, India

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Fluoride is one of the critical ions that influence the groundwater quality. World Health Organization (WHO) and Bureau of Indian Standards (BIS) set an upper limit of 1.5 mg/L in F– concentration for drinking water purpose and above affects teeth and bones of humans. The presence of fluoride in groundwater is due to an interaction of groundwater and fluoride bearing rocks. Fluoride rich groundwater is well known in granitic aquifers in India and elsewhere. Generally, the concentration of F– in groundwater is controlled by local geological setting; leaching and weathering of bedrock and climatic condition of an area. The main objective of the present study is to assess the hydrogeochemistry of groundwater and to understand the abundance of F– in groundwater in hard rock terranes of Ambaji region, North Gujarat. A total of forty-two representative groundwater samples were collected and analyzed for major cations and anions using ICP-AES, Ion-Selective electrode, UV-Spectrophotometer and titration methods. The F– concentration in groundwater of this study area ranges from 0.17 to 2.7 mg/L. Among, twenty groundwater samples have fluoride exceeding the maximum permissible limit as per the BIS (1.5 mg/L). It is also noticed that residents of this region are affected by dental fluorosis. The general order of the dominance of major cations is Na+ > Ca2+ > Mg2+ > K+ and that of major anions is Cl– > HCO_3– > F–.Geochemical classification of groundwater shows most of the samples are Ca-HCO_3– and few are Ca-Mg-Cl and Ca-Na-HCO_3– in the hydrogeochemical facies. The semi-arid climatic conditions of the region, the dominance of granitoid-granulite suite rocks and the fracture network in the disturbed and brittle zone has facilitated development of potential aquifers and enrichment in F– concentration in this area. The concentration of fluoride is due to high evaporation rate, longer residence time in the aquifer zone, intensive and long term pumping for irrigation.