

Hydrochemistry and stable isotope characteristics of groundwater around the coal-fired thermal power plants in Visakhapatnam regions in southern India

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Groundwater is a crucial resource for life on earth and is used in various domains such as industries, agriculture, and households. Inadequate maintenance of drainage systems and improper treatment of industrial effluents are causing a decline in groundwater quality. The present study has focused on understanding the impact of coal-fired thermal power plants on groundwater resources. Around 77 groundwater samples were collected from the Thermal Power Plants in the Visakhapatnam region of Andhra Pradesh, India, in April 2022. The water samples were analyzed for 13 vital physicochemical parameters using ion chromatography (IC), while stable isotopes such as δD and $\delta^{18}O$ were measured using an isotope ratio mass spectrometer (IRMS). The pH values of the groundwater were found in the range of 6.39 to 7.93, whereas EC and TDS range from 330-6200 $\mu S/cm$ and 170-3100 mg/L, respectively. The average concentrations of the cations such as Na^+ , K^+ , Ca^+ , Mg^+ are 252.86 mg/L, 14.48 mg/L, 71.74 mg/L, 36.29 mg/L while anions like F^- , Cl^- , NO_3^- , SO_4^{2-} are 0.64 mg/L, 348.98 mg/L, 40.27 mg/L, 107.26 mg/L, respectively. Piper diagram showed dominance of mixed Ca-Na- HCO_3 type might be contributed due to weathering of rocks-minerals and human activities. Further evaluation of the results by Gibb's plot showed that rock water interactions largely dominated the chemistry of the groundwater system in the Visakhapatnam region. Besides, $\delta^{18}O$ values were found in the range of -7.12% to -2.90% with an average of -5.45%, while the δD values varied between -46.53% to -22.09% with an average of -36.45%. The deviation from the Local Meteoric Water Line (LMWL=6.1199x - 3.0728) and the Global Meteoric Water Line (GMWL=8x+10), suggest that evaporation has a dominant effect over precipitation and groundwater has been affected by local evaporation, rock-water interaction. Based on water quality index (WQI), groundwater is mostly suitable for drinking purposes, however poor water quality observed in the vicinity of the thermal power plants.