Application of multi-hydrochemical indices for spatial groundwater quality assessment: Ziway Lake Basin of the Ethiopian Rift Valley

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The present study evaluates the suitability of groundwater for drinking and agricultural purposes in the Ziway Lake Basin (ZLB) of the Ethiopian Rift Valley. For this purpose, major and trace elements content were analyzed from 55 groundwater samples collected from the study area. Groundwater used for drinking contains multiple inorganic contaminants in levels that exceed the World Health Organization (WHO) recommended limits. The most frequent of these violations were for Na^+, K^+, HCO_3^-, F^-, Mn, As, U, Pb, and Mo. The modelled Drinking Water Quality Index (DWQI) values of the groundwater showed wide variation ranging from 12.7 (Excellent category) to 714 (Unsuitable category) with an average value of 94. Likewise, the Irrigation Water Quality Index (IWQI) of the groundwater varied from 13.2 to 520 with an average value of 106. Both DWQI and IWQI value suggest that groundwater quality is generally characterized as excellent water quality for drinking and irrigation use in the headwater regions of the ZLB and progressively become extremely unsuitable towards the rift floor. The exceptionally high DWQI values to the west of Lake Ziway is mainly associated with the co-occurrence of multiple toxic elements which corresponds to the Quaternary sediments and rhyolitic volcanic rocks. Silicate weathering and ion exchange are the dominant geological processes controlling groundwater quality with limited anthropogenic stress.