Origins of high nitrate in groundwater in Tanzania

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Abstract

Dodoma is located in a semi-arid climate (mean annual rainfall 550 mm) in an area of crystalline basement rock. The groundwater contains high nitrate with NO_3^- concentrations averaging 150 mg l^{-1} and total mineralization between 1000–3000 mg l^{-1}. Factor analysis has been used for the identification of factors that bring about the chemical character of groundwater. Three rotated factors, explaining 77.2% of the total data variance, were extracted. The first factor accounts for 51.0% of the variance and shows high positive correlation with Na^+, K^+, Mg^{2+}, Ca^{2+}, Cl^-, SO_4^{2-}, HCO_3^- and SEC and is attributed to the leaching of surface and soil salts together with mineral dissolution. The second factor accounts for 14.1% of the variance and is positively correlated with NO_3^- and negatively correlated with pH; this is explained by the nitrification process taking place on the sewage effluents. The third factor is highly positively correlated with ^{18}O and ^{2}H, accounting for 12.1% of the variance and is a consequence of evaporation processes. Nitrate concentrations greater than 100 mg l^{-1} are commonly found in both deep and shallow groundwaters. It is concluded that the high nitrate concentrations have originated from the sewage effluents that are advecting and dispersing through macropores under bypass flow mechanisms.