

Hydrochemical Evolution of Ground and Surface Water within the Amansie and Adansi Districts of the Ashanti Region, Ghana

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Abstract

Source–rock deductions of major ions and saturation states of minerals in groundwater were employed to determine the origin of dissolved ions and the thermodynamic controls on the groundwater composition respectively in groundwater within the Amansie and Adansi Districts. The main objective of this study is to characterize groundwater and delineate soil-water-rock interactions responsible for the chemical evolution of groundwater within the districts. Fifty-nine boreholes, twelve wells and two stream samples were collected for quality assessment. Results show that, silicate weathering and ion-exchange reactions are the major processes influencing groundwater chemistry within the Districts. Results also show that groundwater within the districts is strongly to moderately acidic as, 62 % of the groundwaters has pH that range 3.6 - 6.0. Acidity in ground and surface water within the districts is attributable predominantly to natural processes than mining activities; however, the groundwaters still have the potential to neutralize acids due to the presence of silicates/aluminosilicates. The waters are fresh ($EC < 500 \mu S/cm$) with conductivity values which ranged 22.8 – 473 $\mu S/cm$, and a mean value of 172.9 $\mu S/cm$. TDS of the groundwaters ranged 14.9 – 309.8 mg/L with a mean value of 112.6 mg/L. The relative abundance of cations and anions are in the order: $Ca^{2+} > Na^+ > Mg^{2+} > K^+$ and $HCO_3^- > Cl^- > SO_4^{2-}$ respectively. The states of saturation of the groundwaters with respect to major minerals using hydrogeochemical transport model Phreeqc for Windows suggest that, anhydrite and gypsum are subsaturated and indicates that, groundwater within the districts originates from a formation with insufficient amount of these minerals in solution or short residence time of these minerals with groundwater within the districts. Two principal hydrochemical water types; Ca-Mg- HCO_3 and Na-Cl have been delineated, with Ca-Mg- SO_4 , Na-Mg-Ca- HCO_3 and Na-Cl- SO_4 as minor water types. Groundwater within the districts principally evolves from fresh Ca-Mg- HCO_3 type water into Na- HCO_3 type water into Ca-Mg-Cl type water into Na-Cl type water along its flow path due to ion-exchange reactions and therefore, largely characterized by recharge processes through mixing with waters of geochemically different ionic signatures.