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Aquifer management

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Environmental and artificial tracers in hydrogeology

title: **Groundwater recharge estimations in the Densu River Basin, Ghana, using environmental isotope data ($\delta^{2}\text{H}$, $\delta^{18}\text{O}$)**

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Accurate estimation of groundwater recharge is essential for reasonable management of aquifers. A study of environmental isotope ($\delta^2\text{H}$, $\delta^{18}\text{O}$) depth profiles was carried out to estimate groundwater recharge in the Densu River Basin in Ghana. Three observation sites were chosen that differ in their elevation, geology, climate, and vegetation. Water isotopes and water contents were analyzed with depth to determine the flow processes in the unsaturated zone. The measured data showed isotopic enrichment in the soil water near the soil surface due to evaporation. Seasonal variations in the isotope signal of the soil water was observed to a depth of 2.75 m. Below, the isotope signal was attenuated due to high diffusion/dispersion and low flow velocities. The groundwater recharge was determined by numerical modeling of the unsaturated water flow, resulting in a contribution of 6–13% of the precipitation to the groundwater recharge in the catchment area which equals 94–182 mm/a. Besides, the approximate peak-shift method was applied to give information about groundwater recharge rates. Here, slightly different values (110–250 mm/a) were calculated giving a mean groundwater recharge of 11–14% of the annual precipitation. The calculated groundwater recharge rates indicated that more water is renewed than consumed nowadays. However, with an increasing trend in population more clean water is required and the knowledge about groundwater recharge rates is necessary to improve the groundwater management in the Densu Basin.



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