Groundwater recharge estimation and associated mechanism using hybrid chloride mass balance, water level fluctuation and isotopic methods in the White Volta River Basin of Ghana.

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Introduction

Quantifying groundwater recharge and residence time constitute a valuable tool for sustainable exploitation and management of groundwater resources.

Methodology

Groundwater recharge and residence time were estimated using Water Table Fluctuation (WTF), hybrid Chloride Mass Balance (CMB), stable isotopes, carbon-14 and tritium data.

Discussion of Results

The groundwater stable isotope signatures indicate similarities with the isotope signatures of the local rainfall at Navrongo providing the evidence that, most groundwater in the area are of meteoric origin and modern recharge with fast infiltration rate. June, July and August are the probable months in which significant groundwater recharge occurs in the area and only rainfall amounts >10 mm contribute to recharge. The hybrid CMB and WTF methods yielded recharge values ranging from 19.33 to 300.85 mm and 78 to 134.84 mm. This represents mean values of 9.76 % and 9.56 % of annual rainfall respectively. The ^{3}H and ^{14}C data confirms recent recharge with short residence time of < 60 year. s; hence, a renewable aquifer system with good groundwater potential. The short residence time and resilience of the groundwater recharge to climate change is an indication of good groundwater potential and support the evidence that, future changes in rainfall and recharge are unlikely to lead to failure of improved groundwater supplies. Hence, efforts and possible legislations must be enacted to control groundwater contamination. A new method of using CMB method in environment with extensive anthropogenic activities has been proposed.

Keywords: groundwater recharge, chloride mass balance, water table fluctuation, stable isotopes, residence time; tritium, carbon-14