Multi-proxy (CFCs, Cl, δ18O and δD) assessment of the origin, residence time and recharge of groundwater in the Bilate River basin (BRB) of southern main Ethiopian rift (SMER)

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Abstract

The volcanic aquifer of Bilate river basin (BRB) that situated on the southwestern side of the MER serve as sole reservoir of water supply for urban and rural people found in the basin. This study investigates residence time and groundwater recharge process in the Bilate river basin. For the first time, this research work delivers information on the resident time and groundwater recharge on the basis of multi tracer approach (CFC's, Cl, δ ^{18}O and δD). The δ ^{18}O and δD value of groundwater found in the range of -4.9 to -1.1isotopic value of groundwater drawn along or close to AAMWL and GMWL, indicates that groundwater recharge is of meteoric origin. The groundwater of BRB volcanic aquifer comprises substantial amount of CFCs concentration. It is observed from CFC data that the oldest component of groundwater was recharged prior 1950, while the younger component recharged in different time as of 1950. The relation found between CFC's indicates that groundwater comprise mainly of binary mixture with young groundwater in the age of 20-25-year-old and that of groundwater older than 60 years. The fraction of young water in the groundwater ranges from 0.134 to 0.89 and shows decreasing trend from highland towards the rift. CFC-113 is conservative in the system and used to determine groundwater lifetime in the Bilate river basin that ranges from 26 to 63 years. The conservative chloride method i.e. chloride mass balance employed to Bilate river basin calculated yearly average groundwater recharge to be 219 mm/y which accounted for 21% of the mean annual areal rainfall. This research can help us better understand how groundwater circulation and recharge mechanism works, as well as how long groundwater stays underground in the complex hydrogeological setting of rift volcanic aquifer.

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