ABSTRACT

Integrated approach has been used to investigate the hydrogeological framework of a complex fractured volcanic aquifer system in the Upper Awash river basin located at the western shoulder of the Ethiopian rift. The groundwater flow system and mechanism of recharge of different aquifers have been studied using conventional hydrogeological field investigations, hydrochemistry, isotope hydrology and numerical groundwater flow modeling techniques. Litho-hydrostratigraphic relationships were constructed from lithologic logs obtained from exploratory drilling of deep boreholes. The result indicates quite complex flow pattern and hydraulic characteristics of the different volcanic aquifers. The litho-hydrostratigraphic correlation indicates that the permeable and porous scoraceous lower basaltic aquifer is extended laterally all the way from the Blue Nile Plateau to the study area. .The analysis of the temporal and spatial variation of water samples from different places revealed clear groundwater-surface water interactions. New evidences have also emerged on the inter-basin groundwater transfer. Two distinct regional basaltic aquifers (Upper and lower) are identified showing distinct hydrochemical and isotopic signatures. In the southern part of the study area the upper and lower aquifers form one unconfined regional aquifer system. In the northern and central part of the basin, it appears that the two systems are separated by regional aquiclude forming confined aquifers, in places with artesian wells. The groundwater from the deep exploratory wells (>250m) tapping the lower basaltic aquifer and wells located in the south were found to be moderately mineralized (TDS: 400-600 mg/l), with relatively depleted stable isotope composition and with almost zero tritium. In contrast, the upper shallow aquifer has lesser ionic concentration, more isotopically enriched. Evidences from the different methods clearly indicate inter-basin groundwater transfer from the Blue Nile basin to the Upper Awash basin. The evidences also converge to testify common origin of recharge, presence of hydraulic connectivity for systems tapping the lower basaltic aquifer. This has enormous practical implication in finding large groundwater reserve at a greater depth that can solve the current water supply problems of the community including the capital Addis Ababa. It will also have important role in finding more regional aquifers along the plateau-rift margins in many areas having similar hydrogeological setup as the study area.

Key words: Ethiopia, Upper Awash Basin, Volcanic aquifer, Hydrostratigraphy, Groundwater recharge, Hydrochemistry, Isotope, Groundwater flow modeling