ISOTOPES AS A MARKER FOR POTENTIAL IMPACT OF RIFT TECTONICS ON THE GROUNDWATER SYSTEM OF THE AWASH BASIN IN THE EAST AFRICAN RIFT

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1. Introduction

Located in the tectonically active East African Rift System (EARS), the Awash Basin in Ethiopia has a complex hydrogeological setting. Until now, the groundwater dynamics and the impact of the structural setting on groundwater flow in this semi-arid region are not well understood, though the local population heavily depends on groundwater as a major water supply. Not only the use of groundwater, but also its impact on surface water is of importance in the Basin, as groundwater inflow related to recent tectonic activities appears to play a significant role in the rapid rise of the level of Lake Beseka (0.12 m/year) (Ayenew 1998, Goerner et al. 2005). This in turn causes a frequent rebuilding of infrastructure in the affected area.

2. Methods and preliminary results

With a combination of isotope hydrology, hydrogeochemistry and remote sensing the present study investigates the flow regime development and dynamics of groundwater including the vertical stratifications of the aquifers as well as groundwater flow affected by the tectonic setting. Stable isotopes (¹⁸O, ²H) were applied to investigate the origin of groundwater, mixing between different aquifers, and the interaction between ground- and surface water. ³H was applied to determine groundwater dynamics and ⁸⁷Sr/⁸⁶Sr were applied to reveal the origin of groundwater and its history of water rock interaction.

Although a simple hypothesis has been proposed by various researchers about the EARS groundwater dynamics, suggesting the escarpment ridge to constitute the recharge area discharging into the rift valley (e.g. Ayenew, 1998, 2003), results from recent and own hydrogeological investigation and hydrochemical analysis put this premise in question (Kebede 2004) and point to a more complex hydro(geo)logical setting. This is indicated by differences in hydrochemical composition and stable isotopic signatures (e.g. ⁶⁰⁸O of -2.5 ‰ on the plateau (Kebede 2004) and of -6‰ to -4‰ on the rift flanks) between shallow and deep groundwater. Moreover, a local occurrence of thermal water was revealed, the chemical composition of which appears to differ depending on the spring's location in relation to the rift structure. We looked at the implications of faulting and subsidence on the hydrological network (Goerner et al. 2005) and propose that recent tectonic activity has modified the structure of the basin, thus changed the hydro(geo)logical system and triggered the growth of the lake Beseka.

First results of the identification of morphological expressions of fracturing and fracture zones are shown from detail lineament analysis applying enhancements and several convolution filters using remote sensing data. This is combined with an assessment of groundwater evolution and lake stratifications according to the development of hydrochemistry and its isotopic fingerprint.

3. References


