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title: **The volcanic aquifer system of the Middle Awash basin (Main Ethiopian Rift, Ethiopia)**

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The Middle Awash basin is located in the active volcano-tectonic centre of the East African Rift valley (Fig. 1) and includes complex hydrogeological systems. At regional scale, groundwater flow converges towards the rift floor constrained by mountain blocks bounding the rift floor in both side. On the other hand, the nature and distribution of aquifers are locally controlled by geological structures that affected the rocks.

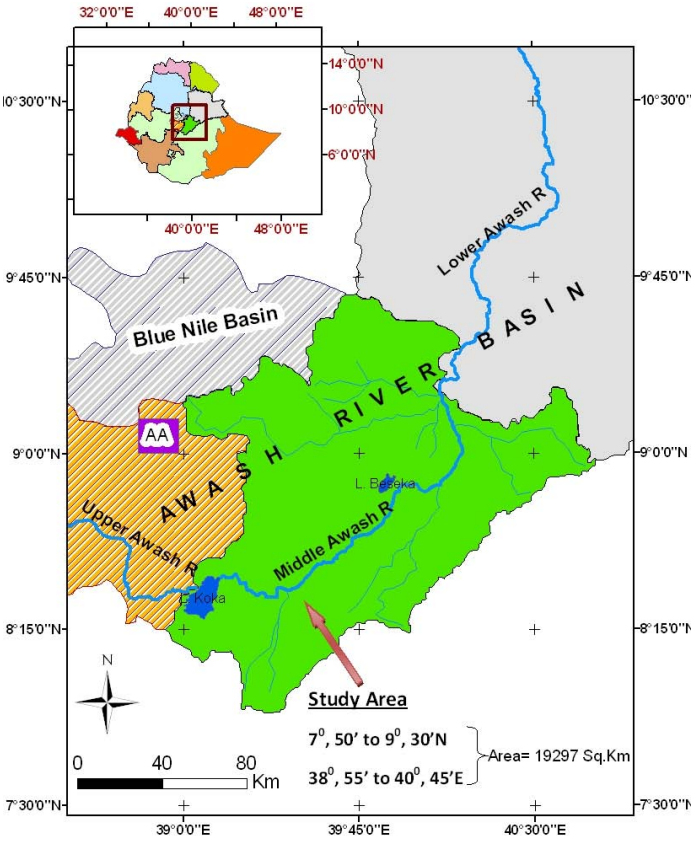

Figure 1. Location map of the Middle Awash Basin.

Integrated approach including hydrochemistry, environmental isotopes and geophysics was applied to analyze the hydrogeological systems of the basin. The combined results from various hydrogeological datasets show two distinct aquifer systems linked to geology and landforms. The calc-alkali rocks like basalts, ignimbrites, and trachybasalts form aquifers in the mountain regions. Ground waters in this region have generally acceptable natural water quality unaffected by volcanotectonics and geothermal activities. Laterally the aquifers are intercepted by slice of massive landscapes which cause lateral confinement forming a discontinuous and compartmentalized flow system. In this region, both deep and shallow flow systems have identical water chemistry of Ca–Na–HCO_3 type with TDS < 400mg/l and contain modern water. On the other hand, the alkali vesicular rocks like scoria, pumice, tuff and volcanoclastic form rift floor aquifers. Hydrochemically, the waters are Na–HCO_3 with TDS > 800 mg/l and groundwater quality is largely affected by geothermal activities.

The effect of geological structures on groundwater flow system in the study basin is substantial. The geoelectric sections along selected transects show layer with similar resistivity exhibit large displacement indicating the disruption of aquifer systems by subsurface faults. Result from 2D tomography show that faults, fissures and fractures brought two separate aquifers into contact as well as form connectivity between irrigation water and groundwater at Wonji basin. On the other hand, faults form breaching the continuity of an aquifer and disconnection between adjoining aquifers and create preferential flow paths. This is particularly common in rift floor where volcanic rocks hosting the faults retain large apertures enabling the preferential flow paths as dictated by groundwater chemistry and water isotopes.

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