GROUNDWATER GEOCHEMISTRY, QUALITY AND ITS IMPACT ON HUMAN HEALTH: FIELD BASED DENTAL FLUOROSIS ASSESSMENT IN THE MAIN ETHIOPIAN RIFT

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This study aims to investigate the link between geology, water quality and health impacts on rural communities in the Main Ethiopian Rift(MER) who rely on the local groundwater as drinking water source. The local population is affected by dental and skeletal fluorosis as an estimated 8 million are exposed to high fluoride groundwater. Of 50 studied groundwater wells, 48(96%) exceed the permissible fluoride limit of 1.5 mg/L prescribed by WHO. The fluoride contents in the groundwater (mean:9.2 ± 9.6 mg/L) are associated with other toxic elements such as As, U, V, Mo and B. Particularly, 54% of the investigated groundwater wells show As concentrations above the WHO recommended limit of 10 µg/L. Leaching experiments of the MER rhyolitic rocks and their weathered sediments were show high concentrations of F, As, Mo and U in leachates, suggesting that the local sediments represent the main source for toxic elements. The health impact was evaluated based on two approaches (1)field observation of the various degrees of dental fluorosis and collection of supplementary interview data (n=73 individuals) including gender, age, water consumption, diet, water sources for drinking; and (2)sampling of biomarkers (toenails and fingernails) for analyses of bioaccumulation of toxic elements. Preliminary data confirm that observational occurrences of prevalence and severity of dental fluorosis (normal-mild-moderate-severe) increase with fluoride concentrations in groundwater. Consequently, the data suggest that higher fluoride concentrations in groundwater are associated with an advanced degree of fluorosis among individuals who consume the groundwater as their primary drinking water. Based on the field dental health assessments, two major areas that are adversely affected by dental fluorosis ("hot spots") were identified. Given water constraints the rural communities are mainly restricted to agricultural products such as maize, teff (Ethiopia's indigenous cereal), and wheat. Dairy products are barely available. Thus, in addition to water quality, poor nutrition and diets (calcium and vitamin D deficiency) are plausibly contributed in aggravating the impact of fluoride on the health of the people. At the next phase of the research, the presence of other contaminants is examined with evaluation of their specific health impacts. This pilot study integrates water geochemistry and field-based epidemiology can be similarly applied to other sectors of the East African Rift.

Keywords: aqueous geochemistry, fluorosis assessment in Ethiopian Rift, human nails