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Effect of groundwater residence time on geogenic fluoride release into groundwater in the Mt. Meru slope area, Tanzania, the Great Rift Valley, East Africa

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People living in the Great Rift Valley in East Africa suffer from fluorosis resulting from their consumption of groundwater. This paper shows that geogenic fluoride contamination in a natural water system has changed in the last two decades in the Mt. Meru slope area of northern Tanzania based on water quality, dating of the residence time, and stable isotopes of groundwater. The results demonstrate that 1) the average recharge altitude of groundwater with a high geogenic fluoride concentration is estimated to range from 1900 m to 3000 m on the southern slope of Mt. Meru, and the fluoride concentration tends to increase with an increase in the recharge altitude, 2) the fluoride concentration increases with increasing groundwater residence time for groundwater with a residence time of 20 years or longer, suggesting that water-rock interaction processes (weathering, dissolution, and ion exchange), which depend on the contact time between the volcanic aquifer and groundwater, have predominated for approximately 20 years or longer, and 3) the mixing of aerobic young water and old groundwater has been active for approximately 20 years, and the fluoride concentration is increasing in some shallower well waters. The mixing of fluoride-contaminated groundwater with aerobic water infiltrating the aquifer through pumping groundwater in the last two decades may increase the spread of groundwater contaminated with fluoride due to increased water demand caused by rapid population growth, and urbanization, industrial growth, and the expansion of irrigated agric.