Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.33212

Charting the Presence of Critical Raw Materials in Geothermal Fields: A Case of Kenya Rift System

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The demand for Critical Raw Materials (CRM) has increased due to their role in energy transition. These critical materials vary in their occurrence across different geological formations. Although volcanic rocks are known to contain them, it is crucial to investigate their concentration in brine. Thus, there is need for exploring non-conventional sources such as geothermal brine. Their extraction alongside energy production in geothermal power plants, provides non-conventional ways of mining them. The East African Rift System is endowed with geothermal resources. Our objective was to determine the concentration of 13 critical raw materials in brine and thermal springs: Li, Rb, Cs, Sr, Ba, Ti, V, Cr, Ni, Cd, B, Sb, and Se in three geothermal fields: Olkaria, Menengai, and Paka within the Kenya Rift system. We sampled 22 geothermal brines and 15 thermal springs. The samples were analyzed using ICP MS and OES. The temperatures of the thermal springs ranged from 35.3 to 91 °C, and those of the brines from 57.7–98 °C. All samples were near neutral to alkaline (6.92-9.72 pH). Olkaria samples have a mixture of Na-Cl and Na-HCO_3 water types, Menengai and Paka brines belong mainly to the Na-Cl type. Thermal springs are a mixture of Na-Cl and Na-HCO_3 water types. Concentration of CRM are as follow: Li (0.011- 4.89 ppm), Rb (0.011-12 ppm), B (up to 120 ppm), Cs up to 1.0 ppm, Ba (0.00002-0.280 ppm), As (<2.2 ppm), while others (Ti, V, Cr, Ni, Cd, Sb, and Se) are below 0.1 ppm.

Generally, thermal springs have lower concentrations of these critical raw materials compared to brine samples, while the concentrations are comparable across the three geothermal fields. The low concentration is attributed to the high-water flow-through and the resulting dilution factor and the low concentration of the CRM in the host rocks. The findings suggest that the levels within the brine samples are low and, at the moment, not suitable for economic extraction. Monitoring the brine and thermal springs composition will ensure that future changes in the composition and the dynamic of the water flow are captured.