

Critical raw materials in geothermal fluids of the East African Rift (Tanzania)

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Within the framework of the research project "CRM-geothermal", we seek for an environmentally friendly co-production of critical raw materials (CRM) together with the provision of geothermal energy. The East African Rift System (EARS) is known for its high potential for geothermal energy with particularly the eastern branch as the most juvenile sector, where hot rift waters migrate along permeable faults sometimes up to the surface. High levels of CRM such as rare earth elements (REE), Sr, Mg, and He are expected in waters and solids in the rift, specifically in areas affected by carbonatite and other carbonate bearing volcanic rocks. In 2022, a survey was conducted to determine the CRM content in geothermal water, gas and surrounding rocks along the EARS in Tanzania.

Samples were collected at gas emanations, hot springs, alkaline lakes, and geothermal wells. The survey covered 13 sites between Lake Natron in the North and Lake Malawi in the South. Results of noble gas analysis show a mixed crustal-mantle contribution with total He concentrations reaching up to 7 vol.-% and $^3\text{He}/^4\text{He}$ ratios from ~ 0.04 up to $3.4 R_a$. They indicate a stronger mantle (higher $^3\text{He}/^4\text{He}$) component in samples from the southern part. According to a first screening of rock samples, the mineral thorite could be one source mineral among others of crustal radiogenic ^4He emission. Mineral analysis for REE in solids (rocks, sediments, deposits, stromatolites) is ongoing, and preliminary results show a remarkable concentration of REE-containing accessory minerals in volcanic rocks and elevated concentrations of REE distributed at specific sites in sediments. Water samples from hot springs (26-74 °C) and nearby alkaline lakes typically show high pH values (9-10) and are characterized by high carbonate alkalinity, elevated chloride, sulfate, and fluoride content and a very high potassium concentration of up to 9000 mg/L.

Figure: Petrography of Lake Easy basalt: Microprobe BSE image showing the enrichment of REE in carbonate phases.

