Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.34261

Evaluation of the Co-production Potential of Geothermal Energy and Critical Raw Materials in the East African Rift

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The CRM-Geothermal research project examines the sustainable co-production of critical raw materials (CRMs) alongside geothermal energy. The East African Rift System (EARS) provides substantial geothermal potential, driven by Quaternary volcanism and fault-controlled fluid migration [1]. Field expeditions across Tanzania, Malawi, and Rwanda investigated the occurrence of elements such as Sr, Li, Ge, REE, and He at geothermal sites [2,3,4]. The surveys covered 44 sites from northern Tanzania to south Malawi along the eastern branch and 15 sites along its western branch in Rwanda. Gas, water and solid samples from hot springs, lakes and boreholes were collected. On-site, geological observations, infrastructure and land use were documented alongside with results of in-situ measurements of physicochemical parameters of gas and water.

Hot springs (26–78°C) in Tanzania [2,4] and Malawi [3] exhibit alkaline pH (7.6–10.0), elevated carbonate alkalinity and chloride, fluoride, and potassium contents. Gas geochemistry revealed helium concentrations up to 7 vol% in southern Tanzania and 1 vol% at two sites in Malawi. Hot springs (25–71°C) in Rwanda have more acidic pH (5.2-7.6) and ten times lower chloride and fluoride concentrations. The lithium content in geothermal waters of southern Rwanda is locally above 1 mg/l, exceeding those measured in Tanzania (0.78 mg/l) and Malawi (0.46 mg/l). Also in Rwanda, germanium is locally present at ca.20 µg/l in springs with the highest temperature. In southern Tanzania, strontium concentrations are locally ≥10 mg/l. However, the ∑REY concentration is ≤0.2 mg/l in all studied localities.

These cratonic geothermal fluids are suitable for geothermal heat extraction. However, their low CRM concentrations render potential co-extraction economically challenging. The Mbaka Fault in southern Tanzania produces strontium-rich hot fluids, potentially worth to be harvested in addition to power and heat. In Malawi and Rwanda, the geothermal potential remains underutilized although local communities, like in Mawira (Malawi) or in Gisenyi (Rwanda), use the opportunity of 60–70°C warm water for bath, spa activities and laundry.

Harnessing this energy could provide sustainable local heating and diversify national energy sources, easing pressure on hydropower during climate extremes.

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