Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.26778

Extraction of Critical Raw Materials from Geothermal Precipitates from Reykjanes, Iceland

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Faced with the ever-increasing resource demand of an unremittingly growing and industrializing population, the synergy of energy and raw material extraction in the geothermal industry has been considered in the contexts of orebody-EGS and geothermal fluids [1, 2]. This research evaluates the potential of another non-traditional resource: geothermal precipitates (scales) and their enrichments in critical raw materials (CRMs) that have been described as equivalent to epithermal ore-deposits'. The spotlight is on sulfide scales from the Reykjanes geothermal field in Iceland that are consistently enriched in the CRMs As, Bi, Co, Ga, Mn, Sb, V and W, along with others of economic interest and importance [3]. Average concentrations upstream of the high-pressure wellheads include 24.6 ppm As, 76.5 ppm Co, 5.4 ppm Ga, 768.8 ppm Mn, 4.68 ppm Sb, 242.0 ppm V and 3.30 ppm W [3]. In laboratory batch tests of mild leaching of scale granulate from a wellhead pipeline, we utilize a variety of seawater-like, acidic or complexing leachants previously successfully employed in the leaching of sulfide-dominated ore mineralizations [1]. Fluid- and lithogeochemical analyses of leachates and leached scale test the expectation of the aforementioned CRMs from As to W being mobilized along with elements like Cd, Se, Sn, Mo and Ag. Their release is quantified in terms of magnitudes and rates of leaching, which allow to assess the effectiveness of each leachant. By devising and implementing, for the first time, a simple geochemical method for CRM recovery from sulfide scales, this study becomes complementary and contributory to EU projects dedicated to the independent and interlinked supply of energy and critical metals, as well as to global efforts within the green energy transition and towards a resource-efficient future [1, 2].

[1] Kilpatrick, Rochelle, Rushton, Lacinska, Fúzéri, Cenergy, Marriot, Hamilton, Watts, Mountney & Kemp (2017), *The Horizon Europe CHPM2030 project*, Deliverable D2.2.

[2] CRM-geothermal Project Consortium (n.d.), retrieved February 5, 2025, from https://crm-geothermal.eu.

[3] Grant, Hannington, Hardardóttir, Fuchs & Schumann (2020), *Ore Geology Reviews* 116, 0169-1368.