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Tracing Critical Raw Materials: Using Geothermal Fluids as Subsurface Probes to identify Platinum Group Element (PGE) Distributions

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Platinum Group Elements (PGEs) are valuable metals with significant economic and geological relevance. Their ore grade enrichment in the geologic record is generally associated with magmatic processes, similar to the production of geothermal heat. Circulation of such fluids within the host rock can remobilize elements, offering a unique opportunity to probe the sub-surface. Despite the economic value of PGEs, there are limited reports of PGEs in geothermal occurrences, likely due to the analytical challenges posed by their low concentrations and intricate compositions.

We developed a streamlined analytical routine for PGEs in geothermal fluids, reducing the need for complex column chemistry. A key strategy involves the combination of isotope dilution (ID) and high-resolution ICP MS. Using a PGE isotope spike for ID ensures accuracy and precision, particularly when dealing with complex matrices. It also allows for additional sample treatment, such as pre-concentration.

A field study at a geothermal well in Cornwall revealed elevated palladium (Pd) concentrations in the geothermal fluids, and analysis of the solid counterparts confirmed the presence of Pd in both scales and host rock. This demonstrates the potential of geothermal environments as a source for these valuable metals. The well, part of the EU-funded CRM-geothermal project, is targeted for co-extraction of lithium and geothermal heat. While co-extraction of PGEs is a potential application, these fluids also serve as readily accessible subsurface probes. We aim to leverage this accessibility to investigate the mass balance of PGEs between geothermal scales, source rocks, and fluids, using the latter to target promising source rocks.

By developing a simplified analytical method and utilizing geothermal fluids as subsurface probes, this research contributes to a better understanding of PGE distribution and mobility. This knowledge is crucial for optimizing geothermal resource development and exploring potential by-product recovery of critical metals.