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Tracing the Thermal History of critical raw material deposits in Bergslagen, Sweden: Insights from high- and low-T thermochronology

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Ensuring the traceability of critical raw materials (CRM) is vital for securing sustainable and ethically sourced supply chains within the EU. The Bergslagen ore province, part of the Fennoscandian Shield, hosts significant CRM deposits including rare earth elements (REE), cobalt, and nickel. However, regional-scale thermochronology studies focused on the long-term thermal evolution of these deposits are still lacking. This study integrates high- and low-temperature thermochronometers to reconstruct the thermal history of 1.91-1.75 Ga granitoid rocks surrounding key CRM deposits in Bergslagen, providing new constraints on potential ore remobilization events.

We apply Rb-Sr thermochronology on biotite to capture high-temperature (250–500°C) thermal events at the University of Gothenburg, complemented by zircon, titanite, monazite and apatite (U-Th)/He low-temperature (≤200°C) age constraints at the University of Göttingen. Bulk granitoid samples (1.91–1.75 Ga) were collected from largely unaltered and undeformed granitoids near deposits such as Bastnäs (REE), Håkansboda (Cu-Co), and Sala (Ni), as well as from drill cores at the Blötberget Fe-P deposit and the I-Edda core in southern Örebro. Additional granitoid samples were obtained along the Western Bergslagen Boundary Zone (also known as the REE line), where previous studies suggest a complex tectonothermal evolution.

Preliminary Rb-Sr results reveal two distinct age groups (~1700–1500 Ma and ~1350–1050 Ma), consistent with far-field tectonic influences previously documented in Sweden. SEM observations verify well-preserved biotite in several samples suggesting minimal alteration and suitability for Rb-Sr geochronology.

Our findings contribute to the growing body of evidence that cratonic regions, despite their perceived stability, experience episodic reheating linked to far-field tectonic events. These insights improve our ability to track past ore remobilization processes and provide a foundation for more efficient mineral exploration strategies in Europe. Routine integration of thermochronology into CRM exploration efforts may enhance predictive models for ore deposition and reactivation, supporting a sustainable transition toward European raw material independence.