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Structural-Chemical Vectors to LCT-Pegmatites in the Varuträsk Area, Sweden

Joel Andersson¹, Edward P. Lynch², Martiya Sadeghi², Samuel Lundsten³, Tobias E. Bauer¹

1. Luleå University of Technology, Luleå, Sweden, 2. Geological Survey of Sweden, Uppsala, Sweden, 3. Luleå University of Technology, Skellefteå, Sweden

The Varuträsk area in northern Sweden hosts the only historic lithium-caesium mine in Sweden. A small-scale mining operation active between 1936-1946 extracted 90.5 t lithium (petalite, spodumene, lepidolite) and 63.3 t caesium (pollucite). The mineralogy of the Varuträsk pegmatite has been described in detail by several pioneering studies, making the Varuträsk pegmatite a classic example in the pegmatite literature. Despite an exponential interest in battery metals, the Varuträsk area has not been investigated from a broader mineral systems perspective and source-transport-trap mechanisms remain unresolved.

As part of the Horizon Europe project Exploration Information System (HORIZON-CL4-2021-RESILIENCE-01 - n°1010557357 –), we combined structural mapping with whole-rock geochemistry including samples from the Varuträsk pegmatite, regionally occurring pegmatites, and potential source granitoids to identify structural-chemical vectors towards prospective pegmatites in the study area.

Results show that peraluminous leucogranites in the area form a geochemical continuum with highly fractionated pegmatites and may represent source intrusions for LCT pegmatite-forming melts. However, published age data indicate the Varuträsk pegmatite is at least >8 m.y. younger than the candidate source granites, which underlines the need for additional geochronology data to help identify the source(s?) and define timespans of the mineralized system.

Potential source granites are bounded by pre-existing shear zones, and aeromagnetic data indicate fabrics deflect around certain plutons. Quartz/granite/pegmatite veining increases towards major structures, indicating these structures served as conduits for fluid-rich granitic melts. Structural entrapment styles vary in the area. Underground mapping (physical and digital) and geological 3D modelling shows the Varuträsk pegmatite constitutes at least two shallowly dipping fault-bounded sheets that crosscut pre-existing foliation in folded, competent mafic volcanic rocks. Regionally occurring pegmatite veins hosted by metasedimentary rocks are bounded by steep fracture planes with a local fertilization trend (La/Ta vs. Mg/Li) approximately normal to pegmatite trends.