Investigating NYF-type Pegmatite deposits in Tysfjord, Norway, using ground geophysics

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Abstract

GREENPEG (2020-2024) is a project funded by the European Union under Horizon 2020, with the primary goal of developing comprehensive exploration tools for identifying lithium-rich pegmatites and high-purity quartz deposits using a variety of methods. The main aim is to establish a sustainable exploration toolkit for small-scale, high-quality ore deposits (<5 million m^3) to reduce the EU's dependence on critical raw material imports (Müller et al. 2022). The project has chosen three demonstration sites in Europe, including Tysfjord in northern Norway, known for its production of high-purity quartz from NYF-type pegmatites.

The Geological Survey of Norway (NGU), one of the thirteen partners in the GREENPEG project, has been tasked with evaluating the effectiveness of ground geophysics in various locations at Tysfjord. Until now, only a few attempts have been made to apply Ground Penetrating Radar (GPR) and Electrical Resistivity Tomography (ERT) in pegmatite exploration (e.g., Oyonga et al. 2015, Patterson & Cook 2002). However, by using these methods along with a careful consideration of local geological conditions and the petrological-mineralogical structure of the targeted pegmatite and its host rocks, it has been demonstrated that GPR and ERT can provide valuable results for near-surface exploration of pegmatites within crystalline rock formations.

ERT profiling has shown a distinct contrast between pegmatite and its host rock, with highly resistive clusters appearing when the host rock is deformed (e.g., at the Jennyhaugen site) or as conductive layering when the pegmatite itself is mylonized (e.g., at the Håkonhals site). In contrast, GPR profiling has offered insights into the geometric features of the pegmatite deposit, revealing a variety of reflectors that help, among other things, to delineate the base of the pegmatite at depths where ERT resolution is limited. Moreover, GPR has been instrumental in establishing a correlation between the presence of pegmatite and low reflectivity, particularly in cases such as the Jennyhaugen site where profile coverage is sufficiently dense. These findings confirm that ground geophysics can serve as an effective and sustainable approach for mapping and characterizing buried pegmatites. However, it's important to note that detecting pegmatites using ground geophysics can be challenging due to the reliance on generic dielectric and geoelectric properties that are not specific to pegmatites, such as low/high resistivity and/or low reflectivity.

References

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