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Application of Soil Geochemistry for Pegmatite Exploration: Spodumene Pegmatites in Ireland and Austria, and High-Purity Quartz-Bearing NYF Pegmatites in Norway

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We investigate the applicability of soil geochemistry in exploration for buried rare metal pegmatites at prospect scale (<25 km^2) as one of a range of exploration tool sets being developed for such deposits within the EU H2020 GREENPEG project. We compare the geochemistry of Ah- and C-horizon soil samples underlain by spodumene pegmatites from the 400 Ma Moylisha prospect, Ireland, and the 270 Ma Wolfsberg prospect, Austria, with those of niobium-yttrium-fluorine (NYF) pegmatites from the granite-hosted 1800 Ma Tysfjord prospect, Norway. At each locality, samples were collected along several parallel transects perpendicular to the long axis of a known buried pegmatite, or pegmatites. All soils were <1 m thick.

We show that the spatial distributions of common indicator elements for spodumene and NYF pegmatites (Li, Cs, Ta, Nb, Be) can be used to accurately locate the known buried pegmatites. Moreover, from principal component analysis (PCA), there are strong correlations among these indicator elements, especially in C-horizon samples. This horizon is also preferentially enriched in rare earth elements (REEs). C-horizon samples above the NYF pegmatites, which are typically rich in REEs, appear to be more enriched in HREEs, whereas Ah-horizon samples tend to host most of the LREEs. These patterns suggest that the comparatively immobile indicator elements and HREEs remain in the C-horizon closest to the buried pegmatites, whereas LREEs and other relatively mobile elements (e.g., Mg, Fe, Ni, Cr, Co, Pb) concentrate predominantly in the Ah horizon. In the Tysfjord NYF pegmatites, there are high U and Th concentrations in both the C and Ah samples that are likely to be detectable in the latter using airborne gamma ray spectrometry. From these results, soil geochemical data and PCA can be effectively used to explore for buried rare metal pegmatites.