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Mineralogical and Geochemical Characteristics of the Carbonatite Laterite at Sokli, Finland

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The Devonian Sokli carbonatite complex, Finland, is composed of an early ultramafic intrusive unit, a phoscorite-carbonatite unit, and a late carbonatite unit. Up to 100 m of laterite occurs on top of the bedrock, comprising a major P, Nb, and REE resource. The laterite formed during the Miocene under a warmer climate and is overlain by up to 5 m of glacial deposits. The laterite is composed of residual primary minerals, dominated by apatite, magnetite and pyrochlore, variably cemented by goethite, hematite, crandallite-group minerals, francolite, and britholite, together with pyrochlore-group and residual niobate minerals. Lenses of francolite ± britholite + vermiculite occur at varying depths. These are locally brecciated and cemented by goethite and Mn oxides. Coarse-grained phlogopite-rich intervals occur at varying depths, locally weathered to vermiculite. Assay data from Sokli Oy indicates REE concentrations are highest (up to over 20,000 ppm) in the shallow part of the laterite and either greatly decrease down the profile or fluctuate, with zones of 10-100x enrichment relative to bedrock, owing to mobilisation during weathering and lithological variation. There are only minor differences in the bulk REE pattern between laterite and bedrock, except for Fe oxide-rich laterite, which is enriched in the light REEs. REE concentrations positively correlate with Fe and Nb. Phosphate mineralogy controls enrichment trends with P, with secondary francolite zones having very low REE concentrations, whilst crandallite-group minerals correlate with strong REE enrichment, indicating at least two stages of weathering and phosphate mineralisation. The detailed paragenesis will be the subject of further investigation, alongside in-situ analysis to help determine the REE budget in the laterite.