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## Sokli – A Multimetal Carbonatite Deposit Abounds with Critical Elements

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Sokli, one of the largest carbonatite complexes in the world, is a world-class multimetal deposit located in northeastern Finland. In the center of the oval-shaped complex is a magmatic core composed mostly of carbonatites and phoscorites, which transition into metasomatized carbonatites and ultramafic rocks toward the outer zone of the complex. They are surrounded by an extensive fenite aureole, and the whole complex is cut by lamprophyre dykes of varying ages as well as late REE-bearing carbonatite dykes. On top of the bedrock are layers of weathered rock, laterite, and glacial till, where the laterite constitutes a major resource of P, REE, Nb, and Fe.

The lateritic P-deposits are mainly composed of primary fluorapatite, micas, and magnetite, with secondary francolite, crandallite, and iron and manganese oxides. In some areas, the laterites can be enriched in REE and Nb, where REE are mainly incorporated in fluorapatite and monazite/rhabdophane, whereas the bulk of Nb is in pyrochlore. Laterite units enriched in Fe, Mn, and vermiculite are also found.

The most promising hard rock deposits in Sokli are related to phoscorites and late REE-bearing carbonatite dykes. Phoscorites are potential targets for several different elements that are incorporated mainly in fluorapatite (P, REE), pyrochlore (Nb, Ta, REE, U, Th), and magnetite (Fe). The late REE-bearing carbonatite dykes comprise a highly potential exploration target, with REE incorporated largely in kukharenkoite as well as ancylite and monazite. Additionally, the whole carbonatite massif can be considered as a giant low-grade P-resource with approximately 3.5 wt % of  $P_2O_5$ .

Chiefly due to challenging location, complexity of the ores, and political decisions, the deposits in Sokli are unexploited to this day. Elements such as P, REE, Nb, and Mn are in high demand, which emphasizes Sokli's position as one of the most important critical element deposits within Europe.