

Constraints on the formation of the Archean Siilinjärvi carbonatite-glimmerite complex, Fennoscandian shield

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The Siilinjärvi carbonatite-glimmerite complex is the oldest carbonatite deposit currently mined for phosphorous, and one of the oldest known on Earth at 2610 ± 4 Ma. The carbonatite-glimmerite is a 900 m wide and 14.5 km long tabular body of glimmerite with subordinate carbonatite, surrounded by fenites. The rocks range from nearly pure glimmerite (tetraferriphlogopite = tfp) to carbonatite (>50% modal carbonate), but the latter forms only 1.5% by volume of the complex. Carbonatite occurs as thin (few cm) roughly vertical anastomosing lamella in glimmerite which grade into slightly later and thicker (10 cms) vertical veins that are concentrated in the center of the complex. The laminated structures may represent late consolidation of cumulates. Despite the large carbonate-phlogopite modal variability, the compositions of primary phases calcite, dolomite, tfp, apatite and richterite do not vary significantly across the complex. Moreover, the distribution of apatite is rather uniform, with average glimmerite and carbonatite containing 10.4 and 9.9 modal % apatite, respectively.

Compositionally the carbonatite veins are calcsio-carbonatites, whereas the glimmerites are potassic ultramafic rocks with Mg# over 0.8. All are cumulates, but are geochemically linked, showing similar trace element trends, such as evident mantle normalized negative Ti- and Nb-anomalies, possibly related to early fractionation of Ti-magnetite or titanite. Average C-O isotopic compositions $\delta^{13}\text{C}=3.7\text{‰}$ and $\delta^{13}\text{O}=7.4\text{‰}$ [1] indicate a mantle derivation [2]. Characteristics described above suggest that the Siilinjärvi complex formed via crystal accumulation from mantle-derived magmas passing through a large, well mixed magma chamber. Recently described mica-richterite-carbonate dykes in the vicinity are prospective as potential parental magmas, but further work is needed to understand the full range of dykes in the area.

[1] Tichomirowa *et al.* (2006) *Lithos* **91**, 229-249. [2] Taylor *et al.* (1967) *Geochim. Cosmochim. Acta* **31**, 407-430.