

2.05 Ga A1-type felsic to intermediate igneous suite and related Nb-Zr-REE mineralization at Otanmäki, central Finland

KIMMO KÄRENLAMPPI¹, EERO HANSKI¹, ASKO KONTINEN², HANNU HUHMA³, KRAUSE JOACHIM⁴, THOMAS HEINIG⁴, YANN LAHAYE³

¹Oulu Mining School, University of Oulu, Finland
kimmo.karenlampi@oulu.fi

²Geological Survey of Finland, Kuopio, Finland

³Geological Survey of Finland, Espoo, Finland

⁴Helmholtz Institute Freiberg, Freiberg, Germany

A-type granites record ancient rifting events and host deposits of high-tech metals, such as the rare earth elements (REE). We have studied the geology, geochemistry, geochronology and Sm-Nd isotope compositions of a globally uncommon suite of ca. 2.04–2.06 Ga ferroan A1-type igneous rocks in central Finland, Fennoscandian Shield^[1]. The suite consists of gneissic peralkaline to peraluminous granites and related syenite, monzonite and monzodiorite^[1].

The Otanmäki A-type rocks have $\epsilon_{Nd}(2050 \text{ Ma})$ values ranging from +2.5 to -3.4 and trace element characteristics similar to ocean island basalts (OIB), suggesting their derivation from mafic mantle-derived parental magmas similarly as has been proposed for many other A1-type suites globally^[1]. However, the peraluminous granites exceptionally show Nb/U, Nb/Yb and Th/Yb ratios more similar to those of Archean granitoids than OIBs, indicating role of crustal contamination in their genesis^[1].

The Otanmäki suite A-type rocks host two Nb-Zr-REE deposits: Kontioaho, consisting of an up to 50-m-thick tabular granitic body, and Katajakangas, comprising several closely-spaced 0.1- to 1.4-m-thick quartz-rich veins. A peraluminous monzogranite forms the wall rock for both deposits, but the mineralized rocks have a geochemical signature similar that of peralkaline-metaluminous alkali feldspar granite adjacent to the monzogranite. The main ore minerals are allanite, zircon and titanite with minor Nb-REE-Th-U oxides. Geochemical and geochronological data and Nd isotope compositions of the mineralized rocks indicate that they formed from highly fractionated, volatile-bearing (e.g., F, CO₂) late-stage residual melts of the A-type magmatism.

[1] Kärenlampi, K., Kontinen, A., Huhma H. & Hanski, E. Geology, geochemistry and geochronology of the 2.05 Ga gneissic A1-type granites and related intermediate rocks in central Finland: implication for the tectonic evolution of the Karelia craton margin. Bulletin of the Geological Society of Finland (2019) (in press)