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Multi-mineral investigation of Sr-Nd-Hf isotope heterogeneity probing the origins of late-orogenic granites in Finland

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Late-orogenic granites in southern Finland represent one pulse of crust formation during the Svecofennian orogeny (1.9-1.8 Ga). Considerable Hf- and Nd-isotopic heterogeneity is preserved both between and within three examples of these S-type granites [1]. Two of these have similar magmatic zircon εHf_i and bulk-rock εNd_i values but differ in degree of magmatic zircon εHf_i variability and extent of zircon inheritance. The third granite has lower magmatic zircon εHf_i and bulk-rock εNd_i values. Distinct differences in the Hf isotope compositions of the magmatic and inherited zircon populations highlight that the melt component of the leucogranites do not directly acquire their isotopic composition from their sources (of which inherited zircons are remnants), which suggests some form of disequilibrium melting.

The present study investigates the heterogeneity in these granites through a combination of major and trace element and Sr-Nd-Hf isotopic analyses of minerals (separates and in thin section) and bulk-rock powders. Analyses of the Hf isotope compositions of zircon mineral separates and bulk-rock powders will assess the mass balance between the magmatic and inherited zircon and other mineral components in the rock. Examination of the isotopic heterogeneity will be extended to other systems. A significant host for Nd is monazite, which laser ablation analyses show also contains moderate amounts of Sr (~95 ppm) relative to the bulk-rock samples (80-180 ppm). The new LA data also show that garnet in these samples have high Sm/Nd (3-7) and Lu/Hf (mostly 8-20) ratios relative to the bulk-rock samples (Sm/Nd 0.14-0.19, Lu/Hf 0.04-0.12). Garnet Nd and Hf isotope compositions and geochronology can be compared with other minerals to test for disequilibrium. This multi-isotope approach with inter-phase comparison aims to build an intricate picture of the three magmatic systems and has the potential to reveal unknown source components. Combined with existing in situ zircon Hf isotope data, our rich dataset will probe the relationships between the granites and their sources, and the melting processes.

[1] Kurhila M, Andersen T, Rämö OT (2010) Diverse sources of crustal granitic magma: Lu-Hf isotope data on zircon in three Paleoproterozoic leucogranites of southern Finland. Lithos 115:263-271