Magmatic age of the Norra Kärr alkaline complex determined by U–Pb and Lu–Hf isotopes of metasomatic zircon in fenite


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The Norra Kärr alkaline complex in southern Sweden is a small igneous intrusion of agpaitic nepheline syenites, which is characterised by complex magmatic Na-Ca-Zr-Ti-REE silicate minerals instead of conventional zircon and titanite. The wall rock—originally a TIB granite—was strongly affected by syn-magmatic alkali metasomatism (fenitisation) and now consists largely of albite and aggregates of biotite and aegirine(-augite). Here, abundant anhedral zircon (100–500 µm) and zircon inclusions (<10 µm) are associated with fluorite, aegirine(-augite), andradite, bastnaësite, xenotime, fluorapatite, and magnetite. We characterised zircon in the fenite to indirectly date the agapitic magmatic activity.

U–Pb and Lu–Hf isotopic compositions of zircon and eudialyte (only Lu–Hf) were determined by LA-MC-ICP-MS at the Department of Geosciences, University of Oslo.

A reliable upper concordia intercept age of a mostly-concordant group of zircons gave 1488 ± 8 Ma (2σ, p = 0.86, n = 23), within error of the weighted mean 207Pb–206Pb age (reworked data, previously reported by Sjöqvist et al., 2014).

Lu–Hf systematics of zircon in the fenite and eudialyte in the nepheline syenites—in addition to mineral associations in the fenite—agree with a genetic link between the magmatic and metasomatic activity by showing identical initial 176Hf/177Hf ratios. The εHf for the fenite zircon at the time of formation (1.49 Ga) is 6.44 ± 0.5 (2σ), which is significantly above the expected signature of Svecofennian crust at that time (ca. −5 ± 2), but is similar to a “mildly-depleted mantle”.

References: