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Petrogenesis of ultramafic lamprophyres and carbonatites of the Alnö complex (central Sweden)

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Central Iapetus Magmatic Province (CIMP) represents a large igneous province associated with the development of the Iapetus Ocean [1]. In Baltica, some of the carbonatite complexes (Fen, Alnö) have been linked to extensional tectonics that followed the opening of Iapetus. Based on the results of the age dating, both Alnö and Fen appear to be contemporaneous with the second pulse within the CIMP at ~590 Ma [1]. We investigated carbonatites and ultramafic lamprophyres (alnöites) from Alnö, their type locality [2]. Here, several dyke generations are mainly found within the erosive section of a collapse structure.

Using LA-ICPMS, the contents of transition metals in mica from alnöites are on average 20× (for Cr) and 35× (for Ni) higher compared to their contents in phlogopite from the associated carbonatites. Both the lamprophyres and carbonatites reveal whole-rock compositional characteristics similar to partial melting of metasomatically modified source characterised by anorogenic signature. The lamprophyres and carbonatites show comparable mantle ranges of δ^7Li values (3.6–7.6‰) while having variable Li contents (2–4 ppm in carbonatites, 11–16 ppm in alnöites, 18–28 ppm in 'kimberlitic alnöites' – local name for olivine-rich variety). Overlapping ranges in Sr–Nd isotope compositions of uncontamined alnöites (Sr_{590} = 0.70309–0.70317; εNd_{590} = 2.6–2.7) and carbonatites (Sr_{590} = 0.70309–0.70311; εNd_{590} = 2.5–2.7) imply a depleted mantle to be involved in the petrogenesis of the Alnö rocks. Single-stage depleted-mantle Nd model ages of ~0.9 Ga can be linked with the evolution of the Rodinia supercontinent.

Collectively, the origin of the ultramafic lamprophyres and associated rocks of the Alnö carbonatite complex can plausibly be explained by carbonated alkali-rich silicate melts derived in a plume-fed rift setting, and tapping melts from ancient metasomatised subcontinental lithospheric mantle.

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