Identifying the origin of olivines in ultramafic lamprophyres from Labrador, Canada, by minor and trace elements

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Olivine is the major constituent in the upper mantle, and the first phase to fractionate in mafic magmas. Hence, investigation of major, and especially minor and trace, elements can provide new insights into our understanding of mantle and magmatic processes, and can help to identify the types of rock present in the source during generation of the parental melts [1].

In this study, olivines in the type aillikites (ultramafic lamprophyres) from the Aillik Bay in Labrador, Canada, were analysed. The olivines range from euhedral to rounded, possibly abraded crystals, so that the proportion of phenocrysts and mantle xenocrysts is uncertain from petographic observations alone. Aillikites are classified in the IUGS scheme as inequigranular, porphyritic rocks with phenocrysts of olivine and phlogopite in a carbonate-rich groundmass [2]. Whole rock analyses of these aillikites (obtained in prior studies by Tappe et al.[3]) show a depletion in SiO_2, Al_2O_3 and Na_2O, and an enrichment in MgO, CaO and TiO_2 [3]. Primary magma affinity is shown by high-Ni and high-Cr concentrations, and carbonatitic affinity is indicated by elevated K_2O, and high CO_2 and P_2O_5 values [4].

Our study provides data for major element concentrations using EPMA analysis (spots and maps), and focuses on determination of minor and trace element compositions, obtained by LA-ICP-MS (spot analyses) in fresh olivine crystals with different zoning patterns (normal, reversed and/or no zoning). Acquired precise trace element concentrations are compared with olivines from different mantle and igneous origins and applied to mantle and magma petrogenesis.

[1] Foley *et al*. (2013) *EPSL* **363**, 181-191. [2] Tappe *et al*. (2005) *J. Petrology* **46**, 1893–1900. [3] Tappe *et al*. (2006) *J. Petrology* **47**, 1261–1315. [4] Tappe *et al*. (2007) *EPSL* **256**, 433–454.