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HSE concentrations and highly radiogenic Os isotopic signature in orogenic lamproites from the Bohemian Massif: implications for subduction-related metasomatism of the sub-continental lithospheric mantle

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Lamproites are peralkaline, ultrapotassic and perpotassic mantle-derived rocks with low contents of Ca, Al and Na, high K/Al ratios, and extremely high concentrations of many incompatible elements (e.g., Ba, Zr, Ti). They form numerous dykes along the eastern termination of the Moldanubian and Saxothuringian zones of the Variscan Bohemian Massif (BM), with presumed emplacement age of 330 Ma (Krmíček et al., 2016). We focus our study on their highly siderophile elements (HSE: Os, Ir, Ru, Pt, Pd, Re) concentrations and Re–Os isotopic system, as opposed to previous studies, which focused on their whole-rock geochemical composition and various lithophile and chalcophile isotopic systems.

The lamproites from BM show significant depletion in HSE, namely Pt and Ru, compared to the only other available full dataset for archetypal lamproite (Kimberley block, Australia; Graham et al., 1999). On the other hand, when considering only Re and Os, elements for which multiple studies exist, our values (0.001–0.029 ppb and 0.002–0.106 ppb respectively) are consistent with other orogenic lamproites worldwide (eg. Prelević et al., 2014 and references therein). Compared to other mantle derived melts, all HSE abundances are well below the values of both OIB and continental flood basalts (Gannoun et al., 2016).

High-precision TIMS analysis revealed highly variable $^{187}Os/^{188}Os_{(330Ma)}$ ratios, ranging between 0.1627–0.6311 (γOs $\sim$ 30–406). No significant difference between samples from different geological unts was observed. These values are best explained by variabe crustal contamination of the sub-continental lithospheric mantle source of the studied lamproites. Given their low Os concentrations, addition of small to moderate amounts of crustal material with highly radiogenic Os isotopic signature could result in the observed $^{187}Os/^{188}Os$ values. This conclusion is further substantiated by previously published whole-rock trace element and Sr–Nd–Pb–Li isotopic data (Krmíček et al., 2016), suggesting the presence of metasomatizing metasomatised (and regionaly contrasting) crustal material component in the mantle source of lamproitic melts.

References:

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