

Sr and Nd isotopes of Les Guilleries Variscan lamprophyres: Insights on mantle evolution

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Lamprophyre dykes of unknown origin have been studied in Les Guilleries massif, NE Iberia. These vertical to subvertical dykes intrude pre-Variscan metasedimentary rocks and late-Variscan granitoids. The lamprophyres show porphyritic texture with phenocryst of feldspars (anorthite > k-feldspar ± albite), amphiboles (kaersutite and hornblende) and others fully replaced by chlorite and albite. The groundmass is mainly composed of chlorite, albite, epidote and amphibole with minor calcite, titanite, quartz, fluoroapatite, Cr-illmenite, zircon and allanite. On the basis of this mineralogy, the lamprophyres are classified as spessartites. Chemical multielement pattern shows a typical crustal-like signature with enrichments of LILE and LREE, distinct negative Nb-Ta, Ti and Eu anomalies and positive Pb anomaly, which confirms the calc-alkaline nature. Comparison with calc-alkaline lamprophyres from Eastern and Central Europe Paleozoic massifs reveal unique features of Les Guilleries lamprophyres, like lower K_2O/Na_2O , Zr/TiO_2 , La/Yb, Th/Yb, Zr/Y and higher Al_2O_3 and Nb/U. Some of this features are also observed in calc-alkaline lamprophyres from Aiguablava (Catalan Coastal Ranges, CCR) and Maladeta (Pyrenees).

Sr-Nd isotopic compositions ($^{87}Sr/^{86}Sr$: 0.710085-0.711627; $^{143}Nd/^{144}Nd$: 0.512231-0.512249) suggest an enriched lithospheric mantle source, similar to granitoids and other calc-alkaline lamprophyres from the Variscan orogen. However, the geochemical and isotopic characteristics suggest that Les Guilleries lamprophyres may correspond to transitional compositions towards those of Permian alkaline lamprophyres in the Spanish Central System (SCS). An evolution is observed from: 1) Early Carboniferous lamprophyres in Eastern and Central Europe, that appear enriched in $^{87}Sr/^{86}Sr$, K_2O , LILE, LREE and have lower ϵNd_i values, towards 2) Late Carboniferous-Early Permian calc-alkaline lamprophyres in CCR, with similar patterns but lower enrichments, to 3) Late Permian alkaline lamprophyres in the SCS, with OIB affinity, lower $^{87}Sr/^{86}Sr$ and higher ϵNd_i values. Additionally, Cretaceous alkaline lamprophyres from Pyrenees and Les Guilleries show even higher ϵNd_i values with OIB affinity. This evolution in lamprophyre compositions probably reflect the evolution of lithospheric mantle sources throughout geological time.