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# PGE and Re-Os geochemistry of lamprophyres in the Zhenyuan gold deposit in Yunnan Province, China: Petrogenetic implications and mantle evolution

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Lamprophyres are generally thought to be formed from mantle-derived magmas and can provide significant insight into the continental lithospheric mantle (CLM) composition and its metasomatic history. Cenozoic lamprophyres are widespread along the Ailaoshan tectonic belt in the Sanjiang region, SW China, where there are also many important gold deposits, especially the Zhenyuan gold deposit. In this gold deposit, lamprophyres are closely associated in space-time to the gold ore bodies. However, the evolution of the lamprophyres during magmatic differentiation, and the mantle enrichment mechanism remain controversial. Thus, we have carried out a geochemical investigation of the lamprophyres in terms of platinum-group elements (PGEs) and Os isotopes.

The Zhenyuan lamprophyres are calc-alkaline with $SiO_2$ of 41.4 to 50.1 wt%, and total alkalis ($Na_2O+K_2O$) of 1.17 to 7.56 wt%. Consistant with previous studies of calc-alkaline lamprophyres, they are strongly light-rare-earth elements enriched, with enrichment of large ion lithophile elements and depletion of high field strength elements, indicating they came from an enriched lithospheric mantle metasomatized by subduction slab fluids.

The Zhenyuan lamprophyres can be divided into high-Os ($>$ 0.05 ppb Os) and low-Os ($<$ 0.05 ppb Os) ones. The isotopic ratio of $^{187}Os/^{188}Os$ corrected for *in situ* growth in the lamprophyre is highly variable, ranging from typical mantle values to 1.13. These lamprophyres seem to represent some of the most radiogenic Os from mantle-derived rocks. The highly radiogenic Os isotopic signatures are interpreted to be due to long-time integration of elevated Re/Os in the lithospheric mantle, possibly due to subduction-related metasomatism. The slab-derived fluids may include sulfide liquid or oxidized and Cl-rich aqueous fluid to transfer palladium-group PGEs (PPGEs) and Re (relative to iridium-group PGEs (IPGEs)) from the subducted slab to the overriding mantle wedge. The highly variable $^{187}Os/^{188}Os$ ratios of the low-Os lamprophyres might also have resulted from metasomatism by a deeply derived carbonate melt, which did not elevate the Os concentration significantly.

The Zhenyuan lamprophyres feature low PGE contents and can be classified into two groups by their primitive mantle-normalized PGE patterns. Group A is characterized by strongly negative Ru anomalies, while Group B is characterized by slightly negative Ru anomalies and low total PGE contents. Very high Cu/Pd and low Pt/Y ratios suggest that the low PGE contents were likely related to sulfide removal, especially in Group B. Fractionation between PPGEs and IPGEs and marked Ru anomalies may have been mainly controlled by olivine and chromite crystallization. Hence, the PGE patterns in Zhenyuan lamprophyres may be interpreted by a two-stage magma evolution model. The first stage involved S-saturation and sulfide removal, producing variable total PGE concentrations. The second stage involved S-undersaturation and early crystallization of mafic silicate minerals (e.g. olivine), fractionating PGEs.