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An enriched heterogeneous mantle beneath the Spanish Central System: inferences based on the composition of the Permian alkaline lamprophyres

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The Spanish Central System (SCS) is a Hercynian metamorphic-plutonic terrane crosscut from Permian to Jurassic by different types of dyke swarms, which successively represent: 1) calcalkaline, 2) alkaline and, finally, 3) tholeiitic magmas (Villaseca et al., 2004). Though types 1 and 3 are mantle-derived melts showing some crustal imprint, the alkaline suite is clearly mantle-derived (Villaseca et al., 2004). The alkaline dykes from the SCS can be divided in two groups: I) basic to ultrabasic lamprophyres and diabases, and II) basic to acid monzo-syenitic porphyries.

The lamprophyres and diabases composition is enriched in incompatible trace elements, with highly fractionated REE chondrite-normalized patterns and characteristic Nb-Ta positive peaks. This composition suggests a metasomatic event within their mantle source prior to their generation. They do not show geochemical evidences of contamination or assimilation with crustal rocks (Ce/Pb $\sim$ 16-28 and Nb/U $\sim$ 48-76). According to their major element chemistry we can separate these dykes in two groups: with sodic and potassic affinities. The lamprophyres and diabases also records two different isotopic signatures (Sr-Nd-Pb), representing partial melts derived from two different mantle sources: lithosphere and asthenosphere related.

Their high to moderate $(Dy/Yb)_N$ values (1.2-2) indicate the presence of residual garnet within the mantle source and, thus, derivation from a source deeper than 80 Km (McKenzie and O'Nions, 1991). Taking into account the lithosphere thinning at the end of the Hercynian orogen (during Permian) these sources may be close to the base of the lithosphere.

The nature of the metasomatism in the mantle under the SCS may be estimated according to the incompatible trace element ratios of the lamprophyres and diabases. The high K content of these alkaline dykes implies the involvement of phlogopite or amphibole during melting. The potassic lamprophyres show a positive correlation of Ba/La, Rb/La ratios when plotted against K/La, which points to participation of phlogopite. Amphibole is a likely phase, instead, to have played an important role in the formation of the sodic dykes. In any case, the lack of negative K anomalies in the primitive mantle-normalised patterns, points to total consumption of those minerals during melting. The high P_2O_5 concentration (0.3-1%) in these alkaline dykes is also suggestive of presence of apatite in the mantle source, also supported by their frequent P negative anomalies in the primitive mantle- normalised patterns.

The absence of subduction related geochemical fingerprints favoured that metasomatism, both within lithospheric and asthenospheric sources, have been caused by volatile and incompatible element-enriched magmas probably ascending from the asthenosphere.

References

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