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Mafic and felsic plutonism in the Elvas region (SW Iberia, Portugal): two distinct Nd isotope sources and geodynamics

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The occurrence of mafic (mainly gabbros and diorites) and felsic (syenites and granites) rocks, in close spatial association, in the Elvas region, at the northern part of the Ossa-Morena Zone, could be interpreted as a single bimodal (alkaline) plutonic complex. However, in spite of scarce isotopic (Sm-Nd) data, the co-magmatic origin of both rock groups (mafic and felsic) has already been questioned [1].

Based on the mineral chemistry of primary clinopyroxenes (Di–Hd, %En: 45.5 – 27.2) and representative whole-rock analyses, gabbros and diorites of the Elvas massif show a transitional character between alkaline and non-alkaline fields and wide compositions: SiO_2 (42.47 – 58.00 wt%); TiO_2 (0.24 – 1.68 wt%); Y/Nb (4.0 – 10.7); Th (0.1 – 6.8 ppm); Zr (18.6 – 576.9 ppm). The felsic group is composed by highly differentiated rocks which correspond to distinct levels of silica saturation and alkalinity. Peralkaline syenites usually present sodic (riebeckite) and sodic-calcic (aegirine-augite, ferrowinchite) inosilicates and reveal quite variable compositions: SiO_2 (57.50 – 72.07 wt%); TiO_2 (0.10 – 1.45 wt%); Th (1.7 – 67.0 ppm); Zr (133.0 – 4800.0 ppm). The alkaline granites show hedenbergite as the characteristic inosilicate, presenting relatively common compositions: SiO_2 (61.85 – 78.06 wt%); TiO_2 (0.21 – 0.58 wt%); Th (11.8 – 38.4 ppm); Zr (317.3 – 1234.6 ppm) [2].

Recent Sm-Nd isotopic results, on a total of 18 whole-rock samples (6 mafites and 12 felsites), allow new and more consistent interpretation concerning the petrogenesis of these plutonic rocks. Assuming an age of 490 Ma [3], the felsic rocks provide ($+0.6 < \varepsilon Nd_{490} < +4.3$), similar to other contemporary (per)alkaline rocks of this region [4], reflecting magmatic extractions from time-integrated depleted mantle sources followed by variable and incomplete mixing (and/or AFC-type) processes with enriched, probably crustal sources. This alkaline/peralkaline magmatism is thought to represent the main regional record of the rifting event which presumably led to the opening of the Rheic Ocean.

On the other hand, the mafic plutonic rocks of the Elvas massif cannot represent the magmatic precursors of these syenites and granites as they show completely distinct Nd isotopic ratios ($-3.7 < \varepsilon Nd_{490} < -1.2$) indicating important contribution of long-term enriched (crustal) sources. Instead, considering the age and the Nd isotopic signature of other mafic plutonic unit emplaced nearby (the Campo Maior massif: ca. 370 Ma; $-6.0 < \varepsilon Nd_{370} < -5.2$) [5], and recalculating the isotopic ratios of the Elvas massif for the same age ($-4.3 < \varepsilon Nd_{370} < -1.6$), it is plausible to consider that these plutons (Campo Maior and Elvas) can be coeval and representative of the Variscan magmatism in this region. In such hypothesis, the differences between these isotopic values could be explained, on a time-integrated basis, either by magmatic sources for the Elvas massif less enriched in *LREE* than the sources involved in the Campo Maior massif, or, if both plutonites share similar depleted mantle sources, by magmatic

differentiation paths considerably affected by crustal contamination processes, which reached higher degrees in the Campo Maior massif.

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