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Syntectonic Variscan magmatism in the Aguiar da Beira region (Iberian Massif, Portugal)

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The Aguiar da Beira region (Portugal) is located in the core of the Iberian Massif, more precisely in the Central-Iberian Zone, which is dominantly composed by abundant volumes of plutonic rocks, emplaced into Late Proterozoic – Early Cambrian and Palaeozoic metasediments, mainly during or slightly after the third deformation phase of the Variscan Orogeny (D3). A considerable amount of these granites are syntectonic, intruded during the peak of this deformation event (D3).
In particular, at the Aguiar da Beira region, two suites of syntectonic granitoids represent distinct magmatic series: a medium- to coarse-grained porphyritic biotite granodiorite-granite (322 Ma), which belongs to the early granodiorite series, and a medium-grained muscovite-biotite granite (317 Ma) that is part of the two-mica peraluminous leucogranites suite.
The petrographic, geochemical (whole-rock and mineral compositions) and isotopic (Sr-Nd, δ^{18}O-wr and δ^{18}O-zr) study of the two intrusions reveals their remarkably different character. It is concluded that they correspond to two independent magma pulses, derived from distinct sources and/or petrogenetic processes. The biotite granodiorite-granite is a weakly peraluminous intrusion, characterized by intermediate to felsic SiO_2 contents (66 – 68 %), high Ba, Sr and REE, and biotite with high Al and Mg contents, typical of the calc-alkaline associations. The Sr-Nd initial ratios are homogeneous ($(^{87}Sr\text{-}^{86}Sr)_{322}$: 0.7070 - 0.7074; εNd322: -3.9 to -4.6) and overlap the isotopic signatures of lower crustal felsic metaigneous granulites (Villaseca et al. 1999). This similarity, which is further supported by δ^{18}O-wr and δ^{18}O-zr data, may indicate an origin by anatexis of lower felsic metaigneous rocks. Alternatively, the same data, allied to the presence of microgranular enclaves seen in this intrusion, can also be explained by the mixing of lower crustal derived magmas and mantle melts. By contrast, the muscovite-biotite granite has an entirely distinct geochemical signature, typical of S-type granites: a highly evolved and strongly peraluminous character (SiO_2 = 72 – 74 %; CaO = 0.3-0.6 %; A/CNK = 1.18 - 1.36, low Mg, Ti, Ba, Sr, ΣREE, HFSE contents, and high Al_2O_3-TiO_2 ratio e Rb-Sr ratios), high $(^{87}Sr\text{-}^{86}Sr)_{317}$ (0.7104 - 0.7146), low εNd317 (-7.7 to -8.7), and high δ^{18}O (δ^{18}O-wr = 11.33 %; δ^{18}O-zr = 9.5 $\pm$ 0.2 ‰). The data suggest that this magma was derived from the partial melting of metasedimentary middle crustal protoliths, which has been successfully modeled. The observed variation in major and trace element composition suggests an evolution controlled by fractionational crystallization of a mineral association composed by plagioclase, biotite, apatite, zircon, monazite, ilmenite.

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