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Petrogenetic relationships among Variscan granitoids and Li ± F-rich aplite-pegmatites in the Central Iberian Zone (Spain and Portugal)

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Lithium (± F, Sn, Nb, Ta, P) mineralization is common in the Central Iberian Zone (CIZ) of the Iberian Massif (Spain and Portugal). The CIZ represents the westernmost segment of the European Variscan Belt. It is characterized by extensive syn- to late-D_2, S-type, granitic magmatism (330-290 Ma) and by the occurrence of high-grade metamorphic complexes with a regional extent. In this region the Li-rich rocks occur in a NNW-SSE striking belt, ≈500km long and ≈150 km wide. This mineralization mainly appears in aplite-pegmatite bodies, where the main Li-rich minerals are the silicates spodumene, petalite and Li-rich micas, and phosphates of the amblygonite-montebrasite series. Many of these Li-rich bodies show an aplitic texture, frequently with the development of line-rock units. Coarse crystals are also common, but usually smaller than 10cm long; and internal zoning of the pegmatites, if present, usually does not show the development of a core nor intermediate zones. The Li-richest bodies usually show an important overall enrichment in this element in the whole dyke, with no evidence of internal fractionation, often with values in Li_2O>1% wt, and high Na, F and P contents.

A magmatic origin is the most accepted theory for the genesis of the pegmatitic melts. In the southern region of the CIZ, the Li-mineralization seems to be mainly related to highly fractionated leucogranitic facies of late- to post- tectonic, S-type, granitic units. However, in the northern part of the CIZ the affiliation of the Li-rich rocks is more difficult to establish. The late- to post-tectonic granites are less abundant, whereas pre- to syn-tectonic, anatectic granites are common, often occurring in high-grade metamorphic complexes, and frequently related to migmatites. A petrogenetic relationship among the Li-aplite-pegmatites and those syn-tectonic granites would imply a significant mobilization of Li during the Variscan magmatism in the CIZ, with the generation of quite similar Li-mineralization along most of the orogeny, that is, associated with granites of different ages/origin. Another possibility is that the Li-mineralization occurring in the northern parts of the CIZ is just spatially related to the syn-tectonic granitoids. In this case not-outcropping, late- to post-tectonic granites would be the parental melts. In both cases the parental granites would most probably be peraluminous, two mica, S-type leucogranites, usually P-rich and Ca-poor, originated by the partial melting of peraluminous metasedimentary rocks, including greywackes and shales. High degrees of fractional crystallization (up to 99%) of these granitic melts is the most plausible mechanism to explain the composition of the Li-richest bodies occurring in the CIZ. The distribution of the rare-element pegmatites in this region, often with the Li-F-richest facies occurring farthest from the parental granite, suggests a previous vertical chemical zonation of the melt within the source pluton, inherited by the pegmatitic melt before it intruded into the fractures where it crystallized. The higher enrichment in F, as well as H_2O and P, would reduce the viscosity of the most fractionated melts in a great extent, enhancing its mobility and, in turn, lowering the liquidus temperature.