Geochemical tracers for LCT Li-rich pegmatites: from granite to apatite composition as indicators of Li-mineralization in the Central Iberian Zone

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Introduction

Lithium-enriched aplite-pegmatites are relatively common in the Central Iberian Zone (CIZ) (Spain and Portugal), in a ~75,000 km^2, NNW-SSE striking belt. These aplite-pegmatite bodies are usually dyke-like and appear grouped in pegmatite fields, sometimes spatially zoned around a granite intrusion (Roda-Robles et al. 2018). Their main Li-bearing minerals are spodumene, petalite and *lepidolite*, with minor amblygonite-montebrasite. Field, geochemical, structural and geochronological data indicate that the origin of this Li-mineralization is related to the major Variscan granitic magmatism occurring between 320 and 290Ma. However, not all the Variscan granitic series distinguished in this region are petrogenetically related to the Li-bearing pegmatitic fields. Detailed studies, including bulk-rock chemistry of granitic and pegmatitic rocks as well as major and trace elements analyses of apatite have allowed the determination of the linkage between this Li-mineralization and the different granitic series in the CIZ.

Granitic rocks from the CIZ may be classified into five geochemically distinct series (Roda-Robles et al. 2018): (S1) two-mica highly peraluminous leucogranites; (S2) P-rich highly peraluminous granites; (S3) P-poor moderately peraluminous granites; (S4) moderately to low peraluminous granites; and (I) low peraluminous I-type granites. S1 and S2 have a dominant metasedimentary derivation, whereas the other three granitic series come mainly from metaigneous sources. Chemically, S3, S4 and I series show long, quite continuous trends of decreasing Al_2O_3, Fe_2O_3, CaO, MgO, TiO_2, P_2O_5 and Sr contents as SiO_2 increases. In contrast, S1 and S2 series present shorter compositional trends with higher P_2O_5 and lower CaO concentrations. Contents in the incompatible elements F, Li, Ta, Cs, Rb and Sn are higher in the S1 and S2 than in the other granites, with continuous trends from these granitic series through the simple pegmatites, up to the Li-richest ones. It is remarkable that in the S1 and S2 granitic series there is an inflexion point in the Sr content, with an increase in this element from the most fractionated leucogranitic units up to the Li-rich pegmatites. The observed chemical trends, together with other geological data, clearly suggest that the P ± F-rich, Ca-poor, strongly peraluminous granites of the S1 and S2 suites are most probably the parental granites of the Li-rich pegmatites in the CIZ.

Main chemical variations observed in apatite associated with the different facies of S1 and S2 granites and with the simple, P-rich (intermediate) and Li-rich pegmatites correspond to Mn, Sr, Y and REE. In general, apatite from the Li-rich pegmatites and from the granites related to them are the Mn- and Sr-richest and the Y- and REE-poorest ones (Roda-Robles et al. 2022).

Therefore, the characterization of the chemical signature of the granites combined with the mineral chemistry of apatite may help exploration for Li in the CIZ. Moreover, these geochemical indicators may likely be used in other pegmatitic belts.

References

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