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Pressure–temperature–time assessment for the intrusion of the spodumene-bearing dyke from Alijó (northern Portugal)

Nora Santos-Loyola[1], Encarnación Roda-Robles[1], Idoia Garate-Olave[1], Jon Errandonea-Martin[1], and Alexandre Lima[2,3]

[1]University of the Basque Country UPV/EHU, Faculty of Science and Technology, Geology Department, Leioa, Spain (nora.santos999@gmail.com)

[2]Department of Geosciences, Environment and Spatial Planning, University of Porto, Porto, Portugal

[3]Institute of Earth Sciences, Porto, Portugal

The Barroso–Alvão Pegmatite Field (Galicia-Trás-os-Montes Zone of the Iberian Massif) has been a target of abundant geological and mineral resource exploration studies in the last decades. Since lithium demand is increasing significantly at global scale as critical raw material for green technologies, the region has acquired a special relevance in terms of Li exploration. Within the distinguished aplite-pegmatite types in the area, the dyke of Alijó (currently in exploitation) corresponds to the spodumene-bearing type. The estimation of the P-T-t conditions for its intrusion provides useful information to constrain petrogenetic processes related to the origin of the cited pegmatite field.

The presence of albite and K-feldspar coexisting in the studied dyke point to a high H_2O activity in the pegmatitic melt, which would decrease the temperature (T) of the solidus. Additionally, the lattice twin observed in microcline indicates that the crystallization of orthoclase took place followed by a rapid decrease of T, leading to the conversion of orthoclase to microcline. Thus, the presence of the lattice twin shows that the crystallization T must have been above 450–500°C (Ribbe, 1983). Considering the abovementioned minimum crystallization temperatures, the paragenesis of both primary and secondary spodumene (the later as a result of primary petalite replacement) restricts the primary pressure conditions to 2–3 kbar (e.g. London, 1984). Besides this paragenesis, the occurrence of eucryptite supports a sufficiently rapid decrease of T (and P) to allow the coexistence of these phases in the studied aplite-pegmatite. In agreement with the mentioned, the frequently observed 'comb-like' Unidirectional Solidification Textures (UST) in the margins of the dyke imply a strong and rapid undercooling of the system, probably caused by the exsolution of a H_2O-rich fluid phase from the pegmatitic melt, once intruded into the open fracture where it occurs, combined with the high contrast of T between the pegmatitic melt and the relatively cooled host metasedimentary rocks.

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