



Rare-element pegmatite-forming melt during Variscan orogeny: genesis, propagation and consolidation

Sarah Deveaud (1,2,3), Laurent Guillou-Frottier (1,2,3), Romain Millot (1,2,3)

(1) BRGM, ISTO, UMR 7327, 3 av. Claude Guillemin, 45060 Orléans, France, (2) CNRS/ISTO, UMR 7327, 1A rue de la Férollerie, 45071 Orléans, France, (3) Université d'Orléans, ISTO, UMR 7327, 1A rue de la Férollerie, 45071 Orléans, France

The Variscan rare-element pegmatite fields mainly enriched in Li, Nb and Ta are subject to increasing mining exploration in the last few years. Indeed, Li from pegmatite deposits is recognised to be less sensitive to supply disruptions than Li from brine deposits. Thus, new metallogenic guides need to be defined in order to meet the growing demand for Li, Nb and Ta metals, and to ensure supply of strategic metals at the European scale. Three Variscan rare-element pegmatite fields have been selected to apply a multi-approach study in order to understand the genesis of pegmatite-forming melt, their propagation and their clustered consolidation at the crustal scale. The Monts d'Ambazac (French Massif Central), Barroso-Alvão (Portugal) and Forcarei-Lalin (Galicia, Spain) pegmatite fields present a similar age (~305-315 Ma), a similar geodynamical context (syn- to post-collisional) and same kind of mineralisations (LiCsTa type) but show distinct intensity of deformation affecting various country-rocks.

Firstly, spatial statistical analyses have been developed to constrain the spatial distribution of the Monts d'Ambazac and the Barroso-Alvão pegmatite fields. Secondly, Li-isotopic analyses in micas have been used to investigate the role of $\delta^{7}\text{Li}$ as geochemical tracer of LCT-pegmatites (from the less to the more evolved and lithium-rich pegmatite type). Finally, spatial and temporal relationships between pegmatites and hosting-rocks have been discriminated with structural field data mainly obtained on the Monts d'Ambazac and Forcarei-Lalin pegmatite fields. In addition, Li- isotopes results corroborate that Li-fractionation is neither affected by fractional crystallisation nor by crustal anatexis processes in a significant way. These $\delta^{7}\text{Li}$ values (‰) being independent from the degree of magmatic fractionation (K/Rb ratio) and ranging from -3.5 to +3.5 ‰ tend to confirm that these pegmatite-forming melts evolve independently of each other.

Our results demonstrate the main role of tectonic context during pegmatite-forming melt genesis and their propagation through activated shear-bands, opening of tensions gashes, magma pumping and space filling by pegmatite-melt crystallisation. Based on field observation such as mineralised pegmatitic veins, the role of chemistry and rheology of hosting-rocks on pegmatite differentiation type and on their morphology can be constrained. In particular, high permeability shear zones could play a crucial role in the ascent of low viscosity pegmatite-forming melts.

To refine our results, preliminary numerical models have been developed to constrain the ascent of a pegmatitic melt from a deep crustal source. The "exotic" physico-chemical properties (large viscosity contrasts due to temperature- and water content-dependence) have been accounted for, and the experiments with large Peclet numbers reproduce individual patches of low viscosity melts disconnected from the parental source.