3-year PhD thesis _ 2021-2024

The hydrothermal system of the Beauvoir granite (Massif Central, France) and its impact on the mobility and the distribution of rare metals

The Beauvoir granite (Massif Central, France) is the world-class reference for highly differentiated granites enriched in rare metals (Li-Sn-Ta-Nb-Be and others), and therefore is a key scientific target for understanding the geological processes controlling the concentration of these critical metals. While it is widely recognised that purely magmatic processes (partial melting, fractional crystallisation, etc.) are responsible for their primary enrichments, the impact of hydrothermal processes on the redistribution of these rare metals, from the scale of the mineral to that of the granite intrusion and its host rocks is much less quantified. However, this is a key aspect in understanding the evolution of the Beauvoir granite from its crystallization to its exhumation, as well as its current mineralogical, geochemical and textural characteristics in the perspective of a potential mining operation. In this context, the objective of this PhD project is to characterise the hydrothermal system of the Beauvoir granite with two major axes: (1) quantifying the behavior of metals during magma-fluid (immiscibility), fluid-fluid (mixing, immiscibility) and fluid-rock interactions and (2) tracing the origin (magmatic, metamorphic, meteoric) and the impact of hydrothermal fluids. The analytical strategy is mainly based on advanced *in situ* chemical and isotopic analyses on fluid inclusions and mineral (SEM, electron microprobe, microthermometry, Raman spectroscopy, LA-ICP-MS and ion microprobe).

The 3-year PhD thesis is funded by Labex Ressources21 (https://ressources21.univ-lorraine.fr/) and will take place within the framework of a consortium of projects (PhD theses, postdocs) on the Beauvoir granite co-funded by the IMERYS company. The thesis will be mainly carried out in Nancy (France) at the GeoRessources (http://georessources.univ-lorraine.fr/) and CRPG (http://www.crpg.cnrs-nancy.fr/index.php) laboratories of the Université de Lorraine (https://www.univ-lorraine.fr/) and CNRS, and will be supervised by Antonin Richard and Julien Mercadier. The PhD student will be physically based at GeoRessources (Mineral Resources team) and will collaborate with the members of the consortium as well as with Matthieu Harlaux (University of Nevada, Reno) and IMERYS.

Applications should be sent by email to antonin.richard@univ-lorraine.fr and julien.mercadier@univ-lorraine.fr before August 21, 2021. Interviews will be carried out during the first week of September (remote if needed). Applications must include a CV, a letter explaining the interest in the subject, the last transcripts, 2 letters of recommendation (if possible one from a MSc superviser and another from a MSc professor) and any other document relevant to support this application. The thesis will start at the beginning of October 2021.