Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.3595

Protracted crustal and mantle melting during the late stages of the Variscan orogeny: a case study in the Paleozoic basement of the external western Alps

JEAN-BAPTISTE JACOB[1], KÉVIN FRÉVILLE[2], EMILIE JANOTS[3], MARC POUJOL[4], STÉPHANE GUILLOT[5], PIERRE TRAP[2], JÉRÉMIE MELLETON[6] AND MICHEL FAURE[7]

[1]Université Grenoble-Alpes
[2]Université de Franche-Comté
[3]ISTerre-UGA
[4]Géosciences Rennes
[5]CNRS
[6]BRGM
[7]Université d'Orléans

Presenting Author: jean-baptiste.jacob@univ-grenoble-alpes.fr

The Variscan Belt of Europe is a typical example of a composite magmatic province, in which large volumes of granitoids were generated from various crustal and mantle sources and by several processes during the syn to late collisional evolution. In such a complex setting, many questions arise regarding magmatic and heat sources and melting mechanisms.

We present a case study focused on the Variscan basement of the external Western Alps, in the massifs of Belledonne and Pelvoux. In this area, three distinct magmatic suites have been recognized: (i) Mg-K-rich subalkaline granitoids (Mg-K group) rich in mafic enclaves (MMEs); (ii) ferroan medium/high-K granitoids (Fe-K), almost devoid of MMEs; (iii) an ultrapotassic suite consisting of (quartz)-syenite plutonic bodies and lamprophyres. We exploited a large dataset of whole rock geochemical analyses and single grain zircon U-Pb dates obtained on these three suites to constrain their timing of emplacement, evaluate the relative contribution of these series over time, and identify possible magmatic sources.

Distribution analysis of zircon U-Pb dates reveals that emplacement of the Mg-K granitoids occurred over a protracted period from ca. 350 Ma to 295 Ma, with two dominant production peaks near 340 Ma and 305 Ma. In contrast, the Fe-K granitoids mostly emplaced during a short-lived event at ca. 305-295 Ma. Two dated ultrapotassic granitoids yielded concordant ages at ca. 325 Ma. Fe-K and Mg-K granitoids contain various loads of inherited pre-Carboniferous zircons, suggesting significant crustal contribution while the ultrapotassic granitoids are devoid of inheritance.

Ultrapotassic rocks are interpreted to derive from LILE-rich metasomatized sub-continental mantle. Both Mg-K and Fe-K suites are subalkaline and moderately peraluminous, with remarkable scarcity of highly peraluminous compositions. This likely reflects the Al-poor composition of the crustal pile, which contains a mix of mafic and felsic igneous rocks and volcano-sediments, and is thus more prone to generate “I type” than “S types” granitoids. High Mg# in the Mg-K granitoids suggests incorporation of a mantle component, either by assimilation of the mafic enclaves or by mixing of crustal melts with ultrapotassic fractionates. Evolution toward Fe-K granitoids is interpreted to indicate increasing contribution of crustal melts over time.