Geophysical Research Abstracts
Vol. 20, EGU2018-8817-1, 2018
EGU General Assembly 2018

The granulitic residue of the Variscan granites of central Iberia: challenges to restite unmixing and peritectic entrainment models

Carlos Villaseca (1,2) and David Orejana (1)

(1) Complutense de Madrid, Petrología y Geoquímica, Spain (granito@ucm.es), (2) Instituto de Geociencias (UCM, CSIC), 28040 Madrid, Spain

The origin of granitic magmas in a crustal recycling context implies that deep-seated residual granulites and shallower granite batholiths have to be consanguineous. Moreover, the heat necessary to achieve granulite-facies metamorphism, driving extensive melting, might be mostly generated by thickening of fertile lithotypes rich in heat-producing elements, which is only possible in intracontinental collisional orogens. The Variscan Spanish Central System (SCS) batholith, in central Iberia, is a useful example of the above background. It is mainly composed of peraluminous felsic granites and it has been related to a suite of granulite xenoliths of ultra high temperature (UHT), carried by post-Variscan ultrabasic alkaline lamprophyres. These granulites indicate that the SCS lower crust is composed by peraluminous meta-igneous felsic types (90-95 %), with subordinated pelitic (7 %) and pyroxene-bearing mafic ($\leq$1 %) varieties.

A set of arguments points to the granulitic SCS lower crust being the restitic counterpart of the outcropping granitic batholith. Major and trace element composition indicates that UHT granulites have high MgO, FeO_t, TiO_2, Cr, Ni and low SiO_2, Na_2O, K_2O, Rb, Th, U relative to the average composition of pelitic and metaigneous country rocks, consistent with a more mafic, dehydrated and residual composition. Granulite-facies rocks from outcropping migmatite terranes do not show such an extreme residual composition and give rise to anatectic leucogranites and minor restite-rich granitoids with a dissimilar composition with respect to the large granite batholith. Similarities in the isotopic composition (Sr-Nd-O-Pb-Hf), the U-Pb zircon ages (305-285 Ma) and inherited zircon age populations between UHT granulites and Variscan granites are robust arguments supporting a source-extracted melt relationship. Moreover, the high temperatures (Ti-in zircon) determined in these Variscan granites (mostly 800-865 ºC) are consistent with an adiabatic ascent ($\sim$100 ºC decrease) from a deep melting area (900-1100 ºC and $\sim$10 kbar conditions) to epizonal levels ($\sim$3 kbar).

Granulite conditions in the SCS lower crust were reached after the thickening and collapse of the Iberian Variscan belt, involving widespread partial melting. The scarcity of basic magmatism and related mafic granulites suggests a minor role of mantle-derived underplating. The Variscan orogen in central Iberia outstands for an apparently nil crustal growth. The elevated radioactive heat production of a fertile thickened crust makes unnecessary a mafic thermal input to achieve UHT conditions at the base of the crust. Consequently, the Variscan granites resulted from reworking of Neoproterozoic to Cambrian metasedimentary and Cadomian meta-igneous rocks within the lower crust.

The study of deep-seated granulites helps to discuss the role played by the source in the chemical variation observed in granites (e.g., peritectic assemblage entrainment, PAE). The studied UHT granite residues add some troubles to PAE models: most REE, Y and Zr are hosted in common granulite minerals (plagioclase, K-feldspar, garnet, rutile), accessories are almost exhausted during partial melting (Th-U-depleted granulites), and residual plagioclase is around $An_{32}Or_{18}Ab_{50}$. Mineral chemistry helps to distinguish between residual and magmatic crystals in peraluminous granites and indicates that the SCS hot S-type granites are not in accordance with PAE modelling.