



Petrology and geochemistry of mafic and ultramafic metamagmatic rocks emplaced within the anatectic series of the middle crust of the Variscan Pyrenees: example of the Gavarnie-Heas dome, West Pyrenees

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Within the anatectic formations of the middle crust of the Variscan Pyrenees occur in some massifs (Alberes, Aston, Trois Seigneurs, Lesponne...) ultramafic and mafic rocks forming polymetric or plutons mileage enclaves. The most significant example is the Héas Gavarnie Dome in the Western Pyrenees. Within this dome of metasedimentary formations affected by a common anatexis (peak conditions at around 730 °C and 4.3 kb) the mafic and ultramafic series form three massifs: the Troumouse massif in the south, mostly made of diorites; the Aguila massif consisting of diorites which contains some hornblendite enclaves; the Gloriette massif, consisting of diorites and norites associated with ultramafic rocks (orthopyroxenites and hornblendites). All of these rocks are affected by variable degrees of metamorphism resulting in the development of secondary amphibole and biotite and cross cutted by a network of granitic bodies.

Petrological and geochemical studies show that these rocks mostly correspond to a basic metamagmatic series with a calc-alkaline affinity and characterized by enriched REE (432 ppm) contents, and REE fractionation processes ($(La/Yb)_N = 7.5$; $(La/Sm) = 2.5$ and $(Gd/Yb) = 1$). They have positive Eu anomalies ($Eu/Eu^* = 3.5$) and the following trace element characteristics: (1) enrichments in U; (2) Nb and Sr depletion; and (3) large positive Pb anomalies. $^{87}Sr/^{86}Sr$ isotopic ratios of mafic and ultramafic rocks range from 0.7045 to 0.7117 and $[\text{U+Th}]/\text{Nd}$ from -5.2 to -10.5. These signatures are typically crustal and show that these rocks have preserved the isotopic fingerprints of lower crustal magmatic processes.