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Geochemistry of biotite granites from the Lamas de Olo Pluton, northern Portugal

Susana Fernandes (1), Maria Gomes (1), Rui Teixeira (1), and Fernando Corfu (2)

(1) Department of Geology, University of Trás-os-Montes e Alto Douro, Vila Real, Portugal (mgomes@utad.pt, 351 259350480), (2) Department of Geosciences, University of Oslo, P.O. Box 1047 Blindern, N-0316 Oslo, Norway

In the Central Iberian Zone (CIZ) extensive crustal recycling occurred during the post-thickening extension stage of the Variscan orogeny (∼330–290 Ma). After the ductile deformation phase D3 (∼320–300 Ma), characterized by the intrusion of large volumes of highly peraluminous granitic magmas, rapid and drastic tectonic changes at about 300 Ma gave rise to the brittle phase of deformation D4 that controlled the emplacement of Fe-K subalkaline granites (296–290 Ma; Dias et al. 1998).

The Lamas de Olo Pluton (LOP) is controlled by NE-SW and NW-SE fracture systems, probably related to the Régua-Verin fault zone (Pereira, 1989). The LOP is a medium to coarse-grained, porphyritic biotite granite, accompanied by medium- to fine grained, porphyritic biotite granite (Alto dos Cabeços- AC) and a more leucocratic, fine-grained, slightly porphyritic biotite-muscovite granite (Barragens- BA). The contacts between LO and AC are generally diffuse, whereas those to BA are sharp. In fact, the BA granite can occur in dykes and sills cutting LO and AC. Microgranular enclaves and xenoliths are very rare. The LOP intrudes the Douro Group, presumably of Precambrian to Cambrian age, and two-mica granites from the Vila Real composite massif. The LOP granites consist of quartz, microcline, plagioclase, biotite, zircon, titanite, tourmaline apatite, fluorite, ilmenite, magnetite, and rutile, with muscovite in BA granite and rare allanite in the LO and AC granites. The plagioclase composition is of oligoclase (An12) – andesine (An35) for LO granite, albite (An9) – andesine (An30) for CA granite and albite (An5) – oligoclase (An20) for BA granite. There are decreases in: a) anorthite content from phenocryst to matrix plagioclase; b) Ba content from phenocryst to matrix microcline in all granites. The Fe2+ biotite has a composition similar to that of biotite from calc-alkaline to sub-alkaline rock series. The LO and AC granites are meta- to peraluminous with ASI variable between 1.05 and 1.21, and display isotopic signatures of (87Sr/86Sr)i = 0.7044–0.7077 and [U+F065]Nd = -2.2 to -1.1.

Six samples of LO define a whole rock isochron age of 285±15 Ma with (87Sr/86Sr)i = 0.7051±0.001 (MSWD = 0.11). Two monazite analyses for the LO granite yield an weighted average 207Pb/235U age of 297.19±0.73 Ma, consistent with the preliminary ID-TIMS U-Pb analyses of two transparent and euhedral prisms of zircon that define a concordia age of 296.37 ±0.52 Ma (MSWD = 0.66).

The linear trends of major and trace elements variation diagrams of LO and AC granites and their similar mean values of (87Sr/86Sr)i point, at this stage, to an involvement of mid-crustal sources, probably mixed with asthenospheric material. Therefore, LOP consists of post-D3 biotite granites installed in higher structural crustal levels, testifying the occurrence of a crustal growth episode after the major recycling processes that occurred during the deformation phase D3.

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