Geochemistry of igneous rocks from Carrascal Massif (Central Portugal) – a preliminary approach

(1 fig.)

A. R. SOLÁ[1] – A. M. R. NEIVA[2] – M. L. RIBEIRO[1] – M. E. MOREIRA

[1] Department of Geology of Geological and Mining Institute, Portugal, rita.sola@igm.pt
[2] Department of Earth Sciences, University of Coimbra, Portugal, neiva@ci.uc.pt
[3] Laboratory of Geological and Mining Institute, Portugal

Introduction and geological setting

The Portuguese Variscan granitoids crop out extensively in the two central domains of the Iberian segment: the Central Iberian Zone (CIZ) and Ossa Morena Zone (OMZ). The CIZ granites are mainly of S type (Neiva – Gomes, 2001). They are better exposed and studied than the OMZ granites. Plutonic mafic rocks are more abundant and larger volumes are associated with granitic massifs at OMZ than CIZ (Bard – Fabries, 1970).

The Carrascal Massif is located at the transition between these two geotectonic zones, presents Variscan deformation and is NW-SE elongated (Fig. 1). It intruded Precambrian to Palaeozoic rocks and the contacts are fault bounded to the major Badajoz-Cordoba shear zone. Field observations and thin sections do not show any evidence of contact metamorphism. The massif is zoned and consists of a rim of medium- to coarse-grained porphyritic biotite granite and a core of medium- to fine-grained biotite granite. Very fine- to medium-grained mafic rocks (gabbro, diorite, monzodiorite) and some ultramafic rocks crop out scattered as an elliptical ring within the core (Fig. 1).

Petrography

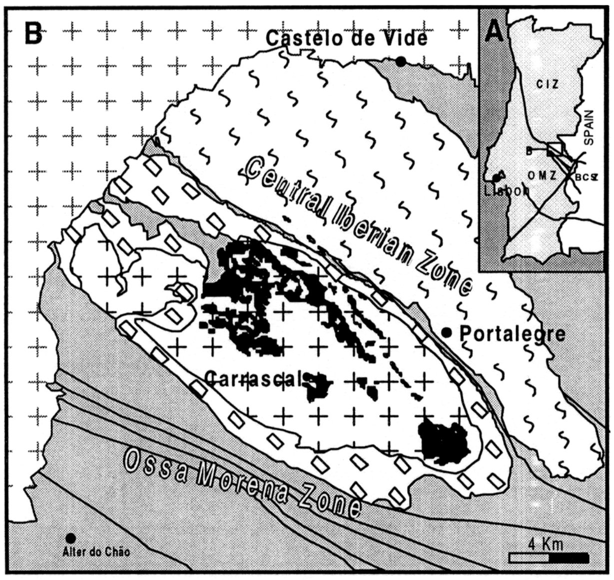
Gabbro, diorite and monzodiorite are deformed. Although being locally strongly deformed, some original textures are well preserved. They have hypidiomorphic to allotriomorphic granular, microgranular and intergranular textures. Locally an ultramafic rock has cumulate texture and contains large crystals (<4 mm) of poikilitic amphiboles and their inclusions are totally retrograded into sericite, chlorite, epidote, calcite and fibrous amphiboles. Iron oxides and sulphides are main accessory minerals. Some amphibole crystals are surrounded by biotite. The mafic rocks consist, in variable proportions, of plagioclase, amphibole (mainly hornblende), biotite, quartz, rare K-feldspar, and also sphene, zircon, apatite, ilmenite and rare sulphides. However, fibrous amphiboles, epidote, and chlorite are related to a retro-metamorphic process.

Granodiorite, monzogranite, and syenogranite contain quartz, K-feldspar, plagioclase, biotite, chlorite, rare epidote and allanite and also zircon, ilmenite and apatite. The porphyritic granite has phenocrysts of K-feldspar and plagioclase. Commonly they are weakly to moderately deformed, with the preserved igneous texture. However, strongly deformed facies with a clear foliation (protomylonitic texture) also occurs.

Geochemistry of minerals of mafic rocks

Plagioclase crystals are strongly zoned from An 6 to An 64, either normal or inverse or oscillatory zoned.

Backscattered images and electron microprobe analyses of amphiboles commonly show exsolutions and reac-



Nisa-Albuquerque batholith (late-Variscan)
medium- to fine-grained biotite granite
medium- to coarse-grained porphyrilic biotite granite
mafic rocks
} Carrascal Massif (deformed by Variscan orogeny)
Portalegre Massif (deformed by variscan orogeny)
Precambrian to Paleozoic rocks
main faults

Fig. 1 A – Geological setting of the area B located at the Central Iberian (CIZ) / Ossa-Morena (OMZ) boundary within Badajoz-Cordoba shear zone (BCSZ). B – Schematic geological map of Carrascal Massif and host rocks after Fernandes – Gonçalves 1971.

journ1_2_03_v14_bez neucasti.p65 115 7.5.2003, 15:09

tion rims in individual crystals. Magnesiohornblende and actinolite are the most common compositions. In general, magnesiohornblende shows lamellar exsolutions of cummingtonite-grunerite. A few single crystals consist of a magnesiohastingsite core and a rim of tschermakite, ferrohornblende and ferro-actinolite.

Biotite has Fe/(Fe+Mg) of 0.52–0.58.

Geochemistry of rocks

Mafic rocks have (wt%) SiO_2= 43–58; TiO_2= 0.7–1.4, total Fe_20_3= 7–19; CaO= 4–8, MgO= 3–21, Ba = 50–744 ppm, Sr= 68–254 ppm and Rb= 11–123 ppm.The AFM diagram suggests that mafic rocks belong to a calc-alkaline sequence. ASI [molar Al_2O_3/ ($CaO+Na_2O+K_2O$)] is 0.82–0.97 in mafic rocks, but 1.0–1.3 in both granite rim and core.

Although the granite core tends to be slightly more evolved than the granite rim, they are not chemically well distinguished. Rim and core have respectively (wt.%) SiO_2 67–76 and 70–77; TiO_2 0.1–0.6 and 0–0.3; total Fe_20_3 1.4–4.2 and 0.9–3.0; MgO 0.3–1.4 and 0.1–0.7; Ba 189–611 and 279–805 ppm, Sr of 37–133 and 33–110 ppm and Rb of 92–168 and 112–199 ppm.

Among mafic rocks and granites Al_2O_3, total Fe_2O_3, MgO, CaO, and K_2O show curved variations when plotted against SiO_2, but there is a gap between mafic rocks and granites. The plots of Na_2O, P_2O_5, Zr, Nb, Y, Ba, Sr, and Rb, versus SiO_2 show that mafic rocks and granites define two distinct trends.

Discussion

The occurrence of ultramafic and mafic rocks with high Mg contents included in granites are uncommon in Portugal (Ribeiro *et al*, 1987). However, the mafic rocks from the Carrascal Massif have compositions similar to those of Quérigut Complex (Roberts *et al*, 2000) and Gredos-Avila Batholith (Bea *et al* 1999) in the Variscan Chain.

Field relationships and geochemical data suggest that mafic rocks and granites from Carrascal Massif are not related. They are derived from distinct protholiths, but their isotopic signatures are being determined.

Acknowledgements. Thanks are due to Geological and Mining Institute and Geosciences Centre of Coimbra University, Portugal. Prof. B. J. Wood and Dr. S. Kearns are gratefully acknowledged for the help given to A. R. Solá to use the electron microprobe at Bristol University, U. K., and the financial support of the European Community Access to Research Infrastructure action of the Improving Human Potential Programme, contract HPRI-CT-1999-00008

References

Bard, J. P. – Fabries, J. (1970): Apercu pétrographique et structural sur les granitöids de la Sierra Morena Bol. Geol. Min España t 81 (2–3) pp. 227–244.

Bea, F. – Montero, P. – Molina, J. F. (1999): Mafic Percursors, Peraluminous Granitoids, and Late Lamprophyres in the Avila Batholith: A Model for the Generation of Variscan Batholits in Iberia. Journal of Geology, 107 (4), 399–419.

Fernandes, A. P. – Gonçalves, F. (1971): Nota preliminar sobre o provável maciço subvulcânico do Carrascal (Portalegre-Alto Alentejo). Bol. Mus. e Lab. Min. Geol. da Fac. Cięnc, Univ. Lisboa Vol. 12-Fasc 1 pp. 37–46.

Neiva, A. M. R. – Gomes, M. E. P. (2001): Diferentes tipos de Granitos e seus Processos Petrogenéticos: Granitos Hercínicos Portugueses. Mem. acad. das cięncias de Lisboa, t XXXIX, pp. 53–95.

Ribeiro, M. L. – Moreira, A. – Munhá, J. (1987): Ultramafitos da região de Monção (NW de Portugal) – implicações petrogenéticas. Comun. Serv. Geol. Portugal, t 73, fasc 1/2, pp. 59–65.

Roberts, M. P. – Pin, C. – Clemens, J. D. – Paquette, J. L. (2000): Petrogenesis of Mafic to Felsic Plutonic Rock Associations: The Calc-alkaline Quérigut Complex, French Pyrenees. Journal of Petrology, 41, 6, pp. 809–844.