

Petrogenesis of the Santa Eulália Plutonic Complex (Alentejo, Portugal): contribution from recent elemental and isotopic (Sr-Nd) geochemical data

José Carrilho Lopes¹, Helena Sant'Ovaia², Pedro Nogueira³, Helena C.B. Martins^{2*},
Fernando Noronha², Luis Lopes⁴

¹ Centro de Geologia Univ. Lisboa; Dpt. Geociências, E.C.T., Universidade de Évora, Portugal, carrilho@uevora.pt

² Centro de Geologia Univ. Porto, DGAOT, F.C., Universidade do Porto, Portugal, hbrites@fc.up.pt

³ Centro de Geologia Univ. Porto; Dpt. Geociências, E.C.T., Universidade de Évora, Portugal

⁴ Centro de Geofísica de Évora; Dpt. Geociências, E.C.T., Universidade de Évora, Portugal

*- presenting author

The Santa Eulalia Plutonic Complex (SEPC) is a late-Variscan granitic massif with elliptical contours intersecting the NW-SE Variscan dominant regional structures in the most northerly sectors of the Ossa-Morena Zone (Iberian massif). The host rocks of this plutonic complex are meta-sedimentary formations generated between Proterozoic and Lower Paleozoic, some of them strongly affected by contact metamorphic processes related to the SEPC intrusion, and now recognized as a set of hornfels with a wide compositional range. SEPC has two main granitic facies which present different compositions and textures. It can be classified as a ring igneous complex composed, from the rim to the core, by a medium- to coarse-grained pink granite (G0-group), with biotite (\pm hornblende) as the dominant mafic mineral, involving large (kilometric) elongated masses of mafic (gabbroic) to intermediate (granodioritic) rocks, here called M-group, and a central gray medium-grained granite (G1-group), typically monzonitic, with biotite as the main mafic mineral, sometimes showing a slight porphyritic tendency, namely in a few outcrops located in transitional zones, near the contact with the peripheral G0-type ring.

Magnetic Susceptibility (MS) analysis sustain major genetic differences between pink and gray SEPC granites. G0 facies present relatively high values of magnetic susceptibility ($Km > 10^{-3}$ SI) compatible with the presence of magnetite, while the low values registered in G1-group ($Km < 10^{-4}$ SI) are consistent with the presence of ilmenite. Distinct magnetic behaviour of these two granitic facies also reveal contrasting redox conditions during the magma genesis and cooling process (Sant'Ovaia *et al.*, 2011).

Elemental geochemistry confirms significant differences between G0 and G1 facies. G0 granites represent more evolved liquids ($>SiO_2$ wt.% and $<MgO$ wt.%) with dominant metaluminous character, plot close to A-type fields (Whalen *et al.*, 1987), and some samples show negative Eu anomalies. Instead, G1 facies are typically monzonitic granites with a slight peraluminous character and no significant Eu anomalies (Lopes *et al.*, 1998). Relationships between SiO_2 vs. (Na_2O+K_2O-CaO) indicate that G0-group and G1-group have alkali-calcic and calc-alkaline character respectively; both granitic groups, should be

classified as magnesian according to SiO_2 vs. $\text{FeO}^t/(\text{FeO}^t+\text{MgO})$ correlation (Frost *et al.*, 2001).

Recent Sr and Nd isotopic data obtained for 15 samples (5 per group of facies) were used considering an age around 290 My (Pinto, 1984). The least evolved gabbro of the M-group has a mantle Nd isotopic signature ($\epsilon\text{Nd}_{290}=+1.7$) representing the highest value of the wide ϵNd_i range revealed by this group of facies ($-3.0<\epsilon\text{Nd}_{290}<+1.7$). Representative samples of G0 granite, belonging to the external ring, show a narrower range of ϵNd_i values ($-2.3<\epsilon\text{Nd}_{290}<-0.9$) which is included in the previous M-group ϵNd_i range. G0-group also plots in the mantle-crust Sr-Nd isotopic alignment apparently defined by mafic-intermediate rocks of M-group. In contrast, the grey granites placed in the central part of the SEPC (G1-group), diverge from this trend, showing clearly lower ϵNd_{290} values ($-5.9<\epsilon\text{Nd}_{290}<-4.7$) which suggest petrogenetic processes involving dominant crustal melts and/or primary magmas strongly contaminated by crustal fractions. Also $(^{87}\text{Sr}/^{86}\text{Sr})_{290}$ vs. $(1/\text{Sr})$ projection points to a likely ACF-type differentiation process showing that crustal assimilation were probably more important during the petrogenesis of the G1-facies than in the magmatic event which provided the association between M and G0 groups, probably dominated by fractional crystallization mechanisms with relatively lower contribution of crustal assimilation.

This work has been financially supported by PTDC/CTE-GIX/099447/2008 (FCT-Portugal, COMPETE/FEDER).

References

- Frost, B.R., Barnes, C.G., Collins, W.J., Arculus, R.J., Ellis, D.J. & Frost, C.D. (2001). A Geochemical Classification for Granitic Rocks. *Journ. of Petrol.*, 42, 2033-2048.
- Lopes, J.C., Munhá, J.M., Wu, C.T. & Oliveira, V.M.J. (1998). O Complexo Plutónico de Monforte-Santa Eulália (Alentejo-NE, Portugal central): caracterização geoquímica e considerações petrogenéticas. *Comun. Inst. Geol. e Mineiro*, 83, 127-142.
- Pinto, M.S. (1984). Granitóides caledónicos e hercínicos na Zona de Ossa-Morena (Portugal) – nota sobre aspectos geocronológicos. *Memórias e Notícias Publ. Mus. Lab. Min. Geol. Univ. Coimbra*, 97, 81-94.
- Sant’Ovaia, H., Lopes, J.C., Nogueira, P. (2011). Multidisciplinary study of Santa Eulalia Plutonic Complex (Central Portugal): Preliminary insight, (2011) *Min. Mag.*, 75, 3, 1795.
- Whalen, J.B., Currie, K.L. & Chappell, B.W. (1987). A-type granites: geochemical characteristics, discrimination and petrogenesis. *Contr. Min. Petrol.*, 95, 407-419.