U-Pb geochronology and Nd isotope contributions to the interpretation of a peculiar ring massif: the Santa Eulália plutonic complex (SW Iberia, Portugal)

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The Santa Eulalia plutonic complex (SEPC) is a late-Variscan granitic body placed in the Ossa-Morena Zone. The host rocks of the complex belong to metamorphic formations from Proterozoic to Lower Paleozoic. The SEPC is a ring massif (ca. 400 km2 area) composed by two main granitic facies with different colours and textures. From the rim to the core, there is *(i)* a peripheral pink medium- to coarse-grained granite (G0 group) involving large elongated masses of mafic and intermediate rocks, from gabbros to granodiorites (M group), and *(ii)* a central gray medium-grained granite (G1 group).

The mafic to intermediate rocks (M group) are metaluminous and show wide compositions: 3.34–13.51 wt% MgO; 0.70–7.20 ppm Th; 0.84–1.06 (Eu/*Eu\**)N (*Eu\** calculated between Sm and Tb); 0.23–0.97 (Nb/*Nb\**)N (*Nb\** calculated between Th and La). Although involving the M-type bodies and forming the outer ring, the G0 granites are the most differentiated magmatic rocks of the SEPC, with a transitional character between metaluminous and peraluminous: 0.00–0.62 wt% MgO; 15.00–56.00 ppm Th; and 0.19–0.42 (Eu/*Eu\**)N ; 0.08–0.19 (Nb/*Nb\**)N [1][2]. The G1 group is composed by monzonitic granites with a dominant peraluminous character and represents the most homogeneous compositional group of the SEPC: 0.65–1.02 wt% MgO; 13.00–16.95 ppm Th; 0.57–0.70 (Eu/*Eu\**)N ; 0.14–0.16 (Nb/*Nb\**)N . According to the SiO2 vs. (Na2O+K2O–CaO) relationships, the M and G1 groups predominantly fall in the *calc-alkaline* field, while the G0 group is essencially *alkali-calcic*; on the basis of the SiO2 vs. FeOt/(FeOt+MgO) correlation, SEPC should be considered as a *magnesian* plutonic association [3].

New geochronological data (U-Pb on zircons) slightly correct the age of the SEPC, previously obtained by other methods (290 Ma, [4]). They provide ages of 306 ± 2 Ma for the M group, 305 ± 6 Ma for the G1 group, and 301 ± 4 Ma for the G0 group, which confirm the late-Variscan character of the SEPC, indicating however a faintly older emplacement, during the Upper Carboniferous. Recent whole-rock isotopic data show that the Rb-Sr system suffered significant post-magmatic disturbance, but reveal a consistent set of Sm-Nd results valuable in the approach to the magmatic sources of this massif: M group (−2.9 < *εNdi* < +1.8); G1 group (−5.8 < *εNdi* < −4.6); G0 group (−2.2 < *εNdi* < −0.8).

These geochemical data suggest a petrogenetic model for the SEPC explained by a magmatic event developed in two stages. Initially, magmas derived from long-term depleted mantle sources (*εNdi* < +1.8 in M group) were extracted to the crust promoting its partial melting and extensive mixing and/or *AFC* magmatic evolution, thereby generating the G1 granites (*εNdi* < −4.6). Subsequently, a later extraction of similar primary magmas in the same place or nearby, could have caused partial melting of some intermediate facies (e.g. diorites) of the M group, followed by magmatic differentiation processes, mainly fractional crystallization, able to produce residual liquids compositionally close to the G0 granites (*εNdi* < −0.8). The kinetic energy associated with the structurally controlled (*cauldron subsidence* type?) motion of the G0 liquids to the periphery, would have been strong enough to drag up M group blocks as those occurring inside the G0 granitic ring.

*References:*

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