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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 km^2 area) composed of 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 a wide range of 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 of 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 SiO_2 vs. (Na_2O+K_2O–CaO) relationships, the M and G1 groups predominantly fall in the *calc-alkaline* field, while the G0 group is *alkali-calcic*; on the basis of the SiO_2 vs. $FeO_t/(FeO_t+MgO)$ correlation, SEPC should be considered as a *magnesian* plutonic association [3].

New geochronological data (U-Pb on zircons) slightly modify the age of the SEPC obtained by other methods (290 Ma, [4]). These data provide ages of 306 $\pm$ 2 Ma for the M group, 305 $\pm$ 6 Ma for the G1 group, and 301 $\pm$ 4 Ma for the G0 group, which confirm the late-Variscan character of the SEPC, indicating however a slightly older emplacement, during the Upper Carboniferous. Recently obtained whole-rock isotopic data show significant post-magmatic disturbance to the Rb-Sr system, but reveal a consistent set of Sm-Nd results that are valuable for inferring the magmatic sources of this massif: M group ($-2.9 < \varepsilon Nd_i < +1.8$); G1 group ($-5.8 < \varepsilon Nd_i < -4.6$); G0 group ($-2.2 < \varepsilon Nd_i < -0.8$).

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 ($\varepsilon Nd_i < +1.8$ in M group) were emplaced into the crust, promoting its partial melting and extensive mixing and/or *AFC* magmatic evolution, thereby generating the G1 granites ($\varepsilon Nd_i < -4.6$). Subsequently, a later emplacement 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 ($\varepsilon Nd_i < -0.8$). The kinetic energy associated with the structurally controlled (*cauldron*

subsidence type?) motion of the G0 liquids to the periphery is considered to have been strong enough to drag up the M group rocks as blocks occurring inside the G0 granitic ring.

References:

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