Sr-Nd isotopic constraints on the genesis of Hercynian granitoids from the Central Iberian Zone, Northern Portugal

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In the Central Iberian Zone (CIZ) of the Iberian Massif large volumes of granitoids were emplaced during the post-collisional stage of the Hercynian orogeny (syn- to post-D3, the last ductile deformation phase). This was the main period of successive granite generation (Ferreira *et al.*, 1987) which exhibits great composition variability (Dias *et al.*, 1998):

(1) Syn-D3 granitoids, 319-313 Ma. Moderately peraluminous granodiorites to monzogranites and highly peraluminous two-mica leucogranites of calc-alkaline and aluminopotassic affinities.

(2) Late-D3 biotite-dominant granitoids, 311-306 Ma. Mainly as composite massifs displaying a wide compositional range from gabbroic to granitic and a monzonitic affinity. They are metaluminous to peraluminous. The more basic rocks have a shoshonitic affinity and occur as small stocks. Other plutons exhibit characteristics of aluminopotassic associations.

(3) Late-to post-D3 granitoids, *ca.* 300 Ma. Highly peraluminous two-mica leucogranites of aluminopotassic affinity.

(4) Post-D3 granitoids, 296-290 Ma. Slightly metaluminous to peraluminous monzogranites of subalkaline ferro-potassic affinity occurring as zoned plutons.

Rb-Sr and Sm-Nd isotopic data provide constraints on the nature of the parental reservoirs involved in the granite production as well as on the mechanisms that control the genesis and evolution of the magmas. These data show a general negative correlation without a simple relationship between isotope signatures and the major petrographic types. The younger subalkaline ferro-potassic granitoids (post-D3 granitoids) have more depleted Sr-Nd compositions within the range $(^{87}Sr/^{86}Sr)_i$ = 0.7033-0.7060 and εNd_i = -1.5 to -2.3. The syn- and late-D3 granitoids show a more evolved isotopic signature (Sr_i>0.7070 and εNd_i <-4.4).

In the syn- and late-D3 groups, calc-alkaline and monzonitic series display continuous trend of increasing Sr_i and decreasing εNd_i from metaluminous (gabbros, quartz diorites, monzodiorites, quartz monzodiorites) to peraluminous (granodiorites, monzogranites) rocks within the range Sr_i = 0.7050-0.7106 and εNd_i = -2.3 to -6.8. The highly peraluminous leucogranites display the most evolved isotopic compositions (Sr_i>0.711 and εNd_i <-7.0).

From the integration of geochemical and isotopic data a diversity of sources and processes is assumed. During the D3 deformation phase (*ca.* 320-300 Ma) successive isotopic evolved and highly peraluminous magmas were generated from a heterogeneous metasedimentary upper-crustal source ($Sr_{320-300}$>0.711 and $\varepsilon Nd_{320-300}$<-7.0), giving rise to the two-mica leucogranites. In the syn- and late-D3 periods (*ca.* 320-305 Ma) peraluminous monzogranites were probably produced by partial melting of heterogeneous metasedimentary or metaigneous lower crust materials ($Sr_{320-305}$ = 0.709-0.711 and $\varepsilon Nd_{320-305}$ = -5 to -7). During these periods a large amount of hybrid magmas are generated by the interaction of these crust-derived liquids and a mantle-derived magma (equivalent to the gabbroic rocks) yielding an enriched isotopic signature (Sr_i = 0.705 and εNd_i = -2). The Sr-Nd isotopic data are conformable with the resulting composite plutons being originated by AFC processes between mantle and crustal magmas (Dias & Leterrier, 1994).

A rapid and drastic change occurred at about 300 Ma, between a compressive ductile tectonic regime (D3, *ca.* 320-300 Ma) associated with calc-alkaline, monzonitic and alumino-potassic plutonism and a fragile phase of deformation (D4) which controlled the emplacement of the subalkaline ferro-potassic granitoids at 296-290 Ma. These granitoids have evolved chemical compositions and display the most depleted Sr-Nd signature, suggesting a contribution of a distinct mantle component (more depleted) or melting of mafic crustal sources or both.

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