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THE ORIGIN OF GRANITES AND RELATED ROCKS

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Crustal zoning of Neoproterozoic pre-collisional granites in the Paraíba do Sul belt, Rio de Janeiro, Brazil

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Neoproterozoic pre-collisional magmatic rocks in the central part of the Paraíba do Sul belt (PSb) of southeastern Brazil are formed by lineated and foliated batholiths which are structurally concordant with the regional NE-SW and NNE-SSW trends of the belt, and constitute an expanded association including tonalite, granodiorite and granite, comparable to Cordilleran I-type batholiths but with more evolved petrographic and geochemical compositions.

The PSb in Rio de Janeiro State has four domains, separated by ductile shear zones with predominantly horizontal slip. From SE to NW the domains are: Litorâneo, Serra dos Órgãos, Paraíba do Sul and Juiz de Fora. The shear zones are high angle except for the contact between the Juiz de Fora and Paraíba do Sul domains which is middle/low angle. The main metamorphic and structural features of the first three domains in mainly amphibolite facies were imposed during the Neoproterozoic, while the essentially granulitic Juiz de Fora domain is dominantly Paleoproterozoic. In all domains, migmatized orthogneisses of the Paleoproterozoic basement and Proterozoic metasediments are present.

The precollisional batholiths of the central portion of the PSb mainly occur south of the Além-Paraíba ductile shear zone, in the Serra dos Órgãos and Litorâneo domains, and were intruded at a deep crustal level under granulite or high amphibolite facies conditions. Massifs mainly composed of charnockites or of rocks of the charnockitic association occur in the Litorâneo domain, in which the Angelim tonalitic massif at its northern limit is the exception. The charnockitic rocks occupy a belt whose length in Rio de Janeiro State alone reaches over 400 km. Rb-Sr whole rock isochron ages around 600 Ma have been obtained.

The Serra dos Órgãos domain contains the homonymous batholith, the largest in the region with a length of 165 km and a width of 30 km. The granitoids contain biotite and amphibole, together with clino- and orthopyroxene in the charnockitic rocks. The common accessories are zircon, apatite, opaque minerals, allanite and titanite. The rocks are medium- to coarse-grained, inequigranular, and sometimes porphyritic with foliated, granoblastic and recrystallized textures. Mylonitic rocks are common especially near the borders of the massifs. Except for the Angelim tonalite, compositions are usually slightly expanded. In all massifs, microgranular quartz diorite to monzodiorite enclaves are common.

The magmatism is medium- to high-K, metaluminous to peraluminous, and calcic to alkali-calcic Peacock indices. Rocks of the charnockitic association are usually more calcic and richer in Mg and Ti, and are less K-rich and relatively poorer in HFSE than the other rocks. Some of the intermediate Serra dos Órgãos rocks fall in the tholeiitic field of the FMA diagram. Tectonic discrimination diagrams with major elements identify the rocks as pre-collisional or mantle fractionates, while the trace elements point to syn-collisional or volcanic arc origins.

The spatial distribution of granitoid types in the PSb is comparable to that of the Mesozoic-Cenozoic cordilleras of western North and South America. The pre-collisional granitoids also have a crustal zoning, with deeper intrusion levels in the internal part of the belt, and somewhat shallower intrusion in the external part.