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The complex patterning of granites and their feldspars in the deep crust

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During the post-orogenic stage of the Neoproterozoic coastal orogen in Brazil, inversely zoned plutons intruded a narrow mostly S-N tectonic corridor crosscutting all previous lithologies. Structural measurements, mapping of flow patterns, geochemical and isotopic data point towards contrasting compositional domains, which have been generated during a time span between 20 to 30 Ma during Cambro-Ordovician times (ca.520-490 Ma).

Mostly sub-vertical internal contacts between units suggest generation from large magma bodies of contrasting compositions, which mixed and hybridized at different proportions. They crystallized while crossing the lower to middle-crust (< 25 km depth from geobarometric studies). Accordingly mushroom- to funnel-like magma-chambers and/or conduits register snapshots of the interaction dynamics between granitic and basaltic magmas.

This work focuses on the pluton of Santa Angélica (SA), where mafic rocks predominate: two gabbroic twin cores are surrounded by hybrid regions in complex patterns of stretching and folding. Granite predominates only at the border region.

Mineralogical and whole-rock geochemical data point towards an expanded high-K calc-alkalic to alkalic suite. Rocks grade from biotite-hypersthene-augite monzogabbro, biotite-monzodiorite to allanite-biotite granite. Granitic to gabbroic rocks are metaluminous and both enriched in incompatible elements. This is more characteristic for the mafic to intermediary rocks. Anomalous K₂O, Ba, Sr, and LREE contents, as well as high contents in HFS elements such as Ti, Y, Nb, P, and Zr are typical. Low-silica rocks contain very high Ba and Sr values, over 5,000 and 1,500 ppm, respectively.

In comparison to the average nMORB mafic and hybrid rocks from SA are extremely enriched in Rb, Ba (up to 500X), K, La, Ce, P, Nd and Zr and show no depletion of compatible elements such as Tb and Y. On the other hand in comparison to average OIB magmas, mafic and hybrid rocks from SA are still enriched in Rb, Ba (up to 10X), similar in K, La, Ce, Nd and Zr and slightly depleted in Nb, Sr, Sm, P, Ti and Y.

As a consequence an abnormal mantle enrichment episode is thought to be the source for the enriched basic magma.

Magma mixing and fractional crystallization are recognized as main differentiation processes during the evolution of the different rocks.

Almost identical Sr–Nd isotopic ratios for both gabbrodiorite and granite point towards a highly homogenized mixed system, which is not consistent with the homogenization degree of the whole magmatic body at outcrop scale. A granitic magma contaminated a previously enriched mantle-derived basaltic magma in such a way to produce a hybrid monzogabbro with the same isotopic signature as the granite.

In this work we will discuss: 1) evidence for different mixing episodes, 2) whether the end-members are still to be found in the outcropping rocks, 3) differential mobility of major and trace elements and, 4) the role of late fluid-rock interaction in the system as depicted by the complex