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Petrogenesis of the syn-orogenic calc-alkaline magmatism in the Agudos Grandes Batholith, SE Brazil

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The Agudos Grandes Batholith is a result of voluminous and long-lived (>615-565 Ma) granite magmatism developed in the Apiaí Domain of the Ribeira Belt in SE Brazil. The largest volume of granite was emplaced during the "syn-orogenic" period and is largely dominated by foliated metaluminous high-K calc-alkaline granites (610±2 Ma; Ibiúna-type), with subordinate peraluminous leucogranites (610± 1 Ma; Turvo-type) and allanite and titanite-rich biotite granites (608±5 Ma; Itapevi-type).

The Ibiúna-type hornblende-biotite granites span a wide range of SiO_2 (63-73 wt.%) and are characterized by high Mg# (usually, 40-50) and high Ba and Sr contents. REE patterns are fractionated (La_N/Yb_N= 16-62); low Rb/Sr and U/Th ratios and the Sr-Nd-Pb isotope signature are indicative of significant contribution from old lower crust. Their signature strongly contrasts with the Turvo-type muscovite-biotite leucogranites, which intrude them and are have high SiO_2 (73-75 wt.%), high U/Th, and low Zr and LREE.

The Itapevi-type is fine-to medium-grained, equigranular to porphyritic biotite granites with abundant allanite and titanite. These granites span a similarly large compositional range (60-74 wt.% SiO_2), but differ from the Ibiúna-type by their consistently lower Mg# (25-40) and Sr, and higher Ba/Sr, Zr, Hf, LREE and Th at a given silica content. They have fractionated REE patterns, with a mafic equigranular sub-type enriched in HREE (La_N/Yb_N= 25-96) when compared with a felsic sub-type (La_N/Yb_N= 7-37). A porphyritic sub-type is petrographically similar to the Ibiúna type, and is distinguished by its lower CI (~8).

Major-element geochemical modeling shows that the felsic Itapevi cannot be derived from the mafic Itapevi variety by fractional crystallization; the results show that fractionated melts do not reach high values of SiO_2 as observed in the Itapevi-felsic. A better fit is achieved by fractional crystallization of a magma akin to Ibiúna-type and up to 18% assimilation of a metapelite; the presence of inherited zircons with ~1.8 and 2.1 Ga is consistent with the budget of detrital sources in the Apiaí Domain.

The Itapevi mafic and porphyritic sub-types, which show evidences of interaction with a mafic magma (e.g., mafic enclaves), can be modeled as resulting from mixing between the Itapevi felsic sub-type and a basalt magma.

Heat flux provided by the intrusion of the Ibiúna granites resulted in low-degree (F~ 0.07-0.37) partial melting of more fertile protoliths (metawackes) at shallower crustal levels generating the anatectic peraluminous Turvo-type leucogranites.