

Geochemistry, geochronology and tectonic setting of the granitic magmatism in the Pien region, south Brazil

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The Pien area (southeastern State of Paraná, southern Brazil) represents the juxtaposition of two major geological domains separated by the Pien Suture Zone (PSZ)^{1,2,3}. The northern domain is composed of calc-alkalic granitoids (Rio Pien Granitic Suite - RPGS) and the southern is represented by high alumina and low-K calc-alkalic amphibolite-granulite gneisses (Luis Alves Terrane).

Several disrupted lenses of a mafic-ultramafic suite (predominantly serpentinites) occur along the PSZ. These rocks are strongly deformed showing a tectonic contact with the host rocks. Their geochemical characteristics (Ti, Cr, Ni and REE) are similar to the ophiolites observed in supra subduction settings.

The RPGS represents a 22 km wide granitoid terrain made of medium to coarse grained, greyish and red quartz-monzodiorites, granodiorites and monzogranites^{4,3}. Most of these granitoid rocks are affected by a strong shearing deformation, developed under greenschist to lower-amphibolite metamorphic conditions. The evolution of the PSZ during the Neoproterozoic initially involved RPGS overthrusting towards S-SE, followed by transcurrent movement.

The eastern part of the area is occupied by the Agudos do Sul Granitic Massif (ASGM) which represents the youngest granitoid intrusion in the Pien area. It is formed mainly by fine and coarse reddish monzogranite, syenogranite and alkali-feldspar granite. Subordinately, granodiorite facies with small late gabbro-diorite intrusions are also found.

The available U-Pb, Rb-Sr and K-Ar geochronological data for the RPGS and ASGM (Figs. 1 and 2), indicate a time interval between 660 to 590 Ma during which the granitoid (RPGS) emplacement, deformation with associated metamorphic recrystallization and late granitoid intrusion (ASGM) took place.

The RPGS rocks have medium K calc-alkalic metaluminous to slightly peraluminous compositions while the ASGM rocks are high K calc-alkalic to alkaline and slightly peraluminous. Trace element patterns for the RPGS (Fig. 3.a) are typical of andino-type volcanic-arc calc-alkalic magmatism. The ASGM and most RPGS granitoids exhibit fractionation and progressive enrichment in LREE, without Eu anomalies. The ASGM can be distinguished from the RPGS by their high K, Rb, Th, Ta, Nb, LREE and low Ba (Fig. 3.b). They also have higher K₂O/Na₂O, Rb/Sr, Rb/Zr, Ta/Zr and lower K/Rb ratios. The trace elements characteristics of ASGM are very similar to the volcanic-arc geochemical character presented by the RPGS.

Considering the initial ⁸⁷Sr/⁸⁶Sr isotopic ratios for the RPGS (0,704) and ASGM (0.707), and the Nd isotopic data, it is possible to suggest a magma source involving two components: a hydrated mantle wedge and paleoproterozoic continental crust. The latter reflected by high ε_{Sr}(t), very negative ε_{Nd}(t) values and Nd model ages of 2.0 to 2.1 Ga (Fig. 4).

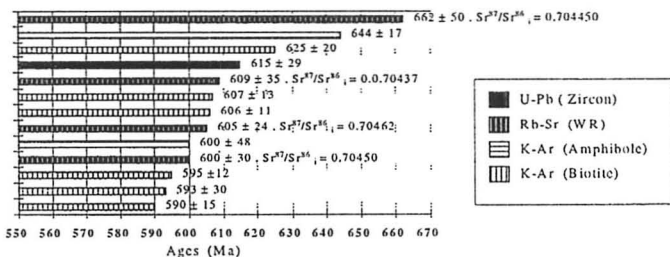


Fig. 1 - U-Pb, Rb-Sr and K-Ar geochronological data for the RPGS

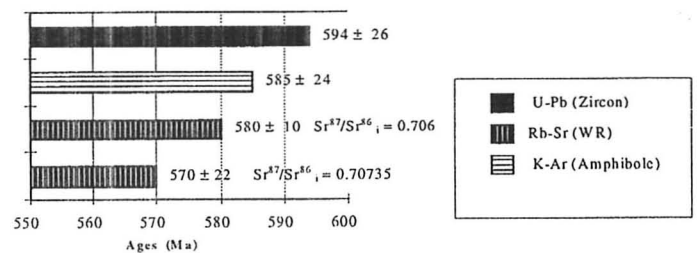


Fig. 2 - U-Pb, Rb-Sr and K-Ar geochronological data for the ASGM.

The analysis of the entire set of the available geological data for the granitoid rocks in the Pien area allows the suggestion of a Neoproterozoic geotectonic scenery of an active continental margin, where the RPGS represents the roots of a magmatic arc formed above a N-NW dipping subduction zone and deformed during the collision between the Luis Alves and Curitiba Terranes. The ASGM represents a late to post-collision magmatic episode occurred along the Pien Suture Zone.

References

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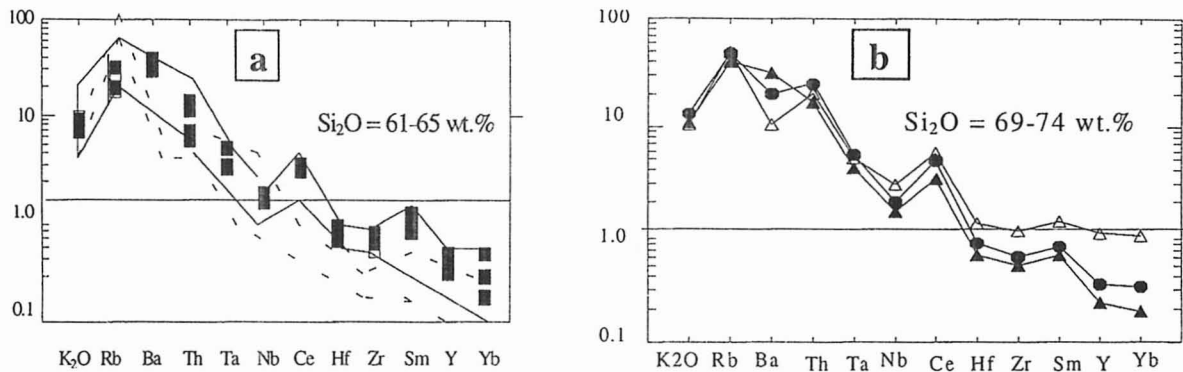


Fig. 3 - Trace element geochemical patterns for granitic samples from RPGS (a) and ASGM (b) normalized against ocean granite ridge⁵. Stippled field = upper crustal melts (syn-collision) granites. Solid field = magmatic arc granites and late to post-orogenic granites (data source from Pearce *et al.*⁵ and Harris *et al.*^{6,7}).

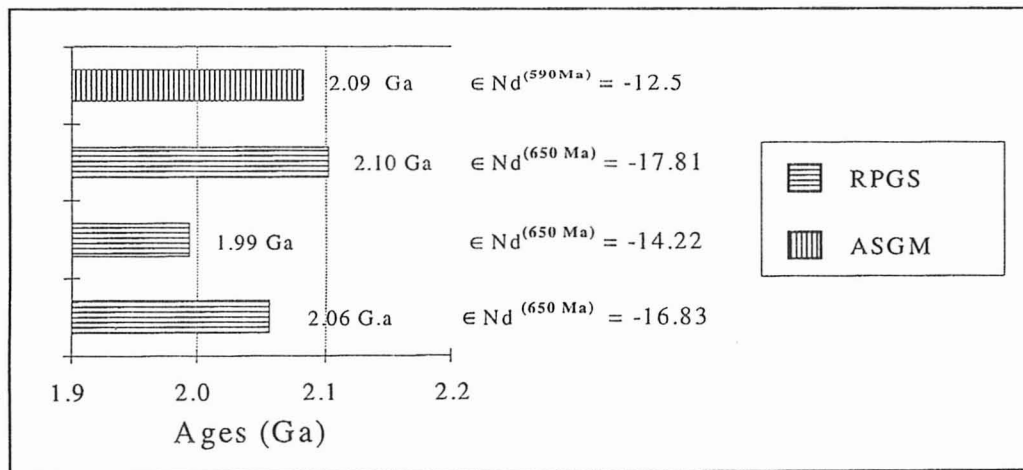


Fig. 4 - Nd model ($T_{DM}^{(T)}$) ages for samples from the RPGS and ASGM.