

Geochronological map of the Precambrian terrains of Paraná and Santa Catarina States, southern Brazil: Tectonic implications

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Introduction

The aim of this paper is to present the authors' idea about the tectonic interpretation of the available geological and isotopic data for the basement area of Paraná and Santa Catarina States. As it is normal in these cases the information data are not homogeneously distributed in the area, which makes the interpretations more reliable in some areas than others. The geochronological base has more than 1000 data including K-Ar, Rb-Sr, Pb-Pb, U-Pb and Sm-Nd ages. The studied area comprises a complete cross section through the Precambrian terrains of the eastern parts of Paraná and Santa Catarina States. All the geological units observed have a roughly NE-SW trend which allows the extrapolation of the interpretations made in this area into most of Rio Grande do Sul and southeastern region of São Paulo States.

Tectonic Domains

In a 450 Km cross section from Florianópolis (SE) to Castro (NW), it is possible to recognize several tectonic units with different geological, structural and geochronological patterns. From SE to NW the principal domains are: 1) *Florianópolis Granite-Migmatite Belt* - ranging from strongly deformed calc-alkaline granites and migmatites to isotropic pink-reddish alkaline granitoids and volcanic rocks; 2) *Brusque Schist Belt* - greenschist to amphibolite supracrustal volcanosedimentary associations (2a) with intrusive granitoids (2b) and few basement nuclei; 3) *Itajaí Foreland Basin* - anchimetamorphic turbidites and acid volcanic rocks with conglomerates and sandstones at the base; the basin is more deformed at its southern border; 4) *Luis Alves Terrain* - calc-alkaline orthogranulites with many lenses of mafic rocks and very subordinate metasedimentary rocks; 5) *Guaratubinha-Campo Alegre Volcanosedimentary Basins* - non deformed and non metamorphic acid volcanic rocks with some minor sedimentary contribution; 6) *Pien Mafic-Ultramafic and Granitoid Belts* - several disrupted ultramafic (mainly serpentinite) bodies (6a) and deformed calc-alkaline granitoids (6b) occurring in a NE-SW suture zone between the Luis Alves (S) and Curitiba (N) terrains; 7) *Curitiba Terrain* - biotite amphibole and amphibole banded gneisses with granulite gneiss and mafic rocks (in the northern part), heterogeneously remigmatized; 8) *Camarinha Foreland Basin* - anchimetamorphic to greenschist metasedimentary rocks strongly deformed by regional folding and strike-slip faults; 9) *Apiaí Schist Belt* - dolomites (sometimes with stromatolites), limestones and expressive phyllite pile with minor volcanic contribution, deformed and metamorphosed at green-schist to amphibolite metamorphic grades (9a) with coarse grained biotite rich calc-alkaline granitoids of Três Corregos Batholith (mainly slightly deformed) and late alkaline reddish isotropic intrusive granitoids (9b); 10) *Itaiacoca Schist Belt* - predominately carbonatic rocks often with stromatolitic structures and a volcanosedimentary association where high-K volcanic rocks compose an important part (10a). All the units suffered a

regional green-schist metamorphism with its northernwestern border clearly showing a thermal aureole produced by the Cunhaporanga calc-alkaline batholith(10b); 11) Castro Volcanosedimentary Basin - acid to intermediate volcanic rocks with a subordinate sedimentary basal sequence; 12) Costeiro Granite Belt - it is the only major tectonic unit present in the area that is not observed in the profile. This domain outcrops in the northeastern part of Parana State being composed by biotite-sphene rich calc-alkaline granitoids with late intrusive two mica leucogranites.

Data Base

The geochronological data, summarized in the table 1, includes all available isotopic information for the studied terrains produced during almost 35 years. However, most of the U-Pb and Sm-Nd data were obtained only in the last 10 years and many of them are still unpublished. The data presented represents the geochronological pattern characteristic of the indicated domain obtained on each method. The ages are expressed in Ga. Most of these data can be found in the references 1 to 8.

TECTONIC DOMAINS	K - Ar minerals	Rb - Sr wr	Pb - Pb wr	U - Pb zircons	Sm - Nd TDM	Sm - Nd Ndt
1	.55-.61	.52-.63	1.6 +- .3	.60-.62	1.3-1.8	-2 -8
2a	.55-.60	.60-.81		1.4-1.6	1.9-2.1	-7 -10
2b	.54-.64	.62-.64	-	.48-.65	1.6-1.9	-8 -22
3	.51-.53	.53-.54	-	.56	1.7-2.2	-8 -14
4	1.7-2.1	1.9-2.7	2.1-2.4	2.2-2.8	2.3-3.1	
5	.45-.50	.50-.57	-	.60 -.63	-	-
6a	.50-.60	~	-	-	2.5-3.6	-1 -23
6b	.61-.68	.60-.65	-	.61-.71	2.0-2.1	-14 -18
7	.55-.65	.60-2.2	-	2.0-2.1	2.3-2.8	-1 -7
8	.48-.50	-	-	-	-	-
9a	.50-.80	.55-1.7	1.1-1.7			
9b	.56-.65	.51-.79	.75-.78	.66-.72	2.1-2.2	-16 -20
10a	.61-.63	1.1-1.4	1.3-1.7		2.3-2.7	-5 -17
10b	~.59	.54-.75	-	-	1.8-2.7	-6 -13
11	.43-.46	.48-.50	-	-	-	-
12	.46-.56	.54-.59	-	.59-.62	1.9-2.2	-12 -20

The analysis of these geochronological and isotopic data allows the following conclusions: a) all the observed domains with exception of Luis Alves Terrain, gave Neoproterozoic mineral K-Ar ages; b) almost the same pattern can be found for the Rb-Sr whole rock isochrons; c) all the studied grantoids with or without volcanic-arc affinity gave Neoproterozoic or even younger ages by K-Ar, Rb-Sr and U-Pb methods; d) all the ND(DM)model ages gave pre-Neoproterozoic values, strongly suggesting the inexistence of juvenile crustal accretion at Neoproterozoic time; e) the Epsilon ND(t) are always negative ranging between -1 to -23 which is in good agreement with the earlier interpretation f) the granitoids observed in the first domain (Florianopolis Granite-migmatite Belt) gave consistently younger ND model (~1.4Ga) ages which is in accordance with the suggestion that these material came from a younger lithospheric mantle than the other domains which came, in general, from a protholith older than 1.9Ga.

Tectonic Interpretation

Most of the boundaries between these domains are tectonic, represented by late-Neoproterozoic shear zones which makes very difficult the proposition of any model where a paleogeographical reconstruction could be proposed involving all the different domains. It is possible that the majority of these domains (with exception of the late tectonic basins and granites) are exotic: they did not evolve on their present position.

The analysis of the geochemical and isotopic data indicated that the granitoid belts (1, 2b, 6b, 9b, 10b, 12) could represent the roots of Neoproterozoic magmatic arcs developed during Brasiliano (800-600) and Rio Doce (620-500) orogenesis (Brasiliano Mega-cycle). It is also suggested that the supracrustal schist belts, that in many cases host these granitoid belts, are continental-margins sequences which started their sedimentation during Mesoproterozoic (1.6 to 1.4 Ga) times and did not evolve in a back-arc basin as is usually proposed. Here we postulated the dissociation of the schist belt tectonic-sedimentary evolution and the granitoid belt intrusions. Meanwhile the ages of the principal metamorphic episodes that affected all the schist belts are in good agreement with the emplacement ages obtained in the associated granitoid belts.

The magmatic history of the Luis Alves granulite terrain started during Neoproterozoic time. High grade metamorphism occurred at 2.3 Ga. The Neoproterozoic thermo-tectonic episodes that affected the entire Paleoproterozoic banded-gneisses (Curitiba Domain) only affect its northern border. These two terrains represent fragments of older continental landmasses involved in the Neoproterozoic evolution.

Conclusions

In conclusion the interpretation of the geological and isotopic data allows the suggestion that the present configuration was established during the Neoproterozoic due to the collage of these different terrains at the end of the Brasiliano Mega-cycle. The distribution of these units, in roughly NE-SW belts, is interpreted as the amalgamation of these domains towards NW representing an accretion on the eastern border of the Parana Craton.

The late tectonic volcanosedimentary basins of Guaratubinha, Campo Alegre and Castro and the alkaline-peralkaline granites (that affects the Luis Alves and Curitiba domains) could represent an extensional episode which took place around 600+-20 Ma and occurred in the interval between the compression related to the Brasiliano and Rio Doce orogenesis.

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