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THE ROLE OF THE CURITIBA AND LUIS ALVES MICROPLATES DURING THE WEST GONDWANA ASSEMBLY

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Introduction

The structural framework of the northern part of the Brazilian southern region (central portion of the Mantiqueira Province) resulted from the juxtaposition of several crustal blocks, which were variably affected by the Neoproterozoic tectonics. In this area three major Precambrian units can be identified: the southern part of the Ribeira Belt (Apiaí fold belt), the granite-gneiss-migmatitic domain composed of the Curitiba and Luís Alves microplates, and the northern part of Dom Feliciano Belt. The assembly of these continental masses was part of Western Gondwana agglutination (Brito Neves et al., 1999; Basei et al., 2008; Cordani et al., 2003).

This paper examines the geology of the Luís Alves and Curitiba microplates by characterizing their complex geological history and proposing that they were not fragments of the Rio de La Plata and Paranapanema cratons.

Geological Setting

The Apiaí Fold Belt represents the supracrustal sequences that constitute the southern part of the Ribeira Belt. It contains Mesoproterozoic (ca. 1,750-1,450 Ma) and Neoproterozoic supracrustal sequences (ca. 800-600 Ma) revealing a polycyclic evolution. Roots of Neoproterozoic magmatic arcs (Cunhaporanga, Três Córregos and Agudos Grandes) were recognized in the majority of the supracrustal domains (ca. 630-580 Ma). The Paleoproterozoic basement inliers are composed of Rhyacian tonalitic gneisses (ca. 2,200 Ma) and deformed Statherian A-type granites of ca. 1,750 Ma of age (Cury et al., 2002).

South of the Lancinha Shear Zone, the Atuba Complex exemplifies the Curitiba Microplate basement. Banded migmatites composed of biotite-amphibole mesosomes and tonalitic-trondhjemitic leucosomes of Rhyacian age (2,100-2,200 Ma) predominate, strongly

affected by a second migmatitic event during the late Neoproterozoic. These rocks compose the Atuba Complex (Siga Jr. et al., 1995) representing the basement of Curitiba Microplate. The Atuba Complex is covered by low-grade Neoproterozoic metavolcano-sedimentary sequences (Capiru, Setuva and Turvo-Cajati) and has been intruded by anorogenic alkaline-peralkaline granitoids of the Serra do Mar Suite.

The contact between the Curitiba and Luís Alves microplates is marked by the Piên Suture Zone, characterized by deformed arc-related calc-alkaline granitoids (ca. 615 ± 5 Ma) where basic and ultrabasic rocks (630 Ma) are present. The mafic rocks are remnants of an obducted oceanic floor (Basei et al., 1992; Machiavelli et al., 1993). The roots of a Neoproterozoic magmatic arc lying between these microplates are thought to be an Ediacaran active margin, where oceanic crust was consumed.

The Luís Alves Microplate (Basei et al., 1992) basement consists predominantly of hypersthene gneisses of Siderian- Rhyacian ages, migmatitic and granitic rocks. To a lesser extent kinzigitic gneisses also occur, together with iron formations and quartzites. A striking characteristic of this domain is the presence of basic and ultrabasic rocks (pyroxenites, metagabbros, amphibolites and magnesian schists), which in some places (e.g. Barra Velha – 2,100 Ma) constitute the predominant rock type.

The Dom Feliciano Belt resulted from a subduction process involving a E-dipping oceanic plate, producing a magmatic arc during the Upper Proterozoic (Florianóplis batholith), a series of supracrustal rocks (Brusque Group) and a foreland basin (Itajaí Group) in its external portion (anchimetamorphic sediments and volcanic rocks). A marked tectonic vergence from SE to NW with transport of all its units against the foreland (Luís Alves Microplate) can be recognized.

Discussion

The granitic-migmatitic-granulitic domains belonging to the Luís Alves and Curitiba continental fragments separate the two major supracrustal belts of southern Brazil represented by Ribeira (NW) and Dom Feliciano (SE) belts. In the granite-gneiss domain, indications of an Archean origin and high-grade metamorphism of Paleoproterozoic age are common (Basei et al., 1998, Hartmann et al., 2000). Despite sharing many similarities these two continental blocks were not part of a single block.

The Luís Alves Microplate consists of migmatitic-gneissic rocks that underwent granulite facies metamorphism. This TTG-type association also underwent retrograde metamorphism to the amphibolite facies. The two high-grade metamorphic events, the first of Siderian age with a climax around 2,354 ± 23 Ma and the second of Rhyacian age (2,181 ± 21 Ma), can be characterized and are separated by a time gap of ca. 200 million years during which erosion and deposition of sedimentary rocks must have occurred (Basei et al 1999;Hartmann et al, 2000). On the other hand, the Curitiba Microplate presents just one generation of ca. 2,100 Ma high grade metamorphic rocks (charno-enderbites). These rocks show a massive structure and do not exhibit the banding observed in the migmatitic amphibole gneiss that predominate in the Atuba Complex. Despite the strong influence of the Neoproterozoic overprint the best example of Archean zircons found in both microplates has been found in the Atuba Complex (Sato et al., 2003). In addition, another important difference between these microplates is the presence of a metasedimentary cover (Capiru-Setuva and Turvo Cajati formations) in the Curitiba Microplate that has no equivalents in the Luís Alves domain.

In the entire Mantiqueira Province the basement of the Luís Alves Microplate represents the only large continental fragment that was not affected by the Neoproterozoic tectono-thermal overprint, remaining cold and stable since the end of the Paleoproterozoic, with cooling K-Ar ages around 1,800 Ma, whereas the Curitiba domain was intensely affected by the Brasiliano Cycle with abundant evidence of Neoproterozoic migmatization and crustal melting.

Gravimetric data suggest that the thickness of the Luís Alves Microplate reached ca. 45 km, making it impossible to consider that it is composed entirely of outcropping granulitic gneisses. Therefore it is suggested that crustal thickening occurred by the end of the Paleoproterozoic when the Santa Catarina Granulitic Complex was thrusted over a Paleoproterozoic juvenile complex (Mantovani et al., 1989; Hallinan et al.,1993; Basei et al., 1998). This hypothesis is also based on the contrast observed between Nd model ages (TDM) that indicate mostly Paleoproterozoic model ages for the volcanic cover and intrusive granitoids and Neoarchean for the gneisses of Santa Catarina Granulitic Complex, ruling out the derivation of the Neoproterozoic igneous rocks from the Luís Alves gneiss.

In both microplates younger rocks from volcano-sedimentary basins and undeformed A-type granitoids formed under an extensional regime between 600 and 588 Ma, which represents the influence of the surrounding Neoproterozoic tectonics on the Curitiba and Luís Alves microplates. These Neoproterozoic units show clear contrasts regarding metamorphism and deformation when compared to the gneissic rocks of their basement. These units either lie discordantly on top of, or are clearly intrusive into, the gneisses. Among the cover units, non-metamorphosed volcanosedimentary basins are well represented by the Campo Alegre and Guaratubinha basins, with an important alkaline felsic magmatism associated in space and time with several of A-type alkaline-peralkaline plutons (Serra do Mar Suite/Graciosa Province). These basins reflect extensional events that took place in the Luís Alves and Curitiba terrains by the end of the Neoproterozoic (Siga Junior et al., 1999).

Even considering their Paleoproterozoic basements (a common age in the Brazilian shield), the Luís Alves and Curitiba microplates, as such, must be understood as exotic Neoproterozoic units that were involved in the tectonic events related to the closing of the oceans consumed by the approximation of large cratonic masses (Rio de La Plata, Paranapanema, Congo and Kalahari) that culminated in the formation of Western Gondwana.

Conclusions

The subduction of the Curitiba Microplate northwestwards must have generated the Três Córregos, Cunhaporanga and Agudos Grandes batholiths that were emplaced within the Apiaí Belt supracrustal rocks. This subduction process started ca. 640-630 Ma and ended with the collision around 600 Ma. The suture between these two segments is represented in surface by the Lancinha-Itariri Shear Zone.

At the same time interval and resulting from the same general tectonic process (convergence of major cratons), the Piên magmatic arc developed in the southern border of the Curitiba Microplate, representing the interaction between the Curitiba and Luís Alves microplates, the latter subducting northwestwards. In this region there are records of the subduction-collision event between 630 Ma (ophiolitic remains) and 600 Ma (post-collisional granitoids).

A short stabilization period followed the agglutination of these microplates and of the assembly of this segment to the terrains to the west (mainly Paranapanema Craton).

Between 600 and 580 Ma the Campo Alegre, Guaratubinha and Corupá volcano-sedimentary basins developed, as well as the A-type granitoids of the Serra do Mar Suite, reflecting the extensional events resultant from the approximation of the Costeiro Granitic Belt (Paranaguá/Costeiro Terrain), which collided with the Curitiba-Luís Alves complex around 580 Ma.

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