



## PROVENANCE AND DEPOSITIONAL AGE OF THE DOM FELICIANO BELT SUPRACRUSTAL UNITS, BRAZIL - URUGUAY: CORRELATIONS WITH SW AFRICA \*

Basei<sup>1</sup>, MAS; Frimmel<sup>2</sup>, H.E.; Nutman<sup>3</sup>, A. & Preciozzi<sup>4</sup>, F.

<sup>1</sup>Instituto de Geociências, Universidade São Paulo, Rua do Lago 562, S.P., Brazil e-mail: baseimas@usp.br

<sup>2</sup>Institute of Mineralogy, University of Würzburg, Am Hubland, D-97074 Würzburg, Germany, e-mail: hartwig.frimmel@mail.uni-wuerzburg.de

<sup>3</sup>Research School of Earth Sciences, Australian National University, Canberra, Australia., e-mail: allenshiher@optusnet.com.au

<sup>4</sup>Facultad de Ciencias, Universidad de La República, Montevideo, Uruguay, e-mail: fepre@fcien.edu.uy

**Key words:** Dom Feliciano Belt, detrital zircon, SHRIMP, Neoproterozoic, Gondwana amalgamation

### INTRODUCTION

The metavolcanosedimentary units that integrate the central Dom Feliciano Belt (DFB) represent supracrustal rocks distributed between the Granite Domain in the southeast and forearc basins in the northwest. In this central segment, metavolcanosedimentary sequences predominate, occurring discontinuously along 1,200 km, in a narrow NE-SW belt of average widths around 40 km (fig. 1).

Three distinct metamorphic complexes can be distinguished. These are from north to south the Brusque, Porongos and Lavallega Complexes. They consist of polydeformed sequences in which at least three fold phases can be distinguished associated with a mass transport to NW. The dominant foliation in most of the rocks is a peak-metamorphic transposition surface S2. The regional metamorphism reached greenschist facies and locally low amphibolite facies.

The continuity of the individual supracrustal sequences is likely, because of strong similarities in their geotectonic setting, metamorphic history, post-depositional granitic magmatism, and geochronology. However, more evidences is required to prove such continuity and detailed comparative studies of the lithostratigraphic columns of each belt have not been carried out. Basement inliers within these belts are Paleoproterozoic (2.3 - 2.0 Ga), affected by Neoproterozoic metamorphism and granite genesis (~ *ca.* 610 +/- 10 Ma).

This work presents some results of U-Pb dating of detrital zircon from the Brusque, Porongos and Lavallega supracrustal units that make up the Dom Feliciano Belt.

### THE BRUSQUE METAMORPHIC COMPLEX

The Brusque Metamorphic Complex is constituted by two metavolcanosedimentary branches that are separated by the Valsungana batholith. In the northern branch the sedimentary sequences start with a pelitic-psammitic unit (garnet-rich mica quartz schists and quartzites) that grade

to psammitic-pelitic units (metarhythmites and homogeneous sericite schists), overlain by a metavolcanosedimentary unit (metamarls, calc-schists, metabasic rocks and subordinate; gray sericite schists (Basei, 1985). The mafic rocks represent a syn-sedimentary basic magmatism of tholeiitic to alkaline affinity. Liquid immiscibility structures are frequently observed, characterizing them as variolitic basalts (Silva et al, 1985; Sander 1992).

In the southern segment, the basal sequence is composed of a metavolcanosedimentary unit that possibly represents the rift phase of the Brusque paleobasin. In this unit volcano-exhalative deposits are characterized by a thick pile of tourmalinites spatially associated with meta-basalts, banded iron formation, orthoquartzites micaschists and calc-silicate rocks (Silva et al, 1985; Basei et al 2000). This sequence is discordantly overlain by a metasedimentary unit constituted by a thick psammitic-pelitic pile where micaceous quartzites, quartz sericite schists, pelitic sericite schists predominate with occasional acid metavolcanics.

### THE PORONGOS METAMORPHIC COMPLEX

In Rio Grande do Sul the Porongos Metamorphic Complex is composed in the vicinity of Santana da Boa Vista by a basal psammitic metasedimentary unit where meta-arkose and impure quartzite beds intercalate metapelites and rare amphibolitic gneisses. Quartzitic metarhythmites predominate in the intermediate portion. On top, a *ca.* 2,000 m thick pile of micaschist occurs with intercalated marble and orthoquartzite. The Cerro da Árvore nappe comprises a dominantly metavolcanic sequence with meta-andesite, metadacite and varied pyroclastic rocks. Subordinately, metachert, marble, metapelite, graphite schist and rare quartzite occur (Jost, 1982). The metamorphic conditions that affected these units vary from greenschist facies to the staurolite zone in the amphibolite facies. The mineral assemblages indicate low to medium pressure (2.0 to 4.8 Kb).

It is suggested that the Encruzilhada do Sul domain belongs to the Porongos Complex, rather than to the Pelotas Batholith, as stated in previous works (the Cordilheira Shear Zone separates the Pelotas Batholith from the Encruzilhada do Sul rocks) representing the basement and partly Porongos deep levels metamorphosed to the amphibolite facies.

### **THE LAVALLEJA METAMORPHIC COMPLEX**

In Uruguay the Lavalleja Group represents the southern segment of the central DFB supracrustal belts, and it comprises three formations from E to W: the Zanja del Tigre, Fuente del Puma and Minas Formations (Sánchez Bettucci, 1998). They reflect a decrease in metamorphic grade from E to W, from low amphibolite - greenschist to very low (anchimetamorphic) grade in the NW region.

The Zanja del Tigre Formation corresponds to a metavolcanosedimentary sequence in which gabbros and amphibolites occur within micaschists, garnet-rich schists and varied marbles. Metamorphism reached the amphibolite facies. It is overlain by the metavolcanosedimentary units of the Fuente del Puma Formation, which is made up of metaconglomerates, calc-arenites, calc-dolomites and micaschists with clear increase in volcanic terms (gabbros, basalts, volcanic breccias and rhyolites) when compared to Zanja del Tigre Formation. The upper Minas Formation consists exclusively of metapelites, quartzites, arkoses, and limestones containing stromatolites.

### **U-PB (SHRIMP) AGES OF DFB DETRITAL ZIRCONS**

Zircon grains were separated from a garnet-biotite schist collected north of Botuverá in the Brusque Metamorphic Complex. They yielded ages predominantly in the 1000 - 1900 Ma range, with three maxima around 1050, 1500 and 1850 Ma. Paleoproterozoic and Archean ages are noticeably lacking. More significant is the lack of Neoproterozoic III detrital grains. However, a sample from a level of sedimentary rocks with mafic tuff contribution, collected in the Votorantin Quarry near Ribeirão do Ouro, not only contain 1800-2200 Ma detrital zircon grains, but also a volcanogenic zircon population that yielded ages around 890 Ma. This value, together with the data for sample SC1 (a micaschist with volcanic contribution) collected near Nova Trento strongly indicates that the deposition of the Brusque Complex units occurred in the Neoproterozoic.

The Porongos Metamorphic Complex was sampled along the Pelotas-Caçapava highway, after the bridge over the Camaquã river. Zircon grains from a micaschist yielded four main age populations around 2000, 1600, 1200 and 600 Ma. Isolated points yielded ages between 2400 and 2600 Ma with the ages of the main sediment sources ranging from 1200 to 1600 Ma. However, the most significant result obtained for the Porongos Complex is related to the ages between 800 and 600 Ma. These values indicate that the deposition in the Porongos paleobasin should not be older than 620 Ma (youngest zircon) and it thus is, as the Brusque complex, a Neoproterozoic unit.

The Lavalleja paleobasin, or at least the Fuente del Puma Formation, is also Neoproterozoic. A representative phyllite sample collected at Ruta 60, present ages distributed between 1800 and 3000 Ma, with concentrations around 1800 to 2000 Ma, 2400 Ma, 2700 Ma, and 3000 Ma. Four values between 700 and 600 Ma define the Neoproterozoic deposition of this unit.

A sample from a rhythmic metapsammitic rock of the Zanja del Tigre Formation was collected at Ruta 12. Differently from the other Dom Feliciano Belt samples, most of the zircon age data fall between 2700 and 3400 Ma. Another conspicuous age cluster occurs around 2200 Ma. The abundance of Archean ages excludes the Piedra Alta Terrane (2100-2000 Ma) as the main source area for these sediments. It is likely that such source area is the Nico Pérez Terrane, where values around 3.4 Ga have been observed (Hartmann et al, 2001). It is possible that the Zanja del Tigre Formation is not part of the Lavalleja Belt but of its basement instead, with probable sedimentation in the Mesoproterozoic. U-Pb zircon dating indicated values around 1750 Ma for the protomylonitic, leuco-granitoids associated with this unit (Sánchez Bettucci et al 2004).

### **DISCUSSION OF THE RESULTS AND COMPARISON WITH SOUTHWESTERN AFRICAN SEDIMENTS**

The pattern of zircon U-Pb ages for the basement terrains throughout the SE portion of Brazil and Uruguay is marked by Archean and Paleoproterozoic values with significant lack of late Mesoproterozoic data. Consequently, the supracrustal rocks derived from erosion of these rocks should present a similar pattern. On the other hand, values in the 900-1200 Ma interval can be considered as an "African" radiometric signature, typical of the Gariep and Damara belts, inherited from their basement, the Namaqua Metamorphic Complex. In the SE portion of Brazil and Uruguay, this signature was found only in the Rocha Group in Uruguay (Basei et al 2005).

For the Dom Feliciano Belt, the results obtained from detrital zircons of the three segments that constitute this belt indicate Neoproterozoic ages, positioning the sedimentation of these supracrustal units in the Brasiliano Cycle. This conclusion solves a long-lasting problem that resulted from the lack of ages directly related to the time of deposition of these units.

A tectonic model to explain the obtained ages is proposed, considering that the Rocha Group is the direct physical continuity of the Gariep Belt in South America (Basei et al 2005; Frimmel & Basei, this volume). The Dom Feliciano Belt supracrustal units represent the Neoproterozoic Rio de La Plata Craton marginal basins, located west of the Major Gercino-Cordilheira-Sierra Ballena suture zone. The lack of ages between 900 and 1200 Ma in the Dom Feliciano Belt metasedimentary units is explained considering the barrier formed by the large Neoproterozoic ocean that existed prior to the Gondwana amalgamation between the South African supracrustal rocks (Gariep and its corresponding basins) and its magmatic arc (present Florianópolis-Pelotas-Aiguá

batholiths) and the south American Rio de La Plata marginal basins (DFB supracrustal rocks).

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## RESUMO

São apresentados alguns resultados U-Pb em zircão detrítico para as unidades supracrustais que compõem os Complexos Metamórficos Brusque, Porongos e Lavallega constituintes do Cinturão Dom Feliciano. O padrão das idades obtido, marcado pela predominância de valores arqueanos e paleoproterozóicos somado a fraca presença de valores do final do Mesoproterozóico, sugerem que esse material provém preferencialmente dos domínios do embasamento observados em toda a porção sul-oriental do Brasil e Uruguai. Por outro lado, valores no intervalo 900-1200 Ma podem ser considerados como uma “assinatura radiométrica africana”, herdada do Cinturão Metamórfico Namaqua”. Essa assinatura é reconhecida na porção sudeste do Brasil e Uruguai somente no Grupo Rocha no Uruguai. Adicionalmente, as idades neoproterozóicas obtidas para os três segmentos supracrustais do Cinturão Dom Feliciano permitiram posicionar sua deposição ao Ciclo Brasileiro.

Um modelo tectônico para explicar as idades obtidas é proposto considerando o Grupo Rocha como a continuidade física na América do Sul do Cinturão Gariép e, as unidades supracrustais do Cinturão Dom Feliciano como bacias neoproterozóicas marginais ao Craton Rio de La Plata, localizadas a oeste da zona de sutura Major Gercino-Cordilheira-Sierra Ballena. A ausência de idades no intervalo 900-1200 Ma nas unidades metasedimentares do Cinturão Dom Feliciano é explicado considerando a barreira formada pelo vasto oceano neoproterozóico que teria existido antes da amalgamação de Gondwana separando as supracrustais africanas (Gariép e bacias correlatas) e seu arco-magmático (atuais batolitos Florianópolis, Pelotas e Aiguá) das bacias marginais sul-americanas (rochas supracrustais do Cinturão Dom Feliciano).

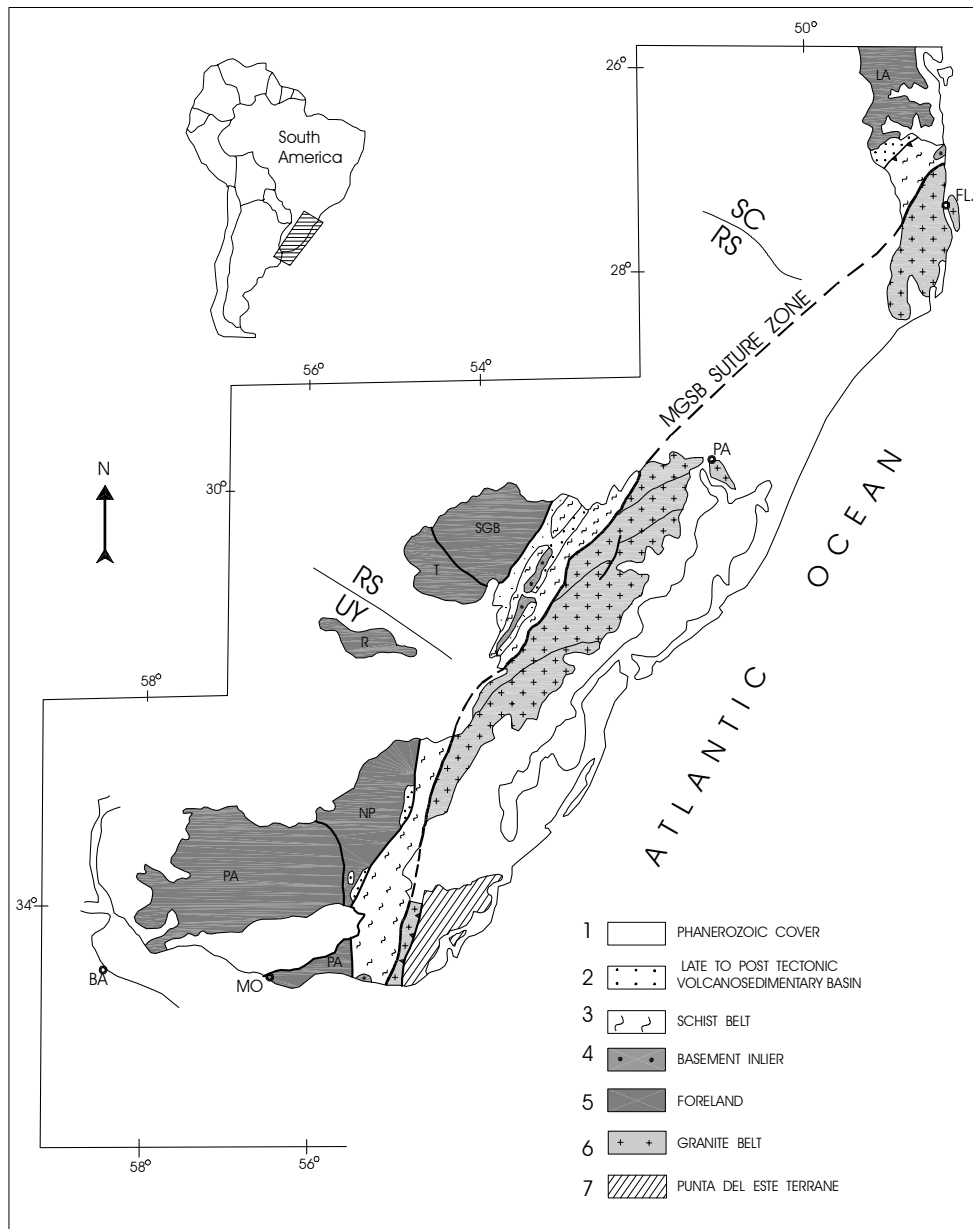


Figure 1- Geological Map of Southeastern Brazil and southern Uruguay:

1) Phanerozoic cover; 2) Basins: Itajaí (SC), Camaquã (RS), Arroyo del Soldado-Piriapolis (UY); 3) Schist Belts and Intrusive granitoids: Brusque Metamorphic Complex (SC), Porongos Metamorphic Complex (RS), Lavalleja Metamorphic Complex (UY); 4) Paleoproterozoic Basement inliers: Morro do Boi (SC), Encantadas (RS) and Punta Rasa (UY); 5) Foreland –Luis Alves Microplate (LA), Piedra Alta Terrane (PA), São Gabriel Block (SGB), Taquarembó (T), Rivera (R) and Nico Perez (NP), – 6) Granite Belt: Florianópolis (SC), Pelotas (RS) and Aiguá (UY) batholiths; 7) Punta del Este Terrane (PET)