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U-Pb, Sm-Nd, AND Pb-Pb GEOCHRONOLOGY OF THE SÃO DOMINGOS S-TYPE GRANITE, AND ITS BEARING ON THE TECTONIC ENVIRONMENT OF THE SW AMAZON CRATON AT THE MESO-NEOPROTEROZOIC BOUNDARY.

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Introduction and Geological Setting

The Amazonian Craton is one of the largest cratonic areas in the world, and occurs in the northern part of South America. It covers an area of about 4.3 x 10^5 km^2 subdivided into six major geochronological provinces based on isotope geology, structural trends, lithologies and geophysical evidences. The oldest province of the craton comprises the Archean nuclei, which are included in the Central Amazonian Province. Paleoproterozoic orogenies are developed in the border zone of the stable Central Amazonian Province, represented in its eastern and northern part by the 2.2-2.0 Ga Maroni-Itacaiúnas Province, and in its western side by the 2.1-1.9 Ga Ventuari-Tapajós Province. Age determinations have defined the 1.80-1.55 Ga Rio Negro-Juruena Province, which evolved through successive magmatic arcs (1.79-1.74 Ga Alto Jauru and 1.57-1.52 Ga Cachoeirinha arcs). The Rondonian/San Ignácio Province was developed through accretionary arcs (1.45-1.42 Ga Santa Helena and 1.38-1.34 Ga San Ignacio arcs). Finally, the Sunsás Province includes older terranes reworked between 1.3 Ga and 1.0 Ga and a small amount of juvenile material. Its evolution has been associated with the inversion of the continental margin followed by continent-continent collision processes at the Meso and Neoproterozoic boundary represented by the Sunsás orogeny, Aguapeí thrust belt and Nova Brasilândia terrain. This work deals with isotope constrains (U/Pb, Sm/Nd and Pb/Pb) of the Neoproterozoic São Domingos suite, which is intruded into the Santa Helena batholith of the 1450-1500 Ma arc.

São Domingos Suite

The São Domingos Suite (SDS) is a S-type granites comprised roughly of circular bodies. The main lithology is a white, isotropic and fine-grained granite. Pegmatitic facies also may be observed near to borders, presenting higher contents of biotite and muscovite. Locally magmatic layering can be seen as a formation of higher amounts of biotite or garnets. K-feldspar, quartz, plagioclase, biotite, muscovite and garnet are the major minerals; zircon, apatite and oxides occur as the accessory minerals. Two U-Pb (single grain) zircon ages indicated upper intercept age (four points) of 930 ± 12 Ma for a muscovite biotite-pegmatite and 936 ± 26 Ma for a garnet-bearing granite.

Pb isotope ratios obtained on leaches of garnets yielded an imprecise Pb/Pb isochron age of 891 ±110 Ma (MSDW=0.59). A two-point Sm/Nd mineral (K-feldspar and garnet) isochron for the garnet-bearing granite yielded an age of 927 ± 5 Ma. Both isochron ages are in agreement (within analytical errors) with U/Pb zircon ages. The above geochronologic data strongly indicate that SDS crystallized at ca. 930 Ma, and that it is younger than the Aguapeí

Thrust Belt K/Ar age of ca. 980 Ma. These ages may suggest that SDS rocks originated under an extensional regime after the collisional process of the Aguapeí Thrust Belt.

The Nd evidence (ε_{Nd} values for two samples are –14 and –2) of SDS rocks indicates an origin from crustal protoliths. In addition, two samples yielded $\delta^{18}O$ values of + 8.6‰ and + 9.0‰, and the whole rock chemical analysis (4 samples) indicate slightly peraluminous character for the SDS rocks, suggesting probably mixture of pelitic metasedimentary protoliths for the granite genesis.

Pb initial isotopic compositions were also determined from K-feldspars of the more important regional units. These results, when plotted on a $^{207}Pb/^{204}Pb$ *versus* $^{206}Pb/^{204}Pb$ evolutionary diagram, indicate that the Santa Helena rocks evolved along a growth curve with μ value of 9.50 while Alto Jauru and Cachoeirinha rocks and the SDS rocks evolved along a growth curve with a μ value of 9.85. We can conclude that the source for the Santa Helena magmas probably had a U/Pb ratio slightly lower than that for the Alto Jauru and Cachoeirinha magmas, and that the SDS magmas formed by the melting of the Alto Jauru and Cachoeirinha rocks, although SDS rocks are hosted by the Santa Helena batholith.

Tectonic Implications

At the end of the Mesoproterozoic (Figure 1) an important continental extension (rifting) took place in the SW Amazonian Craton, represented by the deposition of sedimentary rocks of the Sunsás and Vibosi groups in Bolivia, and the Aguapeí and Nova Brasilândia groups in Brazil. Furthermore, these basins were closed during the development of shortening and uplift processes resulted from plate collision probably related to Rodinia assembly. Up to now two metamorphic pulses were identified: a regional metamorphism at ca. 1100-1080 Ma in the Arequipa-Antofala terrane (Tostal, 1996), the Garzon-Santa Marta massif (Restrepo-Pace et al., 1997) reported within the Andean Chain, and the Nova Brasilândia terrane (Rizzoto et al., 1999) located in Rondonia state. A second metamorphic episode occurred at ca. 1000-980 Ma in Bolivia (Sunsás event) and Brazil (Aguapeí thrust belt), as reported by Litherland et al. (1986) and Geraldes et al. (1997), respectively.

The granitic activities in the Nova Brasilândia region took place in two distinct pulses at 1098 ± 10 Ma (U/Pb; Rio Branco granite) and 995 ± 15 Ma (U/Pb; Rio Pardo granitic suite; Rizzoto, 1999). Metamorphism age of the Nova Brasilândia rocks is indicated by anatetic granitic at 1100 ± 08 Ma and $^{40}Ar/^{39}Ar$ data reported by Tohver et al., (2000) at 1104 ± 3 Ma and 1091 ± 2 Ma (plateau ages) in biotites of metamorphic rocks constrains the cooling of the crust.

The Aguapeí Thrust belt K/Ar dating in sericites yielded ages at ca. 980 Ma (Geraldes et al., 1997). Recent $^{40}Ar/^{39}Ar$ data (plateau age) for the Aguapeí deformation (Tohver et al., 2000) indicate a hornblende age of 970 ± 6 Ma.

The Sunsás Cycle magmatic activity in Bolivia occurred between 1005 and 993 Ma (Rb/Sr ages) and is represented by the Rincon del Tigre Igneous Complex (Rb/Sr age of 992 ± 86 Ma) and syn to late-kinematics granitoids (Rb/Sr age of 1005 ± 12 Ma). K/Ar ages in micas of Sunsás group metasedimentary rocks suggest a metamorphic peak at 1005-972 Ma. According to Teixeira and Tassinari (1984) these ages are in agreement with those already observed for the Younger Granites of Rondônia. The effects of the Sunsás Orogeny in northern Rondônia region and adjacent areas occurred between 1.15 and 0.97 Ga. It includes mainly emplacement of rapakivi granites, mafic dikes and granitic plutons between 1080 and 970 Ma into the older Rio Negro/Juruena and Rondonian/San Ignacio rocks. These effects are

partially coeval with the Sunsás Orogeny in Bolivia as well as the evolution of the Aguapeí Thrust Belt and the Nova Brasilândia Terrane.

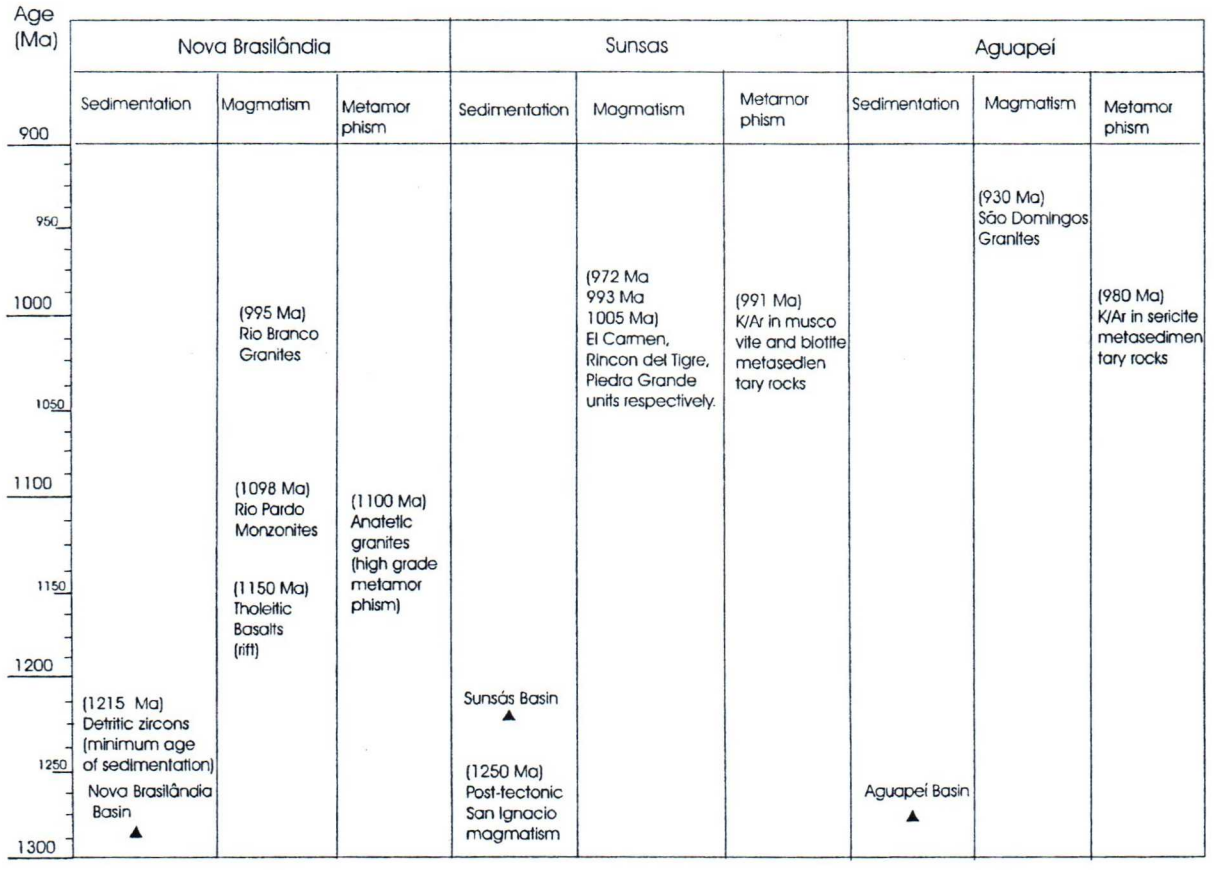

Figure 1. SW Amazonian Craton geologic events from 1.3 Ga to 0.9 Ga.

Global correlations and Conclusions

The western part of the Amazonian Craton, like the Grenville Province, is a multi-orogen region formed between 1.8 and 1.0 Ga where successive magmatism, metamorphism and deformation took place. The Grenville Cycle was subdivided by Rivers (1997) into Elzeverian Orogenic Cycle (1290-1190 Ma) and Grenvillian Orogeny, which comprises the terminal continent-continent collision and the respective pulses, subdivided into the Sawinigan, Ottawan and Rigolet. The ca. 1100 Ma metamorphism age of the Nova Brasilândia and the Arequipa-Antofala rocks allow correlation of these rocks with the first stage of the Laurentia-Amazonia collision, represented in Laurentia by the Sawinigan (1190-1140 Ma) pulse. The Sunsás and Aguapeí deformational events may be correlated with the Rigolet (1000-980 Ma) pulse, and may have formed in the final stage of the agglomeration of Rodinia.

Post-collisional correlatable igneous episodes in the Grenville Province are represented by granitoid plutons and aplite dykes dated between ca. 966-956 Ma, followed by crustal thickening (Tucker and Gower, 1994, Gower, 1996, Wasteneys, 1996). In the Sveconorwegian orogen (1.1-0.9 Ga) of SW Sweden and S-SW Norway, post-collisional bimodal rift-related AMCG intrusions and dolerites are recorded at ca. 966 Ma and 956 Ma interval. Examples of S-type leucogranites of ca. 930 Ma similar to the SDS granites here reported have been described in east Greenland (Kalsbeek et al., 2000). These rocks were

interpreted as formed in high-grade metamorphism not related to the Grenvillian event, but to na earlier episode of extension and crustal thinning.

Arc-related granitoids of Grenvillian age (1190-980 Ma) have been recognized only in Bolivia, suggesting that the evolving continental margin was westward (actual) from the studied area. In such framework, the magmatic activities represented by the S-type granites of the SDS, dated at 930 ± 12 Ma and 936 ± 26 Ma (U/Pb zircons) may be related to extensional tectonics like the post-Grenvilian S-type granites reported in Greenland. SDS rocks probably are the result of melting of Alto Jauru and Cachoeirinha orogenic rocks as a result of gravitational collapse following crustal overthickening achieved during the preceding Grenvillian collision, which is locally represented by the Aguapeí thrust belt rocks.

References

Bingen et al. (1998), Precambrian Research, 90:159-186.

Estrepo-Pace et al. (1997), Earth and Planetary Science Letters, 150:427-441.

Geraldes et al. (1997), International Geology Review, 39:438-448.

Geraldes et al. (2001), Precambrian Research (in press).

Gower (1996), Geological Society Special Paper, 112:197-218.

Kalsbeek et al. (2000), The Journal of the Geological Society, 157:1215-1226.

Larsen (2000), International Geological Congress, 2000 (Rio de Janeiro). Abstracts.

Litherland et al. (1986), Overseas Memoir British Geological Survey, 9(153p.).

Rivers (1997), Precambrian Research, 86:117-154.

Rizzoto et al. (1999), Simpósio de Geologia da Amazônia, 6,. Ext. Abs., 490-493.

Teixeira and Tassinari (1984), Simpósio Amazônico, 2, Actas, 87-102.

Tohver et al. (2000), GSA Meeting 2000 (Denver). Abstract Volume.

Tosdal (1996), Tectonics, 15:827-842.

Tucker and Gower (1994), The Journal of Geology, 102:67-78.

Wasteneys (1996), Precambrian Research, 81:101-128.