

PROBING THE CRUST FROM THE NE BRAZIL THROUGH THE ISOTOPIC GEOLOGY FROM THE PROTEROZOIC ÁGUAS BELAS-CANINDÉ GRANITIC BATHOLITH, PERNAMBUCO-ALAGOAS TERRANE, BORBOREMA PROVINCE

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INTRODUCTION

The Pernambuco-Alagoas Terrane (PAT) was proposed by Santos (1995) to the unit previously defined by Neves (1975) as the Pernambuco-Alagoas Massif. This unit is limited to the north by the Rio Capibaribe, Alto Moxotó and Alto Pajeú Terranes and to the south by the Sergipano System and the São Francisco Craton. Silva Filho et al. (2002) characterized several batholiths of the PAT where the Águas Belas-Canindé Batholith (ABCB) is the larger one, located into the Água Branca Crustal Domain.

The ABCB occupies an area of ca. 5,000 sq. km, showing a NE-SW trending axis. It makes making contact to the south and to the east with the Sergipano Fold System, through low-angle faults, and to the west and to the north with the metasediments of the Cabrobó Complex, through the Ouro Branco low-angle fault. The contacts with the Cabrobó Complex are sharp and marked by the Tanquinho Granitic Complex. Geochemical signature showed by various granitic plutons from the ABCB suggests the same evolved during two processes, subduction and a later collisional process, respectively. Same fault was later reactivated as a transcurrent one. This work evaluates the significance of the Águas Belas-Canindé Batholith during the Brasiliano and the pre-Brasiliano orogenies which might have occurred in the area, based on field and isotopic geology.

GEOLOGIC SETTING AND PETROGRAPHY

Geologic mapping 1:100.000 have recently been done, supported by remote sensing imagery and petrographic studies. It reveals the existence of dozens of granitic plutons and stocks, mainly late tectonic, intruded into tonalitic to syenogranitic diatexites. Some have been dated (Silva Filho et al., 2002), yielding Neoproterozoic ages. The diatexites form nucleus around Fazenda Nova Village, to the SE of Dois Riachos town and around Poço das Trincheiras town, totaling ca. 200 km². Metatexites occur to the south of Inhapi, along the contact with the Cabrobó Complex, grading into diatexites and forming a complex of ca. 200 km². Orthogneisses of metaluminous composition occur only in the Fazenda Nova village.

Preliminary petrographical and field work data show the granites, together with previous works, are either peraluminous and metaluminous. The peraluminous super-suite is represented by medium to high-K and high-K granites. The medium to high-K, peraluminous plutons are represented by Serra do Boqueirão, Carneiros (one of

the largest plutons of the batholith), Lagoa do Correio, Ouricuri, Fazenda Ribeira de Baixo, Serra da Capela, Rui Palmeira, Dois Riachos, São José da Tapera, Serra do Poço, Serra do Macaco, Serra do Almeida, Lagoa do Tanque and Manuel da Costa. The syn-tectonic plutons show NE-SW trends. They are mainly quartz-diorites to quartzmonzonites, biotite quartzmonzodiorites to granodiorites, tonalites, biotite monzogranites, biotite granodiorites, syenogranites and monzogranites. The mineralogy is comprised by biotite, ± muscovite, plagioclase, quartz, zircon, ± apatite, microcline and ± opaques. No one shows either garnet or aluminosilicates. The high-K, peraluminous plutons are the Serra das Lagoas pluton and Fazenda Gameleira stock. They are biotite quartzmonzonites and quartzsyenites, and syenogranites in composition, respectively.

The metaluminous super-suite is represented by medium to high-K plutons and stocks, high-K plutons, shoshonitic affinity plutons (ex: the Serra do Catu Complex). The medium to high-K series is represented by the Lagoa do Correio pluton and the Fazenda Supapo stock. They are quartzdiorite, quartzmonzodiorite, quartzmonzonite, granodiorite, tonalite, and monzogranite in the composition. The texture ranges from equigranular to inequigranular. When porphyritic, they show phenocrystals ranging from 1 to 5cm long. The main minerals are plagioclase, alkali feldspar and quartz. The accessories are amphibole, biotite, titanite, opaques, apatite, zircon, ± epidote, ± leucocoxene, ± allanite, ± sericite, ± carbonate, ± rutile and ± muscovite. The high-K suite is represented by the Tanquinho Complex (Serra Negra, São Raimundo, Serra dos Bois and Maravilha plutons), Moita stock and the syn-tectonic stock of Santana do Ipanema. The Tanquinho Complex occupies ca. 600 km² of area, being among the major one in the Borborema Province. It is comprised by four plutons of quartz-monzonitic, granodioritic, monzogranitic and syenogranitic composition. They have medium to coarse inequigranular texture, with phenocrystals ranging from 2 to 5 cm long. Some plutons show dioritic enclaves. The main minerals are quartz, plagioclase and alkali feldspar. The accessories are amphibole, pyroxene, titanite, apatite, zircon, opaques, magmatic epidote, allanite, chlorite, carbonate, rutile and leucocoxene. Rapakivi texture is common. The shoshonitic affinity suite is represented by the Serra do Catu Complex, Serra da Caiçara and Fazenda Branquinha stocks, Santana do Ipanema dykes and Ribeira do Capiá megadykes. The Serra do Catu

Complex is comprised by porphyritic to inequigranular quartz-monzonites, syenites and quartz-syenites. They commonly show mafic enclaves. The main minerals are alkali feldspars, quartz and plagioclase. The accessories are calcic amphibole, alkali amphibole, clinopyroxenes, opaque, sphene, allanite, apatite, secondary epidote and zircon. The Serra da Caiçara stock is comprised by porphyritic syenogranites. The megadykes are comprised by porphyritic syenogranites, quartzsyenites and syenites. The mineralogy of the Serra da Caiçara and of the megadykes are similar to that showed by the Serra do Catu Complex. They fill a NE-SW fracture system.

ISOTOPIC GEOLOGY

Twenty five samples of granites and three of migmatites from the Águas Belas-Canindé Batholith have been analysed in the Isotope Geochemistry Laboratory of the University of Kansas, following the procedures of Patchet & Ruiz (1987). The results show the granites from the batholith groups three-fold; (1) Metaluminous and peraluminous granites with T_{DM} ranging from 0.90 Ga to 1.23 Ga. and ϵ_{Nd} ($t=0.6$ Ga.) ranging from -2.0 to $+3.0$; (2) Metaluminous and shoshonitic granites showing T_{DM} ca. 1.40 Ga and ϵ_{Nd} ca. -6.0 ($t=0.6$ Ga.). (3) Metaluminous and peraluminous granites with T_{DM} ranging from 1.90 Ga to 2.10 Ga and ϵ_{Nd} ($t=0.6$ Ga.) ranging from -8.0 to -12.0 . The analyzed migmatites are diatexites with metaluminous amphibole bearing non-restitic mafic phase. They show T_{DM} age ranging from 1.16 Ga. to 1.33 Ga. and ϵ_{Nd} ($t=0.6$ Ga.) ranging from -0.7 to -2.8 . The mineralogy and preliminary whole-rock geochemistry of the Group 1 plutons favors the hypothesis that their protoliths were mainly igneous rocks, either volcanic or plutonic. These data, associated with the Sm-Nd isotopic geochemistry, suggest that the best candidate for their protolith are: (1) mixture of juvenile material associated with the Cariris Velhos cycle and a small amount of older (Paleoproterozoic) crust, or (2) juvenile material of Neoproterozoic age, mixed with Paleoproterozoic or Cariris Velhos crust, giving rise to magmas which evolved through an AFC process. The syenogranites to monzogranites represents the most differentiated members. Amphibole \pm biotite granitoids (metaluminous) with composition ranging from diorites to granodiorites of Group 1 granitoids show Nd signatures and tectonic setting similar to the peraluminous intrusions. Thus, different crustal compositions with similar Nd isotope signature were involved in the protolith of the ABCB, suggesting a vertically zoned crust in the area. The tectonic setting suggests the ascent of a primitive magma occurred through an existing shear zone system, reactivated during a Brasiliano transtensional event. Suites similar to the Tanquinho complex have been identified in others batholiths from the PAT, attesting the similarities between the batholiths and the importance of underplating magmas during the Brasiliano cycle. Plutons from Group 2 granites show high-K to shoshonitic composition (Serra do Catu, Serra da Caiçara and the megadykes) and T_{DM} ages around 1.40 Ga. The

correlation between their Nd isotopes, geologic setting and geochemistry (Silva Filho et al., 1995, 1996) suggest the possibility of similar protoliths. An enriched lithospheric mantle is the best candidate for the protolith of the high-K calc-alkaline to shoshonitic magmas. The similarities between their isotopic signatures and related migmatitic country rocks suggest they came from same lithospheric layer. The plutons that comprise Group 3, require a variation to the previous described model. These plutons show different Nd isotope and trace element geochemical signatures with T_{DM} around 2.14 Ga. and ϵ_{Nd} ($t=0.6$ Ga.) around -12.4 , which reflects a small degree of partial melting of a mafic Paleoproterozoic crust.

DISCUSSION AND CONCLUSIONS

The geochemical, geological and isotopic data from Group 1 granites suggest mafic underplating during the late Meso and Neoproterozoic in the PAT. These granites show volcanic arc signature (Silva Filho et al., 2000). Nd isotope associated with the arc signature suggests that the mafic magma may have been a mixture from a subducting oceanic slab (1.0 Ga.?) and older lithospheric mantle. The mafic magmas differentiated to yield a zoned lower crust, explaining the geochemical differences among the granitoid magmas subsequently derived from it.

The Group 2 granites show a narrow range of ϵ_{Nd} ($t=0.6$ Ga.) data, suggesting they came from a homogeneous source. They show as well similar isotopic signature to their migmatitic country rocks. The best hypothesis so far identified for generating process of these granites, based on Nd x Sr isotopic data, is melting of mafic rocks derived from enriched mantle, incorporated into the lower crust during the Brasiliano cycle. These mafic rocks might have been originated from a mantle enriched by the subduction of a 1.5 Ga., or even older crust.

The Nd isotopic signatures of Group 3 granites are associated with high LILE contents (Silva Filho et al., 1996). They show inherited zircons and high and restricted SiO_2 values. Evidence of mantle metasomatism during the Trans-Amazonian Orogeny within the Borborema Province has been reported by various authors. Thus the best candidate for the protolith of these granitoids is a mantle material, enriched in incompatible elements during the Trans-Amazonian Orogeny. They might have incorporated (with some assimilation) into the crust during the Brasiliano cycle, or during the later stages of the Trans-Amazonian Orogeny.

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