THE PAN-AFRICAN/BRASILIANO ARC-RELATED MAGMATISM AT THE COSTEIRO DOMAIN OF THE RIBEIRA BELT, SOUTHEASTERN BRAZIL: NEW GEOCHRONOLOGICAL AND LITOGEOCHEMICAL DATA

TUPINAMBÁ[1,2], M.; TEIXEIRA[2], W.; HEILBRON[1], M. & M., BASEI[2]

[1] Tektos - Geotectonic research group of the Faculty of Geology of State University of Rio de Janeiro (UERJ);

[2] CEPEGeo - Geochronological research center - Geosciences Institute, University of São Paulo (USP).

INTRODUCTION

The *Ribeira Belt*[1] is a Brasiliano/Pan-African belt that extends along the Brazilian Atlantic Coast. Its major tectonic organization can be defined by two important terranes[2]: a) the Occidental Terrane, constituted by a pile of superposed allochtonous terranes tangentially transported towards São Francisco Craton[3,4]. They were subsequently deformed by transpressional oblique shear zones that transport granitic plutons[5,6,7]; b) the Oriental Terrane (Heilbron *et al.* this volume) of the Ribeira Belt , also known as *Costeiro Domain*[8] or *Serra do Mar Microplate*[9].

In this work we present new geochemical and geochronological data about the arc-related rocks of the Rio Negro Complex. The role of this pre-collisional magmatism on the evolution of the Ribeira Belt is also discussed. The studied area is located at *Serra dos Órgãos*, a local name for the 1.000 km-long mountain range that extends along the brazilian atlantic coast, generically called Serra do Mar.

THE COSTEIRO DOMAIN (ORIENTAL TERRANE) OF THE RIBEIRA BELT

The Costeiro Domain is limited at west by an important moderate northwest dipping (~35°) shear zone, and underlies the Occidental Terrane. The major lithological associations of this domain are: a) tonalitic to granodioritic orthogneisses, quartz-dioritic stocks and leucogranitic gneisses that integrates the *Rio Negro Complex*[10]; b) a megasheet of granodioritic to granitic orthogneiss (*Serra dos Órgãos Batholith*[11]) which is intruded in the Rio Negro Complex; c) high-grade metasediments (*Paraíba do Sul Group*[12]) comprises garnet-(cordierite)-(sillimanite)-biotite gneisses, quartzites, calc-silicate rocks and marbles; d) non-foliated granite stocks and sills[13].

The overall structure of the Costeiro Domain is relatively simple: a) the metasediments contain numerous isoclinal recumbent folds[14,15]; b) the orthogneisses show a coarse foliation that gently dips northweast, which is parallel to the axial plane of the isoclinal folds of the metasediments; c) discrete vertical transpressional and transtensional shear zones are related to the latest phases of deformation.

PREVIOUSLY REPORTED PRE-COLLISIONAL MAGMATISM AT THE RIBEIRA BELT

A whole history of a magmatic arc, the *Rio Doce Magmatic Arc*, were presented for the Costeiro Domain[24]. The low-K metaluminous plutonic series (gabro-diorite-tonalite-granodiorite) pre-collisional magmatism (590-570 Ma) is represented by calc-alkaline batholiths like *Angelim, Bela Joana* [16]. However, other authors have reported older ages of pre-collisional granitoid gneiss within the Ribeira Belt, based on Rb/Sr isochronic ages (table 1). The tectonic evolution at the Espírito Santo State, 100 km north of the studied area, comprises a 650-600 Ma pre-collisional phase[17]. Even at the Central Ribeira Belt, it has been proposed a 625-590 time interval for this type of magmatism[4]. It is also possible that the pre-collisional magmatism has been lasted from 650 to 570 Ma.

THE RIO NEGRO COMPLEX AND ITS PRE-COLLISIONAL TONALITIC GNEISSES

The rocks of this complex were first described as banded or homogeneous migmatites[25]. This premise precluded further geochemical or geochronological research during the last twenty years on these rocks. We attempted to consider these migmatites as a sequence of orthogneisses, which cuts each other in many ways, in a manner of a meta-igneous complex[10]. The most widespread rock of the complex is a *Tonalitic Gneiss.* It is a mesocratic, coarse grained rock, comprised by quartz, plagioclase (oligoclase), biotite, hornblende. Titanite and zircon are the accessory minerals. Planar aggregates of hornblende and biotite give the gneissic aspect of the rock. Poiquiloblastic hornblende and biotite are primary minerals, and lobate contacts and anhedral quartz represents late stages of magmatic crystallization. The subsequent dynamic metamorphic reaction is hornblende => biotite +

titanite + opaque. Granoblastic textures including plagioclase, quartz, and even hornblende may be present in some samples.

LITOGEOCHEMISTRY

Five samples of tonalite gneiss of the Rio Negro Complex were collected at the Serra dos Órgãos Region and analyzed at ACTLABS (Ontario, Canada). The results were compared with four samples of the Angelim Batholith[16]. All samples form a calc-alkaline trend on AFM diagram[18], varying from metaluminous to slightly peralkaline (Angelim Batholith). At the R1XR2 diagram[19] the samples perform a pre-collisional trend (figure 1), the same as indicated by other tectonic discriminant diagrams as the Rb x (Y+Nb)[20], figure 2.

THE AGE OF THE TONALITIC TO GRANODIORITIC GNEISSES FROM THE RIO NEGRO COMPLEX

These migmatitic gneisses have been considered as a paleoproterozoic basement[5,6], since there was no geochronological data about them. However, geological mapping[21] has shown that the published 620 +/- 20 Ma concordant zircon age[22] was obtained from a Rio Negro Complex leucogneiss, and not from the Serra dos Órgãos Batholith, as thought by other authors[4,23].

Based on the above, we attempt to obtain another U/Pb zircon age from a well known outcrop of the Rio Negro Complex. We collected a 30 kg weight sample of tonalitic gneiss from an active quarry 2,0 km NE of Duas Barras town. The typical zircons of the rock are huge crystals (5:1), well formed and full of rutile inclusions. Four fractions of different magnetic properties were separated and performed at Geochronological Research Center of the University of São Paulo. Two nearly concordant fractions are shown on the Concordia diagram of the Figure 3, with an upper intercept at 637 +/- 20 Ma, which eliminates any hypothesis about a Palaeoproterozoic age for the sample. A fraction presenting U-excess is also concordant but was not included on the age calculation. Two more fractions, including an air-abraded one, are currently waiting to run at the mass spectrometer.

CONCLUSIONS

The geochronological and geochemical data, presented together with published analyses, suggest that a magmatic arc was active at the Costeiro Domain of the Ribeira Belt during the pre-collisional phase of the Brasiliano-Pan African Orogeny. The life span of the arc is quite long (640 to 590 Ma) and is distinct from that of the Rio Doce Orogeny[9] but is the same interval for the pre-collisional phase of Brasiliano Orogeny at other mobile belts around São Francisco Craton. The proposed magmatic arc occupies 2/3 of the area of the Costeiro Domain, almost 600-km along the Atlantic Coast, from northern São Paulo State to Southern Espirito Santo State. It is noteworthy that at the Occidental Terrane of the Ribeira Belt[2] there is no record of pre-collisional magmatic rocks up to now. It contains, instead, many syn- to late collisional granitoids. The existence of a magmatic arc at the Oriental Terrane (Costeiro Domain) brings new constraints on the palaeogeography of the orogenic zone.

REFERENCES

1. ALMEIDA, F. F.M. de et al., In: The Ocean Basin And Margins (Nairn & Stelli,Eds.), Plenum, Nova York: 411-416 (1973)
2. HEILBRON, M. et al. *This Volume*
3. ROSIER, G. F., Boletim 222 DGM/DNPM, Rio de Janeiro, (1957)
4. HEILBRON, M.et al., *Rev. Bras.Geoc.* **25** (4): 249 - 266 (1995)
5. EBERT, H. D.et al - *Simpósio Nacional De Estudos Tectônicos*, **III**: 139-141 (1991)
6. MACHADO, R. & DEMANGE, M., *Bol. IG-USP*, Sér. Cient., **25**: 81-96 (1994)
7. HEILBRON, M., *Tese de Livre Docência*, Faculdade de Geologia, UERJ, Rio de Janeiro, 110 p. (1995)
8. MACHADO, N. et al. *Precambrian Research*, **79**: 347-361 (1996)
9. CAMPOS NETO, M. C. & FIGUEIREDO, M.C.H. *J. South Am.Earth Sc.*, **8** (2): 143-162 (1995)
10. TUPINAMBÁ, M. et al., *Congresso Brasileiro de Geologia*, **XXXIX** (6):104-106 (1996)
11. GROSSI SAD, J. H. & BARBOSA, L. M. *Boletim Especial Sociedade Brasileira de Geologia*, Belo Horizonte:15-21 (1985)
12. EBERT, H., *An.Acad. Bras.Cienc.*,**40** (Supl):215-229 (1968)
13. JUNHO, M. C. B., - *An. Acad. Bras. Cienc.*, **65**: 161-179 (1993)
14. LAMEGO, A. R. - 1964 - O Homem E A Guanabara, 2nd Ed. Biblioteca Geográfica Brasileira, 5, Série A. IBGE, Rio de Janeiro, 498 Pág.
15. HEILBRON, M. et al., *Simposio de Geologia do Sudeste*,**3:**174-179 (1993)
16. RÊGO, I. T. S. F., *Tese de doutoramento*, Instituto Geociências,USP,São Paulo, 348 p. (1989)
17. WIEDEMANN, C. M., *Bol. IG-USP*, Publ. Especial, **18**: 79-81 (1996)
18. IRVINE, T. N. & BARAGAR, W. R. A.*Canadian Journal Of Earth Science*, **8**:523-548 (1971)
19. BATCHELOR, R. A. & BOWDEN, P., *Chemical Geology.*, **48**: 43-55 (1985)
20. PEARCE, J. A. et al. *Journal of Petrology*. **25**: 956-983 (1984)
21. TUPINAMBÁ, M. et al., *South-American Symposium on Isotope Geology*, **I**: 320-322 (1997)

22.DELHAL, J et al., *Ann. Soc. Géol. Bélg.*, **92** (2): 271-283. (1969)
23.MACHADO, R., *Tese de Livre-Docência*,Instituto Geociências,USP, São Paulo, 215 p. (1997)
24.FIGUEIREDO, M. C. H. & Campos Neto,M.C., *An. Acad. Bras. Cienc.*, **65**(Supl.):63-82 (1993)
25.MATOS, G. M. M. et al., Projeto Faixa Calcária Cordeiro-Cantagalo. Rel. Final,CPRM, Belo Horizonte, 620 p. (1980)
26.MACHADO, R.et al., *Congresso Brasileiro de Geologia*, **XXXIX** (1): 38-40 (1996)
27.BATISTA, J. J., *Tese de Doutoramento*,Instituto de Geociëncias,USP, Sao Paulo, 168 p. (1984)
28.BATISTA, J. J & Kawashita,K., *Simpósio Regional de Geologia*, V (1): 187-200 (1985)
29.FONSECA, A. C. et al.,. *Congresso Brasileiro de Geologia*, **XXXIV**: 2333 - 2345 (1984)
30.SIGA JR, O. et al., *Congresso Latino Americano de Geologia*, V (I): 349-370 (1982).

Batholith	Age (Ma)	IR	Reference
Angelim	732 +/- 32		27
	612 +/- 22	0,7091	23
	502 +/- 133	0,711	28
Bela Joana	600 +/- 10	0,708	28
	603 +/- 50		29
Niterói	714 +/- 10	0,7057	30
	644 +/- 30	0,7100	23
	564 +/- 21	0,7122	
	531 +/- 19	0,7134	

TABLE 1: Rb/Sr whole-rock isochron ages from pre-collisional orthogneisses of the Costeiro Domain of the Ribeira Belt. IR: Initial $^{87}Sr/^{86}Sr$ ratio from the isochron.

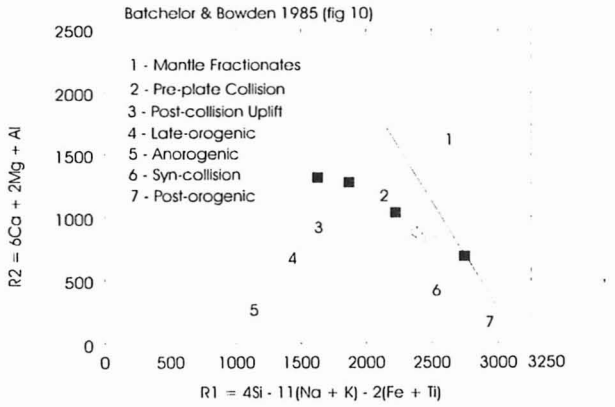

Figure 1: Pre-collisional trend of tonalitic gneisses. Open Circles: Angelim Batholith. Squares: Rio Negro complex.

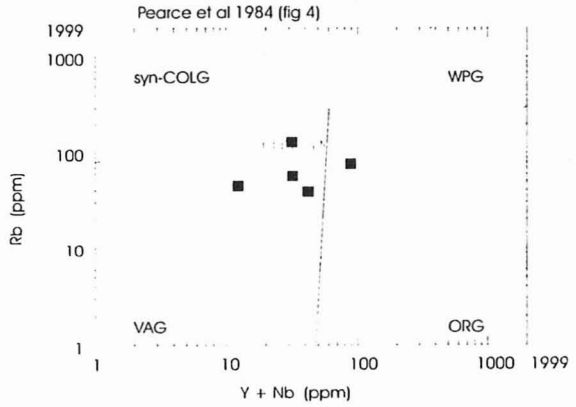

Figure 2: Volcanic-arc signature of the Rio Negro Complex and from Angelim Batholith.

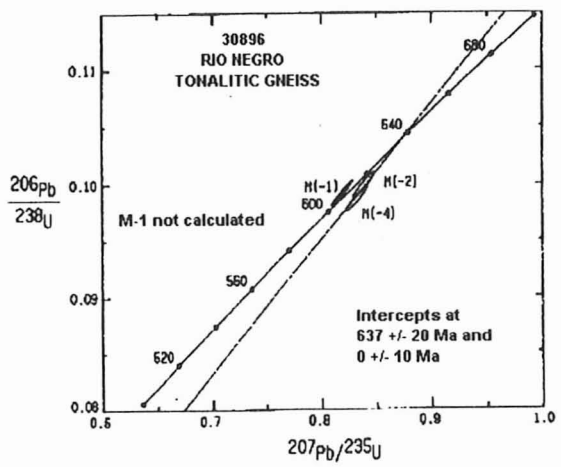

Figure 3: Concordia diagram of the U/Pb zircon fractions. Sample 30896, tonalitic gneiss of the Rio Negro Complex.