THE ATLANTIC OROGENIC BELT OF SOUTHERN BRAZIL: AN OROGEN OF ANDEAN TYPE OF NEOPROTEROZOIC AGE ?

Michel DEMANGE[(1)] and Romulo MACHADO[(2)]

(1) Ecole des Mines, 35 rue Saint-Honoré, 77 305 Fontainebleau, FRANCE
(2) Universidade de São Paulo, Instituto de Geociências, Caixa Postal 11 348, São Paulo, BRAZIL

KEY WORDS : Braziliano orogeny, transpressional orogen, Neoproterozoic, granite

INTRODUCTION

The structure of the Brazilian shield is mostly due to the Brasiliano orogenic cycle, which occured between 1 and 0,5 Ga (Almeida et al., 1973; Brito Neves and Cordani, 1991). Several mobile belts formed during this cycle, surround cratonic areas that are made of earlier terranes and their stable cover. In the south-eastern Brazil, the Atlantic orogenic belt (Ferreira, 1972; Machado and Endo, 1993; Endo and Machado, 1993) streches for more than 2000 km from Uruguay to the Espírito Santo state in Brazil, on the edge of the São Francisco and Rio de la Plata cratons. The Luiz Alves intermediate craton divides the Atlantic belt into two domains: the Paraíba do Sul belt in the North and the Dom Feliciano belt in the South (fig.1).

This orogen shares several features with the Mesozoic-Cenozoic Cordilheras of the western Americas:

1- AN OROGEN BUILT ON A CONTINENTAL CRUST

The Atlantic orogenic belt is made of several longitudinal domains separated by major complex faults (fig.1 and 2). In every domain, both basement and cover series are recognized. The basement is made of Archean and Trans-Amazonian para- and orthogneisses. The cover series of Middle to Upper-Proterozoic age, are largely shelf sediments with minor interbeded volcanics. In the Alto Rio Grande domain these volcanics exhibit a geochemical zoning of active margin type (Campos Neto, 1991).

2- A TRANSPRESSIONAL OROGEN

The Atlantic orogenic belt exhibits a positive flower structure (Machado and Endo, 1993, fig.3): the northwestern units are thrusted on the São Francisco and Rio de la Plata cratons while the south-eastern units are thrusted south- eastwards. In the Dom Feliciano belt, the Pelotas batholith separates the domains of opposite vergences.

This pattern is due to a polyphase orogenic evolution where two main cycles are recognized:

1- the Brasiliano 1 cycle (850-750 Ma, Trompette, 1994), still poorly documented, produced the subduction of the "ophiolites" (described at the northwestern edge of the belt, Soares et al., 1990; Pedrosa-Soares et al., 1992; Röig and Schrank, 1992), the collision of the entire Atlantic belt terranes with the São Francisco and Rio de la Plata cratons and the emplacement of the G1 granites.

2- the Brasiliano 2 cycle (650-490 Ma) comprise a first transpressional stage of contemporaneous thrusting and dextral shear faulting which is responsible of the remarkable positive flower structure of the belt. G2 granites, usually metamorphosed into orthogneisses (dated between 630 and 570 Ma), emplaced during this first stage. Later stages produced gentle folding and sinistral reactivation of previous shear zones. G3 and G4 granites (570-490 Ma) are contemporanous or postdate these late events.

3- THE GRANITES: PETROLOGY, GEOCHEMISTRY AND REPARTITION IN SPACE AND TIME

The G2 and G3-G4 granites form complex batholiths and stocks, emplaced at various levels of the

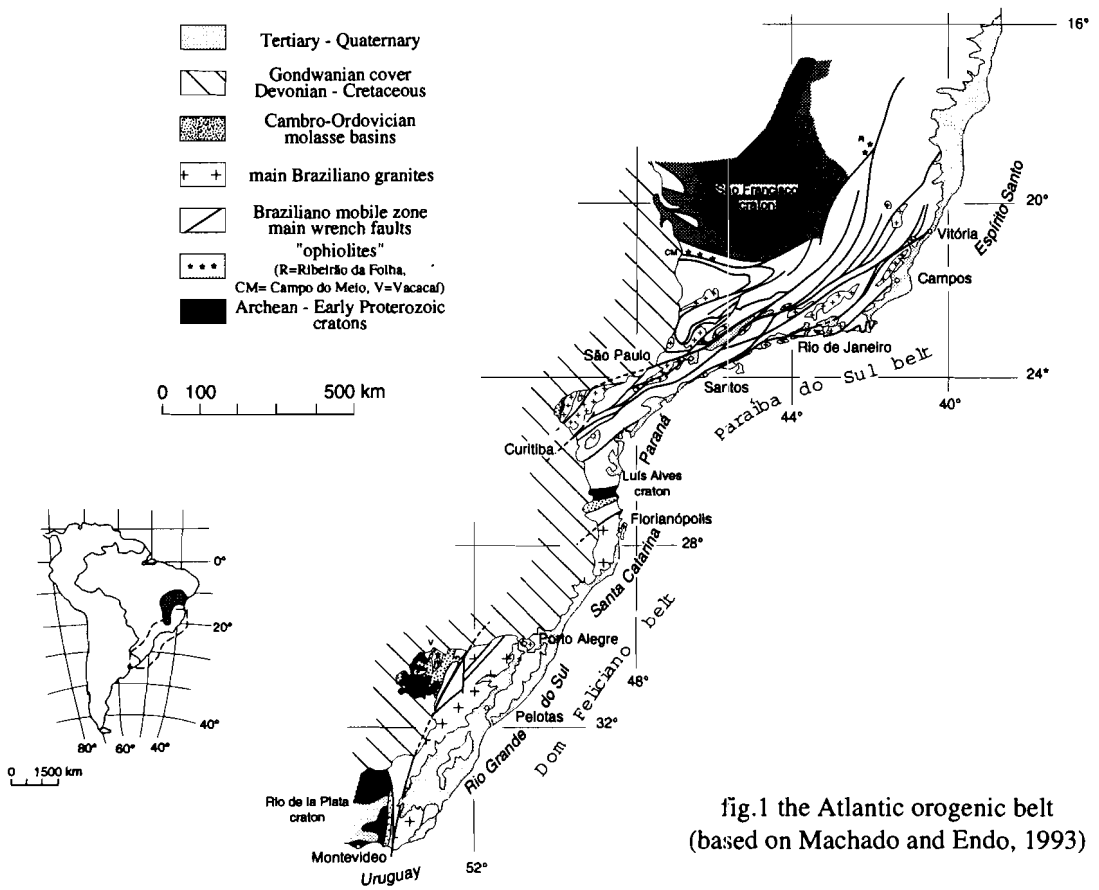

fig.1 the Atlantic orogenic belt
(based on Machado and Endo, 1993)

crust from greenschist to the granulite facies, scattered through the whole belt with the exception of the more external units towards the cratons.

All these granites are complex intrusions that associate basic, intermediate and acidic rocks. These associations define magmatic series that present such variety that they cover almost the entire field of the granitoids (fig.4). These series share many common characteristics: same subalumineous character (the most differenciated members become slighly peralumineous), same iron-magnesium ratio that is comparable to the one of calcalkaline series, same sodium level. The variety of the rock types is due to the opposition between calcic and potassic series (confirmed by many other elements).

Repartition in space and times of these magmatic series is noteworthy: G2 granites exhibit a zonality through the belt with the most calcic series in internal position and the most potassic ones in external position toward the craton. The late G3-G4 series are potassic ones: in the Paraíba du Sul belt they are all in internal position superimposed on the domain of the early calcic series. The Pelotas batholith exhibit a weak zonation with less potassic series at the East (Pelotas suite) and more potassic series at the West (Encruzilhada suite) . The youngest intrusion are alcaline syenites. Brown (1982) considers such spatial and temporal disposition as characteristic of an active continental margin involving an old basement.

CONCLUSION

The tectonic pattern in positive flower structure, the presence everywhere of an old basement, the type and distribution in space and time of the magmatism, is similar to the Andean cordilhera model (Soler, 1991; Smitz et al., 1993): the Atlantic belt of Southern Brazil is a remarkable example of an orogen of this type of Neoproterozoic age. Moreover, this belt exhibits a level of erosion that has not yet been reached in more recent orogens. It is thus a unique example of the deep-seated parts of an Andean type orogen.

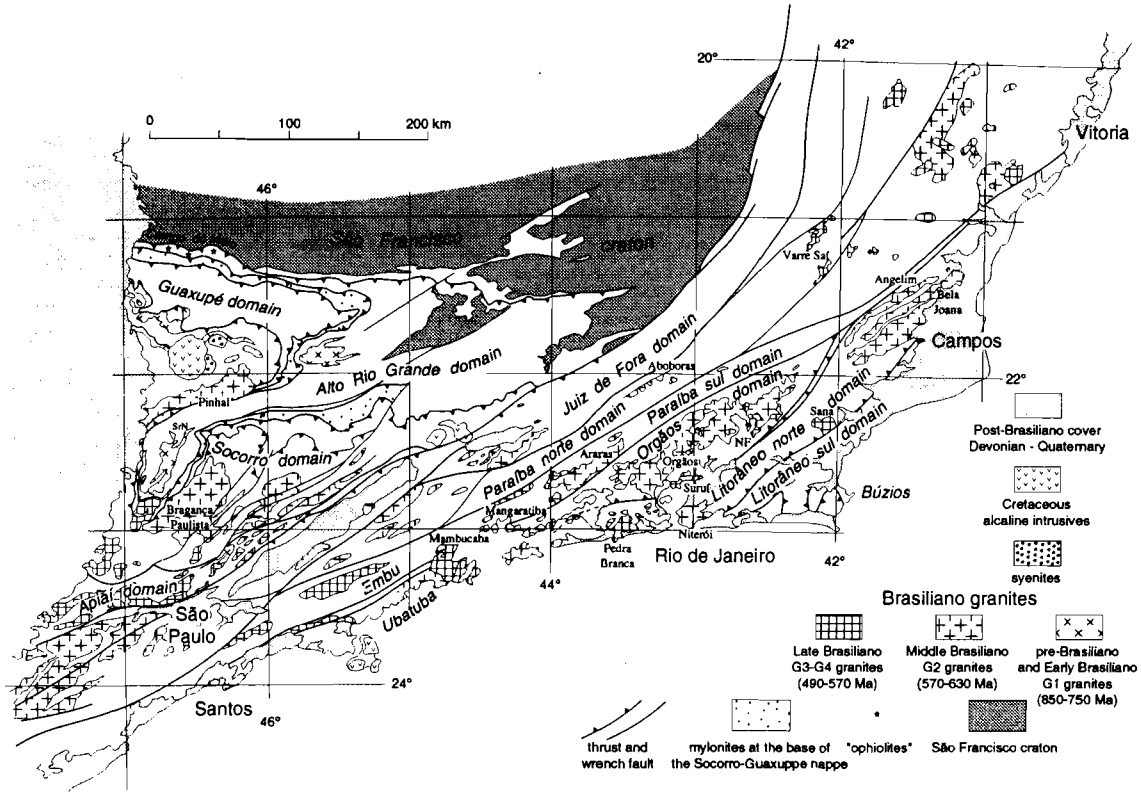

fig.2 map of the Paraíba do Sul belt
(based on the compilation by Demange and Machado, in press)

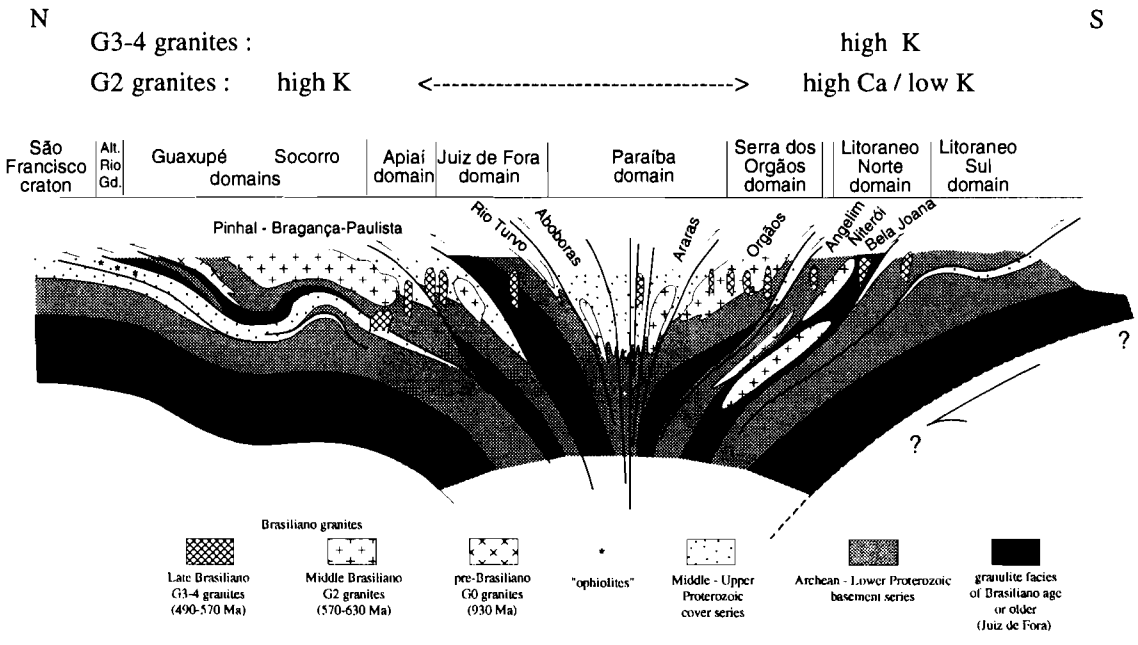

fig.3 schematic cross-section of the Paraíba do Sul belt

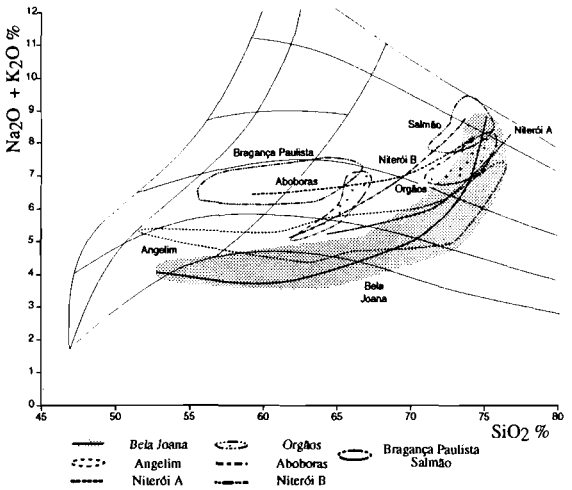

fig.4a Paraíba do Sul belt early G2 granites

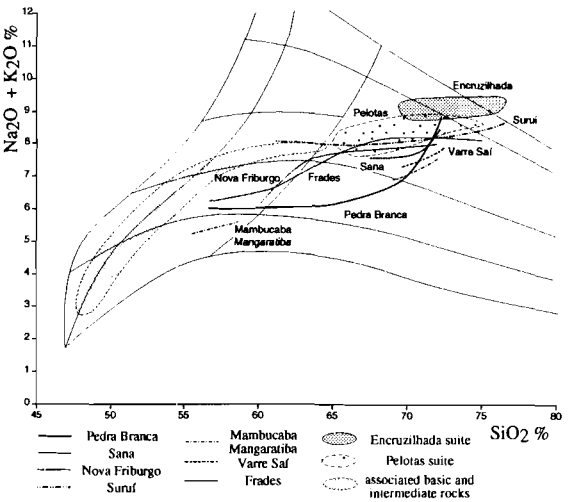

fig.4b Paraíba do Sul belt late G3-4 granites and Pelotas batholith

REFERENCES

Almeida, F.F.M., Amaral, G., Cordani, U.G. and Kawashita, K., 1973. The Precambrian evolution of the South American cratonic margins South of the Amazon river. In: Nairm, A.E.M. and Stehli, F.G., editors, Ocean basins and margins. V.1. Plenum Publ. Co, New York, 411-446

Brito Neves, B;B. and Cordani, U.G., 1991. Tectonic evolution of South America during late Proterozoic. Precambrian Res., 53, 23-40

Brown, G.C., 1982. Calcalkaline intrusive rocks: their diversity, evolution and relation to volcanic arcs. In Thorpe, R.S., editor, Andesites. John Willey and sons, New Yok, 437-461

Campos Neto, M.C., 1991. A porção ocidental da Faixa Alto Rio Grande - Ensaio de Evolução tectônica. PhD thesis, Inst. Geoc., Univ.São Paulo, 210 p. (unpublished)

Demange, M. and Machado, R. Neoproterozoic granites of the Paraíba do Sul belt (Rio de Janeiro state, Southern Brazil): Geology, petrography, geochemistry and tectonic implications. Precambrian Res., 53, (in press)

Endo, I. and Machado, R., 1993. O sistema de cisalhamento transatlântico: um modelo neotectônico transpressional para o neoproterozóico do Brasil Oriental. IV Simp. Nac. Estudos Tectônicos, Belo Horizonte, 12: 356-359

Ferreira, E.O., 1972. Explanatory note of the tectonic map of Brazil. Bol. Dep. Nac. Prod. Min., 1, Rio de Janeiro, 19 p.

Machado, R. and Endo, I., 1993. O cinturão de cisalhamento atlântico: um exemplo de tectônica transpressional neoproterozóica. IV Simp. Nac. Estudos Tectônicos, Belo Horizonte, 12: 191-198

Pedrosa-Soares, A.C., Noce, C.M., Vidal, P., Monteiro, R.L.B.P. and Salazar, E., 1992. Toward a new tectonic model for the Late-Proterozoic Araçuai (SE Brazil) - West Congolian (SW Africa) belt. J. S. Am. Earth Sci., 6 (1/2) 33-47

Röig, H.L. and Schrank, A., 1992. Caracterização da zona de sutura Jacuí-Conceição - limite norte do complexo de nappe do Guaxupé (MG). An. XXXVII Congr. Bras. Geol., Bol. Res. Exp., 1: 283-285.

Soares, P.C., Fiori, A.P. and Carvalho, S.G., 1990. Tectônica collisional oblíqua entre o bloco Paraná e a margen sul du Craton de São Francisco. An. XXXVI Congr. Bras. Geol., 6: 2723-2734.

Soler, P., 1991. Contribution à l'étude du magmatisme associé aux marges actives. Pétrographie, géochimie et géochimie isotopique du magmatisme crétacé à pliocène le long d'une transversale du Pérou central. PhD thesis, Univ. Paris VI, Paris, 846 p.

Schmitz, M., Giese, P. and Wieger, P., 1993. Crustal thickening in the Central Andes. Results from refraction and crustal balancing. II Symp. Intern. geodyn. Andine, Oxford (UK). ORSTOM, Paris, 33-36

Trompette, R., 1994. Geology of the Western Gondwana (2000 - 500 Ma): Pan-african - Brasiliano aggregation of South America and Africa. A.A. Balkema, Rotterdam, XII-350 p.