Geochronological and geochemical data on the transition zone between Luis Alves and Atuba Complexes, south Brazil.

Harara, O.M.[1]; Basei, M.A.S.[1] & Siga Júnior, O.[1]

[1] Instituto de Geociências - Universidade de São Paulo, Brazil

The Pien and adjacent areas (Figure 1) represent the transition zone between two major crustal fragments separated by the Pien Suture Zone (PSZ). The northern fragment is constituted by Neoproterozoic calc-alkaline and metaluminous Rio Pien Granite Suite (RPGS). The Atuba complex, situated north of the RPGS, represents a Paleoproterozoic belt intensively reworked by a tectono-thermal event during Neoproterozoic time[1,2] (Table 1).

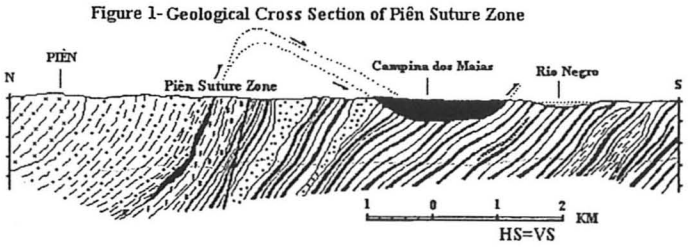
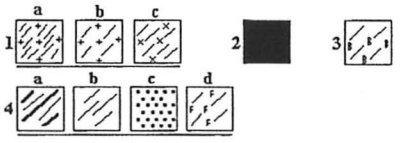


Figure 1- Geological Cross Section of Piên Suture Zone



1-Rio Piên Granite Suite (a-reddish biotite ultramylonite facies. b-reddish biotite and hornblende mylonitic facies. c-greyish biotite and hornblende mylonitic facies). 2-Mafic-Ultramafic Suite. 3-Biotite and amphibole Gneisses. 4-Amphibolitic and Granulitic Gneisses Terrain (a-isotropic, banded and mylonitic (PSZ) mafic granulite gneisses. b-biotite rich granulites. c-garnet rich mafic gneisses. d-felsic granulite gneisses.

The southern fragment is formed by high alumina and low-K calc-alkaline gneisses representing the northern margin of the Luis Alves Terrain (LAT). In the Piên area the LAT is composed, by several orthogneissic units where massive, finely foliated and banded felsic to mafic granulites predominate. The rocks of this fragment usually show granulitic metamorphic parageneses dated at the end of Paleoproterozoic time. Lower amphibolitic retrogression, imposed by PSZ evolution, took place during Neoproterozoic time as shown by K-Ar biotite ages. The EW and NE trends related to PSZ, modified the regional NW direction characteristic of the granulite domain.

The biotite gneiss and biotite-amphibole-gneiss lenses (figura 1) that occur near and along the PSZ have a shoshonitic to high-K calc-alkaline chemical composition which are characteristic of active continental margins. K-Ar biotite results from these rocks yielded Neoproterozoic cooling ages.

Several lenses of a disrupted mafic-ultramafic Suite[3,4], predominantely serpentinites, occur along the PSZ (Figure 1), strongly deformed and always trending NE. The principal northern body is located in the PSZ while the southern one represents a klippe over the granulite gneisses (Figure 1). Their geochemical characteristics (Ti, Cr, Ni) are similar to ophiolites of supra subduction zone setting. K-Ar analyses of plagioclase gave Neoproterozoic ages although Sm-Nd whole rock isochron yielded Paleoproterozoic ages (Table 1). North of the principal ultramafic bodies garnet-rich mafic gneisses (Figure 1) occur. These rocks, with eclogitic characteristics, are interpreted as slices tectonically emplaced during the PSZ evolution.

GEOLOGICAL UNITS	U-Pb (Zircon) Ages	Rb-Sr (WR Isochrons) and initial $^{87}Sr/^{86}Sr$	K-Ar (Mineral Ages)	Sm-Nd (WR) and mineral ages	TDM Ages	Refer.
Luis Alves Terrain. Regional Data	2.89 to 2.2 Ga	2.7 to 1.9 Ga (0.701 to 0.704)	Biotite, amphibole,plagioclase and WR: 2.0 to 1.7 Ga	2258 ±67	2.98 to 2.22 Ga	1
Piên Region		2.0-2.1 Ga (0.702 to 0.704)	Biotite, amphibole and plagioclase : 1.9 to 1.7 Ga (Near PSZ)Biotite: 650 to 620 Ma	WR and minerals : 1.7-1.8 Ga	2.7 2.3 in Garnet-rich gneisses	1, 3, 4, 5
Mafic-Ultramafic Suite			Plagioclase: 500 to 600 Ma	WR: 2248 ± 46 Ma	3.78 to 2.49 Ga	1, 3
Rio Piên Granite Suite	615 ± 29 Ma	605 ± 24 Ma (0.70462) 662 ± 50 Ma (0.70445) 609 ± 36 Ma (0.7043) 600 ± 30 Ma (0.704, 0.707)	Biotite : 605 to 595 Ma Amphibole : 644 ± 17 600 ± 48 Ma		1.99 Ga 2.06 Ga 2.10 Ga	1,, 4, 5
Agudos do Sul Granitic Massif	594 ±26 Ma	570± 22 Ma (0.70735)	Biotita : 541±28 Ma Amphibole : 585±24 Ma		2.09 Ga	1
Atuba Complex	2.13 to 2.09 Ga	2.22 to 1.82 Ga (0.701 to 0.706). 617±17 to 577±17 (0.713 to 0.718)	Biotite and Amphibole : 620 to 560 Ma	Minerals : 585±30	2.82 to 2.23 Ga	1,2

Table 1- Geochronological data for Luis Alves, PSZ and Curitiba Terrains

The RPGS represents part of an approximately 22 km wide granitoid terrain made up of quartz-monzodiorites, granodiorites and monzogranites[4,5]. Protomylonitic to ultramylonitic structures are always present with N66E/N64W trending foliation. The high-K calc-alkaline-alkaline and slightly peraluminous granitoids of the Agudos do Sul Granitic Massif (ASGM) are non-deformed granitoids intrusive along the PSZ. The principal facies are fine to coarse grained reddish monzogranite and syenogranite to alkali feldspar granites. The available U-Pb, Rb-Sr and K-Ar geochronological data[3,4,5] (Table 1) indicate that the RPGS emplacement, deformation, metamorphic recrystalization and cooling occured between 650-595 Ma. The ASGM has emplaced around 590 Ma when RPGS was already cooled.

Trace element patterns for the RPGS are similar to volcanic arc calc-alkaline magmatism. The ASGM and mainly RPGS granitoids exhibit fracionation and progresive enrichment in LREE, without Eu anomalies, and ASGM can be distinguished from the RPGS by their high K_2O/Na_2O, Rb/Sr, Rb/Zr, Ta/Zr and lower K/Rb ratios. The trace elements characteristics of ASGM are very close to that presented by RPGS. The low initial $^{87}Sr/^{86}Sr$ isotopic ratios for the RPGS (0,704), slightly high (0.707) for the ASGM combined with Nd isotopic data (T_{DM} and ϵNd) suggest a magma source involving a hydrated mantle wedge and some contribution from a Paleoprotero.zoic continental crust.

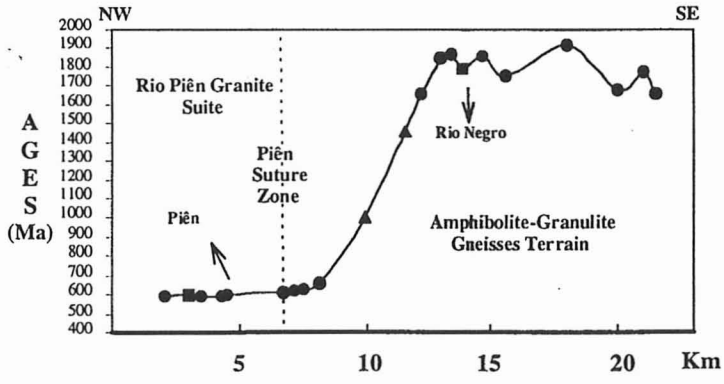


Figure 2 - K-Ar mineral ages between São Bento do Sul-SC and Piên-PR. squares-amph.; Dots-biot.; triangles-plagiocl.,

The NW-SE profile of K-Ar cooling ages (Figure 2) shows regional Paleoproterozoic ages (1.9-1.7 Ga) for LAT and decreasing ages (1.6-1.0 Ga) to Neoproterozoic ones (650-605 Ma) near of the PSZ. Based on these results, the tectonic evolution of the PSZ can be interpreted, with the aid of structural data, involving initial RPGS overthrusting towards S-SE, followed by transcurrent movement and reseting of the K-Ar system during the tectono-thermal reactivation of the Paleoproterozoic granulite gneisses terrain.

The analyses of the entire data allows the suggestion of a Neoproterozoic geotectonic scenery of a N-NW dipping subduction zone, where an island arc evolution was followed by an active continental margin setting[4,6]. The mafic-ultramafic suite can represent island arc remnants without associated volcanic arc basalts. The RPGS represents the roots of an magmatic arc emplaced above the mentioned subduction zone where the shoshonitic to high-K calc-alkaline biotite-amphibole gneiss was emplaced during the transition stage between the mentioned settings. All geological units were tectonically deformed during the collision of the Atuba and Luis Alves terrains. The ASGM represents a late to post collision magmatic environment occurred along the PSZ, already inactive at this time.

References

1. SIGA JR, O. (1995) (*PhD.thesis*). 212p .IG-USP.
2. SIGA JR. *et al* (1995). *Boletim IG-USP*. sér.cient. **26**:69-98.
3. GIRARDI, V.A.V. *et al* (1974) *CONGR. BRAS. GEOL*, **28**, PA. p.532-533.
4. HARARA, M.O (1996) *(Master Thesis)*. 196p .IG-USP.
5. MACHIAVELLI, A. *et al*.,1993. *Geochim.* Brasil.,**7**(2):113-129.
6. BASEI, M.A.S. *et al* (1992). *RBG.* **22**(2):216-221.