

NEW U/Pb AND Sm/Nd GEOCHRONOLOGICAL DATA OF PALAEOPROTEROZOIC ORTHOGNEISS AND AMPHIBOLITE (SERRA NEGRA UNIT) FROM THE AMPARO BASEMENT COMPLEX, SOUTHEASTERN, BRAZIL

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This work presents new U/Pb and Sm/Nd data from a biotite-hornblende orthogneiss and associated amphibolite from the Archean Palaeoproterozoic Amparo Basement Complex located within the central Ribeira Belt, northeast State of São Paulo. The isotopic analyses were performed at the Geochronology Laboratory of the Brasilia University; UNB. Sample localities are between the cities of Lindóia and Socorro (São Paulo State, southeastern Brazil).

GEOLOGICAL SETTING

The Amparo basement Complex is composed of migmatites, orthogneisses and granitoid rocks representing a TTG suite. It may be considered the basement of the Alto Rio Grande Mesoproterozoic Belt (Campos Neto, 1991) and has been interpreted along the last years to be of Archean age (Artur et al., 1988; Wernick and Oliveira, 1986; Artur, 1988; Tassinari and Campos Neto, 1988). Based on new data Fetter et al., 2001; Tassinari and Nutman, 2001 demonstrate that the migmatite near the town of Amparo are the oldest rocks within the Amparo Complex where the paleosome yields U/Pb zircon age of 3000 Ma.

Near Serra Negra, Lindóia and Socorro cities an orthogneiss associated to amphibolite and ultramafic rocks occur within the migmatites of the Amparo Complex, and is named the Serra Negra Orthogneiss (Serra Negra Unit) by Campos Neto, 1991 and considered of Archean age by this author. In these areas orthogneiss and migmatites are predominant and are composed by granodiorite to tonalite types.

Biotite-hornblende gneiss and or hornblende-biotite gneiss are the chiefly rock types in the Serra Negra unit between the cities of Lindóia and Socorro with the predominance of tonalitic to granodioritic compositions. Structurally they evidence banded, migmatite and milonitized structures, strongly deformed with intrafolial folds.

Petrographically the migmatites show banded to gneissic blastomylonitic structures with quartz feldspatic leucosome mobilize of granitic composition while the paleosome contain minerals such as hornblende, biotite and plagioclase that represent a tonalite trondjemite composition.

Amphibolite and hornblende schist of mafic to ultramafic compositions occur associated to the gneisses as

lenses or large bodies. Brown hornblende, plagioclase and diopside are chief mineral phases and the hornblende may be present with more than 90% in volume, indicating an ultramafic types. Amphibole and plagioclase show disequilibrium at lower temperatures and calcium hornblende and Fe-actinolite may be present with a more sodium plagioclase.

GEOCHEMICAL CHARACTERISTICS

Geochemically the gneisses show calc alkaline low K trends while the mafic types are of toleitic compositions (Campos Neto, 1991). This conclusion is reinforced in this work with new geochemical analyses. By the new analyses the gneisses are metaluminous to slightly peraluminous granitoids with Shand index near 1. They also belong to a medium to high K calc-alkaline series. Chondrite normalized REE patterns are moderately fractionated with negative Eu anomaly. The multi elements diagram indicate a crustal derivation for this rocks, that are lightly enriched in Rb, Sr and Zr. Amphibolite shows tholeiitic affinities and the same signatures of the gneisses and probably has the same magmatic origin.

RESULTS AND DISCUSSION

Zircon U/Pb analytical data and whole rock Sm-Nd analyses were carried out at the Institute of Geoscience of the University of Brasilia. The sample were prepared to analyses at the Institute of Geoscience and Exact Science of the State University of São Paulo, in Rio Claro.

U/Pb zircon results obtained from a tonalitic biotite hornblende gneiss, collected between the cities of Lindóia and Socorro within the orthogneiss Serra Negra yields an age of 2122 ± 19 Ma (Fig. 1 and Table 1). Sm/Nd data from this locale (Table 2) yields a Nd T_{DM} model age between 2.23 and 2.72 Ga indicating that this event involve significant contributions from Archean sources as well as juvenile accretionary growth.

Fetter et al., 2001 and Tassinari and Nutman, 2001 also mentioned U/Pb zircon results obtained from tonalitic to granitic orthogneiss at around 2.23 and 2.14 Ga (Fetter et al., 2001) and 2032 ± 28 Ma (Tassinari and Nutman, 2001).

Artur et al., 1988 present a whole rock Rb/Sr age of 2.18 ± 100 Ma for a biotite hornblende gneiss occurring near

Monte Alegre do Sul, in the southern portion of the Serra Negra orthogneiss suite now described, indicating a possible metamorphic event or Palaeoproterozoic age.

Another U/Pb determination is obtained from an amphibolite occurring near the city of Lindóia. In this rock the zircon crystals are associated or included in the plagioclase and some of them are inherited. The crystals used for determination are irregular and are of igneous crystallisation or represent a metamorphic event. An age of 2019 ± 60 (Fig. 2 and Table 3) is obtained for this rock. Tassinari and Nutman, 2001 also describe a U/Pb determination in an amphibolite of this region indicating the presence of igneous crystal of zircon with an age of 2003 ± 15 Ma. That is interpreted by the authors as igneous crystallization in a gabbroic (dyke) protolith of the amphibolite body.

As a conclusion for the isotopic results presented for the biotite-hornblende gneiss (Serra Negra orthogneiss) and the associated and possibly cogenetic amphibolite bodies is that they represent a Paeoproterozoic magmatic event around 2000 Ma. It may be compared to the Quirino Unit in the central Ribeira Belt, occurring between the states of Rio de Janeiro and Minas Gerais.

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Table 1. U/Pb zircon data from the biotite-hornblende gneiss M2.

Sample						Pb 206	Pb207*	Pb206*	Correl.	Pb207*	Pb206*	Pb207*	Pb207*				Quant.	
Fraction	Size	U	Pb	Th	U/Th	Pb204	U235	U238	Coeff.	Pb206*	U238	U235	Pb206*					
	(mg)	ppm	ppm	ppm		(obs.)	(pct)	(pct)	(rho)	(pct)	Age	Age	Age	(Ma)				
M2																		
F	0,093	167,78	36,429	11,7	0,0697	14484,2	3,5785	0,378	0,20855	0,38	0,99	0,12445	0,0462	1221,1	1544,8	2020,9	0,82	1
G	0,042	104,39	9,1591	25,91	0,2482	2946,12	1,1901	0,322	0,09064	0,32	0,97	0,09522	0,0718	559,34	795,98	1532,4	1,4	1
H	0,016	195,76	16,915	68,01	0,3474	1551,43	1,1686	0,505	0,08543	0,49	0,97	0,09920	0,115	528,47	785,98	1609,2	2,1	1
I	0,04	161,54	27,824	27,2	0,1684	3395,54	2,6324	0,329	0,16825	0,3	0,92	0,11347	0,129	1002,5	1309,7	1855,8	2,3	1
J	0,023	49,52	4,5023	47,31	0,9554	342,304	1,05	1,91	0,08676	1,83	0,96	0,08778	0,537	536,35	728,89	1377,6	10	1
D1	0,018	168,07	13,107	60,45	0,3597	1724,11	0,9758	0,473	0,07956	0,45	0,94	0,08895	0,157	493,5	691,44	1403,1	3	1
D2	0,035	174,85	42,323	31,09	0,1778	10102,5	3,7293	0,116	0,22748	0,12	0,99	0,11890	0,0169	1321,3	1577,7	1939,8	0,3	1
D4	0,043	201,23	52,719	25,31	0,1258	4189,51	4,2802	0,361	0,24750	0,36	0,99	0,12543	0,0449	1425,6	1689,6	2034,8	0,79	1

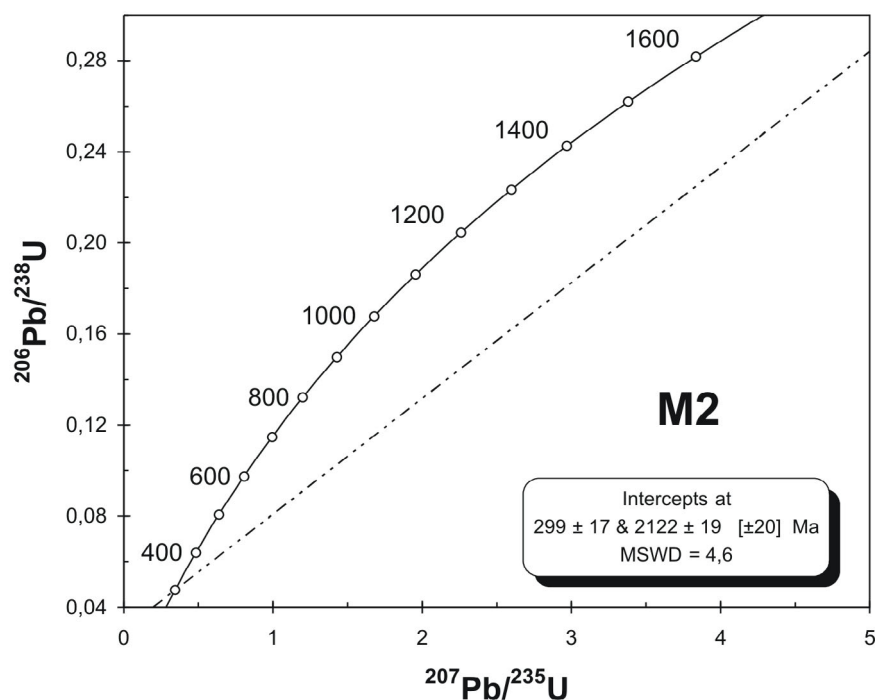


Figure 1. U/Pb concordia diagram of zircon analyses of biotite-hornblende gneiss (sample M2) from Serra Negra Suíte between the cities of Lindóia and Socorro, SP, Brazil.

Table 2. Sm/Nd whole rock data from biotite-hornblende gneiss from Serra Negra Suíte.

Amostra	Sm(ppm)	Nd(ppm)	$^{147}\text{Sm}/^{144}\text{Nd}$	$^{143}\text{Nd}/^{144}\text{Nd}$ $\pm 2\text{SE}$	$\epsilon(t)$	T_{DM} (Ga)
KP 27	6,397	34,995	0,1105	0,511452+/-8	-23,14	2,34
KP 28	6,037	20,973	0,1740	0,511645+/-10	-19,37	-
KP 29	4,970	26,645	0,1129	0,511244+/-11	-27,19	2,72
KP 32	5,8758	32,512	0,1092	0,511505+/-8	-22,10	2,23

Table 3. U/Pb zircon data from the amphibolite AAL-213A

Sample	Fraction	Size (mg)	U ppm	Pb ppm	Pb206	Pb207*	±	Pb206*	±	Correl. Coeff. (rho)	Pb207*	±	Pb206*	±	Pb207*	±	Pb207*	±
					Pb204 (obs.)	U235	2σ	U238	2σ		Pb206*	2σ	U238	2σ	U235	2σ	Pb206*	2σ
AAL213A																		
M(0)1		0.098	33	12	1060	5.6220	0.44	0.32859	0.38	0.877	0.12409	0.21	1832	8	1920	7	2015	4
M(1)2		0.106	38	13	507	5.2823	0.47	0.30479	0.43	0.912	0.12569	0.20	1715	8	1866	8	2039	3
M(2)3		0.040	46	14	626	4.7262	0.97	0.28074	0.93	0.961	0.12210	0.27	1595	16	1772	16	1987	5

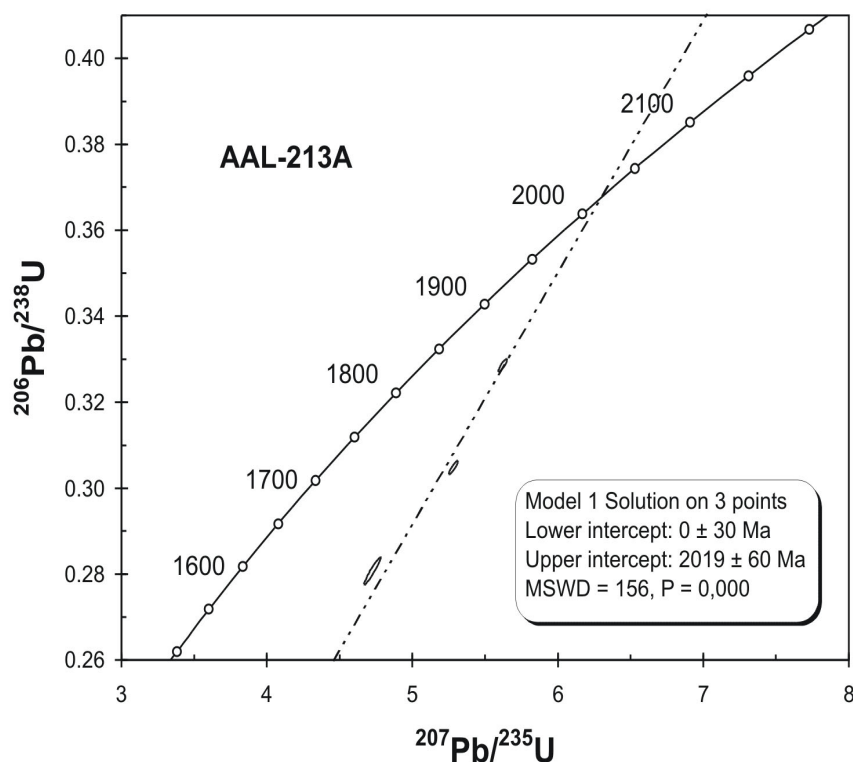


Figure 2. U/Pb Concordia diagram of zircon analyses of an amphibolite (sample AAL-213A) associated to the biotite-hornblende gneiss.

RESUMO

Este trabalho apresenta novos dados U/Pb e Sm/Nd de biotita-hornblenda gnaisses e anfibolito do Complexo Amparo, de idade Arqueana-Paleoproterozóica, localizado na porção central do Cinturão Ribeira, região nordeste do estado de São Paulo. As amostras foram coletadas próximo às cidades de Lindóia e Socorro.

Dados geoquímicos indicam que os gnaisses são granitóides de composição metaluminosa a peraluminosa da série cálcio alcalina de médio a alto potássio. Padrões de ETR, são moderadamente fracionados, com anomalia negativa de Eu. Diagramas multi elemento indicam uma derivação crustal para essas rochas, que são levemente enriquecidas em Rb, Sr e Zr. O anfibolito revela afinidades toleíticas e as mesmas assinaturas de ETR que os gnaisses e provavelmente tem uma origem magmática comum.

Resultado U/Pb obtidos em zircão de um biotita-hornblenda gnaiss tonlítico, coletado dentro do ortognaiss Serra Negra, forneceu uma idade de 2122 ± 19 Ma. Determinações Sm/Nd feitas para algumas amostras forneceram uma idade modelo T_{DM} entre 2,23 e 2,72 Ga, indicando que este evento envolve significativa contribuição de fontes arqueanas bem como acreção juvenil.

Outra determinação U/Pb é obtida para o anfibolito. Nessa rocha os cristais de zircão estão associados ou inclusos no plagioclásio e alguns deles evidenciam serem herdados. Uma idade de 2019 ± 60 foi registrada para essa rocha.

Como conclusão aos estudos isotópicos ora apresentados, para o biotita-hornblenda gnaiss e rochas anfibolíticas associadas, pode-se dizer que eles representam um evento magmático ocorrido a cerca de 2000 Ma e que pode ser comparado ao evento semelhante que representa a Unidade Quirino, que ocorre entre os estados do Rio de Janeiro e Minas Gerais.