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## STATHERIAN TAPHROGENESIS IN THE BORBOREMA PROVINCE, NE BRAZIL

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### INTRODUCTION

The orogenies of the Orosirian and Riacian periods conserved extensive agglutinations of supercontinental masses, in the middle/upper part of the Paleoproterozoic Era. Later, after these orogenies, a series of Statherian extensional basins/belts were formed in the Borborema Province (and São Francisco Craton).

The taphrogenesis processes (Brito Neves *et al.*, 1995, 1998) involve rifting, sedimentation, volcanism and plutonism. All these processes are recorded in the paleobasins of Orós/Jaguaribe, Peixe Gordo and São José, near the geographical limit between Ceará and Rio Grande do Norte states. One volcanic representant of such basins are recorded through the Saquinho body, southwest of Coreaú village, Ceará state. We present some new U/Pb zircon ages for both the metavolcanic rocks of the São José paleobasin and the metavolcanic body of Saquinho (Fig. 1).

### STATHERIAN PALEOBASINS

The Orós/Jaguaribe system is the best geological example (metasediment and metavolcanic rocks) of the Statherian Period (Sá, 1991; Parente, 1995). The basement of these system is composed by granodioritic to tonalitic ortogneisses with Paleoproterozoic age (2.2 Ga).

The Orós/Jaguaribe Paleobasin is composed by an alternate of metasedimentary and metavolcanic rocks. The metasediments are composed by metapelites, corindon-schists, biotite-muscovite schists, quartzites, carbonates and calcitic to

magnesian marbles. The metavolcanic rocks of Statherian ages are characterized by  $1790 \pm 9$  Ma old metarhyolites (conventional U/Pb zircon method, Van Schmus *et al.*, 1994). Geochemical datas of metariodacites and metabasalts confirm the bimodal character of the volcanism in this paleobasin (Sá, 1991) (Table 1).

The Saquinho body occur in context of the Medio Coreaú Domain (MCD), as a elongated NE-SW orientation composed by metatraqui-andesite and volcanoclastics rocks with approximately 50 km<sup>2</sup>. These rocks are tectonically intercalated in Neoproterozoic rocks of the Ubajara Group

In the Saquinho body three monozircon fractions of the metatraqui-andesite were analyzed through conventional geochronology. All fractions plots concordant in the upper intercept of the concordia diagram, yielding a  $1785 \pm 1.5$  Ma age (Fig. 2A). We interpreted this age as a Statherian crystallization for the volcanism.

The Peixe Gordo sequence is located northwesterly of the Taboleiro Grande village (RN). The Paleoproterozoic basement of this sequence is characterized by granitic/granodioritic/tonalitic orthogneisses submitted to a tectono-metamorphism processes during the Riacian Period.

The Peixe Gordo sequence is described by Cavalcante *et al.* (1998) as a succession of metasedimentary and metavolcanic rocks. Starting from the base, we have amphibole-biotite gneisses, biotite-muscovite leucocratic gneisses, muscovite feldspathic quartzites, calcossilicatic rocks, metaconglomerates, metargilites and metarenites. The metasedimentary rocks are intercalated by metarhyolites, metadacites and volcanoclastic rocks.

Analysis performed in the metavolcanic rocks of Peixe Gordo sequence through Pb/Pb method (zircon evaporation method) reveal age of  $1796 \pm 55$  Ma (Cavalcante *et al.*, 1998).

The São José Paleobasin, located in the extreme west of Rio Grande do Norte state, present a Paleoproterozoic basement composed by granitic to granodioritic ortogneisses, granitic ortogneisses and metabasic rocks. This basement was deformed and migmatized during the Riacian Period and reworked in the Brasiliano cycle.

The São José Group is composed by continental metasediments as: metaconglomerates, círindon gneisses, metapelites, muscovite quartzites and calcitic marbles, intercalated by metarhyolites and metadacites (alkaline volcanism).

Two metavolcanic samples were dated by zircon U/Pb conventional method. The first sample (CHD-84) is a metadacite presenting different zircon

populations, defining a complex isotopic behavior. The zircon crystals present two different populations: a purple rounded one exhibiting evidences of isotopic inherence of the Paleoproterozoic crust (2.2 Ga) and; a prismatic and long grains defining a concordia alignment with a upper intercept at  $1757 \pm 5.4$  Ma (Fig. 2 B), that we consider as crystallization age. The second sample (CHD-83) is a metarhyolite. In that we analyzed 4 monozircon fractions, defining an age of  $1783 \pm 6.7$  Ma (Fig. 2 C), concordant in the upper intercept, interpreted as crystallization age. The lower intercept plots values around 500 Ma interpreted as a Brasiliano reworking.

Cavalcante *et al.* (1998) dating similar metavolcanics of the São José Group utilizing Pb/Pb method (zircon evaporation) obtained identical ages ( $1778 \pm 7$  Ma - Table 1) for the volcanism related to the taphro genesis process.

**Table 1.** Summary of Rb/Sr and U/Pb analyses, obtained in rocks of the Orós/Jaguaribe, Peixe Gordo and São José paleobasins.

Rock type	Geological unit	Methodology	Age (Ma)	References
Metadacite	Orós	Rb/Sr RT	$1707 \pm 46$	Sá <i>et al.</i> , 1986 Macedo, <i>et al</i> 1988
Dacite e Rhyolite	Orós	Rb/Sr RT	$1704 \pm 39$	Macedo <i>et al.</i> , 1988
Metarhyolite	Orós	Rb/Sr RT	$1780 \pm 54$	Sá, 1991
Ortogneisse	Orós	Rb/Sr RT	$1762 \pm 174$	Macedo <i>et al.</i> , 1988
Rhyolitic milonitic	Orós	Rb/Sr RT	$1040 \pm 102$	Macedo <i>et al.</i> , 1988
Ortogneisse	Orós	Zircon U/Pb	$1673 \pm 33$	Sá, 1991
Ortogneisse	Orós/Jaguaribe	Rb/Sr RT	$1793 \pm 36$	Figueiredo F, 1994
Rhyolite + Gneisse	Orós/Jaguaribe	Rb/Sr RT	$1752 \pm 25$	Figueiredo F, 1994
Metavolcanic	S. José Group	Zircon Pb/Pb	$1778 \pm 7$	Cavalcante, Sá & Macedo 1998
Metavolcanic	Peixe Gordo	Zircon U/Pb	$1796 \pm 55$	Cavalcante, Sá & Macedo 1998

## PALEOBASIN STRUCTURATION

The Neoproterozoic continental collision amalgamated the São Francisco/Congo and the West Africa/ São Luís cratons and several platform covers of Statherian and Neoproterozoic ages (Orós/Jaguaribe, Peixe Gordo, São José, Dohameye, Seridó). This orogenic process was responsible for the actual sigmoidal structuration of the paleobasin (Fig. 1) in the north/south and northeast/southwest direction.

This collision are responsible to structural shapes in the paleobasin rocks. These structures are characterized by penetrative foliation with a predominant NE direction, recumbent fold, coaxial refolding, metamorphic banding and post tectonic vertical mylonitic foliations, also a NE orientation. The paleobasins staying as platforms cover for more

than 1000 Ga. There are no concrete evidences of pre-Brasiliano orogenies in the area.

## DISCUSSION AND CONCLUSIONS

The genetic model for the Statherian basins of the Borborema Province necessarily requests a process of crustal extension of the Paleoproterozoic basement. This would be an answer to the process of agglutination of supercontinent that preceded this period. These intracratonic basins occurs in the Bahia State (Chapada Diamantina/Espinhaço) and others north of the Patos Lineament (Rio Grande do Norte Terrane; Santos, 1995). North of the Patos Lineament many other occurrences can still be expected and many have been candidates (the Pio IX supracrustal in Ceará, psamitic units of the substratum of the Parnaíba

Basin of Parnaíba among other), await further research. If these paleobasin were formed in the Traversal Zone, in between the Patos and Pernambuco Lineament (and that is possible) its identification will be more difficult because of the vigor of the deformational processes of the Brasiliano Orogeny.

The largest and deeper sedimentation depocenter occurs in the Orós/Jaguaribe Paleobasins, with sedimentation of the BVAC type passing to QPC type. This characterize an intracratonic environment with oceanic or proto-oceanic character. The metavolcanic body of Saquinho seems to have the same context, but needs future studies.

The volcanic body of Saquinho, of Statherian age, was tectonically thrusted and intercalated in the Ubajara Group owing the Brasiliano collision.

The Peixe Gordo and São José basins are characterized by continental sedimentation and volcanism. The geochronological study of metavolcanic rocks present in these paleobasins, are related to extension processes (stretching and rifting) of the basement around 1.7 to 1.6 Ga. Each paleobasin has different geological characteristics in relation to the volcanism, sedimentation, plutonism and tectonic, although they are of same age. This confirms that the same taphrogenesis process occurred in different types and that the factors that had contributed to this are linked to the reworking of the previous crust (source area).

## REFERENCES

Brito Neves, de B.B., Van Schmus, W.R., Hackspacher, P.C. and Santos, E.J., 1995. Geocronologia da Borborema: os fatos e as questões abertas. In XVI Simpósio de Geologia do Nordeste 2, Recife: 410-413.

Brito Neves, de B.B., Sá, J.M., Nilson, A.A. and Botelho, N.F., 1998. A Tafrogênese Estateriana nos blocos Paleoproterozóicos da América do Sul e processos subsequentes. *Geonomos*. 3(2), Belo Horizonte: 1-21.

Cavalcante, J. C., Sá, J. M. and Macedo, M. H. F., 1998. A delimitação da Faixa Jaguaribeana: novos dados geocronológicos Pb-Pb e Rb/Sr. XL Congresso Brasileiro de Geologia. Belo Horizonte: 11.

Figueiredo Filho, O.A., 1994. Geoquímica e geocronologia de metavulcânicas e metagranítoides no Cinturão Orós/Jaguaribe SW do Ceará. Tese de Doutoramento. IG/USP, São Paulo, 157pp.

Parente, C.V. and Arthaud, M.H., 1995. O sistema Orós/Jaguaribe no Ceará, NE do Brasil. *Revista Brasileira de Geologia*. 25(4): 297-306.

Parente, C. V., 1995. Géologie et paléogéographie d'une plate-forme à évaporites et magnésite d'âge proterozoïque (2 Ga): le cadre géotectonique initial de la ceinture mobile Óros dans la région d'Alencar (Ceará-Brésil). Thèse de Doctorat de l'Université de Nantes. 306pp.

Sá, J. M., 1991. Evolution géodynamique de la Ceinture Proterozoïc d'Orós, Nord-Est du Brésil. Thèse de Doctorat de l'Université de Nancy, 177pp.

Sá, E. F. J., Kawashita, K., Macedo, M. H. F. and Sá, J. M., 1986. Supracrustais monocíclicas no extremo Oeste do Rio Grande do Norte. Simpósio de Geologia do Nordeste, 12. João Pessoa.p.62-74.

Macedo, M. H. F., Sá, J. M. and Kawashita, K., 1988. A idade da faixa Orós: dados preliminares. *Revista Brasileira de Geociências*, 18(3): 1-24.

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