Tectonic evolution of the Jurueña magmatic arc between the Aripuanã and Jurueña rivers: northwest Mato Grosso State, Brazil

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Abstract The area of study is located in the southwest of the Amazon Craton, northwest of Mato Grosso State and it comprises a region between Aripuanã and Jurueña rivers. This paper proposes a geotectonic evolutionary model of a single continental magmatic arc for this Paleoproterozoic segment; its orogenesis starts around 1,820 Ma with subduction, oceanic plate consumption, crust generation followed by continental blocks oblique collision processes after approximately 160 Ma, resulting in the formation of the Jurueña Magmatic Arc. The initial phase lithotypes are represented by oceanic crust remnants from Bacaré-Mogno Complex and sub-volcanic to volcanic rocks from Paranaíta Suite and Colíder Group respectively, which configures a marginal ridge. Southwestern, this belt is in contact with the Jurueña Complex, a portion of the arc deformed in a ductile regime. This segment is composed by Vitória Suite, São Pedro and São Romão Granites and Vespôr Mafic Suite. Volcanic rocks scattered in the complex, apparently filling retro-arc basins, are included in the Roosevelt Group. Post-collisional Type A granitogenesis, related to extensional tectonic, is represented by Serra da Providência Suite. The U-Pb LA-ICPMS geochronology results from two Paranaíta Suite samples, one Vitória Suite and one Vespôr Mafic samples are $1,797 \pm 14$, $1,769 \pm 17$, $1,783 \pm 14$ and $1,773 \pm 15$ Ma, respectively. Ten rock samples were also examined by Sm-Nd method, resulting in T_{DM} ages between 2.25 and 1.88 Ga and $\epsilon_{ND(t)}$ values between -1,9 and +1,92. The isotopic results are compatible with the expected for the Jurueña Magmatic Arc.

Keywords: Southwest Amazon Craton; Jurueña Magmatic Arc; Geochronology.

Resumo *Evolução tectônica do arco magmático Jurueña entre os rios Aripuanã e Jurueña: noroeste de Mato Grosso, Brasil.* A área de estudo está localizada no SW do Cráton Amazônico, com a geologia inserida em um contexto orogenético convergente, que resultou na formação do Arco Magmático Jurueña. O modelo proposto para este processo é de arco magmático continental único com início em aproximadamente 1.820 Ma, com processos de subducção, consumo de placa oceânica, geração de crosta e colisão oblíqua de blocos continentais após aproximadamente 160 Ma. Os litotipos da fase inicial estão representados pelos resquícios de crosta oceânica do Complexo Bacaré-Mogno e pela faixa de rochas plutonovulcânicas deformadas em regime rúptil-dúctil. Esta, que configura uma cordilheira marginal, é composta pelos granitos da Suíte Paranaíta e vulcânicas do Grupo Colíder. A SW, este terreno está em contato com o Complexo Jurueña, deformado ductilmente. O segmento é formado pela Suíte Plutônica Vitória, pelos Granitos São Pedro e São Romão e pela Suíte Máfica Vespôr. Rochas vulcânicas dispersas no complexo, aparentemente preenchendo bacias de retro-arco, são incluídas no Grupo Roosevelt. Granitogênese tipo A, pós-orogênica, relacionada à tectônica extensional está representada pela Suíte Serra da Providência. Os resultados de geocronologia pelo método U-Pb LA-ICPMS de duas amostras da Suíte Paranaíta, uma amostra da Suíte Plutônica Vitória e uma amostra das Máficas Vespôr foram 1.797 ± 14 , 1.769 ± 17 , 1.783 ± 14 e 1.773 ± 15 Ma, respectivamente. Também foram analisadas dez amostras pelo método Sm-Nd, resultando em idades T_{DM} entre 2,25 a 1,88 Ga e valores de $\epsilon_{ND(t)}$ entre -1,9 a +1,92. Os resultados isotópicos são compatíveis com o esperado para o Arco Magmático Jurueña.

Palavras-chave: Sudoeste do Cráton Amazônico; Arco Magmático Jurueña; Geocronologia.

INTRODUCTION The area of study is located in the furthestmost northwest of the Mato Grosso state, southwest of the Amazon Craton, roughly between Aripuanã and Jurueña rivers (Fig. 1). It is of common knowledge that this region lacks of geological and geochronological information, mainly due to the difficulty of access. Historically, the works of Tassinari (1996), Sato & Tassinari (1997) and Tassinari &

Macambira (1999), which compiled the collection of geologic and isotopic data results available at the time, are the pioneers in arrange a geochronological and structural segmentation of the Amazon Craton in provinces and propose a mobile evolutionary tectonic model. These results have been continuously reviewed with more accurate U-Pb TIMS and SHRIMP geochronology data as can be seen in the works of

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Cordani & Teixeira (2007), Cordani *et al.* (2009) and Bettencourt *et al.* (2010).

In summary, by these authors, the early Archean stages comprised juvenile accretion that later culminate with the agglutination of successively younger crustal fragments, given rise to a large cratonic area in the early Mesoproterozoic. In this context, the study area is inserted in the Rio Negro-Juruena province, containing rocks that cooled in the interval around 1.8 Ga to 1.5 Ga. Alongside, also based in regional geochronology, Santos *et al.* (2002, 2008) proposed modifications in the nomenclature, geographic boundaries and age intervals in the previously established Amazon Craton Provinces.

In complement there are several less publicized regional geological survey works, accomplished by Klein *et al.* (2001), Souza *et al.* (2005), Scandolara (2006), Silva & Abram (2008), Oliveira & Albuquerque (2007), Souza & Abreu (2007), Martin & Abdallah (2007), Knust (2010), Alves *et al.* (2010) and Ribeiro & Duarte (2010). These geological surveys are significant taking in account they have promoted the breakdown in geological mapping and stratigraphy. Besides, contain several Sm-Nd and U-Pb geochronological results. Then, the main goal of this paper was to share in short the extensive data set of projects listed, mainly the Rio Aripuanã and Rio Guariba 1:250.000 geological survey, executed by Ribeiro & Duarte (2010) and a set of new geochronological U-Pb LA-ICPMS and Sm-Nd analysis results from samples collected in the area of study.

REGIONAL GEOLOGY The field geology aspects and the geochronological results obtained from rocks samples collected in the area of study and vicinity permitted associate locally, the tectonic evolution in what was originally denominated by Souza *et al.* (2005) as Juruena Magmatic Arc and regionally as part of the Rondônia-Juruena Province. At the time, Santos *et al.* (2008) established that the Rondônia-Juruena Province was formed in the interval between 1,840 and 1,740 million years ago and divided it into two geologically distinct domains (Fig. 1). The Juruena Domain (1,848 to 1,793 Ma), in the east portion of the province, composed by plutonic units: Juruena Granodiorite (1,848 to 1,823 Ma), Paranaíta Suite (1,819 to 1,793 Ma) and Bacaerí-Mogno Complex; rocks from a continental volcanic-plutonic “andine” type arc, composed by intermediate and acid volcanic and volcanoclastic rocks from

the Colíder Group (1,786 to 1,781 Ma), metatonalite and metagranodiorite from the Vitória Suite (1,785 to 1,775 Ma), metagranites São Pedro and São Romão (1,784 and 1,770 Ma, respectively) and orthogneiss from the Nova Monte Verde Complex (1,774 Ma). The Jamari Domain (1,760 to 1,740 Ma), in the west, shows a lithological combination typical of continental arc, with metaquartz-diorite, metatonalite, metagranodiorite and metagabbro subordinate, from the Jamari Complex.

Based on recent geochronology data and according to the tectonic evolution model, the convergent orogenesis that shaped the Juruena Magmatic Arc (JMA) started in about 1,820 Ma ago. Compressive movements from SW to NE displaced an oceanic crust (Bacaerí-Mogno Complex) in the direction of the already cratonized Tapajós Magmatic Arc (TMA), resulting in plate subduction and consumption. The interaction between mantle and crustal sources in this accretionary environment generated hybrid magmas evidenced by rocks with ϵ_{Nd} values ranging slightly between negative and positive. In the area, the rocks related to the first stages of the subduction are arranged in the shape of a marginal ridge, composed by hypohabissal granites from Paranaíta Suite (1,808 to 1,769 Ma) and volcanic/volcanoclastic rocks from Colíder Group (1,803 to 1,766 Ma). This belt is found in tectonic contact with a medium to high grade degree metamorphic domain containing remaining fragments from oceanic crust denominated as Bacaerí-Mogno Complex (Sm-Nd isocron age $2.24 \text{ Ga } \epsilon_{Nd(t)} + 2.5$) and predominantly plutonic rocks from Juruena Complex (1,787 to 1,764 Ma). This complex comprises the Vitória Suite (1,787 to 1,765 Ma), São Pedro (1,796 to 1,730 Ma) and São Romão (1,780 to 1,770 Ma) granites and the Vespôr Mafic Suite (1,773 to 1,764 Ma). Disperse volcanic rocks in the complex, apparently filling retro arc type basins are included in the Roosevelt Group (1,772 to 1,740 Ma). The geological episode that imprints the high grade deformation in the JMA is the collisional Quatro Cachoeiras orogen (Rizzotto *et al.* 2004). In the southwest of the area, closer to the suture, this orogen is identified by metamorphic ages around 1,640 Ma, obtained in overgrowth zircon rims in samples from Jamari Complex (RO) and also by rocks metamorphosed in granulite facies. After, in the Mesoproterozoic, occurs the post-collisional JMA granitogenesis from Serra da Providência Suite (1,605 to 1,505 Ma). Other geological event recorded in

stratigraphy is the Mesozoic mafic dikes from Central Atlantic Magmatic Province (Marzoli *et al.* 1999) and the intrusion of narrow mafic bodies in the Cretaceous.

Fig. 2 presents the geotectonical map from the surrounds of the studied area. It shows the spatial arrangement between the lithostratigraphic units and established an approximated limit between the JMA and TMA.

GEOLOGICAL EVOLUTION AND LITHOSTRATIGRAPHIC Field work, plus petrographic, geochemistry and isotopic analyses allied with the interpretation of high resolution airborne gammaspectrometry and magnetometry geophysics

allowed this work to consolidate a refined geological map and a tectonic-stratigraphic framework in relation to the previous works available in 1:1,000,000 scale (Rizzotto *et al.* 2004). The Figs. 3A, B and C present an 1:250,000 geological map, the tectonic-stratigraphic framework and a schematic geological profile for the area of study.

The most ancient rocks mapped in this region are from Bacaeri-Mogno Complex. They are considered as remains of an oceanic crust and associated terrigenous material that subducted under the TMA cratonized crust. Were identified several peraluminous rocks as sillimanita-cordierite gneiss/migmatite, sillimanita-garnet

Figure 1 – Amazon Craton Geochronological Provinces modified from Santos *et al.* (2008). The A polygon represent the SC.21-V-C Rio Aripuanã quadrangle and the dotted polygon the geotectonic map area.

gneiss/migmatite and calc-silicatic rocks. Outcrops from these lithotypes are scattered throughout the Juruena Complex. In the northeast of the area the outcrops are from volcanic/volcanoclastic and associated hypo-abyssal granites. Regionally, it configures a marginal ridge with approximately 50 kilometers width with 600 kilometers in length, bordering the north of Mato Grosso State, since Peixoto de Azevedo until the vicinity of Apuí, in Amazonas State. This belt is interpreted as a marginal ridge developed along the border of the Tapajós crust. The lithotypes identified are riolite, dacite, andesite and volcanoclastic rocks with primary depositional features preserved from Colider Group and hypo-abyssal monzo/sienogranite and granodiorite from Paranaíta Suite. In Ribeiro & Duarte (2010), rock analysis chemical results showed in tectono-magmatic

discrimination diagrams that the parental magma of these rocks have mantle derivatives affinities and crustal contamination calc-alkaline, colisional type magmatism characteristics. These units isotopic data set displays a range of $\epsilon_{\text{Nd}(t)}$ from -3.06 with $T_{\text{DM}} 2.78 \text{ Ga}$ to $\epsilon_{\text{Nd}(t)} +1.79$ with $T_{\text{DM}} 1.94 \text{ Ga}$, results that also indicate that this magmas source have originated from a mixture of juvenile material with ancient recycled continental crust. The crystallization ages available for these units vary almost equally for both of them and are between $1,803 \pm 3$ and $1,766 \pm 5.7 \text{ Ma}$ in the Colider Suite and $1,808 \pm 14$ to $1,769 \pm 5.7 \text{ Ma}$ in the Paranaíta Suite. These results show a volcano-plutonism period of approximately 40 million years.

In tectonic contact and relatively contemporary to the plutonic-volcanic belt are a medium to high

Figure 2 – Geotectonic map from the surrounds of the studied area. The dotted line represents the approximate limit between the Tapajós and Juruena Magmatic Arcs.

grade metamorphosed group of rocks, crystallized at deeper depths. They represent the root of the JMA and compound the Jurueña Complex. The usage of the term complex was proposed to cluster lithostratigraphic units with petrogenetic affinities, complex spatial disposition and crystallization and model ages around 1,775 and 2,050 Ma, respectively. The units of Jurueña Complex are the Vitoria Plutonic Suite, São Pedro and São Romão granites and the Vespôr Mafic Suite. The Vitoria Plutonic Suite includes met-aluminous high-K calc-alkaline; metadiorite, metagranodiorite, metaquartz-diorite and metatonalite with crystallization ages varying between $1,787 \pm 14$ and $1,765 \pm 4$ Ma. São Pedro and São Romão granites include high-K, aluminous calc-alkaline metamonzogranites and metasienogranites, with crystallization ages between $1,786 \pm 17$ and $1,770 \pm 9$ Ma. They differ from each other in relation to distinct metamorphic textures. The São Pedro Granite has a porphyroclastic texture while the São Romão Granite has a fine foliated one. The unit Vespôr Mafic Suite was established to encompass a series of mafic rock stocks and batholiths. The type section is located at Vespôr farm, district of Colniza, Mato Grosso state. It includes metagabbro, metadiorite and amphibolite with tholeiitic affinity and magmatic arc signature.

Two samples were dated by U-Pb LA-ICPMS resulting in crystallization ages of $1,773 \pm 15$ and $1,764 \pm 13$ Ma (Ribeiro & Duarte 2010).

With scattered occurrence, volcanic rocks in the Jurueña Complex are related to the Roosevelt Group Metavolcanic Unit (Oliveira & Albuquerque 2007). The rocks are pyroclastic (lapilli-tuff crystal-tuff) and effusive (riolite and riodacite). Chemical analysis in these rocks shows high-K and calc-alkaline tendency. Also, tectonic discrimination diagrams suggest a collisional arc generation environment related to back-arc basins (Ribeiro & Duarte 2010). The crystallization ages available for the unit are between $1,772 \pm 12$ and $1,740 \pm 8$ Ma.

After a hiatus of approximately 100 Ma, the JMA post-collisional period is evidenced by the extensive Serra da Providência Suite magmatism. This unit gathers monzogranite and sienogranite with rapakivite texture. Chemically the rocks are sub-alkaline with high to very high-K and A2-type granite signature. A substantial data set of U-Pb crystallization ages results are available for this unit, and reveals a range of ages between $1,606 \pm 24$ and $1,505 \pm 9.8$ Ma, characterizing a 100 million years magmatism period.

In the end of the Mesoproterozoic, an extensional period related to the Sunsás-Aguapeí Orogen

Figure 3 – (A) Geologic map from the area of study, (B) tectonic-stratigraphic framework and (C) geologic profile.

is established. This event determined the formation of graben type basins and deposition of Palmeiral Formation sediments. The lithotypes that compose this unit are basically immature conglomerate and sandstone. The outcrops are typical, forming plateaus easily identified through remote sensing. K-Ar geochronology done by Leal (1978), in basalt from Nova Floresta Formation intruded among the sediments, reveals the ages between 967 ± 17 and $1,098 \pm 17$ Ma.

The Phanerozoic units found are Mesozoic dikes, undifferentiated mafic rocks and alluvial deposits. The dikes directions are N-S to N-E; they are associated with a 200 Ma old extensive magmatism from the Central Atlantic Magmatic Province (Marzoli *et al.* 1999). The term undifferentiated mafic rocks was used to classify informally small aeromagnetic analytic signal dipolar anomalies. It was important to cartography these anomalies due to the possibility of relation with the Cretaceous kimberlitic cluster called Madeirinha, located in the Rio Guariba quadrangle. Finally the Holocene alluvial deposits cover unconsolidated sediments as clay, sand and gravel found optimally in channels and margins from the main drainages.

STRUCTURAL GEOLOGY AND METAMORPHISM The analysis of radar and aeromagnetic remote sensing products, associated with field data allowed the delimitation of three structural domains in the area of study: ductile,

ductile-brittle and brittle domains. Fig. 4 shows the area map with the representation of the domains and interpreted magnetic alignments.

The Ductile domain covers approximately 70% of the area and it is composed by the Bacaerí-Mogno and Jurueña Complex. This domain structural framework was interpreted as the result of a single progressive accretionary event, syngenetic with the JMA evolution. Structural analysis shows three stages of deformation. The first one, D_1 has the compressional vector s_1 position at approximately E-W, is characterized by regional N-S gneissic banding (S_n). In the second stage D_2 the s_1 vector rotates 180° degrees to N-S. This shift is evidenced by isoclinal folds (S_{n+1}) with E-W axial planes. In the third stage D_3 , there is a slightly shift in the s_1 direction to east and the generation of sinistral shear zones (S_{n+2}) parallel to the S_{n+1} folds axial planes. Fig. 5 presents outcrops pictures and schemes for illustrate the event sequences described above.

The peak metamorphic degree in the ductile domain was estimated as amphibolite to high amphibolite facies based on the presence of ductile structures (gneissification and initial migmatitization) and mineral paragenesis rich in garnet, sillimanite predominantly and cordierite. Also, the crustal shortening entailed by the progressive deformation caused the exhumation of this domain of rocks to shallower crust levels and subsequent rebalance of the metamorphic degree to green schist facies, with biotite and

Figure 4 – Structural domains delimited in the area of study.

epidote in substitution of amphiboles. Few U-Pb ID-TIMS results in the area reveal what is considered the peak metamorphism age. A proto-mylonite from São Pedro Granite was dated in $1,669 \pm 6$ Ma by Souza *et al.* (2005) and a granodiorite gneiss from Vitória Suite in $1,669 \pm 7$ Ma by Pinho *et al.* (2003). West of the area, in Rondônia State, a similar mean age of 1,664 Ma was calculated using the results of more accurate U-Pb SHRIMP analyses from metamorphic zircons overgrowth rims published by Santos *et al.* 2008. These results, in the mean of 1,660 Ma, are related in this work to the Quatro Cachoeiras collisional phase defined by Rizzotto *et al.* 2004.

The Ductile-Brittle domain is composed by the volcanic-plutonic belt, located at the northeast of the area. There, the structural features commonly observed in outcrops are sets of fractures associated with sinistral shear zones. These sets of fractures and shear zones were analyzed individually based on the RIEDEL model for brittle regime deformations.

The results indicate that the compression direction s_1 ranged between N45°E and E-W. Unlike the ductile domain, only D₃ transcurrent stage was printed in the rocks from this domain.

The Brittle domain delimitate extensive areas where lithostratigraphic units younger than the deformation stages listed above occur. It is the case of Serra da Providência Suite and Palmeiral Formation sediments where only indiscriminate fractures and preserved sedimentary structures were described.

GEOCHRONOLOGY The radiometric datings were performed in the Laboratory of Geochronology of *Universidade de Brasília*. The analyzed samples were collected by Ribeiro & Duarte (2010) and selected based in two distinct factors. The first considered the sample's importance for understanding the region lithostratigraphic stacking and the second took in account the absence of previous data. Five samples were analyzed for U-Pb LA-CPMS in zircon

MC-129

MC-031

Figure 5 – Sketch of outcrops from the ductile domain that illustrate the three stages of progressive deformation (D₁, D₂ and D₃).

and ten for Sm-Nd total rock (Tab. 1). The analytical results for each sample are summarized in the Tab. 2.

U-Pb laser ablation inductively coupled plasma mass spectrometry methodology

The procedure for concentrate zircon and monazite crystals was reducing the sample in a crusher and take out the fraction lower than 500 μm ; the heavy minerals from this fraction were then concentrated panning. In the next step, the material was passed through the Frantz isodynamic separator and finally the zircon and monazite crystals were handpicked using a binocular magnifier. The mounts were made with cold epoxy resin, worn and polished to expose the crystals interior. The mounts were cleaned in a nitric acid bath (3%), Nanopure® water in ultrasound and acetone for the extraction of any moist residue. The analytical equipment utilized was a Multi-Collector Inductively Coupled Plasma Mass Spectrometry MC-ICP-MS Neptune (Thermo-Finnigan) coupled to Nd:YAG ($\lambda = 213 \text{ nm}$) Laser Ablation System (New Wave Research, USA). The analytical procedure was described by Bunh *et al.* (2009) and basically consists in the laser ablation of crystals in 25 to 40 μm spots, 9 to 13 Hz frequency and 0.19 to 1.02 J/cm² intensity. The powdered material is adduced by He flux ($\sim 0.40 \text{ L/min}$) and Ar ($\sim 0.90 \text{ L/min}$). In every analysis the international standard addition GJ-1 and the TEMORA or intern laboratory standard PAD-1 were utilized. The data was acquired in 40 cycles of 1 second and the reading sequence was 1 blank, 1 standard, 4 samples, 1 blank and 1 standard. In each reading the mass intensity of ²⁰²Hg, ²⁰⁴(Pb+Hg), ²⁰⁶Pb, ²⁰⁷Pb, ²⁰⁸Pb and ²³⁸U was determined. The raw data reduction, including blank corrections, equipment deviation and common led were performed in the

laboratory's own Excel spreadsheet. The ratios uncertainties presented in the Tab. 2 are 1s, in percent. The ages were calculated using the software Isoplot 3.0 (Ludwig 2003).

Samarium-Neodymium methodology The Sm-Nd isotopic analyses followed the methodology described by Gioia & Pimentel (2000). In this procedure, approximately 50 mg of powdered sample was mixed with a tracer solution of ¹⁴⁹Sm and ¹⁵⁰Nd. The sample is dissolved in Savillex® capsules through successive HF, HNO₃ and HCl attacks. The Sm and Nd contents were extracted through cationic exchange columns, made with Teflon and filled with LN-Spec. resin. The Sm and Nd salts are deposited in rhenium filaments with nitric acid and evaporated. The ratios readings were performed in a multi-collector mass spectrometer, model Finnigan MAT 262 in static mode. The ¹⁴⁷Sm/¹⁴⁴Nd and ¹⁴³Sm/¹⁴⁴Nd ratios uncertainties are less than ± 0.55 (2s) and ± 0.0055 (2s) respectively, based in repeated analysis in the international standards BHVO-1 and BCR-1. The ¹⁴³Nd/¹⁴⁴Nd ratio was normalized in function of ¹⁴⁶Nd/¹⁴⁴Nd ratio equals to 0.7219. The T_{DM} values were calculated using the DePaolo (1981) model.

RESULTS

U-Pb laser ablation inductively coupled plasma mass spectrometry methodology

Five rock samples distributed among Vitória Plutonic Suite, Vespér Mafic Suite and Paranaíba Suite were selected for U-Pb. The analytical results are presented in Tab. 2.

Sample MC-027Aa is from a tonalitic composition band from a Suite Vitória layered gneiss. The zircons extracted present a unique morphological

Table 1 – Localization coordinates, petrographic classification and lithostratigraphic units from the samples selected for U-Pb LA-ICPMS and Sm-Nd isotopic analysis

Sample	Zone	UTM E	UTM N	Analysis	Petrography	Unit
MC-002	21S	174028	8966966	Sm-Nd	Metamonzogranite	São Pedro Granite
TD-137	21S	232115	8984950	Sm-Nd	Metamonzogranite	São Pedro Granite
MC-017	21S	268825	8990704	Sm-Nd	Metadacite	Colíder Group
MC-058	21S	218666	8893681	Sm-Nd	Metariodacite	Roosevelt Group
MC-120	21S	289931	8983445	U-Pb and Sm-Nd	Metamonzogranite	Paranaíba Suite
MC-140	21S	333344	8918063	Sm-Nd	Porfiry Monzogranite	Paranaíba Suite
TD-151	21S	246883	9000649	U-Pb	Porfiry Sienogranite	Paranaíba Suite
MC-031Bb	21S	283397	8939543	U-Pb and Sm-Nd	Metagabbro	Vespér Mafic Suite
MC-027Aa	21S	265686	8958090	U-Pb and Sm-Nd	Metatonalite	Vitória Plutonic Suite
MC-027Bb	21S	265686	8958090	U-Pb	Anfibolite	Vitória Plutonic Suite
TD-048B	21S	205722	8958040	Sm-Nd	Enderbrite	Vitória Plutonic Suite
TD-034A	21S	185257	8896746	Sm-Nd	Metamonzogranite	Serra da Providência Suite

Table 2 – U-Pb LA-ICPMS analytical results

Grain	f ²⁰⁶ (%)	Th U	Error (%)				Rho	Apparent Ages				Conc.(%)					
			207Pb		Error (%)			207Pb		(Ma)							
			206Pb	235U	1sigma	206Pb		238U	1sigma	206Pb	238U						
MC-027Aa																	
z08	0.01	0.72	244514	0.108215	0.64	4.748	1.07	0.318222	0.86	0.78	1770	12	1776	9	1781	13	100.65
z12	0.01	0.58	233391	0.111111	0.73	4.950	1.09	0.323093	0.80	0.71	1818	13	1811	9	1805	13	99.29
Z14	0.01	0.48	157017	0.107680	0.79	4.606	1.21	0.310208	0.92	0.74	1761	14	1750	10	1742	14	98.93
z15	0.01	0.41	120382	0.108487	0.91	4.818	1.37	0.322098	1.02	0.73	1774	17	1788	12	1800	16	101.45
Z17	0.01	0.47	208319	0.109170	0.57	4.826	1.07	0.320608	0.90	0.83	1786	10	1789	9	1793	14	100.40
Z21	0.01	0.72	236258	0.109347	0.58	4.788	1.83	0.317588	1.74	0.95	1789	11	1783	15	1778	27	99.41
MC-027Bb																	
Z01	0.19	0.01	8461	0.090670	0.89	3.377	1.98	0.270134	1.77	0.89	1440	17	1499	15	1541	24	107.07
Z02	0.06	0.01	28712	0.091213	0.64	3.494	1.10	0.277834	0.89	0.79	1451	12	1526	9	1580	12	108.92
z03	0.09	0.01	17661	0.092903	1.16	3.634	1.76	0.283697	1.33	0.87	1486	22	1557	14	1610	19	108.35
z04	0.08	0.01	47745	0.093096	0.76	3.568	1.55	0.277941	1.36	0.87	1490	14	1542	12	1581	19	106.12
z05	0.07	0.00	23548	0.090677	0.74	3.223	1.53	0.257790	1.34	0.87	1440	14	1463	12	1479	18	102.69
Z06	0.07	0.01	22198	0.091743	0.70	3.406	1.07	0.269287	0.81	0.73	1462	13	1506	8	1537	11	105.14
z07	0.07	0.03	24100	0.091482	1.05	3.492	1.52	0.276837	1.09	0.82	1457	20	1525	12	1575	15	108.15
z08	0.06	0.00	28927	0.090240	0.87	3.301	2.87	0.265268	2.73	0.95	1431	17	1481	22	1517	37	106.02
z09	0.06	0.01	20030	0.091476	0.78	3.524	1.61	0.279437	1.41	0.87	1457	15	1533	13	1589	20	109.06
Z10	0.07	0.00	24501	0.091417	0.73	3.586	1.27	0.284492	1.03	0.80	1455	14	1546	10	1614	15	110.90
z11	0.11	0.01	14450	0.092539	1.56	3.642	2.37	0.285401	1.79	0.89	1478	30	1559	19	1619	26	109.47
z12	0.06	0.01	27907	0.090468	1.02	3.394	2.51	0.272090	2.29	0.91	1435	19	1503	20	1551	32	108.08
z13	0.08	0.01	12061	0.091878	0.95	3.382	1.73	0.266976	1.44	0.83	1465	18	1500	14	1525	20	104.13
Z14	0.05	0.00	35439	0.091712	0.95	3.502	1.41	0.276945	1.05	0.73	1461	18	1528	11	1576	15	107.84
z15	0.09	0.00	18057	0.093002	1.33	3.635	2.28	0.283476	1.85	0.88	1488	25	1557	18	1609	26	108.13
z16	0.09	0.00	17628	0.091722	0.99	3.331	2.06	0.263409	1.80	0.87	1462	19	1488	16	1507	24	103.12
z17	0.06	0.00	16008	0.092267	0.68	3.490	1.65	0.274358	1.51	0.91	1473	13	1525	13	1563	21	106.11
Z18	0.06	0.01	26916	0.092574	0.65	3.663	2.03	0.286997	1.93	0.95	1479	12	1563	16	1627	28	109.96
z19	0.04	0.03	43273	0.092683	1.04	3.358	1.80	0.262800	1.47	0.91	1481	20	1495	14	1504	20	101.54
z20	0.09	0.01	18718	0.092345	0.70	3.409	1.69	0.267771	1.54	0.91	1474	13	1507	13	1529	21	103.73
MC-031Bb																	
z02	0.02	0.41	163261	0.108419	0.62	4.327	1.03	0.289454	0.83	0.78	1773	11	1699	8	1639	12	92.43
Z03	0.01	0.48	106256	0.106481	0.78	4.386	1.16	0.298716	0.86	0.72	1740	14	1710	10	1685	13	96.83
z04	0.01	0.36	139374	0.108849	0.73	4.437	1.30	0.295646	1.07	0.81	1780	13	1719	11	1670	16	93.79
z05	0.04	0.52	42248	0.106445	1.35	4.520	1.79	0.307985	1.17	0.64	1739	25	1735	15	1731	18	99.50

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Table 2 – Continuation

MC-031Bb	f ²⁰⁶ (%)	Th U	206Pb	207Pb	err (%)	207Pb	err (%)	206Pb	Rho	207Pb	(Ma)	207Pb	(Ma)	206Pb	(Ma)	Conc.(%)	
			204Pb	206Pb	1sigma	235U	1sigma	238U	1sigma	206Pb	235U	238U	206Pb	238U			
z08	0.02	0.58	64929	0.108383	1.57	4.224	2.25	0.282642	1.62	0.71	1772	28	1679	18	1605	23	90.53
z09	0.03	0.46	71754	0.107973	2.05	3.855	2.78	0.258933	1.87	0.67	1765	37	1604	22	1484	25	84.08
Z10	0.01	0.53	125482	0.107343	1.13	4.626	1.60	0.312548	1.14	0.70	1755	21	1754	13	1753	17	99.91
Z11	0.02	0.48	88678	0.107477	2.50	4.663	2.76	0.314659	1.18	0.66	1757	46	1761	23	1764	18	100.37
z12	0.01	0.37	116311	0.109833	0.74	4.818	1.44	0.318155	1.23	0.85	1797	13	1788	12	1781	19	99.11
Z15	0.20	0.43	8056	0.109940	1.12	4.610	1.44	0.304093	0.91	0.60	1798	20	1751	12	1712	14	95.17
Z17	0.01	0.26	145492	0.107139	1.09	4.738	1.51	0.320710	1.05	0.68	1751	20	1774	13	1793	16	102.39
z19	0.01	0.60	210473	0.109115	1.28	4.578	1.59	0.304309	0.95	0.58	1785	23	1745	13	1713	14	95.96
Z20	0.04	0.59	38486	0.107596	1.36	3.858	1.81	0.260076	1.19	0.65	1759	25	1605	14	1490	16	84.72
MC-120																	
Z03	0.02	0.93	65554	0.111106	1.38	4.933	1.93	0.322044	1.35	0.69	1818	25	1808	16	1800	21	99.02
Z08	0.03	0.84	46831	0.110457	1.36	5.004	2.15	0.328576	1.67	0.77	1807	25	1820	18	1831	27	101.36
z09	0.05	0.71	33794	0.111534	0.92	5.120	1.78	0.332926	1.52	0.85	1825	17	1839	15	1853	25	101.53
Z11	0.02	0.95	82539	0.109058	1.65	4.669	2.33	0.310484	1.64	0.87	1784	30	1762	19	1743	25	97.72
Z14	0.09	0.59	17888	0.109538	0.93	4.990	2.16	0.330374	1.95	0.90	1792	17	1818	18	1840	31	102.70
z16	0.04	0.69	35594	0.106355	2.15	4.643	2.57	0.316624	1.40	0.54	1738	39	1757	21	1773	22	102.03
Z18	0.04	0.99	39577	0.108473	2.20	4.659	2.53	0.311533	1.26	0.73	1774	40	1760	21	1748	19	98.55
Z19	0.04	0.66	41676	0.110969	1.42	5.092	2.14	0.332786	1.60	0.74	1815	26	1835	18	1852	26	102.01
z20	0.01	0.71	117111	0.108314	0.80	4.776	1.37	0.319783	1.12	0.80	1771	15	1781	12	1789	17	100.98
TD-151																	
Z03	0.10	0.38	15721	0.108546	1.07	4.852	2.00	0.324222	1.68	0.84	1775	19	1794	17	1810	27	100.91
Z04	0.07	0.38	22196	0.110500	0.74	4.893	1.93	0.321155	1.78	0.95	1808	13	1801	16	1795	28	99.68
Z05	2.76	0.53	550	0.110381	1.21	4.734	2.90	0.311059	2.56	0.90	1806	22	1773	24	1746	39	98.46
Z06	0.07	0.37	20856	0.111820	0.59	4.744	1.50	0.307675	1.37	0.91	1829	11	1775	12	1729	21	97.42
Z08	0.06	0.27	24697	0.110791	0.55	4.657	1.29	0.304832	1.16	0.90	1812	10	1759	11	1715	18	97.49
Z10	0.28	0.38	5632	0.108290	0.64	4.168	2.23	0.279121	2.13	0.96	1771	12	1668	18	1587	30	95.16
Z12	0.08	0.28	19901	0.110615	0.70	4.955	2.18	0.324878	2.07	0.95	1810	13	1812	18	1814	33	100.10
Z13	0.12	0.28	24730	0.111315	0.62	4.783	1.26	0.311621	1.10	0.86	1821	11	1782	11	1749	17	98.14
Z15	0.05	0.37	34139	0.109524	0.64	4.599	1.31	0.304556	1.15	0.87	1792	12	1749	11	1714	17	97.98
Z16	0.14	0.25	8429	0.109248	0.92	4.830	3.04	0.320645	2.90	0.95	1787	17	1790	25	1793	45	100.15
Z17	0.11	0.23	13406	0.108242	0.82	4.888	1.95	0.327526	1.76	0.90	1770	15	1800	16	1826	28	101.45
Z18	0.12	0.25	12139	0.108894	1.19	4.949	2.60	0.329607	2.31	0.95	1781	22	1811	22	1836	37	101.43
Z19	0.13	0.38	11251	0.110183	0.92	4.890	1.39	0.321868	1.04	0.74	1802	17	1801	12	1799	16	99.91
Z21	0.12	0.46	12827	0.108419	0.59	4.570	1.75	0.305710	1.64	0.94	1773	11	1744	14	1720	25	98.61

pattern. They are median sized, bipyramidal, long, colorless, limpid and have prismatic habit. Twenty crystals were analyzed and presented $^{207}\text{Pb}/^{206}\text{Pb}$ between 1,736 and 1,818 Ma. All crystals have low contents of common lead and the Th/U ratios are similar to those found in zircons from igneous source. Data from six crystals with more consistent results were utilized to calculate a concordia age of $1,783 \pm 14$ Ma with $\text{MSWD} = 0.001$ (Fig. 6). This result is considered as the crystallization age of the magma body.

Sample MC-027Bb is from an amphibolitic enclave restrained in a Suite Vitória layered gneiss. The zircon population extracted from this sample is quite homogeneous, composed by round, colorless and limpid short prismatic crystals. Every twenty crystals analyzed presented low Th/U ratios, low contents of common lead and a varying degree of reverse discordance. The concordia calculated with all analytical results showed an upper intercept of $1,439 \pm 39$ Ma (Fig. 7). This age clash with the spectrum of crystallization ages expected. The low Th/U ratios are typical of metamorphic crystals and so the result may represent an age of isotopic re-equilibrium associated with a high temperature metamorphic event previously unnoted in the area of study.

Sample MC-031Bb is from a Vespour Mafic Suite meta-gabbro dike of approximately 60 cm width. The dike is intrusive in proto-mylonitic gneiss from the Vitória Suite. This sample provided colorless to yellowish small to medium sized zircon crystals, with a few fractures and inclusions. Twenty crystals were selected to analysis, however seven of them were not used because they presented instable analytical signal. The remaining data results presented a small lead lost and were used to calculate an upper intercept concordia of $1,773 \pm 15$ Ma (Fig. 8).

This result is interpreted as the crystallization age. It is noteworthy that this is the first age of crystallization calculated for the Vespour Mafic Suite.

Sample MC-120 is from a Paranaíta Suite meta-monzogranite. The zircons crystals extracted from this sample are small, with prismatic bipyramidal habit, colorless to sallow, clear and with a few fractures. At total 18 zircon crystals were analyzed and the data from the nine most consistent analytical results were used to calculate a concordia age of $1,796 \pm 17$ Ma (Fig. 9). This result is interpreted as the crystallization age of the rock.

Sample TD-151 is from a Paranaíta Suite porphyry sienogranite. This sample provided medium sized zircon crystals, with prismatic bipyramidal habit, clear and with rare fractures. The analytical results showed low lead contents (except in two samples with f^{206} over 2.76%) and Th/U ratios over 0.23. Among the data results from 16 analyzed crystals, 14 were selected to age calculation. The obtained data are reasonably

Figure 6 – MC-027Aa concordia diagram. The empty circles represent discordant spots, not used in the age calculation.

Figure 7 – MC-027 Bb concordia diagram with all spots.

Figure 8 – MC-031Bb concordia diagram with all spots.

aligned, indicate a weak loss of lead and provided and upper intercept age of $1,797 \pm 14$ Ma (Fig. 10).

Samarium-Neodymium isotopes The Sm-Nd isotopic analyses were performed in ten samples. These samples are representative of each of the JMA lithostratigraphic units, except for the São Romão Granite. Also one sample from the Serra da Providência Suite was analyzed. With the results were calculated the model ages T_{DM} and the ϵ_{Nd} values in (0) and (t), according to the crystallization age of each rock unit. Tab. 3 shows the results and other relevant information about the studied samples. The Sm and Nd contents vary between 4.28 and 20 ppm and between 19 and 112 ppm, respectively. The model ages results are consistent Paleoproterozoic, between 1.85 and 2.25 Ga. The $\epsilon_{Nd(t)}$ values are slightly negative or positive, indicating the predominant influence of a primitive source magma.

DISCUSSION With the integration of the cartographic results from geological survey projects

(Souza *et al.* 2005, Oliveira & Albuquerque 2007, Souza & Abreu 2007, Martins & Abdallah 2007, Knust 2010) combined with a broad dataset of geochronological results was possible to outline the JMA arrangement and define its position in the geological time scale. Fig. 2 summarizes those results. It is the geotectonical map from the NW of the Mato Grosso state originally published in the works of Ribeiro & Duarte (2010) and Knust (2010). This figure illustrated the JMA, its stratigraphic column, the approximate limit between the magmatic arcs Tapajós and Juruena and the two geotectonical domains that configure the JMA. (1) The marginal ridge compound by the Colider Group and the Paranaíta Suite and (2) The Bacaeri-Mogno and Juruena Complexes, representatives of oceanic and continental arc respectively. The geological maps and the spectrum of model and crystallization ages do not show significant differences between the domains to consider then as distinct magmatic arcs. Fig. 11 exemplifies the statement above through a graphic with model ages (T_{DM}) and $\epsilon_{Nd(t)}$ values from JMA samples plotted. It can be

Figure 9 – MC-120 concordia diagram. The empty circles represent discordant spots, not used in the age calculation.

Figure 10 – TD-151 concordia diagram with all spots.

Table 3 – Sm-Nd isotopic analysis results, $\epsilon_{Nd(0)}$ and $\epsilon_{Nd(t)}$ values, T_{DM} model ages and crystallization age (t) value

Sample	Sm (ppm)	Nd (ppm)	$^{147}\text{Sm}/^{144}\text{Nd}$	$^{143}\text{Nd}/^{144}\text{Nd} (\pm 2\text{SE})$	$\epsilon_{Nd(0)}$	$\epsilon_{Nd(t)}$	Time (t)	T_{DM} (Ga)
MC-002	6.88	40.722	0.1021	0.511622 ± 4	-19.83	1.92	1786 ± 17	1.93
TD-137	5902	33613	0.1061	0.511527 ± 9	-21.67	-0.91	1786 ± 17	2.14
MC-017	7.241	40.92	0.107	0.511679 ± 5	-18.72	1.79	1785 ± 6.3	1.94
MC-058	7.075	38.587	0.1108	0.5117 ± 11	-18.29	1.33	1767 ± 08	1.98
MC-120	5.713	35.428	0.0975	0.511513 ± 6	-21.94	0.97	1796 ± 17	1.99
MC-140	6.849	38.387	0.1078	0.511641 ± 9	-19.44	1.09	1796 ± 17	2.01
MC-031Bb	4.277	19.894	0.13	0.511875 ± 4	-14.89	0.35	1773 ± 15	2.11
MC-027Aa	5.545	26.059	0.1153	0.511586 ± 19	-20.52	-1.9	1783 ± 14	2.25
TD-048B	7.225	39.217	0.114	0.511714 ± 3	-18.02	0.87	1783 ± 14	1.97
TD-034A	20.662	112.558	0.111	0.511766 ± 4	-17.01	-0.09	1537 ± 07	1.88

observed in the graphic that the T_{DM} ages from both plutonovolcanic and complexes domain have virtually the same interval and also that the $\epsilon_{Nd(t)}$ values oscillates slightly positive to negative. These results denote equal magma generation periods, sources and crustal contamination processes that are typical of collisional orogens.

The JMA crystallization ages also support the theory of a single accretionary magmatic arc. The older rocks are at the NE of the area, in the plutonovolcanic domain, with ages between 1,808 and 1,766 Ma. This domain registers the entire range of ages of the arc formation, as expected for an active continental margin. To SW, toward the Jurueña and Bacaerí-Mogno complexes, accounting for deeper rocks, the ages become slightly younger, between 1,787 and 1,764 Ma. Tab. 4 summarizes information about the samples with crystallization ages results used in the article.

About the crystallization ages results from the Roosevelt Group volcanic rocks, they show a younger interval of generation, between 1,772 and 1,740 Ma, when compared to the Colíder Group volcanic rocks. Previous works report two theories for this volcanic episode. Neder *et al.* (2002) describe it as the result from an anorogenic intracratonic extensional event. Rizzotto *et al.* (2004) views it as a

retro-arc volcanism in relation to the JMA. Ribeiro & Duarte (2010) did not identify structures or chemical signatures to interpret this volcanism as the result of an anorogenic extensional event, besides the results showed that these rocks have chemical characteristics of normal continental arc, with magmas generated in a subduction environment and with crustal contamination. The rocks which undoubtedly are correlated to a post-collisional period in relation to the JMA are from the Serra da Providência Suite. In the area these rocks are well preserved from the regional deformation and contain xenoliths from the enclosing units. The geochronological results presented in the Fig. 11 graphic and in the Tab. 4 show that both model T_{DM} and crystallization ages are younger than what is expected for the JMA rocks. The chemical signatures show as well intra-plate, late-orogenic and mantle derived characteristics (Ribeiro & Duarte 2010).

A final observation is that the three structural domains reflect the JMA geotectonic zonation. The brittle-ductile domain comprise the shallow crust plutonovolcanic belt, that is taken as the JMA paleo active continental margin; the ductile domain comprise the arc's highly deformed deep rocks from Bacaerí-Mogno and Jurueña complexes; and the brittle domain which comprise the post-collisional rocks from the Serra da Providência Suite.

Figure 11 – Graphic with model ages (left y axis) and $\epsilon_{Nd(t)}$ values (right y axis) from rocks of the Jurueña Magmatic Arc tectonic domains.

Table 4 – Available U-Pb crystallization ages for the Juruena Magmatic Arc available in the bibliography. The grey filled lines are samples results from the present work

Sample	Longitude	Latitude	Lithology	Unit	Age (Ma)	Error
^a P29	-59.12	-9.15	Monzogranite	CG	1803 ⁽²⁾	3
^a Fi-05	-59.12	-9.00	Máfico Tuff	CG	1797 ⁽²⁾	5
^a GM-008	-53.97	-10.52	Rhyolite	CG	1792 ⁽³⁾	8
^a F2001	-56.28	-9.52	Porfiry Rhyolite	CG	1786 ⁽²⁾	17
ⁱ MA-004	-57.05	-9.35	Porfiry Rhyolite	CG	1785 ⁽³⁾	6.3
^b GM-008	-55.04	-10.88	Porfiry Rhyolite	CG	1781 ⁽²⁾	8
^b GM-080	-55.04	-10.88	Monzogranite	CG	1781 ⁽¹⁾	8
^a B-04	-59.06	-8.96	Basalt	CG	1776 ⁽²⁾	3
^a WB-08	-59.07	-8.97	Ignimbrite	CG	1774 ⁽²⁾	2
^a B-01	-59.02	-8.96	Rhyolite	CG	1770 ⁽²⁾	8
^k RB-012	-60.14	-6.70	Rhyolite	CG	1766 ⁽³⁾	5.7
ⁱ MA-12A	-55.94	-9.82	Bt Granite	PS	1808 ⁽³⁾	14
^b TD-151	-59.30	-9.03	Porfiry Sienogranite	PS	1797 ⁽³⁾	14
^c CC-21	-56.18	-9.87	Bt Porfiry Granite	PS	1793 ⁽²⁾	6
^b MC-120	-58.91	-9.19	Metamonzogranite	PS	1769 ⁽³⁾	17
^b PS-306	-61.32	-9.45	Metagranodiorite	VPS	1787 ⁽³⁾	14
^b PS-042	-57.79	-9.80	Tonalite	VPS	1785 ⁽¹⁾	8
^b MC-27Aa	-59.13	-9.42	Metatonalite	VPS	1783 ⁽³⁾	14
^b CC-233	-56.73	-9.97	Enderbite	VPS	1775 ⁽¹⁾	10
ⁱ WA-227A	-58.46	-10.87	Tonalite	VPS	1771 ⁽²⁾	14
^a P21	-59.13	-9.37	Granodiorite	VPS	1765 ⁽²⁾	4
^c CC-138	-62.89	-13.15	Grt Bt Metagranite	SPG	1786 ⁽¹⁾	17
^b CC-158	-56.65	-9.92	Metamonzogranite	SPG	1784 ⁽¹⁾	17
^a A4	-59.37	-9.27	Hbl Metamonzogranite	SPG	1775 ⁽²⁾	13
^a A3	-59.35	-9.29	Bt Metamonzogranite	SPG	1774 ⁽²⁾	4
^a P20	-59.13	-9.38	Gneiss	SPG	1772 ⁽²⁾	66
^a A8	-59.29	-9.39	Hbl Metamonzogranite	SPG	1766 ⁽²⁾	5
^a A7	-59.36	-9.39	Hbl Metamonzogranite	SPG	1764 ⁽²⁾	32
^a SK-055	-57.51	-11.26	Metamonzogranite	SPG	1763 ⁽³⁾	37
^a P25	-59.12	-9.35	Ttn Bt Metamonzogranite	SPG	1763 ⁽²⁾	6
^a A6	-59.38	-9.23	Gneiss	SPG	1759 ⁽²⁾	3
^m Paraibão	-59.54	-10.08	Porphyritic Granite	SPG	1755 ⁽¹⁾	5
^b PS-019	-60.39	-9.36	Metamonzogranite	SPG	1730 ⁽³⁾	9
ⁱ WA-151	-57.74	-10.95	Metamonzogranite	SRG	1780 ⁽²⁾	13
^b PS-064	-60.06	-9.87	Metasienogranite	SRG	1774 ⁽³⁾	28
^b JD-017B	-56.40	-10.21	Bt Granite	SRG	1770 ⁽¹⁾	9
^b MC-31Bb	-58.97	-9.59	Metagabbro	VMS	1773 ⁽³⁾	15
^b PS-029	-60.07	-9.55	Metagabbro	VMS	1764 ⁽³⁾	13
^b PS-021	-60.03	-9.36	Metadacite	RG	1772 ⁽³⁾	12
^a A1	-59.33	-9.35	Metarhyolite	RG	1767 ⁽²⁾	2
^m Massaramduba	-59.54	-10.08	Metadacite	RG	1762 ⁽¹⁾	6
^a A2	-59.35	-9.33	Mylonitic Rhyodacite	RG	1761 ⁽²⁾	5
^c MQ-96	-60.80	-11.48	Dacite	RG	1740 ⁽¹⁾	8
^s WB-152	-62.22	-9.47	Paragneiss	JC	1769 ⁽¹⁾	-
^d GR-035	-61.90	-11.21	Quartz Diorite	JC	1758 ⁽¹⁾	7
^c 5260-GR-35	-61.89	-11.20	Gnaiss quartzo-diorítico	JC	1757 ⁽¹⁾	9
^d GR-059	-62.90	-9.80	Tonalite	JC	1753 ⁽¹⁾	9
^c 2492-GR-59	-62.90	-9.80	Tonalítico Gneiss	JC	1746 ⁽¹⁾	-
^c 2492-JL-78	-62.83	-10.16	Tonalítico Gneiss	JC	1743 ⁽¹⁾	-
^d JL-078	-62.83	-10.16	Tonalite	JC	1738 ⁽¹⁾	6
^s WB-70	-63.00	-9.94	Enderbítico Granulite	JC	1730 ⁽²⁾	22

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Table 4 – Continuation

Sample	Longitude	Latitude	Lithology	Unit	Age (Ma)	Error
^j PG-JS-26	-64.92	-9.61	Tonalitic Gneiss	JC	1728 ⁽¹⁾	15
ⁱ SP-GR-76	-61.47	-10.75	Sienogranite	SPS	1606 ⁽²⁾	24
^s GM-033	-58.65	-11.41	Mylonitic Granite	SPS	1580 ⁽²⁾	35
^f SP-GR-21	-61.61	-10.81	Monzogranite	SPS	1573 ⁽²⁾	15
^g GR-048	-64.99	-9.04	Granitic Gneiss	SPS	1570 ⁽¹⁾	17
^e MS-6030	-62.12	-9.65	Granitic Gneiss	SPS	1570 ⁽²⁾	17
ⁱ SP-GR-39	-61.63	-11.05	Monzogranite	SPS	1566 ⁽²⁾	3
^f SP-GR-48	-61.42	-10.75	Monzogranite	SPS	1566 ⁽²⁾	5
^h WA-045	-58.77	-10.91	Granodiorite	SPS	1564 ⁽²⁾	12
^e WB-46A/C	-63.04	-9.97	Monzogranitic Gneiss	SPS	1560 ⁽²⁾	-
^j PG-JS-16	-62.94	-9.80	Monzogranitic Gneiss	SPS	1555 ⁽¹⁾	19
^f SP-GR-53	-61.59	-10.78	Sienogranite	SPS	1554 ⁽²⁾	47
^j PG-JS-19	-61.00	-11.51	Sienogranitic Gneiss	SPS	1545 ⁽¹⁾	8
^e AR-3/1	-63.46	-8.81	Monzogranite	SPS	1544 ⁽²⁾	5
^k AR-3-1	-63.46	-8.81	Bt Monzogranite	SPS	1544 ⁽²⁾	5
ⁱ MQ-33	-59.56	-10.11	Ttn Bt Sienogranite	SPS	1537 ⁽¹⁾	7
^j PG-JS-01	-62.90	-9.78	Monzogranitic Gneiss	SPS	1535 ⁽¹⁾	27
^e WB-36	-62.25	-9.68	Quartz-Sienite	SPS	1532 ⁽²⁾	-
^e WB-44A	-63.07	-9.61	Sienogranitic Gneiss	SPS	1526 ⁽²⁾	12
^j PG-JS-32	-61.41	-11.46	Monzogranitic Gneiss	SPS	1522 ⁽¹⁾	10
^b PS-170	-60.51	-9.01	Hbl Bt Sienogranite	SPS	1516 ⁽³⁾	11
^d GR-333	-62.07	-10.78	Metagranite	SPS	1515 ⁽¹⁾	8
^b PS-170	-60.51	-9.01	Hbl Bt Sienogranite	SPS	1505 ⁽³⁾	9.8

^aPinho *et al.* (2003); ^bRibeiro & Duarte (2010); ^cSantos *et al.* (2000); ^dSantos *et al.* (2008); ^eSantos *et al.* (2004); ^fBettencourt *et al.* (1999); ^gPayolla *et al.* (2002); ^hSouza *et al.* (2005); ⁱSilva & Abram (2008); ^jSilva *et al.* (2002); ^kQuadros & Rizzotto (2008); ^lSouza & Abreu (2007); ^mNeder *et al.* (2002); ⁿKnust (2010); ^oAlves *et al.* (2010); ^pJICA & MMAJ (2000); ^qRizzotto *et al.* (2002); ^rMartins & Abdallah (2007). ⁽¹⁾U-Pb SHRIMP; ⁽²⁾U-Pb ID-TIMS; ⁽³⁾U-Pb ICP-MS-LA. CG: Colider Group; PS: Paranaíba Suite; VPS: Vitória Plutonic Suite; SPG: São Pedro Granite; SRG: São Romão Granite; RG: Roosevelt Group; VMS: Vespôr Mafic Suite; JC: Jamari Complex; SPS: Serra da Providência Suite

CONCLUSIONS The regional geological survey projects executed by the Brazilian Geological Survey (CPRM) in the Juruena Domain gather a major but crude dataset of geological data. Focused articles are important to publish and polish the results improving the area geological knowledge and economic potential. The conclusions from this article are:

A) The integration of the available 1:250,000 geological maps made possible prepare the geotectonic map from the NW of the Mato Grosso State and to adjust the limits between the Tapajós and Juruena Magmatic Arcs;

B) The area geologic map is more detailed and improved in relation to the previous 1:1,000,000 scale map. The main stratigraphic changes were in recognizing the Bacaerí-Mogno Complex, framing the deformed plutonic domain into the Juruena Complex and establish the unit Vespôr Mafics to enclosure a series of mafic bodies and lenses previously unknown;

C) The geotectonic map, the litho-chemical interpretations and the geochronology data set allowed consolidate the Juruena Magmatic Arc as a single accretionary continental arc;

D) The range of U-Pb crystallization ages, T_{DM} and $e_{Nd(t)}$ values expected for the JMA are between 1,803 and 1,740 Ma, 2,300 and 1,950 Ma and -3 to +3, respectively.

E) The areas structural arrangement is also consistent with the model of a single continental arc. It was registered in the rocks a three stage progressive compressional deformation (D_1 , D_2 and D_3) through the orogenesis, with the development of regional shear zones that affected both ductile and brittle domains;

F) Based on the results, the authors consider that it is adequate to use the term orogenesis to describe the JMA geological processes.

G) It is necessary a large project to integrate the series of CPRM 1:250,000 recently published geological survey maps from the north of Mato Grosso State, southwest of Amazon State, south of Pará State and north/northeast of Rondônia State. This sort of work promotes the patterning of the litho-stratigraphic unit nomenclature and refines the Amazon Craton

geotectonic evolutionary models thus supporting the discovery of new areas with economic potential.

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References

- Alves C.L., Sabóia A.M., Martins E.G., Stropper J.L. 2010. *Geologia e recursos minerais das Folhas Rio São José do Xingu e Rio Comandante Fontoura*. Projeto Noroeste-Nordeste de Mato Grosso; Programa Geologia do Brasil (PGB). Goiânia: CPRM, 120 p., escala 1:250.000.
- Bettencourt J.S., Tosdal R.M., Leite Jr W.B., Payolla B.L. 1999. Mesoproterozoic rapakivi granites of the Rondônia Tin Province, southwestern border of the Amazonian craton, Brazil – I. Reconnaissance U-Pb geochronology and regional implications. *Precambrian Research*, **95**:41-67.
- Bettencourt J.S., Leite Jr W., Payolla B., Ruiz A.S., Matos R.S., Tosdal R.M. 2010. The Rondonian-San Ignacio Province in the SW Amazonian Craton: an overview. *Journal of South American Earth Sciences*, **29**:28-46.
- Bühn B., Pimentel M.M., Matteini M., Dantas E.L. 2009. High spatial resolution analysis of Pb and U isotopes for geochronology by laser ablation multicollector inductively coupled plasma mass spectrometry (LA-MC-ICP-MS). *Anais da Academia Brasileira de Ciências*, **81**(1):1-16.
- Cordani U.G. & Teixeira W. 2007. Proterozoic accretionary belts in the Amazonian Craton. In: Hatcher Jr R.D., Carlson M.P., McBride J.H., Martinez-Catalan J.R. (eds.). *4-D Framework of Continental Crust, Memoir 200*. Boulder, Geological Society of America, p. 297-320.
- Cordani U.G., Teixeira W., D'Agrella-Filho M.S., Trindade R.I., 2009. The position of the Amazonian Craton in supercontinents. *Gondwana Research*, **15**:396-407.
- DePaolo D.J. 1981. A neodymium and strontium isotopic study of Mesozoic calc-alkaline granitic batholiths of Sierra Nevada and Peninsular Ranges, California. *Journal of Geophysical Research*, **86**:10470-10488.
- Gióia S.M.C.L. & Pimentel M.M. 2000. The Sm-Nd isotopic method in the geochronology laboratory of the University of Brasília. *Anais da Academia Brasileira de Ciências*, **72**(2):219-245.
- JAPAN INTERNATIONAL COOPERATION AGENCY (JICA), METAL MINING AGENCY OF JAPAN (MMAJ). 2001. *Report on the mineral exploration in the Alta Floresta area, Federative Republic of Brazil: phase III*. Tokyo: JICA; MMAJ.
- Klein E.L. 2001. *Geologia e Recursos Minerais da Província Mineral do Tapajós*. Programa Levantamentos Geológicos Básicos do Brasil (PLGB), Projeto Especial Província Mineral do Tapajós (PROMIM TAPAJÓS). Brasília, CPRM.
- Knust S.S.A. 2010. *Geologia e recursos minerais da Folha Porto dos Gaúchos*. Projeto Noroeste-Nordeste de Mato Grosso; Programa Geologia do Brasil (PGB). Goiânia: CPRM, 141 p., escala 1:250.000.
- Leal J.W.L. 1978. *Projeto RADAMBRASIL*. Folha SC. 20. Porto Velho: Geologia, Geomorfologia, Pedologia, Vegetação e Uso Potencial da Terra. Rio de Janeiro: DNPM, 17-184.
- Ludwig K.R. 2003. *Isoplot 3.00 – a geochronological toolkit for Microsoft Excel*. Berkeley Geochronology Center, Special Publication No 4.
- Martins E.G. & Abdallah S. 2007. Geologia e recursos minerais da folha Juína SC.21-Y-C. Projeto Noroeste de Mato Grosso, Programa Geologia do Brasil (PGB). Goiânia: CPRM. 98 p. il., escala 1:250.000.
- Marzoli A., Renne P.R., Piccirillo E.M., Ernesto M., Bellieni G., Min A.D. 1999. Extensive 200-Million-Year-Old Continental Flood Basalts of the Central Atlantic Magmatic Province. *Science*, **284**:616-618.
- Neder R.D., Leite J.A.D, Figueiredo B.R., McNaughton N.J. 2002. 1.76 Ga volcano-plutonism in the southwestern Amazonian craton, Aripuanã-MT, Brazil: tectono-stratigraphic implications from SHRIMP U-Pb zircon data and rock geochemistry. *Precambrian Research*, **119**:171-187.
- Oliveira C. C. & Albuquerque M.C. 2007. Geologia e recursos minerais da folha Aripuanã SC. 21-Y-A. Projeto Noroeste de Mato Grosso, Programa Geologia do Brasil (PGB). Goiânia: CPRM. 92 p. il., escala 1:250.000.
- Payolla B.L., Bettencourt J.S., Kozuch M., Leite Jr. W.B., Fetter A.H., VanSchmus W.R. 2002. Geological evolution of the basement rocks in the east-central part of the Rondônia Tin Province, SW Amazonian craton, Brazil: U-Pb and Sm-Nd isotopic constraints. *Precambrian Research*, **119**:141-169.
- Pinho M.S.B., Chemale Jr. F., Schmus R.V., Pinho F.E.C. 2003. U-Pb and Sm-Nd evidence for 1.76-1.77 Ga magmatism in the Moriru region, Mato Grosso, Brazil: implications for province boundaries in the SW Amazon Craton. *Precambrian Research*, **126**:1-25.
- Quadros M.L.E.S. & Rizzotto G.J. 2008. Mapa geológico e de recursos minerais do Estado de Rondônia estruturado em Sistema de Informações Geográficas (SIG). In:

- CONGRESSO BRASILEIRO DE GEOLOGIA, 44., 26-31 out. 2008, Curitiba, PR. *Anais...* Curitiba, PR: SBG, 2008.
- Ribeiro P.S.E. & Duarte T.B. 2010. Geologia e Recursos Minerais das Folhas Rio Guariba e Rio Aripuanã. Projeto Noroeste-Nordeste de Mato Grosso; Programa Geologia do Brasil (PGB). Goiânia: CPRM, 248 p., escala 1:250.000.
- Rizzotto G.J., Quadros M.L.E.S., Silva L.C, Armstrong R., Almeida M.E. 2002. O Granito Aripuanã: Datação U-Pb (SHRIMP) e Implicações Metalogenéticas. In: CONGRESSO BRASILEIRO DE GEOLOGIA, 41., João Pessoa. *Anais...* João Pessoa: SGB, 2002. p. 469-469.
- Rizzotto G.J., Quadros M.L.E.S., Bahia R.B.C, Ferreira R.B.C, Lopes R.C, Cordeiro A.V. 2004. Folha SC.21-Juruena. In: Schobbenhaus C., Gonçalves J.H., Santos J.O.S., Abram M.B., Leão Neto R., Matos G.M.M., Vidotti R.M., Ramos M.A.B., Jesus J.D.A (eds). *Carta Geológica do Brasil ao Milionésimo. Sistema de informações Geográficas*. Programa Geologia do Brasil. 46 folhas. Brasília: Companhia de Pesquisa de Recursos Minerais, escala 1:1.000.000. 41 CD-ROM.
- Santos J.O.S., Rizzotto G.J., Easton M. R., Potter P.E., Hartmann L.A., McNaughton N.J. 2002. The Sunsás orogen in western amazon craton, South América and correlation with the Grenville Orogen of Laurentia, base on U-Pb Isotopic Study of Detritical and Igneous Zircon. Geological Society of America - Denver Annual Meeting. *Precambrian Geology*, **122**:27-30.
- Santos J.O.S., Rizzotto G.J., Potter P.E., McNaughton N.J., Matos R.S., Hartmann L.A., Chemale Jr F., Quadros M.E.S. 2008. Age and autochthonous evolution of the Sunsás Orogen in West Amazon Craton based on mapping and U-Pb geochronology. *Precambrian Research*, **165**:120-152.
- Santos J.O.S., Hartmann L.A., Gaudette H.E., Groves D.I., McNaughton N.J., Fletcher I.R. 2000. A new understanding of the provinces of the Amazon craton based on integration of Field mapping and U-Pb and Sm-Nd geochronology. *Gondwana Research*, **4**:453-488.
- Santos J.O.S., Van Breemen O.B., Groves D.I., Hartmann L.A., Almeida M.E., McNaughton N.J., Fletcher I.R. 2004. Timing and evolution of multiple Paleoproterozoic magmatic arcs in the Tapajós Domain, Amazon Craton: constrains from SHRIMP and TIMS zircon, baddeleyite and titanite U-Pb geochronology. *Precambrian Research*, **131**:73-109.
- Sato K. & Tassinari C.C.G. 1997. Principais eventos de acreção continental no cráton amazônico baseados em idade modelo Sm-Nd, calculada em evoluções de estágio único e estágio duplo. In: Costa M.L., Angélica R.S. *Contribuições à Geologia da Amazônia*. Belém: FINEP; SBG, p. 91:129.
- Scandolara J. E. 2006. Geologia e evolução do terreno Jamari, embasamento da faixa Sunsas-Aguapeí, centro-leste de Rondônia, sudoeste do craton Amazônico. Tese (Doutorado em Geologia Regional) - Instituto de Geociências, Universidade de Brasília, Brasília. 383p.
- Silva L.C, Armstrong R., Pimentel M.M., Scandolara J.E., Ramgrab G., Wildner W., Angelim L.A.A., Vasconcelos A.M., Rizzotto G.J., Quadros M.L.E.S., Sander A., Rosa A.L.Z. 2002. Reavaliação da evolução geológica em terrenos pré-cambrianos brasileiros com base em novos dados U-Pb SHRIMP, parte III: Províncias Borborema, Mantiqueira Meridional e Rio Negro-Juruena. *Revista Brasileira de Geociências*, **32**(4):529-544.
- Silva M.G. & Abram M.B. 2008. *Projeto Metalogenia da Província Aurífera Juruena-Teles Pires*. Informe de Recursos Minerais. Série Ouro, 16. Programa Geologia do Brasil - PGB. CPRM Goiânia.
- Souza J.O. & Abreu F.W. 2007. *Geologia e recursos minerais da folha Tapaiúna SC.21-Y-B*. Projeto Noroeste de Mato Grosso, Programa Geologia do Brasil (PGB). Goiânia: CPRM. 88 p. il, escala 1:250.000.
- Souza J.O., Frasca A.A.S., Oliveira C.C. 2005. *Geologia e recursos minerais da província mineral de Alta Floresta: relatório integrado*. Programa Levantamentos Geológicos Básicos do Brasil (PLGB), Projeto Província Mineral de Alta Floresta (Promin Alta Floresta). CPRM Goiânia, escala 1:500.000.
- Tassinari C.C.G. 1996. *O mapa geocronológico do Cráton Amazônico no Brasil: revisão dos dados isotópicos*. Tese (Livre-docência) - Instituto de Geociências, Universidade de São Paulo, São Paulo.
- Tassinari C.C.G., Macambira M.J.B. 1999. Geochronological provinces of the Amazon craton. *Episodes*, **22**:174-182.

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