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Geological features and the Paleoproterozoic collision of four Archean crustal segments of the São Francisco Craton, Bahia, Brazil. A synthesis

JOHILDO S.F. BARBOSA[1] **and PIERRE SABATÉ**[2]

[1]CPGG – Centro de Pesquisa em Geofísica e Geologia/UFBA, Federação, 40210-340 Bahia, Brazil
[2]IRD/ORSTOM, Laboratoire de Tectonophysique, Université de Montpellier II, Place Bataillon, Cedex Montpellier, France

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contributed by PIERRE SABATÉ*

ABSTRACT

Recent geological, geochronological and isotopic research has identified four important Archean crustal segments in the basement of the São Francisco Craton in the State of Bahia. The oldest Gavião Block occurs in the WSW part, composed essentially of granitic, granodioritic and migmatitic rocks. It includes remnants of TTG suites, considered to represent the oldest rocks in the South American continent ($\sim 3,4$Ga) and associated Archean greenstone belt sequences. The youngest segment, termed the Itabuna-Salvador-Curaçá Belt is exposed along the Atlantic Coast, from the SE part of Bahia up to Salvador and then along a NE trend. It is mainly composed of tonalite/trondhjemites, but also includes stripes of intercalated metasediments and ocean-floor/back-arc gabbros and basalts. The Jequié Block, the third segment, is exposed in the SE-SSW area, being characterized by Archean granulitic migmatites with supracrustal inclusions and several charnockitic intrusions. The Serrinha Block (fourth segment) occurs to the NE, composed of orthogneisses and migmatites, which represent the basement of Paleoproterozoic greenstone belts sequences. During the Paleoproterozoic Transamazonian Orogeny, these four crustal segments collided, resulting in the formation of an important mountain belt. Geochronological constrains indicate that the regional metamorphism resulting from crustal thickening associated with the collision process took place around 2.0 Ga.

Key words: Geological, geochronological and isotopic research; Archean segments; Paleoproterozoic collision.

INTRODUCTION

We use a synthesis of published and recently obtained data to explain the geological-geotectonic evolution of the basement rocks of the northern São Francisco Craton in Bahia, NE Brazil. In this context, the most important geological studies of the last ten years about the Archean and Paleoproterozoic metamorphic rocks have been analyzed. This resulted in a significant advance of the scientific knowledge of the Craton, not only from the point of view of the regional mapping but also from petrology, geochronology and also isotopic geology. The country rocks of the Craton are composed almost exclusively of high to medium grade metamorphic lithologies, occuping about 50% of the total area of the state of Bahia. Lithologies of the greenschist facies which compose the greenstone belts associ-

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Correspondence to: Johildo S.F. Barbosa
E-mail: johildo@cpgg.ufba.br
*Foreign Member of Academia Brasileira de Ciências

ated to granitoid-migmatitic terrenes represent very small areas when compared to the distribution of high to medium grade. To explain the geological evolution of these older rock units of Bahia we re-examine the existing tectonostratigraphic subdivisions (ancient cores of TTGs, the Gavião Block, Contendas-Mirante Greenstone Belt, Jacobina Group, Jequié Complex, Itabuna Belt, Serrinha Core, Mairi Block, Rio Itapicuru and Capim Greenstone Belt (Barbosa and Dominguez 1996) together with most recently acquired data from Santos Pinto (1996), Bastos Leal (1998), Sato (1998), Teixeira et al. (2000) and Mello et al. (2000), and new radiometric and petrological evidences (Barbosa and Peucat and Barbosa et al. in preparation). In this way, the new data allow us to group the disparate units listed above into four blocks of Archean age which underwent collision in the Paleoproterozoic in the period during which the Transamazonic granitoids were mainly formed. For a better understanding the radiometric ages are listed in the text from the older to the younger ages order, those related to the formation of the rocks and those related to the metamorphic processes. It is described in this paper the geological features of the four Archean blocks, and the lithologic, metamorphic and tectonic evidence of the collision of these crustal segments in the Paleoproterozoic. Simplified geological sections we used to show the final positions of the rock units after collision. It is also shown the position of the studied areas in the São Francisco Craton. This review is important because one evokes, for the first time, the occurrence of Archean crustal segments in the São Francisco Craton basement, which collided during the Paleoproterozoic.

GEOLOGICAL FRAMEWORK

The São Francisco Craton (Almeida 1977) is the best exposed and the most easily accessible unit of the Precambrian Brazilian shield. Considering its boundaries delineated by geophysical data (Ussami 1993), and the surrounding fold belts from the Brasiliano orogeny (Araçuaí, Alto Rio Grande, Brasília, Rio Preto, Riacho do Pontal e Sergipana), it spreads nearly throughout Bahia state and over a large part of Minas Gerais. The Craton is truncated by a major N-S rift-thrust belt in which the Mesoproterozoic Espinhaço Supergroup was deposited. In addition, extensive platform sedimentation took place in the Neoproterozoic (Bambui Group) and Phanerozoic. Archean and Paleoproterozoic terrains of the São Francisco Craton crop out in two geographically distinct areas, the first and large one to the north and northeast of Bahia and, the second to the south towards Minas Gerais (Fig. 1). In the Archean and Paleoproterozoic terrains the rocks are predominantely orthogneiss, equilibrated either in the granulite (Jequié Complex and Itabuna-Salvador-Curaça Belt) or amphibolite metamorphic facies (Gavião Block and Serrinha Block). The last two contain greenstone belts sequences of greenschist facies, such as: Contendas Mirante, Umburanas and Mundo Novo (Archean) and Rio Itapicuru and Capim (Paleoproterozoic).

THE ARCHEAN BLOCKS

Each of the four aforementioned segments (Gavião, Jequié, Serrinha Blocks and Itabuna-Salvador-Curaçá Belt) can be discriminated according to Sm-Nd model ages (Fig. 2), and $\varepsilon_{\mathrm{Nd}} \times \varepsilon_{\mathrm{Sr}}$ constrains (Fig. 3), supporting their distinct origin and evolution. In Figure 2 it is shown the Sm-Nd T_{DM} ages, grading from the oldest, on the west (Gavião Block), to the youngest, on the east (Itabuna-Salvador-Curaçá Belt). The age gradation indicates a crustal accretion in the studied area. In Figure 3 the position of the crustal segments in non-superposed areas suggests that each one of them has individual characteristics, with respect to $\varepsilon_{\mathrm{Nd}}$ versus $\varepsilon_{\mathrm{Sr}}$ (Barbosa et al., in preparation). The Gavião Block is the oldest and the Itabuna-Salvador-Curaçá Belt the youngest, since the latter is closer to the deplet mantle (DM) domain. The comparison of the information of Figures 2 and 3 shows that the continental accretion in the region was probably of the collisional type.

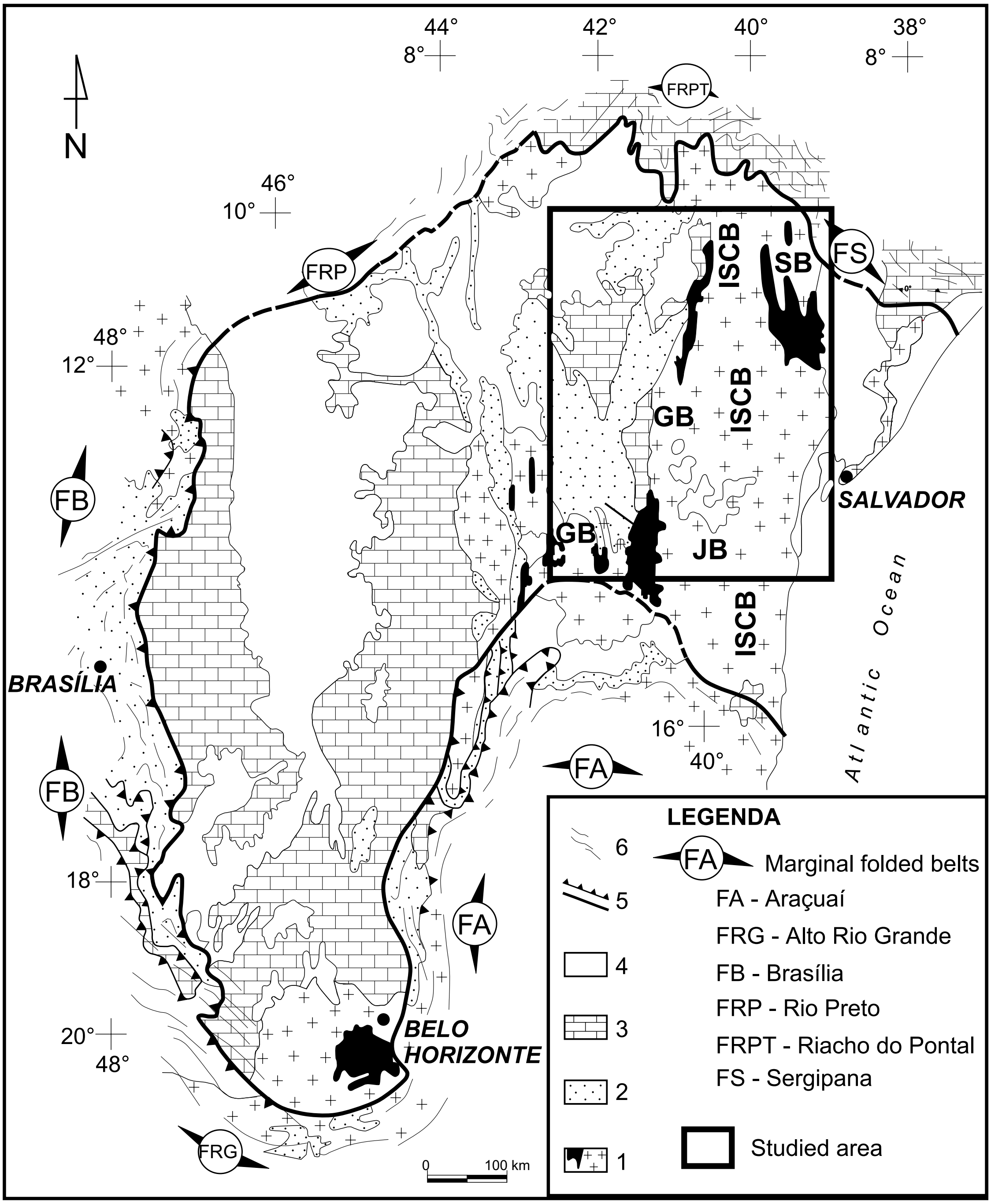


Fig. 1 – Sketch map showing the boundaries and the major structural units of the São Francisco Craton. 1. Archean/Paleoproterozoic basement with greenstone belts sequences (black); 2. Mesoproterozoic units 3. Neoproterozoic units; 4. Phanerozoic covers; 5. Craton limits; 6. Brasilian fold belts; GB. Gavião Block. JB. Jequié Block. SB. Serrinha Block; ISCB. Itabuna-Salvador-Curaçá Belt. This figure shows the studied area. Adapted from Alkmim et al. (1993).

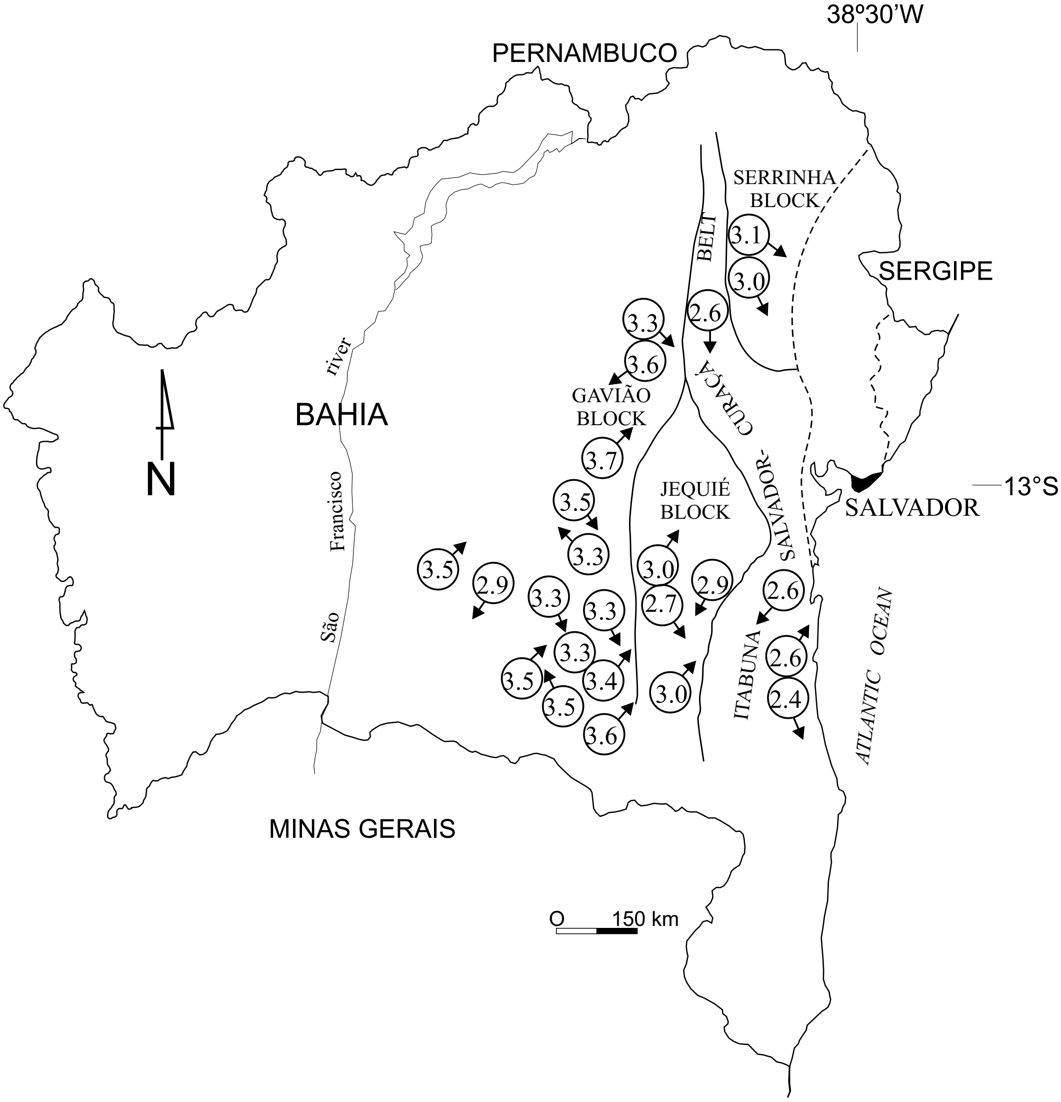


Fig. 2 – Sm-Nd (T_{DM}) ages (Archean and Paleoproterozoic) in Bahia State-Brazil. (Source of data, see tables I-V).

In the Gavião Block (Figs. 2, 4, 5), dated by U-Pb SHRIMP on zircon, two groups of TTG rocks make up the early continental crust metamorphosed in to the amphibolite facies. The first group with age varying between 3.4-3.2 Ga (Sete Voltas/Boa Vista Mata Verde TTGs and Bernarda Tonalite, Tab. I) has been considered, through a geochemical modelling, to originate from the melting of tholeiitic basalts leaving as residues, garnet amphibolites or eclogites. The second group, with ages of 3.2-3.1 Ga. (Serra do Eixo/Mariana/Piripá Granitoids, Tab. I), had similar origin but underwent some crustal contamination (Martin et al. 1991, Marinho 1991, Santos Pinto 1996, Cunha et al. 1996, Bastos Leal 1998). The greenstone belts (Contendas Mirante, Umburanas, Mundo Novo) (Marinho 1991, Mascarenhas and Silva 1994, Cunha et al. 1996, Bastos Leal 1998), were formed in intra-cratonic basins of the early TTG crust, initially with the formation of continental volcanics rocks with age of $\sim$ 3.3Ga (Contendas Acid Sub-Volcanic and Jurema Travessão Tholeiites, Tab. I). These, after ''oceanization'',

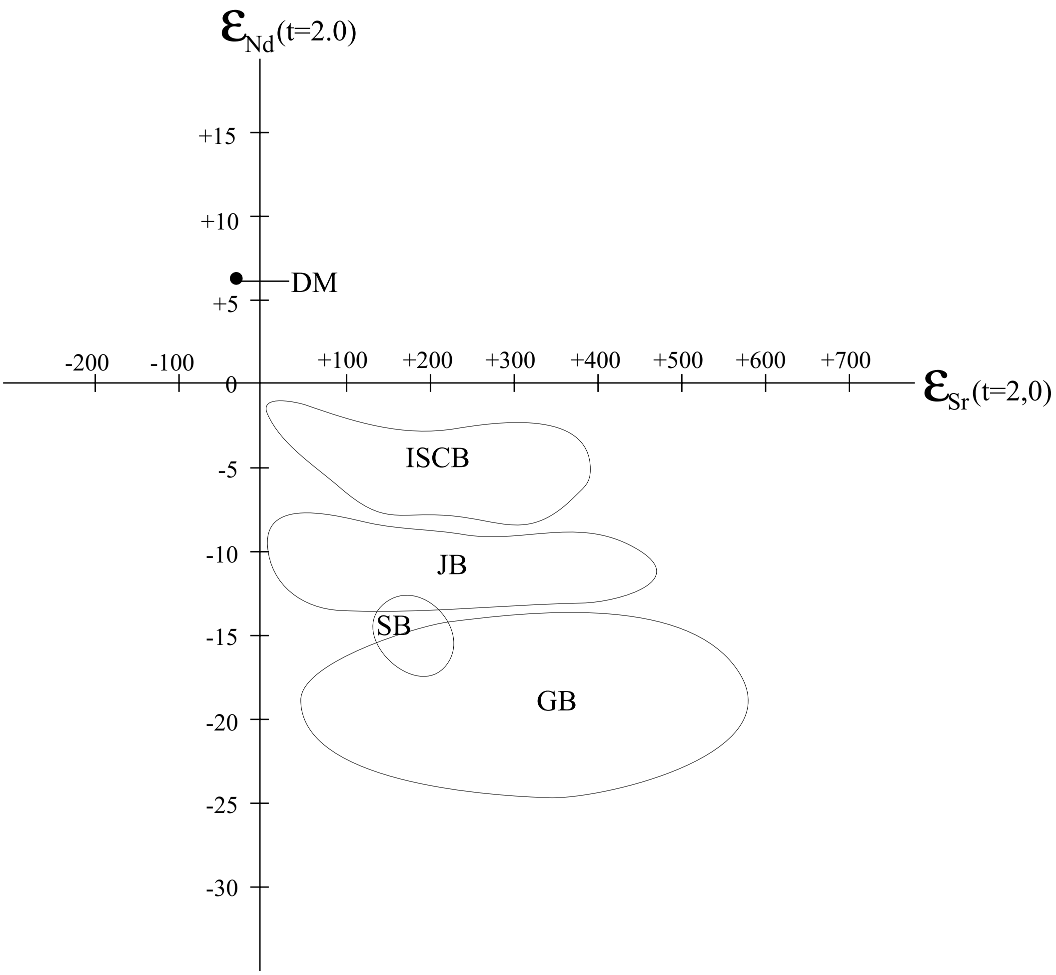


Fig. 3 – $\varepsilon_{\mathrm{Nd}} \times \varepsilon_{\mathrm{Sr}}(t = 2.0\mathrm{Ga})$ diagram showing distinct isotopic fields, related to ISCB (Itabuna-Salvador-Curaçá Belt), JB (Jequié Block), SB (Serrinha Block) and GB (Gavião Block).

have been superposed by basal komatiites, pyroclastic rocks, chemical exhalative sediments and tholeiitic basalts with pillow-lava with age of ~ 3.2Ga (BIF, Tab. I). Detrital sediments overly these supracrustal rocks, and yield minimum age between 3.0-2.8 Ga (Umburanas and Guajerú Detritic Sediments, Tab. I). The amphibolite facies granitic/granodioritic/ migmatitic crust have ages of 2.8-2.7Ga (Malhada de Pedra Granite, Tab. I), and are interpreted as products of partial melting of the TTG suite (Santos Pinto 1996) during the closing of these basins. Calc-alkaline volcanics (~ 2.5Ga), granite intrusions (Pé de Serra Granite, ~ 2.5Ga) and mafic ultramafic intrusions (Jacaré Sill, ~ 2.4Ga), besides phyllites and grewackes, are associated with the Archean greenstone belts (Marinho 1991).

The Itabuna-Salvador-Curaçá Belt (Figs. 2, 4, 5) is composed of at least four tonalite/trondhjemites groups: three Archean, with ~ 2.6Ga and one, Paleoproterozoic (2.1 Ga). (Barbosa and Peucat, in preparation). The Ipiaú and Caraiba tonalites (Tab. II), with ages obtained from zircons, by the Pb-Pb evaporation and U-Pb SHRIMP methods are the examples. (Ledru et al. 1993, Silva et al. 1997, Barbosa and Peucat, in preparation). These tonalites/ trondhjemites are interpreted, mainly on the basis of

TABLE I

Gavião Block. Ages of the Archean main plutonic and supracrustal rocks according to different radiometric methods. Martin et al. (1991) (1), Marinho (1991) (2) Nutman and Cordani (1994) (3), Santos Pinto (1996) (4), Bastos Leal (1998) (5). Asterisks represent SHRIMP data. WR = Whole Rock.

Local		Rb-Sr (Ma)	Pb-Pb WR (Ma)	Pb-Pb Single zircon (Ma)	U-Pb Zircon (Ma)	T_{DM} (Ga)
Sete Voltas TTG (1, 2, 3)	CM	3420 ± 90		3394 ± 5	3378 ± 12*	3.6
Boa Vista / Mata Verde TTG (1,2,3)	CM	3550 ± 67	3381 ± 83		3384 ± 5*	3.5
Bernarda Tonalite(4)	BE			3332 ± 4		3.3
Serra do Eixo Granitoid(4)	SE			3158 ± 5		3.3
Mariana Granitoid(4)	MA			3259 ± 5		3.5
Piripá Gneisses(5)	PI				3200 ± 11*	3.5
Malhada de Pedra Granite(4)	MP	2840 ± 34				3.3
Pé de Serra Granite(2)	PE	2560 ± 110				3.1
Contendas Acid Sub-Volcanic(2)	CM		3011 ± 159		3304 ± 31	3.3
Jurema-Travessão Tholeiites(2)	CM		3010 ± 160			3.3
BIF(2)	CM		3265 ± 21			3.3
Calc-Alkaline Volcanic(2)	CM		2519 ± 16			3.4
Jacaré Sill(2)	CM		2474 ± 72			3.3
Umburanas Detritic Sediments(5)	UM				3335 ± 24* 3040 ± 24*	
Guajeru Detritic Sediments(5)	GU			2861 ± 3 2664 ± 12		

their Rare Earth Elements geochemistry, as resulting of the tholeiitic oceanic crust melting (Barbosa and Peucat, in preparation). The Itabuna-Salvador-Curaçá Belt, also includes charnockite bodies of $\sim$ 2.6Ga age (Caraiba Charnockite, Tab. II) and slivers of intercalated metasediments (quartzites with garnet, Al-Mg gneisses with sapphirine, graphitites and manganiferous formations) and ocean-floor/back-arc gabbros and basalts, originated from mantle sources (Teixeira 1997). All these rocks reequilibrated in the granulite facies during the Paleoproterozoic Transamazonian Cycle, discussed below. Monzonites with an essentially shoshonitic affinity (Barbosa 1990) and with age about 2.4 Ga (Monzonites, Tab. II), according to Pb-Pb evaporation in zircons (Ledru et al. 1993) occur in this Belt as important intrusive bodies. The island-arcs, back-arc basins and subduction zones were the predominant environments during the construction of this Belt (Barbosa 1990, 1997, Figueiredo 1989, Teixeira and Figueiredo 1991). In this phase other tonalite bodies where formed syntectonically, as we will see below.

The Jequié Block (Figs. 2, 4, 5) is characterized by heterogeneous migmatites with supracrustal inclusions that constitute the older sequence at 3.0-2.9 Ga, (Basic Enclaves, Ubaira and Jequié Migmatites, Tab. III) (Marinho 1991, Wilson 1987, Marinho et al. 1994) together with younger granodioritic-granitic at 2.8-2.6 Ga (Maracás, Laje and Mutuipe Granites/Granodiorites, Tab. III) (Alibert and Barbosa 1992). The older rocks are mainly gran-

TABLE II

Itabuna-Salvador-Curaçá Belt. Ages of the Archean main plutonic rocks according to different radiometric methods. Ledru et al. (1993) (6), Silva et al. (1997) (7). Asterisks represent SHRIMP data. WR = Whole Rock.

Local		Pb-Pb Single zircon (Ma)	U-Pb Zircon (Ma)	T_{DM} (Ga)
Ipiaú Tonalite(6)	IP	2634 ± 7		
Caraíba TTG(7)	CB		2695 ± 12*	3.4
Caraíba Chanockite(7)	CB		2634 ± 19*	3.4
Ipiaú Monzonite(6)	IP	2450 ± 1		2.4

ites/granodiorites that form the basement of the rift-type intracratonic basins (Barbosa et al., in preparation), where basalts and andesitic basalts, cherts, banded iron formation, graphitites and kinzigites accumulated (Barbosa 1990). The younger intrusions are granodiorites and granites of high to low Ti that sometimes contain mega-enclaves of the older sequence (Fornari and Barbosa 1994). The Jequié Block rocks have been intensely deformed and reequilibrated into the granulite facies during the Paleoproterozoic Transamazonian Cycle (see below).

The Serrinha Block (Figs. 2, 4, 5) with ca. 2.9-3.0 Ga occurs in the NE of the study area and contains (Gaal et al. 1987, Oliveira et al. 1999, Mello et al. 2000) orthogneisses migmatites and tonalites (Porphiritic Orthogneiss and Rio Capim Tonalite, Tab. IV), which represent the basement of Paleoproterozoic Rio Itapicuru and Capim greenstone belts. These orthogneisses, migmatites and tonalites with gabbroic enclaves are metamorphosed in to amphibolite facies.

THE PALEOPROTEROZOIC COLLISION

The geological evidences coupled with structural, metamorphic and radiometric data suggest a collision of these four crustal segments (Fig. 4), during the Paleoproterozoic Transamazonian Cycle resulting in the formation of a mountain belt with a lenght approximately 600 km, N-S, and a mean width of 150 km, W-E. The traces of this collision are found not only in the structural features, but also by studying the pre-and syntectonic Paleoproterozoic rocks that are intruded into the above mentioned crustal segments, mainly in the Gavião Block (Marinho 1991, Santos Pinto 1996, Bastos Leal 1998, Mougeot 1996) Itabuna - Salvador - Curaçá Belt (Ledru et al. 1997, Oliveira and Lafon 1995, Barbosa and Peucat, in preparation) and Serrinha Block (Silva 1987, Oliveira et al. 1999, Mello et al. 2000) (Fig. 5). Figure 4 sketches the relative position of the four Archean blocks and their movements in the beginning of the Paleoproterozoic. During the sinistral collision, slices of the Jequié Block may have been incorporated in the Itabuna-Salvador Curaçá Belt. Figure 5 shows the final situation of the paleoproterozoic *collage*, indicating the movement of approximation of the blocks, the great trans-thrusts, and the areas where the main paleoproterozoic lithologies have been identified.

In the Gavião Block we can identify: (i) the Jacobina Group (foreland basin) (Ledru et al. 1997) formed by schists, banded iron formations, manganiferous formations, quartzites and metaconglomerates with intrusions of mafic-ultramafic rocks (Mascarenhas et al. 1992), where the siliciclastic metassediments contain detrital zircons with mini-

TABLE III

Jequié Block. Ages of the Archean main plutonic rocks according to different radiometric methods. Marinho (1991) (2), Wilson (1987) (8), Marinho et al. (1994) (9), Alibert & Barbosa (1992) (10). Asterisks represent SHRIMP data. WR = Whole Rock.

Local		Rb-Sr (Ma)	Pb-Pb WR (Ma)	U-Pb Zircon (Ma)	T_{DM} (Ga)
Ubaíra Basic Enclaves(8,9)	UB				3.3
Ubaíra Migmatites(8,9)	UB	2900 ± 24			3.2
Jequié Migmatite(8,9)	JE				2.9
Maracás Granite(2)	MC	2800 ± 12	2660 ± 70		3.2
Laje Granodiorite(10)	LJ			2689 ± 1*	3.0
Mutuípe Granodiorite(10)	MU			2810*	3.0

TABLE IV

Serrinha Block. Ages of the Archean main plutonic rocks according to different radiometric methods. Gaal et al. (1987) (11), Oliveira et al.(1999) (12). WR = Whole Rock.

Local		Rb-Sr (Ma)	Pb-Pb Single zircon (Ma)	U-Pb Zircon (Ma)	T_{DM} (Ga)
Serrinha Porphiritic Orthogneiss(11)	SR			2991 ± 22 3070 ± 3	3.0 3.2
Rio Capim Tonalite(12)	RC	3120	3000 2900 2650		

mum ages ∼ 2.1Ga (Jacobina Conglomerate, Tab. V) (Mougeot 1996) and (ii) the Areião Formation composed of arkoses and sands, that also contain detrital zircons, dated in 2.1 Ga (Detrital Sediments Contendas Mirante, Tab. V) by the U-Pb SHRIMP method (Nutman et al. 1994) (Figs. 5, 6).

In the Itabuna - Salvador - Curaçá Belt, the most important Paleoproterozoic lithologies are: (i) tonalites and trondhjemites, with zircons dated approximately 2.1Ga (Barra do Rocha, Itabuna and Pau Brasil Tonalites and Mairi Quartz-Monzonites, Tab. V), by Pb-Pb evaporation and Pb/Pb whole rock (Ledru et al. 1993, Sabaté et al. 1994, Corrêa Gomes 2000, Barbosa and Peucat, in preparation) and by U-Pb SHRIMP (Silva et al. 1997) (Fig. 5); (ii) Caraiba norites and Medrado gabbros, both with ages slightly older than 2.0 Ga (Oliveira and Lafon 1995) (Tab. V) and containing important ore deposits, the first copper and the second chromium and (iii), syntectonic granites dated at 2.1 Ga (Sabaté et al. 1990) (Fig. 5).

The Rio Itapicuru and Capim Greenstone Belts

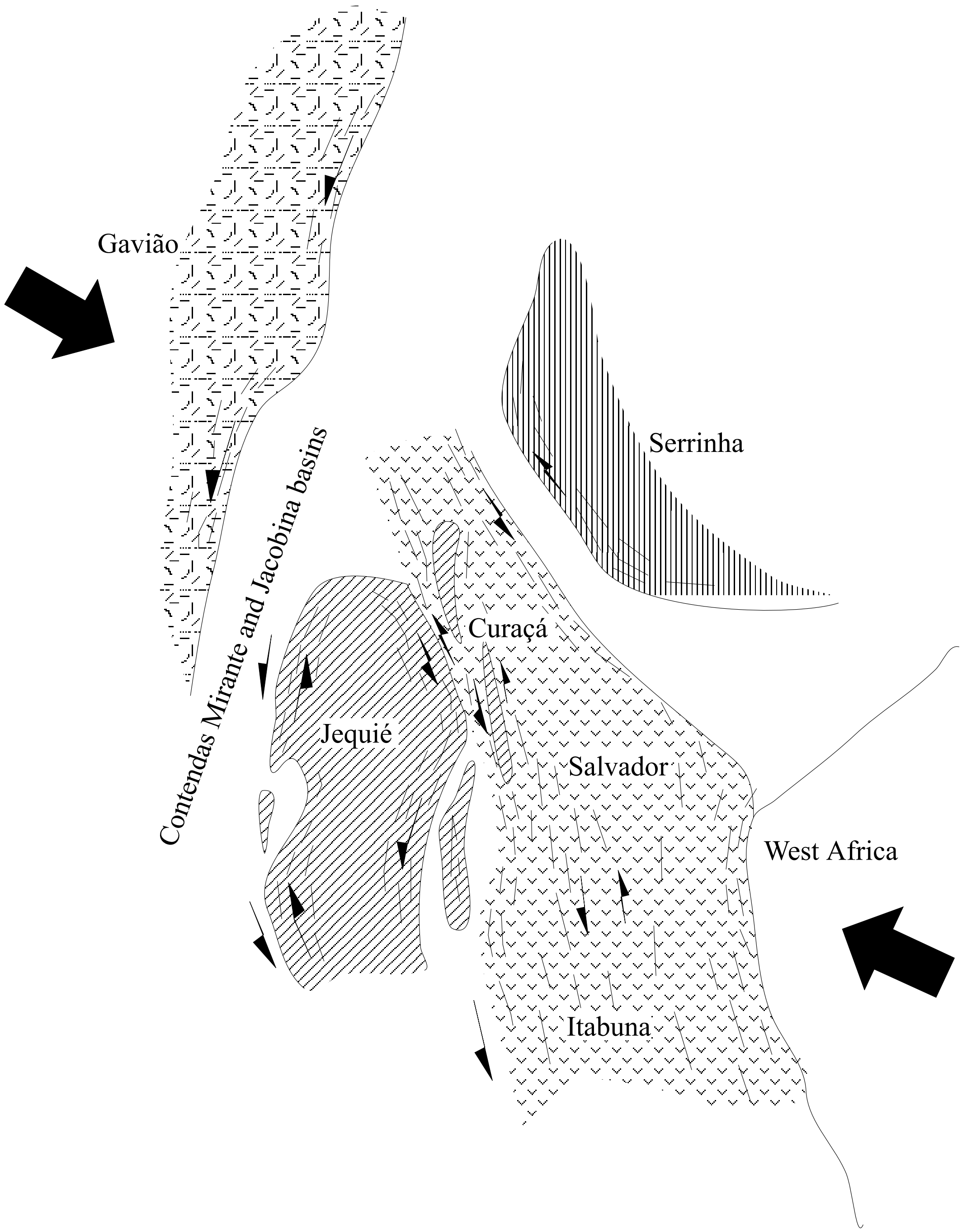
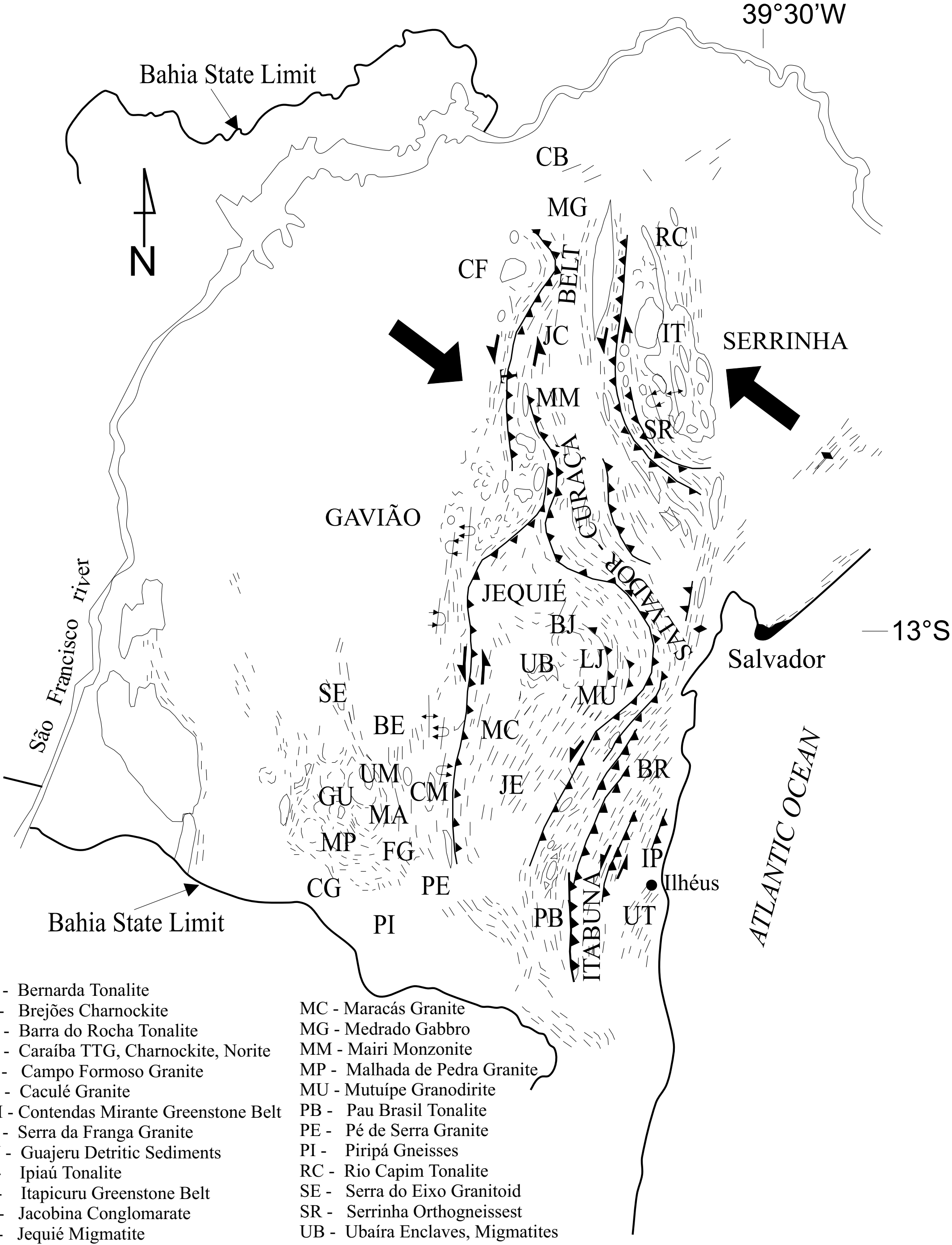


Fig. 4 – Relative position of the Archean blocks prior to Paleoproterozoic collision. The Jacobina Group and the top of the Contendas-Mirante Basin (Areião Formation), both of Paleoproterozoic age, are shown.

(Serrinha Block) formed in back-arc basins (Silva 1987, 1992, 1996, Winge 1984) where: (i) the lower unit of basaltic lava ($\sim$ 2.2Ga) (Itapicuru Basic Volcanics, Tab. V) consists of tholeiitic basalts and mafic tuffs, associated with banded iron formation, cherts, and graphitic phyllites; (ii) the intermediate



BE - Bernarda Tonalite
BJ - Brejões Charnockite
BR - Barra do Rocha Tonalite
CB - Caraíba TTG, Charnockite, Norite
CF - Campo Formoso Granite
CG - Caculé Granite
CM - Contendas Mirante Greenstone Belt
FG - Serra da Franga Granite
GU - Guajeru Detritic Sediments
IP - Ipiaú Tonalite
IT - Itapicuru Greenstone Belt
JC - Jacobina Conglomarate
JE - Jequié Migmatite
LJ - Laje Granodiorite
MA - Mariana Granitoid
MC - Maracás Granite
MG - Medrado Gabbro
MM - Mairi Monzonite
MP - Malhada de Pedra Granite
MU - Mutuípe Granodirite
PB - Pau Brasil Tonalite
PE - Pé de Serra Granite
PI - Piripá Gneisses
RC - Rio Capim Tonalite
SE - Serra do Eixo Granitoid
SR - Serrinha Orthogneissest
UB - Ubaíra Enclaves, Migmatites
UM - Umburanas Greenstone Belt
UT - Itabuna Tonalite

Fig. 5 – Display of the Archean blocks after the Transamazonian collision. The structural data show a global sinistral sense movement. Also show are the locations of radiometric age determinations listed in tables I-V.

unit is formed mainly by felsic rocks (2.1Ga) (Itapicurú Felsic Volcanics, Tab. V), with its composition varying from andesites to calcalkaline dacites; (iii) the upper unit is composed of thick packages of psefites, psamites and pelites. These Paleoproterozoic greenstone belts are different from the Archean greenstone belts of the Gavião Block mainly because they lack significant komatiitic volcanic rocks.

The Paleoproterozoic collision occurred with the movement of the four blocks in the NW-SE sense, identified by the presence of large thrusts and generally sinistral transcurrent zones as the kinematics of the late ductile shear zones demonstrate (Fig. 5).

In NE, the convergence of the Serrinha Block towards the Gavião Block promoted an important crustal shortening, along an axis identified by a radial vergence of the granulites, in the north of the Itabuna-Salvador-Curaçá Belt. This belt continues towards the western part of Gabon, Africa (Ledru et al. 1993). Figure 6 sketches two sections where they show the collision between the Gavião and Serrinha Blocks, which culminated with the divergence of the rocks (positive flower). The Itabuna-Salvador-Curaçá Block was squeezed between them.

In SSE-SSW, during the initial steps of this collision, at about 2.4 Ga (Ledru et al. 1993), a frontal ramp with tangential tectonic vergence resulted in the obduction of the Itabuna-Salvador-Curaçá Belt upon the Jequie Block and thereafter onto the Gavião Block. In the upper part of Figure 7 one can visualize the formation of the upper siliciclastic unities of the Contendas-Mirante and Umburanas Greenstone Belts. This formation happened during the collision between the Jequié and Gavião Blocks. The lower part of the same figure shows the final disposition of the blocks with the vergence of the rocks to the west. In these areas, the obduction of the Itabuna-Salvador-Curaçá Belt over the Jequié Block transformed the Jequié rocks, from the amphibolite to the granulite facies. Recumbent folds with vergence to the west, coaxially refolded and exhibiting isoclinal shapes, are found sometimes in these high-grade metamorphic terrains, testifying to the style of the ductile deformations.

The Transamazonic high grade metamorphism possesses average pressures of 7 kbar and temperatures of about 850°C, with its peak occuring at about 2.0 Ga (Barbosa 1990, 1997). It is considered to originate from the crust at thickening related to the tectonic superposition of blocks during the collision (Figs. 6, 7). During the uplift phase, tectonic ramps with thrusts sliced up the original zonation of metamorphic grades allowing the placement of the megablocks of granulitic rocks, over rocks of the amphibolite and greenschist facies (Fig. 6) (Barbosa 1997). The presence of reaction coronas showing destruction of garnet-quartz or garnet-cordierite, and production of simplectites of orthopyroxene-plagioclase, in the high degree gneisses, both in the SSE, SSW, and NE, has been interpreted as an indication of pressure release. This fact reinforces the presence of these collision processes and of great thrusts, that brought blocks of rocks from deep zones to the more superficial parts of the crust. PTt diagrams elaborated for these metamorphites show a trajectory of the metamorphism of the clockwise type, consistent with the proposed collisional context (Barbosa 1990, 1997) (Figs. 6, 7).

It is worthwhile noting the late charnockitic and granitic intrusions that cross-cut the tectonic stack of older rocks (Figs. 6, 7). Charnockitic bodies with ages of about 2.0 Ga (Barbosa et al. in preparation) (Brejões Charnockites, Tab. V) intruded the northern part of the Jequié Block. In all the other blocks, granitic bodies are intruded in general with peraluminous characteristics, sometimes enriched in biotite and sometimes in muscovite, with a composition close to the minimum ternary and with negative values of $\varepsilon_{\mathrm{Nd}}(t)$, (–13 a –5). The geochemical and isotopic characteristics of these later intrusions supports the hypothesis that they were produced predominantly by crustal melting (Sabaté et al. 1990). With a major concentration in the NE of Bahia, these granites exhibit, in general, Pb/Pb ages of about 2.0 Ga (Caculé, Serra da Franga, Poço Grande, Ambró-

TABLE V

Gavião, Jequié and Serrinha blocks and Itabuna-Salvador-Curaçá Belt. Ages of the Archean main plutonic and supracrustal rocks according to different radiometric methods. Gaal et al. (1987) (11), Ledru et al. (1993) (6), Santos Pinto (1996) (4), Bastos Leal (1998) (5), Nutman et al. 1994 (13), Mougeot (1996) (14), Silva (1987) (15), Barbosa et al., in preparation (16), Oliveira and Lafon (1995) (17), Corrêa Gomes (2000) (18). Asterisks represent SHRIMP geochronological data. WR = Whole Rock.

Local		Rb-Sr (Ma)	Pb-Pb WR (Ma)	Pb-Pb Single zircon (Ma)	U-Pb Zircon (Ma)	T_{DM} (Ga)
Caculé Granite(4)	CG			2015 ± 27		2.6
Serra da Franga Granite(4)	FG			2039 ± 11		
Campo Formoso Granite(14)	CF	1969 ± 29				2.6
Contendas Mirante Detritic Sediments(13)	CM				2168 ± 18*	
Jacobina Conglomerate(14)	JC			3353 ± 11 2086 ± 43		
Itapicuru Basic Volcanic(15)	IT		2209 ± 60			2.2
Itapicuru Felsic Volcanic(15)	IT	2080 ± 90	2109 ± 80			2.1
Poço Grande Granite(5)	IT				2070 ± 47	
Ambrósio Granite(11)	IT				2000	2.1
Barra do Rocha Tonalite(6)	BR			2092 ± 13		
Itabuna Tonalite (16)	UT		2130			2.6
Pau Brasil Tonalite(18)	PB			2089 ± 4		
Caraíba Norite(17)	CB				2051	2.8
Mairi Quartz-Monzonite(17)	MM				2126 ± 19	
Medrado Gabbro(17)	MG				2059	2.9
Brejões Charnockite(16)	BJ			2026 ± 4		

sio and Campo Formoso Granites, Tab. V) (Santos Pinto 1996, Bastos Leal 1998, Gaal et al. 1987, Mougeot et al. 1996). Therefore they can be originated from the melt of hydrated rocks of the amphibolite facies, tectonically placed under rocks of the granulite facies as mentioned before.

Late deformation has formed retrograde shear zones in the Archean blocks. It is assumed that alkaline syenitic bodies (Itiuba, São Felix), with minimum ages of 1.9 Ga in general, have been emplaced in to these zones (Conceição 1993). The syenites intruded the granulites after these rocks reached the amphibolite facies crustal environment (Figs. 6, 7).

FINAL COMMENTS

Figure 8 shows the evolutive steps of the São Francisco Craton basement, main subject of the present paper.

In spite of achieving a reasonable explanation about the general evolution of the metamorphic terrains under consideration, great difficulties still remain when one tries to precise the physical and temporal limits between the Archean and Paleoproterozoic rocks.

Therefore, with our present knowledge it can be concluded that the Archean and Paleoproterozoic condition took place between ∼ 3.4Ga to about

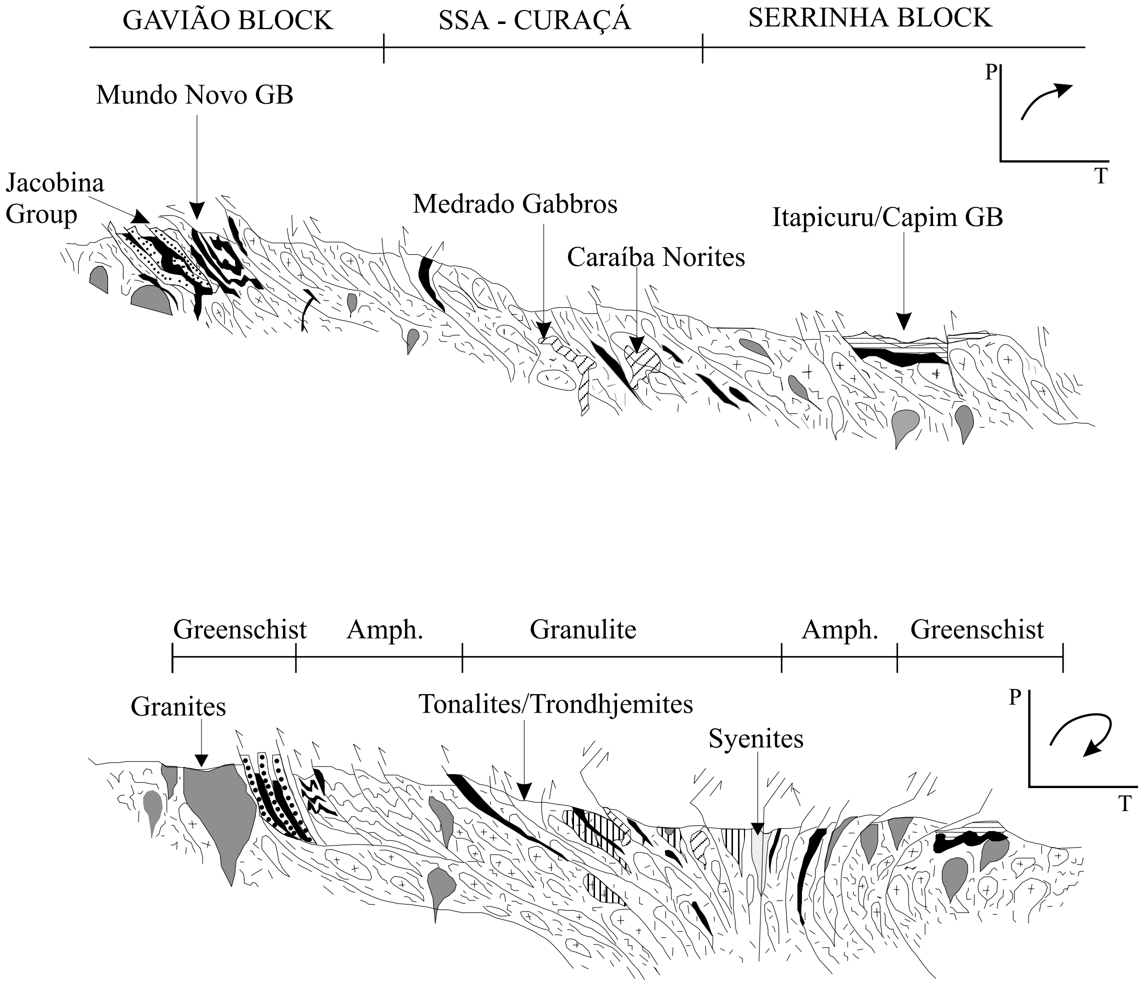


Fig. 6 – E-W sections in NE São Francisco Craton, which show only the Paleoproterozoic age rocks (see text for details). (a) intermediate Transamazonian collision stage with formation of Itapicuru and Capim Greenstone Belts and the basement thrusting over the Jacobina Group. The Caraíba and Medrado mafic-ultramafic intrusions and the syn-tectonic granites are related to this stage. (b) At the ultimate stage of the mountain building, syenite and post-tectonic granites have been intruded. Presently, in the western and eastern parts the superposition of granulitic terrains over the amphibolite and greenschist terrains can be seen. On the right-hand side of each cartoon, PTt diagrams are shown. The clockwise sense for the metamorphic path attests to the collisional context. GB = Greenstone Belt.

$\sim$ 1.9Ga. However, we should emphasize that only between the ages of 2.4/2.3 and $\sim$ 1.9Ga we can identify with more certainty the complete record of rock formation, tectonism, metamorphism, intrusion, and erosion/exhumation that can lead to the characterization of a geotectonic cycle. This so-called Transamazonian Geotectonic Cycle had its apex about 2.1/2.0 Ga according to the radiometric data, and it was of such a strong intensity, that it practically overprinted any evidence of the previous deformation and metamorphism.

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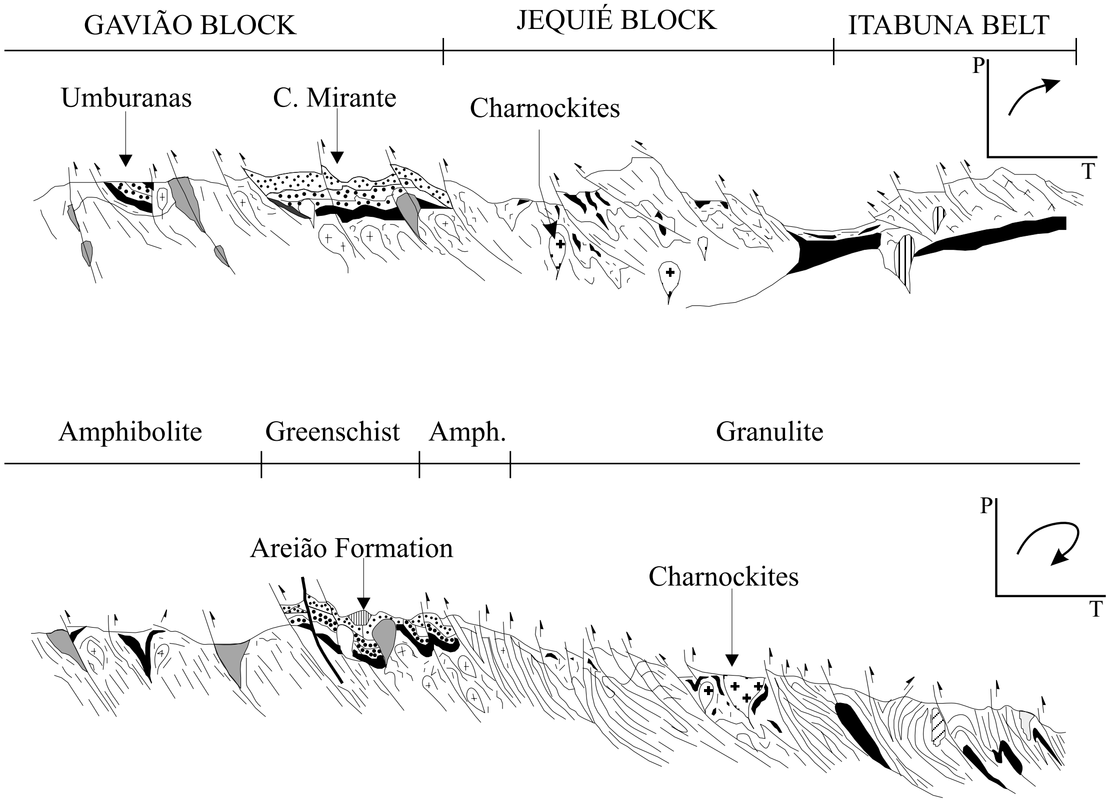

Fig. 7 – E-W sections in SSE-SSW São Francisco Craton which show only the Paleoproterozoic age rocks (see text for details). (a) intermediate Transamazonian collision stage with the last siliciclastic sediment deposition in the Umburanas and Contendas Mirante Greenstone Belts, and the onset of charnockite production in Brejões region. (b) Present situation with Itabuna Belt (granulites), obduction over the Jequié Block and this one over the Gavião Block (amphibolite and greenschist metamorphic rocks). On the right-hand side of each cartoon, PTt diagrams are shown related to the study of the aluminum-magnesian gneisses.

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RESUMO

Pesquisas recentes, geológicas, geocronológicas e isotópicas identificaram quatro importantes segmentos crustais arqueanos no embasamento do Craton do São Francisco na Bahia. O mais antigo, Bloco do Gavião, ocorre na parte WSW, no qual têm sido identificadas rochas de composição essencialmente granítica, granodiorítica e migmatítica incluindo remanescentes de TTGs, considerados como representantes das rochas mais antigas do continente sul americano ($\sim 3,4$Ga) os quais estão associados a seqüências de grenstone belts arqueanos. Ao longo da costa atlântica, da parte SE passando por Salvador e seguindo em direção ao NE está exposto o segmento mais jovem, denominado de Cinturão Itabuna-Salvador-Curaçá. Este é composto essencialmente de tonalitos/trondhjemitos incluindo faixas de metassedimentos e basaltos/gabros de fundo oceânico e/ou bacias back-arc. Na parte SE-SSW da área aflora o Bloco de Jequié sendo caracterizado por migmatitos arqueanos com inclusões de supracrustais além de intrusões multiplas charnockíticas. No NE, ocorre o Bloco Serrinha composto de ortognaisses e migmatitos que representam o embasamento de seqüências de greenstone belts de idade paleoproterozóica. Durante o Ciclo Geotectônico Transamazônico estes quatro segmentos crustais colidiram resultando na formação de importante cadeia de montanhas. O metamorfismo regional resultante do espessamento crustal, que foi asso-

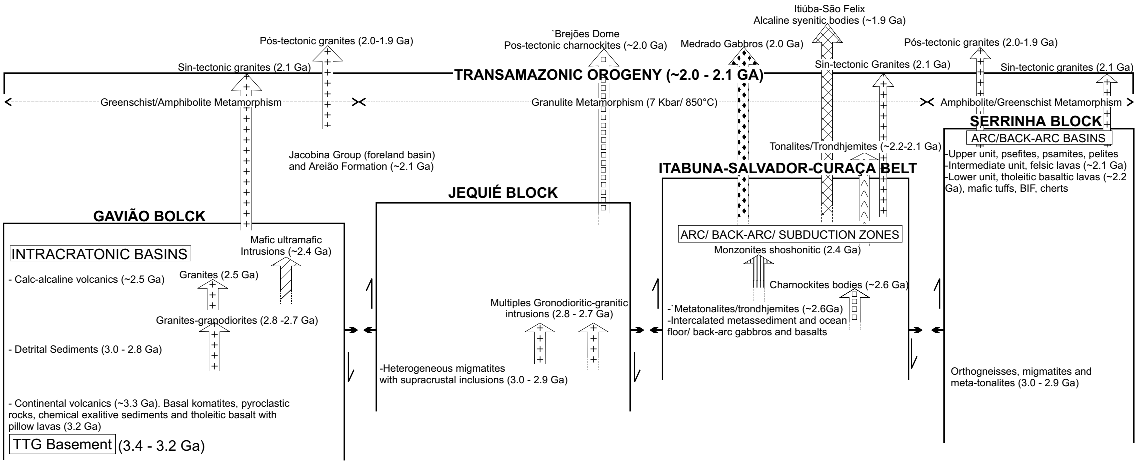

Fig. 8 – Summary of the main evolutive steps Archean and Paleoproterozoic of the São Francisco Craton basement in Bahia. The thick arrows with the simbols shows the main intrusive plutonic rocks and the thin arrows shows the block collision in the sinistral sense.

ciado aos processos colisionais está datado em cerca de 2.0 Ga.

Palavras-chave: pesquisas geológicas, geocronológicas e isotópicas; segmentos arqueanos; colisão paleoproterozóica.

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