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## Geological and structural markers of the eastern Borborema Province based on a geotranssect covering the Paraíba, Pernambuco, Alagoas and Sergipe states, northeastern Brazil

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### Abstract

This study comprises a field investigation of a NE-SW geological transect along the Eastern Borborema Province in NE Brazil. The transect covered distinct geological domains that differ in a number of aspects, being bounded by shear zones. The oldest rocks are found in the Alto Moxotó and part of the Rio Capibaribe terranes in the Transversal Zone Domain as well as in the Belém do São Francisco Complex and Simão Dias Dome in the Sergipano Fold Belt. Early to late Neoproterozoic units are found in all domains, but are strongly restricted within the Alto Moxotó Terrane that is characterized by the oldest tectonic fabric (Dn). Dn+1 markers are mostly observed on the Sergipano Fold Belt, thrusting Neoproterozoic supracrustal rocks towards the São Francisco Craton, evidence an ancient active continental margin. Later strike-slip markers represent the Dn+2 phase and are materialized on the E-W Pernambuco Lineament and the Congo-Cruzeiro do Nordeste Shear Zone that separates the Rio Capibaribe and Alto Moxotó terranes of the Transversal Zone Domain. Lastly, Dn+3 is related to brittle structures such as joints, shear fractures, and veins as well as post-kinematic pegmatite filling-up, that cross-cut all of the studied units, being also attributed to reactivation of the older structures during the Cambrian.

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### 1. Introduction

The South American Platform corresponds to a strongly reworked piece of the continental lithosphere that has been growing and recycled since the early Precambrian. Among the major tectonic provinces defined by the classical work of Almeida et al. (1981), several regional studies have aimed to discuss the evolution of the Borborema Province on the light of the vast possible tectonic settings (e.g. Santos 1995; Brito Neves et al. 2000; Van Schmus et al. 1995; Santos et al. 2010; Neves et al. 2005; Caxito et al. 2020). Concerning its significance in a Western Gondwana context, it has been proposed that accretion and collision tectonics took place, mainly during the Neoproterozoic-Cambrian Brasiliano-Pan African Orogeny (650-500 Ma; Brito Neves et al. 2000 and references therein). Also, a context of intracratonic orogenesis has been proposed, mostly based on whole-rock geochemistry of basement rocks and intrusive granites that

are widespread throughout the province (Neves et al. 2006, 2009, 2020). Early orogenic events within the province are attributed to the controversial Cariris Velhos event (ca. 0.96-0.92 Ga; Santos et al. 2010; Caxito et al. 2020) and Paleoproterozoic convergent episodes (ca. 2.4-2.0 Ga; e.g. Neves et al. 2015; Santos et al. 2015). These events have been defined in a wider context based on compilation studies involving geological mapping from the Brazilian Geological Survey, airborne geophysical surveys, detailed structural analysis and the recent increase of geochemical and isotopic investigations on basement units, supracrustal sequences, intrusive plutonic suites and high-pressure to ultra-high-pressure sequences (e.g. Gomes et al. 2001; Santos et al. 2004, 2010; 2017a, 2017b; Ganade de Araújo et al. 2014a; Caxito et al. 2020, Oliveira and Medeiros 2018). During 2013-2015, several fieldwork campaigns covered a NE-SW 500 km-long geological transect with the intention to describe in detail the units that crop out in the eastern



portion of the Borborema Province, between the states of Paraíba and Sergipe. This investigation was supported by the GEOTERM-Project in cooperation between the Petróleo Brasileiro S.A. (PETROBRAS) and the Universidade Federal da Bahia aiming to support geophysical studies in the Precambrian basement and adjacent Phanerozoic marginal basins in NE Brazil. Although the main goal of this project was dedicated to petroleum prospection, it was an opportunity to work on the basement units, and once that the collected data was only presented in internal reports; this contribution intends to publicize the transection results to a broader audience. Thus, this article proposes to interpret a series of geological structures located in different terranes or tectonic domains of the Borborema Province that are adjacent to the coastal basins.

## 2. Geological setting

The proposed geological transect covers the Alto Moxotó, Rio Capibaribe, and Pernambuco Alagoas terranes as well as the Sergipano Fold Belt of the Borborema Province. This province is located in the NE portion of the South-American Platform, covering an area of approximately 450.000 km<sup>2</sup> (Brito Neves 1975; Almeida et al. 1981). It was formed via convergent episodes of the Brasiliano-Pan African orogeny during the assembly of Western Gondwana (Fig.1, Brito Neves et al. 2000). Its complex stratigraphy encompasses Paleoproterozoic basement units with some Archean nuclei, early to late Neoproterozoic supracrustal metasedimentary and metavolcano-sedimentary sequences as well as a wide occurrence of plutonic and volcanic rocks that are interpreted as remnants of Ediacaran magmatic arcs (Fetter et al. 2003; Arthaud et al. 2008; Brito Neves 2011; Oliveira et al. 2010; Dantas et al. 2013; Caxito et al. 2014a, 2014b; Sial and Ferreira, 2015). Several proposals were introduced in an attempt to divide the Borborema Province into major domains. Most of them are based on the complex network of shear zones that are mostly E-W and NE-SW direction, as presented by Brito Neves et al. (2000): Médio Coreau, Ceará Central, Rio Grande do Norte, Transversal, and Southern (Fig.1). Such domains are interpreted as part of a major orogenic system that continues to the West African Continent (Santos et al., 2017b; Ganade de Araújo et al. 2014a, 2014b). The Transversal Zone Domain is limited by major dextral E-W lineaments, named Pernambuco to the South and Patos to the north, that are connected to NE-SW sinistral shear zones (Van Schmus et al. 1995; Santos and Medeiros, 1999). According to these authors, five tectonostratigraphic terranes are displayed from west to east in São José do Caiano, Piancó-Alto Brigida, Alto Moxotó, Alto Pajeú, and Rio Capibaribe. The Alto Moxotó Terrane comprise the oldest rocks within the Transversal Zone Domain, being referred to by several authors as an early to late Paleoproterozoic basement inlier, formed by several arc-accretion episodes between 2.2.-2.0 Ga (Santos et al. 2015). The oldest rocks correspond to TTG and Sanukitoid crustal segments (Santos et al. 2017b), whereas the dominant sequences are a series of tonalitic to granodioritic orthogneisses that are interleaved with metamafic-metaultramafic rocks submitted to high-grade metamorphism (Santos et al. 2012, 2015, 2013). Within-plate magmatism represents the last important event

within the terrane which is aged at ca. 1.6 Ga (Lages et al. 2019). The main supracrustal unit of the terrane is the Sertânia Complex, which is composed of garnet-biotite schist interleaved with metavolcanic mafic rocks and marble lenses and migmatites as well, considered as Paleoproterozoic by Santos et al. (2004), whereas detrital zircon data published by Neves et al. (2017) points out to an Ediacaran maximum deposition age. The Rio Capibaribe Terrane comprises Rhyacian-Orosirian basement units that were intruded by anorogenic Mesoproterozoic units, such as the A-type Taquaritinga orthogneiss and the Gabbro-Anorthositic Passira Complex (Gomes et al. 2001; Brito Neves et al. 2013; Accioly 2000; Accioly et al. 2005). Two supracrustal sequences are recognized. The Vertentes Complex including metavolcano-sedimentary and metaplutonic rocks, which are interleaved with amphibolites, being Paleoproterozoic in age (Neves et al. 2009) and the Surubim-Carolina Complex, interpreted as an Ediacaran QPC (quartzite-pelite-carbonate) sequence. Recently a metavolcano-sedimentary sequence has been described; being dated at ca. 960 Ma (Santos et al. 2012), but much more geochronological data is needed. Unlike the Alto Moxotó Terrane, late Ediacaran magmatism produced large plutonic expositions, such as the Caruaru-Arcverde Batholith that has a major calc-alkaline character and which is coherent with the peak of granitic magmatism in the region (e.g. Lima et al. 2015). The region located southwest of the Pernambuco Lineament is the Southern Domain of the Borborema Province. In the proposed geological transect, rocks from the Pernambuco-Alagoas Terrane and Sergipano Fold Belt were investigated. The former encompasses Paleoproterozoic gneissic-migmatitic complexes that are covered by a series of metavolcano-sedimentary supracrustal sequences and intruded by vast Ediacaran granitic bodies (Brito Neves and Silva Filho 2019). In a very simplified point of view, the main regional units are the Belém do São Francisco Complex, which comprises most of the gneissic-migmatitic basement as well as the Cabrobró Complex, hosting variable schists, paragneisses, amphibolites, marble and quartzites (Gomes et al. 2001; Silva Filho et al. 2016). The southern boundary of this terrane with the Sergipano Fold Belt is not clearly defined, but the Belo Monte Jeremoabo thrust-system has been attributed as a transpressional boundary (Brito Neves et al. 2000; Lima et al. 2017, 2018). The supracrustal rocks of the Cabrobró Complex are assumed to be deposited during the Cariris Velhos orogeny (Cruz et al. 2014a); whereas gneisses related to the Belém do São Francisco Complex are mostly Paleoproterozoic (Silva Filho and Torres 2002, Cruz et al. 2014b). Lastly, the Sergipano Fold Belt is considered one of the major marginal orogenic belts of the São Francisco Craton (Oliveira et al. 2017). It is characterized by five lithotectonic domains bounded by transpressional shear zones and grouped as Canindé, Poço Redondo-Marancó, Macururé, Vaza Barris, and Estância (Davison and Santos 1989; Carvalho 2005; Oliveira et al. 2010). Besides the abundance of granitic rocks related to the Cariris Velhos (960-920 Ma) and Brasiliano (650-500 Ma) events (Carvalho 2005), three Archean to Paleoproterozoic gneissic migmatitic domes outcrops, being interpreted as basement inliers, named as Itabaiana, Simão Dias and Jirau do Ponciano (Oliveira et al. 2010; Lima et al. 2019).

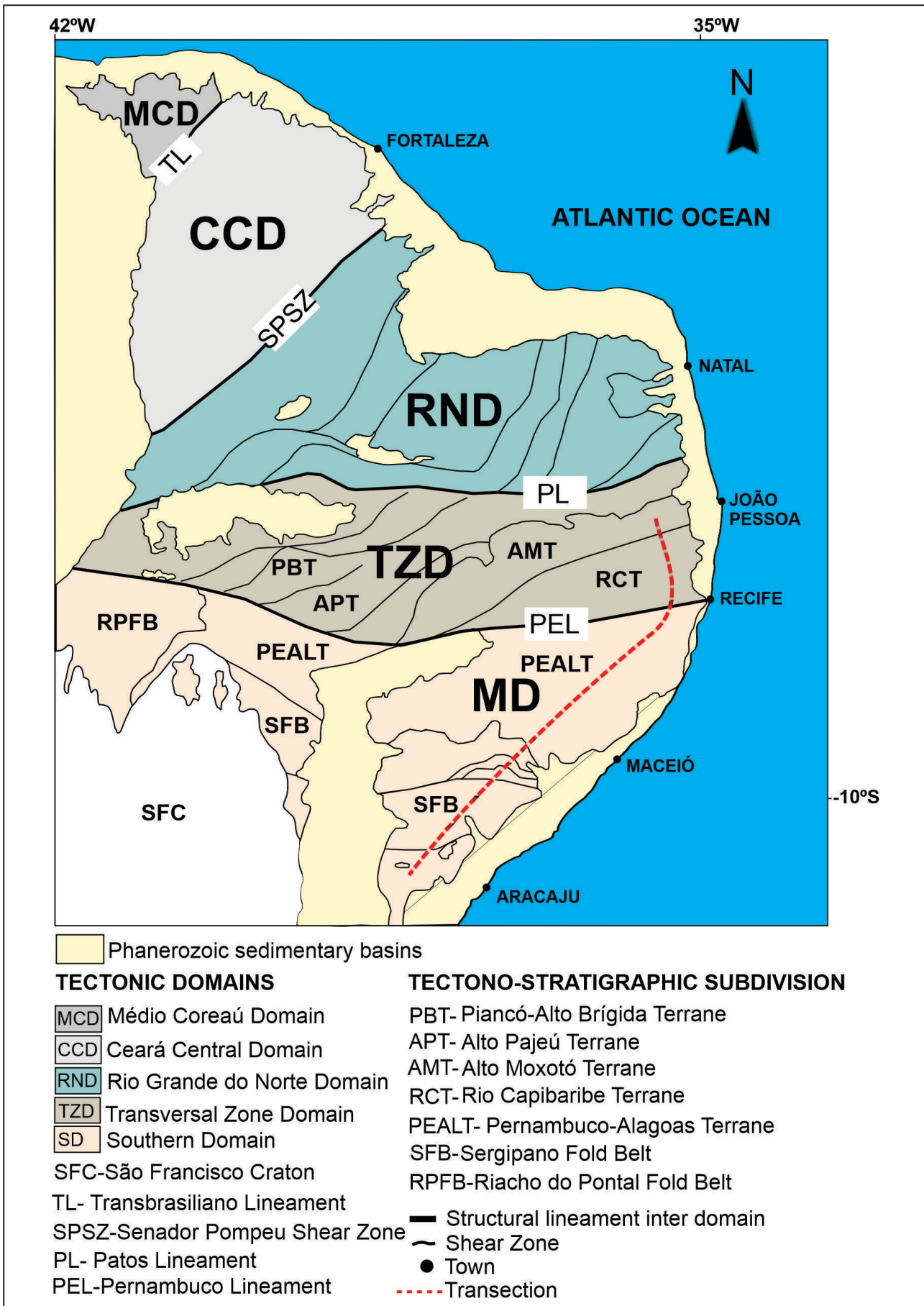


FIGURE 1. Tectonic framework of the Borborema Province showing its major internal domains as well as the geological transect described in this paper. The figure model is according to Brito Neves et al. (2000).

### 3. Results and discussion

#### 3.1. Mapped Units

The geological transect covered the Alto Moxotó (AMT), Rio Capibaribe (RCT), Pernambuco-Alagoas (PEALT) terranes as well as the Sergipano Fold Belt. For didactical purposes, it has been divided in three segments/profiles: 1) A-B comprehending the AMT, RCT and the northern portion of the PEALT, 2) B-C covered the central and southern portion of the PEALT and the SFB, whereas 3) C-D covered the southern SFB including the Itabaiana Dome (Figs.2 and 3). On the eastern Alto Moxotó Terrane, two major geological units stand out. The Floresta Complex was dated at 2.15 Ga by Santos et al. (2017a) and comprises banded orthogneisses with complex migmatitic fabric (Fig. 4a), including folded, *schlieren*, and *schöllen* types. The Sertânia Complex covers a restricted area in the transect occurring as metapelites and metapsamites rich in coarse-grained garnet and tiny biotite lamellae along the schistosity planes that also host centimetric amphibolitic layers. This set is bounded with the units of the Rio Capibaribe Terrane by the strike-slip Congo-Cruzeiro do Nordeste sinistral shear zone in sharp contacts with orthogneisses of the Salgadinho Complex (Paleoproterozoic tonalitic and granodioritic orthogneisses interleaved with metamafic dykes; Brito Neves et al. 2013). This Complex is overlaid by biotite-muscovite schists, garnet-biotite paragneisses, muscovite-bearing marble lenses as well as metavolcanic mafic rocks grouped in the Surubim-Caroalina Complex, which are aged at  $623 \pm 6$ Ma (Neves et al. 2009). The metavolcanic members occur as concordant lenses within the regional tectonics and show evidence of late hydrothermal albitization (Fig. 4b). In addition, gabbro and anorthosite occur as intrusive bodies on the gneisses of the Salgadinho Complex as well as strongly altered ultramafic rocks in which the primary minerals are partially or totally replaced by epidote and actinolite as evidence of greenschist facies metamorphism. On the northern portion of the Pernambuco-Alagoas Terrane close to the mylonitic rocks of the Pernambuco Lineament, i.e. boundary with the Transversal Zone Domain, basement rocks are associated to the Belém do São Francisco Complex occurs interleaved with supracrustal sequences attributed to the Cabrobó Complex. The first is identified by the presence of metaleucogranites, granitic orthogneisses, and locally migmatites with *schlieren* and phlebitic structures, also presenting major K-rich mineral enrichment such as microcline as compared with the previous described migmatites. On the other hand, the Cabrobó Complex consists of metarhytmities (Fig. 4c), metarkose, greywacke, biotite schists, and quartzites. However, it mostly crops out as a thick soil cover, enriched in quartz and potassic feldspar due to the intense weathering of the region. A remarkable feature of the PEALT in the study area is the exposition of a number of batholiths related to the Brasiliano Orogeny, marking higher topography when compared to the neighboring terranes. They were grouped in five facies: i) monzonites and monzodiorite with equigranular texture and sub-rounded diorite enclaves, ii) porphyritic monzogranite and granodiorite; iii) coarse-grained leucosyenite, iv) garnet-bearing leucogranite and v) granites with incipient deformation on their rims as well as magmatic foliation and ellipsoidal diorite enclaves (Figs. 4d and 4e). Several indications of mixing and coexistence of magmas were observed, which

reflects the magmatic history of the region. The boundary of the PEALT with the Sergipano Fold Belt to the south is marked by a series of thrust shear zones. In the northern portion of the area, the Sergipano Fold Belt comprises two major complexes: Arapiraca and Araticum. The former comprises biotite-garnet paragneisses, biotite schists and folded para-derived migmatites as well as calc-silicate rocks, amphibolite, massive marble lenses and leucogranite sheets (two mica-bearing). This unit is bounded to the north with Cabrobó Complex along the Palmeira dos Índios thrust shear zone and to the south by the Belo Monte-Jeremoabo shear zone with Macururé Group, comprising muscovite-biotite-garnet schists interleaved with slightly foliated amphibolites or metagabbros. On the other hand, the Araticum complex is in contact to the north with granitic intrusions of PEALT along Jacaré dos Homens Shear Zone and with the Arapiraca Complex to the east by the Belo Monte-Jeremoabo Shear Zone (Lima et al. 2018). This complex involves garnet-biotite-paragneisses and sillimanite schists, marble, diopside-bearing calc-silicate rocks, felsic to intermediate metavolcanic rocks which are typical associations of high-temperature metamorphism. The amphibolites are divided into three groups: i) common amphibolites with abundant hornblende; ii) diopside-bearing amphibolites with less common hornblende and iii) garnet-bearing amphibolites. The marble and calc-silicate rocks are exposed as small lenses concordant with regional planar structures related to regional thrust tectonics. Nearby to the Macururé Group occurs the Nicolau-Campo Grande metavolcano-sedimentary sequence that corresponds to the supracrustal part of Jirau do Ponciano Dome (Lima et al. 2019). This unit is composed by chlorite schists, sillimanite-biotite paragneiss and metavolcanic rocks lenses that dip to NNW. Metaconglomerates occur interleaved with phyllites and metalimestone representing the basal units of Miaba Group, Vaza Barris Domain, which are overlaid by low-grade to anquim metamorphic members include meta-arenites, limestones, greywacke, silty phyllites (Fig. 4f) and poorly exposed metavolcanic rocks.

The basal unit of the Miaba Group presents a typical petro-tectonic association of a carbonate platform developed on a continental margin as previously proposed by (D'El-Rey Silva 1999). This sequence lies unconformably over the basement gneisses, being interpreted as derived from the erosion of fold belts deposited in the foreland basin. The last important units mapped on this research comprise gneissic and migmatitic rocks of the Itabaiana and Simão Dias Domes, that present variable migmatitic members including metatexites and diatexites that present deformation markers not related to the thrust tectonics imposed on the metasedimentary rocks of the Macururé Group.

#### 3.2. Structural geology

The main observed structures along the transection correspond to the regional shear zones that are generally attributed to the domain or terrane boundaries. The main trend is mostly NE-SW, which is the result of the superimposed ductile deformation of the Brasiliano Orogeny. Also, for didactical purposes, the main deformation events were grouped in Dn, Dn+1, Dn+2, Dn+3, and the main characteristics of each is summarized in Table 1, as well as in the geological cross-sections presented on Fig. 3. The Dn event is the oldest and the most difficult to recognize and structurally analyze, being

identified mainly in Paleoproterozoic granodioritic gneiss of the Floresta and Sertânia Complexes, as well as on the Jirau do Ponciano Dome. This deformation phase can be considered as pre-kinematic with reference to the Brasiliano orogeny stages, but it records high-grade events marked by the generation of *schlieren* type, folded, and phlebitic (veins) structures associated with quartz-feldspars mobilized in migmatitic basement that represents  $S_n$  foliation. In the Alto Moxotó Terrane, the presence of  $F_n$  intrafolial folds, with up to 2 m wavelengths on average, suggesting the presence of an even older deformational fabric. The metamorphic zircon grains in migmatites yield Rhyacian ages suggesting that this phase may be Paleoproterozoic (2.1-2.0 Ga; Santos et al. 2015), which coincides with the metamorphic peak established for this part of the province (Neves et al. 2015), although in most of the Borborema Province, the migmatization event took place at  $566 \pm 6$  Ma (Viegas et al. 2014a), but this is still a contentious topic. The LS-type tectonites of the Floresta and Salgueiro complexes are characterized by low-angle  $S_{n+1}$  foliation and variable dip angles ( $\sim 8^\circ$ - $40^\circ$ , Figs. 4g and 4j), high pitch mineral stretching lineation and pinch-and-swell  $L_{n+1}$  associated to the next deformation stage called  $D_{n+1}$ . The foliation planes (Fig.3) generally plunge towards SSE and also containing  $S_{n+1}$  axial plane due to the refolding of the  $S_n$  foliation. Although less common, paragneisses and mica

schists of the Sertânia and Cabrobó Complex also display such structures as well as preserved kinematic indicators. In preserved foliation planes nearly parallel to the XZ deformation ellipsoid, include brittle-ductile boudins, S-C/C' shear bands, and  $\delta$  and  $\sigma$  sigmoidal alkali feldspar porphyroclasts. The  $F_{n+1}$  folds are mostly isoclinal and recumbent (Fig. 3). For instance, in the Surubim-Caroolina Complex, they are related to the Serra das Mascarenhas Shear Zone, that present tectonic vergence to WNW, which is typical from the Transversal Zone Domain. Despite the recent interpretations of Santos et al. (2017) that this stage might be Tonian, i.e. related to the Cariris Velhos event  $D_{n+1}$  is interpreted as a deformation associated with the Cariris Velhos event, as suggested by (Santos et al. 2010), flat-lying foliation is interpreted by most authors as an early phase of the Brasiliano orogeny (Neves et al. 2015 and reference therein). In addition, in the Campina Grande region, Rodrigues and Archanjo (2011) describe similar structural markers, mapping a very important structural set that bounds the Alto Pajeú and Alto Moxotó terranes, named as Riachão do Bacamarte System, which is related to early stages of the Brasiliano Event.  $D_{n+2}$  deformation markers are widespread and mostly observed on the studied terranes of the Transversal Domain and PEALT. They include high angle to vertical foliation  $S_{n+2}$  (Fig. 3 and 4h), and stretching lineation is ascribed to non-coaxial deformation. They are related to

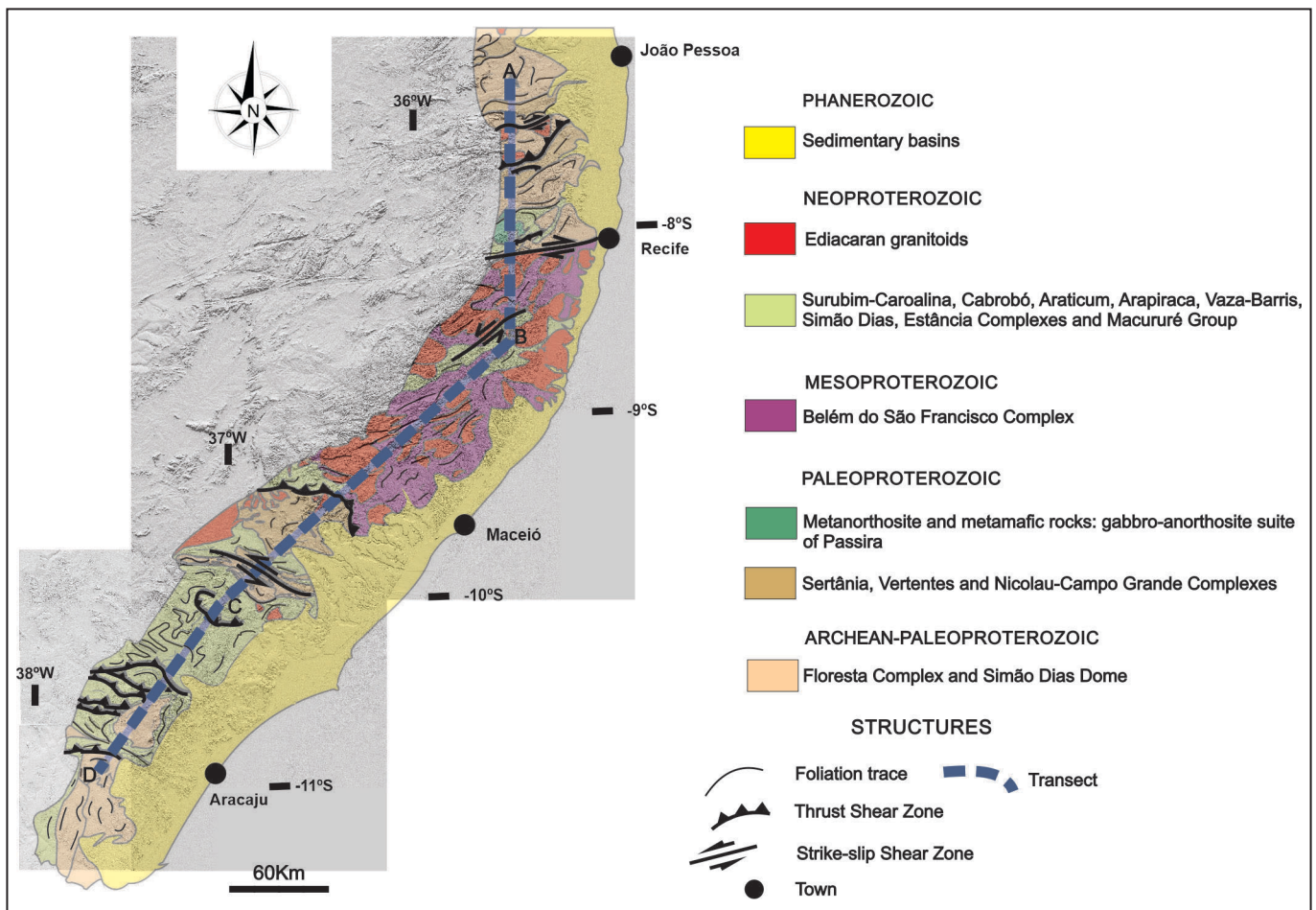


FIGURE 2. Simplified geological map on a SRTM shadow relief emphasizing the A-D transect with identification of the main tectono-stratigraphic terrane/belts and major regional structures.

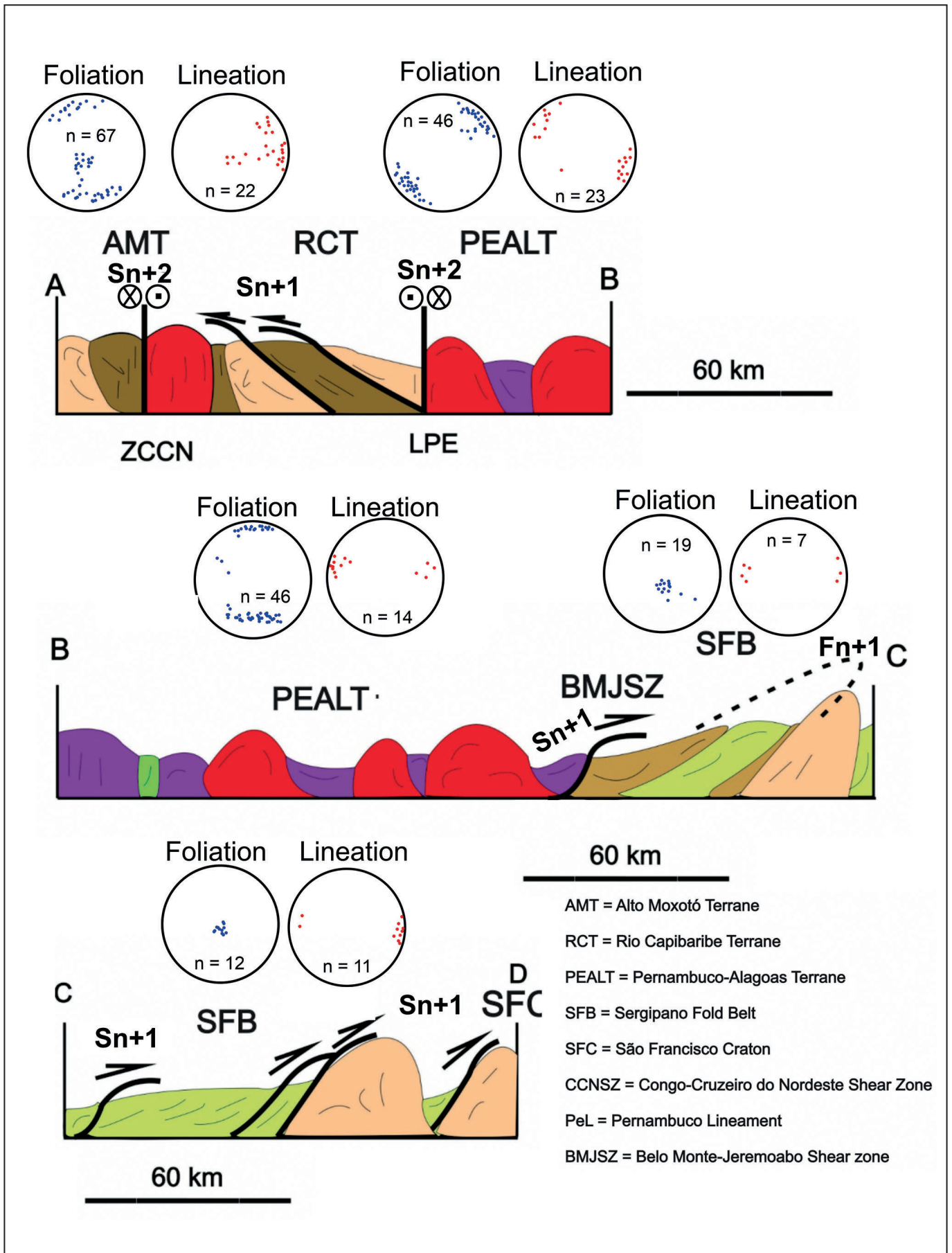
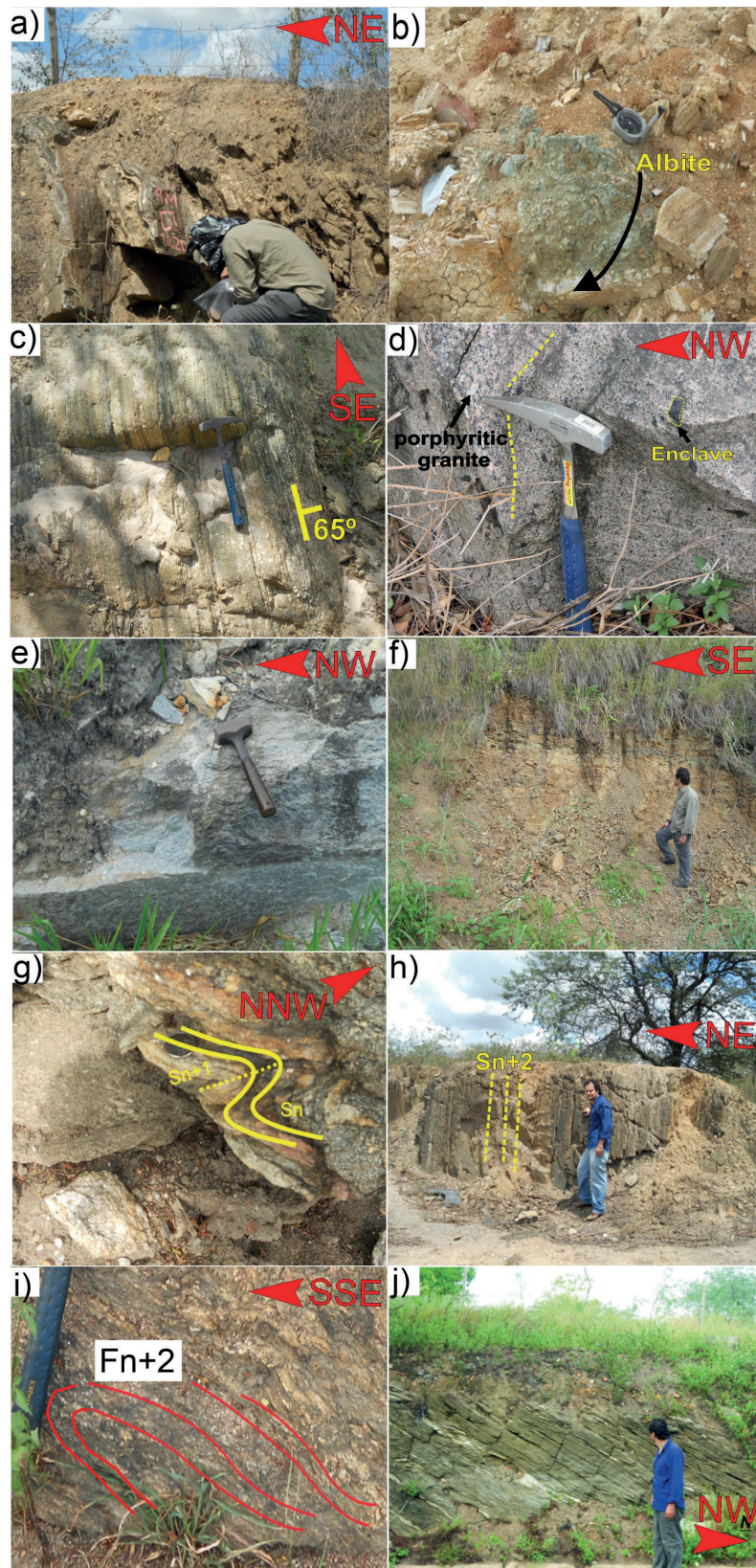


FIGURE 3. Geological section among the main domains addressed and stereographic projections (lower hemisphere) of Schmidt-Lambert net to show the plot of the structural elements.



**FIGURE 4.** General field and structural aspects of the studied region. a) orthogneiss showing gneissic banding with folded structure in the Floresta Complex. b) Mafic metavolcanic rock from the Surubim-Caroalina Complex showing albitization process. c) Metaritmite with high-angle foliation related to Dn+2 event. d) Sub-rounded microenclave-rich monzodioritic rock in contact to porphyritic granite. e) Hornblende diorite with biotite oriented by magmatic foliation. f) Phyllite of the basal unit of Vaza Barris Domain showing subhorizontal primary layered structure. g) gneiss showing asymmetric fold of generation Fn+1 and controlled by contractional tectonic Dn+1 on an axial-plane foliation Sn. h) Sn+2 high-angle foliation related to dextral transcurrent shearing of Pernambuco Lineament. i) Tight fold corresponding to the Fn+2 tectonic phase with vergence to SSE. j) Contractional tectonic regime (Dn+1) showing vergence to SE.

the major Pernambuco Lineament and Congo-Cruzeiro do Nordeste shear zones with predominantly dextral and sinistral kinematics respectively. These structures are characterized by several syngenetic fold patterns of the Fn+2 generation (Fig.4i) with an emphasis in the *en échelon* and drag folds, which are easily observed in the para-derived rocks of the Surubim-Carolina Complex. Through mesoscopic analyses, a wide variety of kinematic criteria can be observed on horizontal surfaces, mainly on protomylonitic rocks, including  $\sigma$ -type porphyroclasts of alkali feldspar and quartz, and S-C/C' shear bands with rotated feldspar. The shear sense indicators show predominant dextral displacement. This event is marked as the climax of the Brasiliano orogeny, being responsible to vast syn-kinematic granites emplaced along major shear zones, such as the Campina Grande and Serra Redonda plutons (i.e. 581 and 576 Ma, respectively; Rodrigues and Archanjo, 2011), and is interpreted as related to lateral escape and extrusive tectonics around 540 Ma (Ganade de Araujo et al. 2014b; Viegas et al. 2013a, 2013b) and can be interpreted as the progressive advance of Dn+1 as described in several orogenic belts (Fossen et al. 2019). Finally, the Dn+3 event that is the result of the critical stress on rocks exposed in the most superficial portion, producing brittle deformation markers. They can be represented by joint systems, shear fractures and less abundant fissures such as cracks. Features typical of the brittle zone such as fault gouge, cataclastic sliding on former joints and pseudotachylyte also were assigned to this phase. The smaller joints occur filled with minerals forming veins of diverse magnitudes such *en échelon* veins. In another hand, the larger joints even form dikes that are filled with pegmatites in the orthogneisses throughout of the Transversal Zone Domain. Other families of joints are filled with mafic rocks interleaved by the metasedimentary rocks of the Floresta and Cabrobó complexes. In plutonic rocks of PEALT brittle structures were identified such as sheeting joints or exfoliation. Conjugated Riedel failures (R-R' system) were observed along the geological profile. The rheological model has revealed that fracture depends on the Earth's geothermal gradient when the stress field arrives at critical value and exceeds the

elastic behavior (Means 1990 among others). The existence of faults in the coastal basins parallel to large deep structures such as the Pernambuco Lineament, as well as earthquakes associated with these structures can represent events of tectonic reactivation during the Cretaceous (Lima Neto et al. 2014). The structural data presented here is compatible with the model that the compartments of eastern Borborema Province are separated by important shear zones, some of which are polycyclic nature, often reworked by the Brasiliano orogeny. Most of them, therefore, have characteristics of the tectono-stratigraphic terranes (Carvalho 2005; Brito Neves et al. 2014; Brito Neves and Silva Filho 2019; Lima et al. 2018, 2019; Santos et al. 2017a, 2017b, 2020; Caxito et al. 2020, among others).

#### 4. Conclusions

The geological transect covered two major tectonic domains. The first one corresponds to the Transversal Zone Domain, where rocks from the Alto Moxotó and Rio Capibaribe Terrane were studied. The second one corresponds to the Southern Domain, whose focus of work was restricted to the Pernambuco-Alagoas Terrane and the Sergipano Fold Belt. This study covered units with ages spanning the Archean to late Neoproterozoic. The oldest rocks are represented by the Paleoproterozoic migmatitic and gneissic rocks that crops out as the Floresta (Alto Moxotó Terrane), Salgadinho (Rio Capibaribe Terrane) and Belém do São Francisco (Pernambuco-Alagoas Terrane) complexes. Supracrustal rocks of the Cabrobó (PEALT), Arapiraca, Araticum, and Nicolau-Campo Grande Complexes, and from the Itabaiana Dome were analyzed in the lithostratigraphic and structural perspective. Migmatitic gneiss of Tonian age from Belém do São Francisco Complex occurs along the Pernambuco-Alagoas Terrane. The main feature of this Terrane is the abundance of Neoproterozoic units, corresponding mainly to supracrustal rocks and abundant plutonic magmatism that corresponds to 40% of the area. The granitic plutonism of the region is evidenced by a suite of rocks varying between

TABLE 1 – Synthesis of the main deformational phases of the transect.

Regimes	Event	Identified structures	Main characteristics
Preterit structures	Dn	Sn	Penetrative foliation associated with migmatitic fabric
		Fn	Intrafolial folds
Contractional	Dn+1	Sn+1	S1-tectonite with low angle foliation plunging to SSE, e.g. Serra dos Mascarenhas Shear Zone
		Ln+1	LS1-tectonite or high pitch mineral stretching lineation and pinch-and-swell
		Fn+1	Isoclinal to recumbent folds and plunging folds with rotated axial surface
Transcurrent	Dn+2	Sn+2	S2-tectonite with high angle foliation in mylonite. The biggest expressions are the Pernambuco Lineament and the Congo-Cruzeiro do Nordeste Shear Zone
		Ln+2	LS2-tectonite with subhorizontal to low pitch lineation
		Fn+2	En échelon fold, drag fold, closed to tight folds, parasitic folds, asymmetric, disharmonic with thickness and wavelength variation
Brittle stage	Dn+3	Riedel failures and joints	Several brittle structures such as sheeting joints in the granites; en échelon veins, fibrous veins, dikes, joints and shear fractures R-R', T, P types



intermediate and acidic rocks such as diorite/tonalite to syenites and granites with porphyritic to equigranular textures. It is notable the presence of an older fabric restricted to the gneisses of the Alto Moxotó Terrane, Belém do São Francisco Complex and Simão Dias Domes (Dn), that based on previous migmatite dating we attribute the Paleoproterozoic age. In the Alto Moxotó and part of the Rio Capibaribe Terrane it is possible to observe several S-tectonites that represent the contractional tectonics. Kinematic indicators suggest that this deformation is subsequent to a Dn deformation, being called Dn+1 that we associate to early and late Neoproterozoic. Structural analysis of the main deformation surfaces indicates top-to-the-NW vergence on the Transversal Zone Domain and top-to-the-S in the Sergipano Fold Belt. Within the latter, such markers are evidenced mainly by the Belo Monte-Jeremoabo, Palmeira dos Índios, and Jacaré dos Homens shear zones, and are associated with crustal boundaries between the Pernambuco-Alagoas Terrane and the Sergipano Fold Belt. The duality of tectonic vergences has been also interpreted as coeval double-verging structures as shown by Lima et al. (2018). Kinematic indicators suggest tectonic vergence of supracrustal rocks towards the São Francisco Craton. Dn+2 is related to the Ediacaran period, corresponding to refolding processes of early tectonics by strike-slip markers, where the most prominent structures include the E-W Pernambuco Lineament and the Congo-Cruzeiro do Nordeste Shear Zone. The last deformational phase, Dn+3, corresponds to brittle structures expressed by reactivation processes during the Cenozoic with fault formation and joints along the province.

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