

Application of U-Pb and Sm-Nd geochronology to understanding the geotectonic history of the Borborema Province, NE Brazil and its implications for the evolution of West Gondwana

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The Borborema Province (BP) of NE Brazil comprises the western part of a wide Pan African - Brasiliano orogenic belt formed during late Neoproterozoic (ca. 0.6 Ga) assembly of West Gondwana. New Sm-Nd and U-Pb results from BP demonstrate a complex history ranging from >3.4 Ga to <0.6 Ga, with major events during the mid to late Archean (3.4 to 2.6 Ga), mid Paleoproterozoic (2.2 to 2.0 Ga: Transamazonian), late Paleoproterozoic (1.8 to 1.7 Ga), late Mesoproterozoic (1.1 to \leq 1.0 Ga), middle Neoproterozoic (0.8 to 0.7 Ga), and late Neoproterozoic (0.63 to 0.57 Ga: Brasiliano). The Patos and Pernambuco shear zones divide BP into three main tectonic domains: a northern tectonic domain (NTD) north of the Patos shear zone; a central tectonic domain (CTD) between the Patos and Pernambuco shear zones; and a southern tectonic domain (STD), between the Pernambuco shear zone and the São Francisco craton (SFC). Brasiliano granitic plutons are common in all domains.

The oldest gneisses and migmatites occur as an Archean nucleus (2.6 to ca. 3.4 Ga) in Caldas Brandão Massif (CBM), west of Natal in eastern NTD. This nucleus is bounded by belts of Transamazonian (2.1 Ga) migmatitic gneisses, metaplutonic rocks, and granulites. Small Archean nuclei have also been found in western Pernambuco and in NW Ceará states, where they are surrounded by Transamazonian gneisses.

Transamazonian gneisses constitute the Rio Piranhas Massif (RPM) in central NTD and basement of Ceará State in western NTD. Transamazonian gneiss, migmatite, and granulite also occur as smaller blocks in CTD and as basement inliers of SFC in southern STD. Brasiliano granites intruded Transamazonian and younger basement, but are less common in the Archean nuclei. The NTD was probably amalgamated about 2.1 Ga, with fusion of the Congo (CC), São Francisco, West African (WAC), and Amazonian (AC) cratons during the Transamazonian-Eburnian orogeny.

Following Transamazonian cratonization, sedimentary and felsic metavolcanic formations were widely deposited about 1.8 to 1.7 Ga as intracratonic supracrustal sequences. On the SFC these are gently to moderately deformed belts; well preserved platform sequences of similar age and character are also found throughout the Amazon craton and Guiana shield (to the north of the continent). In the BP, the Jaguaribeano belt in the central part of the NTD presumably was a similar sequence, but it was strongly deformed during the Brasiliano collision.

Current research is documenting a major orogenic terrain (Cariris Velhos terrain: CVT) that formed about 1.0 Ga in CTD and STD. This terrain was originally proposed from Rb-Sr work. Sm-Nd and U-Pb work now demonstrates that this event occurred over a large region and involved many rock units (metagraywackes, bimodal volcanics, tonalitic plutons, and older basement). The CVT is a major feature of BP and encompasses much of Teixeira-Terra Nova tectonic high, Pernambuco-Alagoas massif, and Piancó-Alto Brigida, Pajeu-Paraíba, and Riacho Pontal fold belts. The extent and origin of CVT are still under investigation by several groups, but preliminary indications are that it may represent a continental-margin arc terrain developed along the NW margin of the SFC-Congo craton. Metasedimentary and metavolcanic units of similar age occur

in the Sergipano fold belt to the south, but their connection to the CVT or Pernambuco-Alagoas massif is not fully resolved at present.

Intracratonic sedimentation and magmatism occurred about 0.8 to 0.7 Ga in the region, resulting in a small mafic complex in CTD (overlying Irajá complex) and a possible accreted terrane in northern STD (Canindé complex). Extensive flysch-like (eugeoclinal) sedimentation occurred in eastern NTD (e.g., Seridó Group) and NW Ceará (Martinopole Group); mio-geoclinal sedimentation (Vaza Barris and Estancia Group) occurred in southern Sergipano fold belt, overlying SFC basement.

During the Brasiliano - Pan African orogeny many cratonic masses, smaller crustal fragments, and juvenile arc terranes were assembled into West Gondwana, producing most of the deformational structures now seen in the BP. However, the BP apparently contains very few, if any, late Neoproterozoic juvenile accreted terranes, such as found elsewhere in West Gondwana, so that it has not yet been possible to define unequivocally any major sutures within the province. That is, the sequential assembly history of the province, with possible intervening fragmentation episodes, has not yet been established.

Nd isotopic data from Brasiliano plutons which represent crustal melts has been very useful in defining major crustal provinces. However, the distribution of isotopic data, in conjunction with petrographic and geochemical data, also indicates that the crust from which the plutons were derived has major vertical variations as well as major lateral variations. Furthermore, continental lithospheric mantle may have also contributed to some of the Brasiliano magmas.

Table 1. Recognized, Major Tectonic Events in Northeast Brazil.

Name	Description of events [Brazilian and global correlatives]	Age (Ma)
Brasiliano events	Post-tectonic plutons	560-600
	Deformation and high-grade metamorphism [Pan-African, Cadomian]	600-650
Pre-Brasiliano	Intra-plate magmatism, sedimentation	650-900
Cariris Velhos orogeny	Flysch sedimentation, volcanism, plutonism (Rifting; arc development?) [Sunsas, late Kibaran, Grenvillian]	950-1100
* * * * *	{Absent or undocumented sedimentation}	1100-1700
Jaguaribeano sequence	Intracratonic sedimentation, felsic volcanism, plutonism [Lower Espinaçao, Gorotire-Beneficente, Svecofennian, Mazatzal-Yavapai]	1700-1800
* * * * *	{Absent or undocumented events}	1800-2000
Transamazonian events	Volcanism(?), sedimentation(?), plutonism, deformation [Eburnian]	2000-2200
* * * * *	{Absent or undocumented events} [Birrimian, Huronian]	2200-2700
Late Archean events	Deformation, metamorphism, plutonism	2700-2800
* * * * *	{Absent or undocumented events}	2800-3200
Middle Archean events	Deformation, metamorphism, plutonism	3200-3500

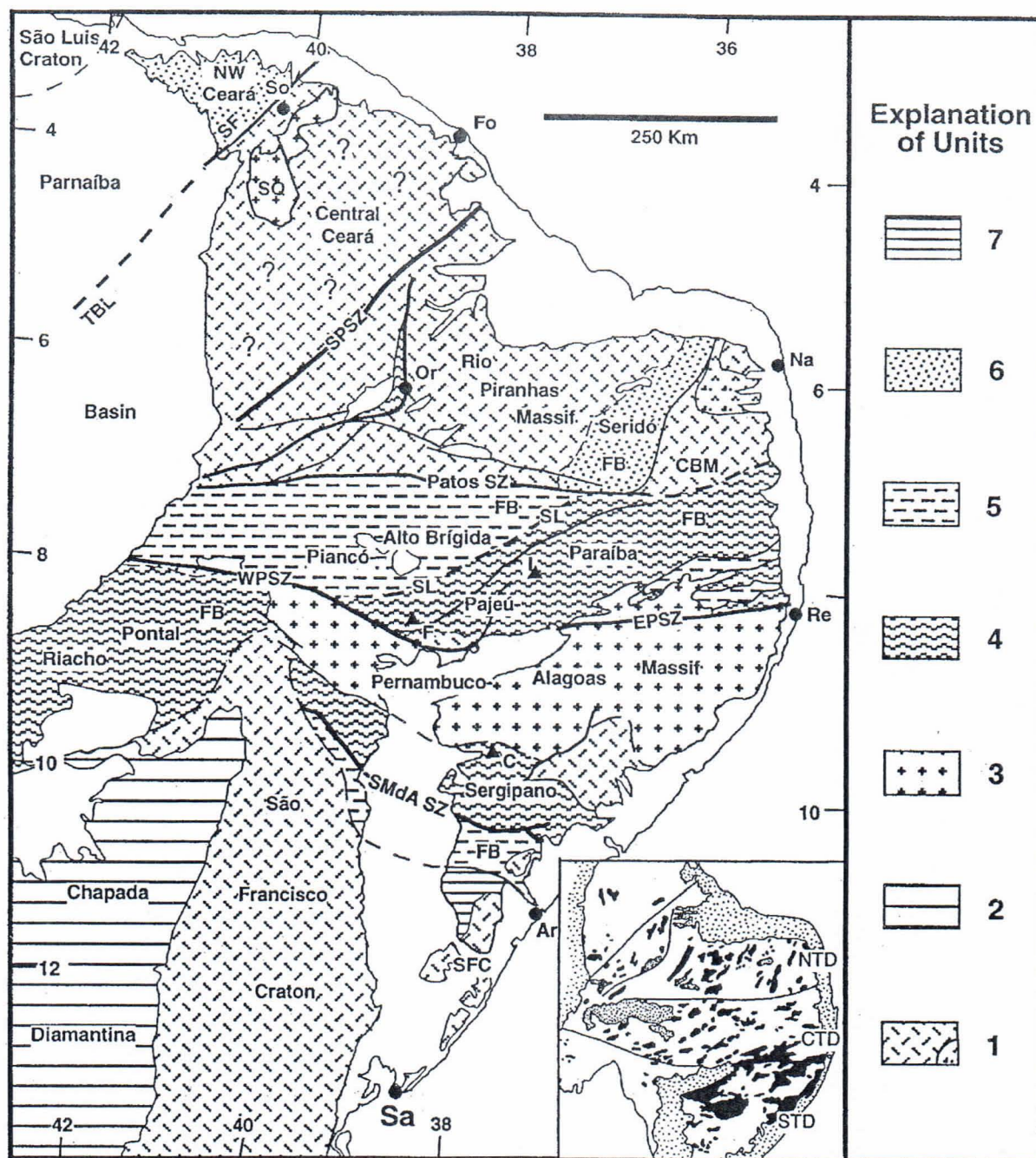


Figure 1. General tectonic map of the Borborema Province. Legend: 1, Archean to Paleoproterozoic basement (inset: Archean nucleus near Natal); 2, Proterozoic cover of SFC; 3, Mesoproterozoic to Neoproterozoic granite-gneiss of Pernambuco-Alagoas massif and Santa Quiteria Complex (SQ); 4, medium to high grade metasedimentary and metavolcanic rocks of ≈ 1 Ga fold belts; 5, lower grade ≈ 1 Ga metasedimentary and metavolcanic rocks of various fold belts; 6, Seridó fold belt (0.8-0.7 Ga) and Médio Coreaú fold belt in NW Ceará; 7, undeformed cratonic cover of Sergipano fold belt; white: undifferentiated Phanerozoic. TBL = Transbrasiliano lineament (SF = Sobral Fault); SPSZ = Senador Pompeu shear zone; WPSZ = western Pernambuco shear zone; EPSZ = eastern Pernambuco shear zone; SMdA SZ = São Miguel do Aleixo shear zone. Fo = Fortaleza; Na = Natal; Or = Oros; Re = Recife; Ar = Aracaju; Sa = Salvador; So = Sobral. Blue triangles denote ca. 750-800 Ma igneous complexes: I = Irajaí; C = Canindé; F = granite near Floresta. Younger Proterozoic units in Ceará not shown. Inset: major tectonic domains (NTD, northern tectonic domain; CTD, central tectonic domain; STD, southern tectonic domain) and general distribution of Brasiliano granites.

