



# The Algodões amphibolite–tonalite gneiss sequence, Borborema Province, NE Brazil: Geochemical and geochronological evidence for Palaeoproterozoic accretion of oceanic plateau/back-arc basalts and adakitic plutons

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## ARTICLE INFO

### Article history:

Received 1 September 2007

Received in revised form 12 June 2008

Accepted 12 June 2008

Available online 29 June 2008

### Keywords:

Palaeoproterozoic oceanic basalt

Geochronology

Geochemistry

Borborema Province

## ABSTRACT

Field relationships, geochemistry and U–Pb zircon and Sm–Nd whole-rock geochronology are used to constrain the genesis of Palaeoproterozoic massive amphibolites and orthogneisses of the Algodões Sequence, Central Ceará Domain, Northeastern Brazil. The 2236±55 Ma-old Algodões amphibolites show trace element geochemical signature and positive  $\epsilon_{\text{Nd}}(t)$  values similar to Phanerozoic oceanic plateau basalts and less often to back-arc basalts. The amphibolites are intruded by tonalitic to quartz-dioritic gneisses of the Cipó unit which were dated at 2160–2170 Ma and 2130 Ma. Neodimium isotope data and whole-rock geochemistry for these gneisses show they are akin to juvenile arc plutonics of the adakitic suite. The likely occurrence of Palaeoproterozoic plateau basalts and arc plutonics in this part of northeastern Brazil render comparisons with similar terranes elsewhere in South America and Africa, which in turn indicate a significant contribution of accretionary orogens in the early assembly of the Columbia Supercontinent.

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## 1. Introduction

The Borborema Province, northeastern Brazil (Fig. 1), has been traditionally described as a mosaic of terranes formed by Neoproterozoic metasedimentary belts and basement complexes, both intruded by extensive granitic batholiths and carved by large-scale transcurrent shear zones with a main tectonic phase related to the Brasiliano/Pan-African Cycle (Almeida et al., 1981; Fetter et al., 2003; Souza et al., 2006). More recently, metavolcanic–sedimentary terranes related to the Cariris Velhos or “Greenvillian” orogeny (ca. 1.0±0.1 Ga, cf. Van Schmus et al., 1995; Brito Neves et al., 1999) and older terranes such as the 1.8 Ga basalt–rhyolite–pelite–quartzite suite of the Orós belt (Sá et al., 1991) have been documented. The basement complexes were described as high-grade gneisses derived from reworked TTG suites and minor metavolcano–sedimentary remnants. In some regions, the gneiss complexes are generally interpreted as isolated Archaean nuclei, such as the Tróia and São José de Campestre Massifs (Dantas et al., 1998, 2004; Brito Neves et al., 2000), or as Palaeoproterozoic remnants of the Hoggar–Potiguar plate (Brito Neves et al., 1999), though the limits of which are poorly defined (Vaughan and Pankhurst, 2008) as well as the tectonic setting.

However, as new geochronological data became available, several authors ascribed crust formation events to the Palaeoproterozoic. This

is the case of the basement to the Seridó belt in the eastern sector of the Borborema Province, where granitic orthogneisses gave U–Pb ages between 2.23 Ga and 1.97 Ga (Souza et al., 1993; Fetter et al., 2000; Neves et al., 2006). Similarly, basement charnockites of the Medium Coreau Domain, at the northwestern border of the Borborema Province yielded zircon U–Pb ages between 2.36 Ga and 2.30 Ga and depleted-mantle Nd model ages (TDM) between 2.38 Ga and 2.61 Ga (Fetter et al., 2000). On the other hand, the occurrence of Eburnian–Trans-Amazonian supracrustal belts is more disputable (Bertrand and Jardim de Sá, 1990).

As a contribution to the understanding of the tectonic setting of basement gneisses and associated supracrustal rocks of the northern portion of the Borborema Province, and to improve supercontinent reconstruction, such as the Atlantica Supercontinent presented by Teixeira et al. (2007), here we report U–Pb and Pb–Pb single zircon ages, Sm–Nd isotope and whole-rock geochemical data for metabasalts and deformed granitoids (the Algodões Sequence) that support the existence of a Palaeoproterozoic accretionary orogen in the Central Ceará Domain of the Borborema Province.

## 2. Geological framework

The Algodões Sequence occurs in the eastern portion of the Central Ceará Domain (CCD), a typical sector of the Borborema Province situated between the Trans-Brasiliano Lineament and the Senador

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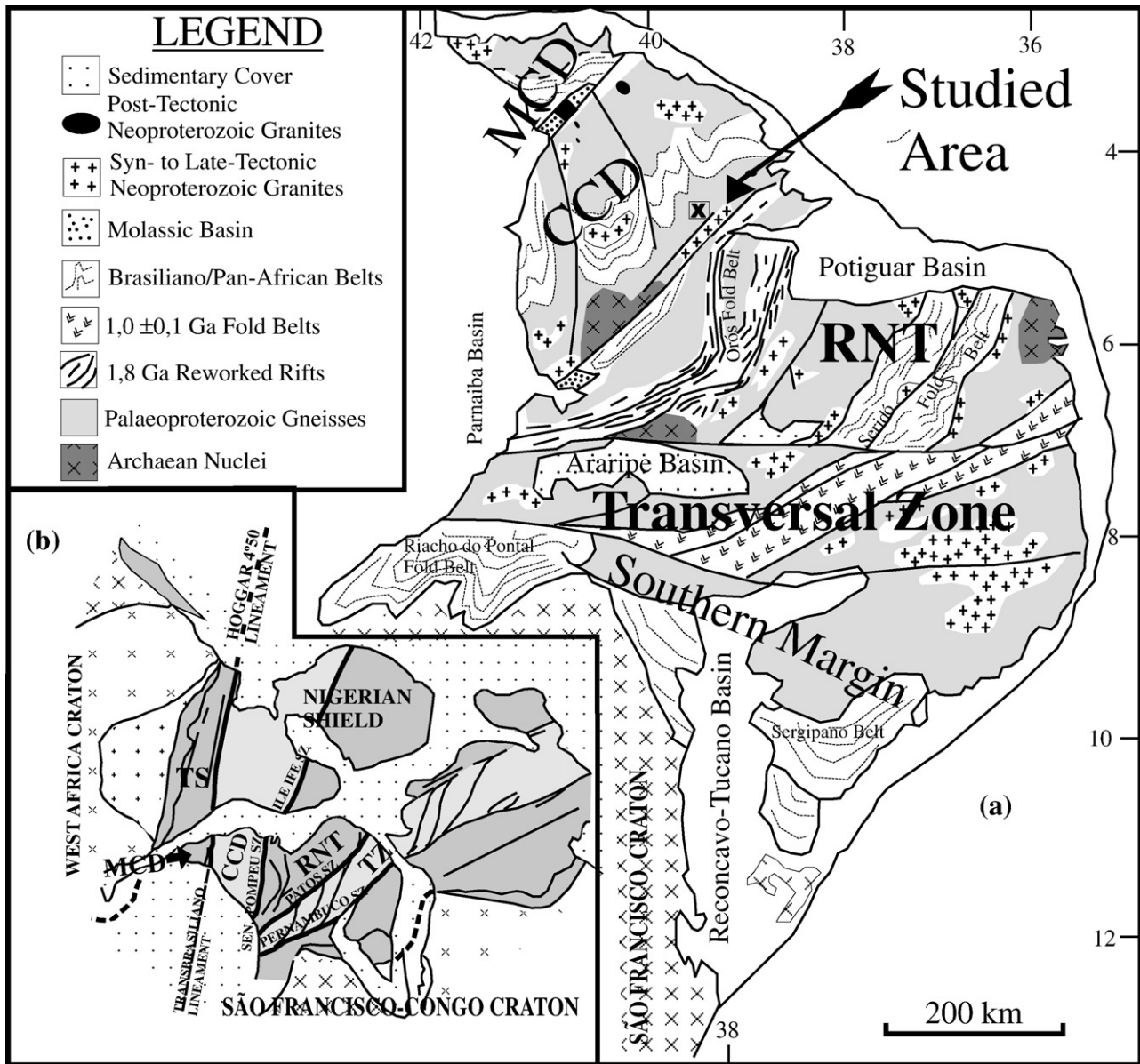


Fig. 1. Simplified geological map of the Borborema Province (a) and correlation with Precambrian Africa on a pre-drift configuration (b). MCD-Medio Coreau Domain; RNT-Rio Grande do Norte Terrane; CCD-Central Ceará Domain; TS-Touareg Shield; TZ-Transversal Zone.

Pompeu shear zone (Fig. 1). The circum-Atlantic correlatives of this domain are possibly the African block located between the Hoggar-4°50' transcontinental shear zone and Ile-Ife shear zone in western Nigeria (Trompette, 1994). The CCD comprises a minor Archaean fragment of the Troia Massif that is partially overlain by quartzite-pelite-carbonate units of the Ceará Group, both widely affected by Brasiliano/Pan-African tangential tectonics (Caby and Arthaud, 1986). Neoproterozoic–Early Palaeozoic magmatism is represented by syn- to late-tectonic calc-alkaline batholiths (e.g., Quixada–Quixeramobim, Itapage, Tamboril granite complexes) and post-tectonic alkaline-peralkaline stocks (Barriga, Serra Aguda, São Paulo and Morrinhos bodies). Martins et al. (1998) and Fetter et al. (2000) reported 2.1–2.2 Ga-old orthogneisses in the central and northwestern parts of this domain.

The CCD is bound to the east by the Rio Grande do Norte Domain (RND) and to the west by the Medio Coreau Domain (MCD). The RND is mostly made up of marine metasedimentary rocks of the Neoproterozoic Seridó belt, a rift sequence of the 1.8 Ga-old Orós belt, high-

grade gneisses of 2.1–2.0 Ga-old basement complexes, minor Archaean nuclei and voluminous Brasiliano/Pan-African granite bodies (Sá et al., 1991; Souza et al., 1993; Dantas et al., 1998; Van Schmus et al., 1995, 2003). The MCD crops out west of the Transbrasiliano Lineament and comprises another Neoproterozoic marine sequence (Martinopole Group), 2.4–2.17 Ga-old high-grade gneisses of basement complexes (Gaudette et al., 1998; Fetter et al., 2000), minor syn- to post-tectonic Neoproterozoic granites and early Palaeozoic molassic basin (Jaibaras Group). A more detailed account of the geological evolution of these two domains is presented in Brito Neves et al. (2000) and Santos et al. (2008).

The Algodões Sequence (Fig. 2) comprises the Algodões amphibolites, Choró paragneisses and the Cipó orthogneisses.

The Algodões amphibolites generally crop out around the Cipó orthogneisses or as conformable layers intercalated with the Choró paragneisses (Fig. 2). They consist of fine-grained, massive to amygdaloidal amphibolite (Fig. 3a) with occasional bands of garnet-amphibolite, lenses of coarse-grained hornblende, and minor

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