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Long-lived Paleoproterozoic granitic magmatism in the Seridó-Jaguaribe domain, Borborema Province—NE Brazil

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ABSTRACT

The northeastern part of the Borborema Province is dominated by Paleoproterozoic migmatitic tonalitic to granitic orthogneisses (Caicó Complex) that are the basement for younger, metavolcanosedimentary rock assemblages. Within this complex gneissified, porphyritic metagranitoid rocks (the G2-type augen gneisses) are fairly common and supposed to define a synorogenic magmatism at *c.* 2.0 Ga. New U–Pb (SHRIMP) on zircons and Sm–Nd data shows that these augen gneisses do not differ significantly from the metaplutonic rocks of the basement complex regarding their nature and emplacement age of the primary magmas. U–Pb ages cluster in a time interval between 2.17 and 2.25 Ga and are correlated with Nd parameters (older t_{DM} model ages and negative initial ϵNd values) indicating an origin from recycling of an older, probably Neoarchean crust. The regional host rocks that accommodate the augen gneiss could be *c.* 2.4–2.3 Ga supracrustal sequences presently preserved as small remnants in the Caicó Complex. The Paleoproterozoic magmatic activity extends to the Late Paleoproterozoic with the intrusion of the Serra Negra pluton (now a coarse augen gneiss) which yielded a (semi) concordant U–Pb age of *c.* 1.75 Ga. This magmatic activity, until now unsuspected in the Caicó Complex, was probably related to crustal extension and rifting over large areas that include the NE Brazil and the Nigerian shield in Africa.

1. Introduction

The Borborema Province (NE Brazil) is a crustal domain of the Brasiliano–Pan African orogen in which more than a half of its Precambrian crystalline rocks were formed in the Paleoproterozoic (2.5–1.6 Ga). The province is part of a larger Neoproterozoic belt that extends farther south into the Brasília Belt and can be traced into Central Africa by means of lithologic correlations and a series of major shear zones (Fig. 1) (Caby, 1989; Trompette, 1997; Van Schmus et al., 2008). The current structural configuration resulted from diachronic Neoproterozoic (not yet precisely dated) events of tectonic collage along lithospheric- or crustal-scale shear zones (Vauchez et al., 1995) in which the Patos shear zone may have constituted a major suture (Fig. 1). Another striking tectonic structure, probably also corresponding to a Neoproterozoic suture, occurs to the west along the Transbrasiliano–Kandi lineament in which juvenile Neoproterozoic continental arc rocks have been described (Fetter et al., 2003). However, it is worthwhile to note that to the north of Patos shear zone and possibly in the Central Nigerian shield high-grade Paleoproterozoic gneisses and migmatites are much more abundant than the juvenile rocks related to the Neoproterozoic orogenies (Brito Neves, this volume). This indicates that the Brasiliano-Pan African tectonic events involved mostly the recycling and reactivation of old crustal blocks, and the development of Neoproterozoic structures would have been controlled by preexisting inherited fabric.

The northeastern portion of the Borborema Province (Fig. 2) consists mostly of high-grade gneisses and migmatites forming the basement of Meso- to Neoproterozoic, often linear, volcano-sedimentary belts. A recent update of geochemical and geochronological data for these Paleoproterozoic metaplutonic rocks concluded they were derived from an enriched mantle at *c.* 2.15 Ga in a geodynamic setting dominated by continental accretion (Souza et al., 2007, and references therein). Of particular importance in this region is a suite of coarse-grained augen gneisses that are considered synorogenic plutons (the G2 granitoids of Jardim de Sá et al., 1995) emplaced during the so called Transamazonian (*c.* 2.0 Ga) orogeny. These bodies usually contain a penetrative gentle dipping foliation and are associated with recumbent folding, which lead Bertrand and Jardim de Sá (1990) to propose that the fabric of large areas in the

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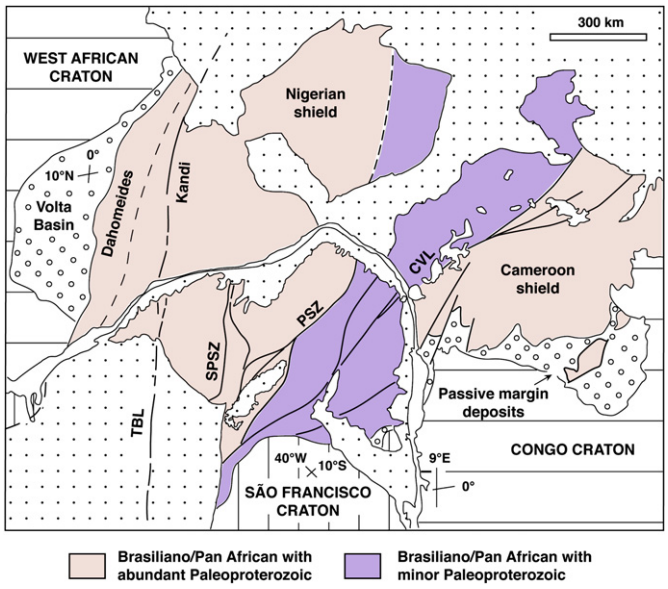

Fig. 1. Pre-drift reconstruction for the main geological features of the Borborema Province (NE Brazil) and the shields of Nigeria and Cameroon in Africa. TBL, Transbrasiliano lineament; PSZ, Patos shear zone; SPSZ, Senador Pompeu shear zone; CVL, Cameroon volcanic line; dotted pattern = sedimentary cover (modified after Van Schmus et al., 2008).

Borborema, Nigeria and, further north, the Hoggar shields would be Early Proterozoic in age. This model considers that the crustal melting, high-grade metamorphism and tangential tectonics in the Seridó-Jaguaribe domain would be pre-Brasiliano structures, which would have significant implications for the geodynamic reconstructions across Atlantic between the NE Brazil and Africa.

The conflicting interpretations regarding the Paleoproterozoic magmatism in the northeastern part of the Borborema Province (e.g., Caby et al., 1990, 1995), particularly for the G2 granitoids, comes from the quite poor quality of the geochronological data set based mainly on whole-rock Rb–Sr isochrons and inconclusive U–Pb zircon ages. In fact, the study of zircons from a few augen gneisses using U–Pb (ID-TIMS) yielded both very discordant analyses and bimodal Pb–Pb age patterns (Jardim de Sá et al., 1995). This paper focus on the geochronology of these old "synorogenic" granitoids, combining cathodoluminescence imaging and in situ U–Pb (SHRIMP) analysis on zircons and whole-rock Sm–Nd isotopic data. We show that the isotopic signature of the G2 magmatic suite is indistinguishable from that of metaplutonic rocks of the basement, which casts doubt the presence of a *c.* 2.0 Ga orogenic event in this part of the province. In addition, our results reveal an unsuspected magmatic activity at *c.* 1.75 Ga that brings new implications on the Proterozoic crustal evolution of this geological domain.

2. Geological setting

The study area (Fig. 2) is limited to the south and west by, respectively, the Patos and Senador Pompeu transcurrent shear zones, while to the north and east it is covered by Mesozoic and Recent sediments. This crustal domain corresponds to the Rio Grande do Norte and Jaguaribe "terranes" but, as we will see, there are no significant geological differences between them. We will call it, hereafter, the Seridó-Jaguaribe domain. Three major geological units are identified in this domain. (a) Large areas of the basement, also known Caicó Complex, are occupied by 2.15–2.20 Ga old high-grade orthogneisses and migmatites often invaded by late-Neoproterozoic to Cambrian granite plutons and pegmatites (not shown in Fig. 2). (b) A small São José de Campestre Archean nucleus occurs to the east. It is mainly composed by trondhjemitic to granitic gray gneisses whose primary magmas were emplaced in a time interval between 3.5 Ga and 2.7 Ga (Dantas et al., 2004). Combined U–Pb and Sm–Nd model ages indicate that the genesis of the São José de Campestre nucleus involved juvenile crustal growth and recycling of a still older crust. (c) Finally, the Caicó Camplex hosts elongated volcano-sedimentary belts deposited both the Late Paleoproterozoic (Orós, Jaguaribe and Serra de São José belts) and schist belts (Seridó) deposited in the Neoproterozoic.

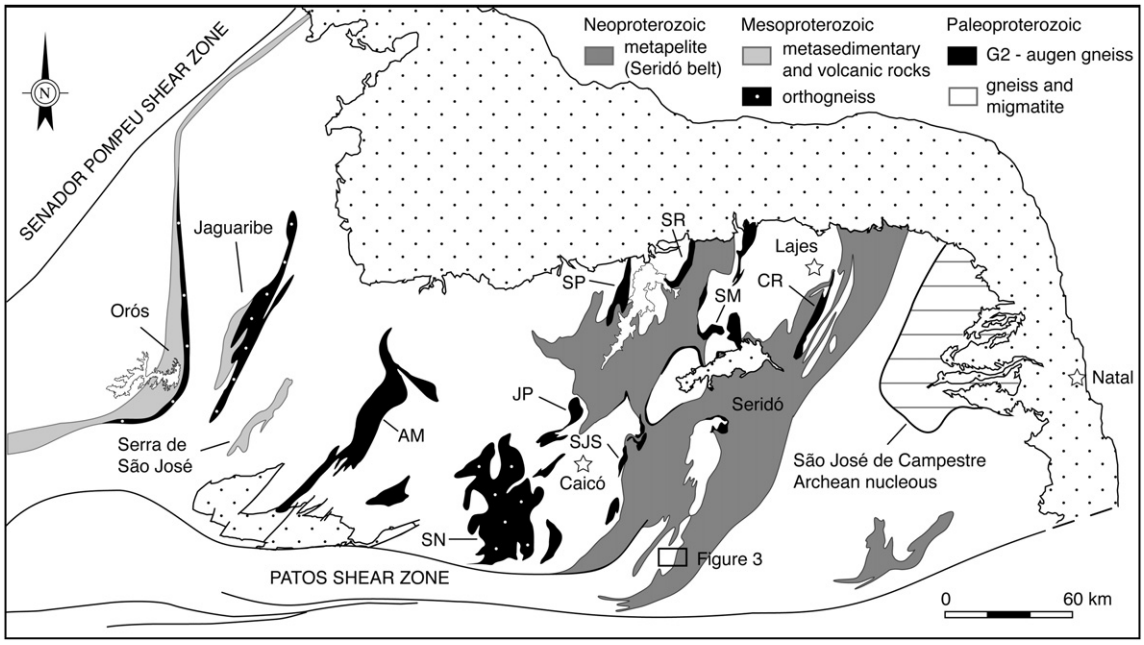

Fig. 2. Simplified geological map of the Seridó-Jaguaribe domain showing the locations of the studied augen gneiss plutons (SJS, São José do Seridó; SR, São Rafael; SM, Santana do Matos; AM, Antônio Martins; SN, Serra Negra; JP, Jardim de Piranhas; SP, Serra das Pinturas; CR, Cerro Corá).