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Constraints on the Statherian evolution of the intraplate rifting in a Paleo-Mesoproterozoic paleocontinent: New stratigraphic and geochronology record from the eastern São Francisco craton

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ABSTRACT

An integrated approach of stratigraphic analysis and U–Pb age dating reveals some information on the tectono-sedimentary evolution of the Statherian cover of the São Francisco craton in the so-called Espinhaço basin (Atlantic shield in eastern Brazil). Here, continental sedimentation patterns, such as alluvial fan, braided-plain and lacustrine facies associations, with associated volcanic rocks are documented in two superposed basin fill-successions, which are defined as the Algodão and Sapiranga Synthems and grouped in the Botuporã Supersynthem. Both studied units consist mainly of conglomerates and cross-bedded sandstones and minor amounts of mudstones, sedimentary breccias, volcanic lava beds and volcaniclastic rocks, which were deposited in a rift basin – the Botuporã rift – during two syn-rifting phases. The Algodão Synthem represents the first rifting phase. The basal synsedimentary conglomerates of this unit were deposited mainly by subaerial debris flows, most likely along and near a rift border fault. The framework of this rock consists of only crystalline rock clasts from the basement and no fragments of volcanic rocks. Detrital zircon grains that were extracted from this facies show ages older than 2.05 Ga. The remainder of the section is dominated by fluvial sandy lithofacies with minor conglomerate lenses and sandstone–mudstone heterolithic lithofacies, which represent distal, waning-flood deposits in a lacustrine environment. The upper section also contains hummocky cross-stratified sandstone lithofacies, which are related to a storm-influenced deposition. On top of the Algodão succession, the volcanic rocks were dated at 1775 ± 7 Ma, which was interpreted as the near final age of the first rift-phase. Representing the second rift-phase, the Sapiranga Synthem shows similar sedimentation patterns to the Algodão Synthem. The Sapiranga Synthem rests directly on the volcanic rocks of the Algodão Synthem, and its basal conglomerates (which are most likely also related to a master fault) contain voluminous clasts of volcanic rocks, sandstones and crystalline rocks. The detrital zircon grains that were extracted from this facies show ages of 1741 ± 14 and 1766 Ma as well older than 2.05 Ga. The volcanic rocks on the upper succession of the Sapiranga Synthem record ages of 1740 ± 10 Ma, which finalized the Botuporã rift evolution. A preliminary geochemical study of volcanic rocks from the Botuporã Supersynthem showed that these rocks are alkaline rocks with high K_2O/Na_2O ratios, which belong to an ultrapotassic suite. The low concentrations of MgO wt.% suggest a felsic ultrapotassic character. The Botuporã Supersynthem is unconformably covered by a volcano-sedimentary rift-succession of EoCalymmian age — the Pajeú Synthem, which represents the second rifting stage of the Espinhaço basin. Several Statherian-related volcano-sedimentary sequences and anorogenic granitoids occur dispersed in the São Francisco block, which requires a regional geologic model to explain the extensional and magmatism process during this time. We used the last Columbia paleocontinental reconstruction to constrain these processes by relating them to far-field continental extensional and magmatic record as part of a silicic LIP, which was triggered by the convection-driven tectonic-plate motion on the western border of the Atlantica block inside of the Columbia supercontinent.

1. Introduction

One of several major continental blocks in the West Gondwana assembly is the São Francisco–Congo paleocontinent (SFCP) (Fig. 1). It comprises two main cratonic areas (the São Francisco craton and the Congo craton) and the surrounding Neoproterozoic orogens (Trompette, 1994). The basement of this paleocontinent was consolidated after the

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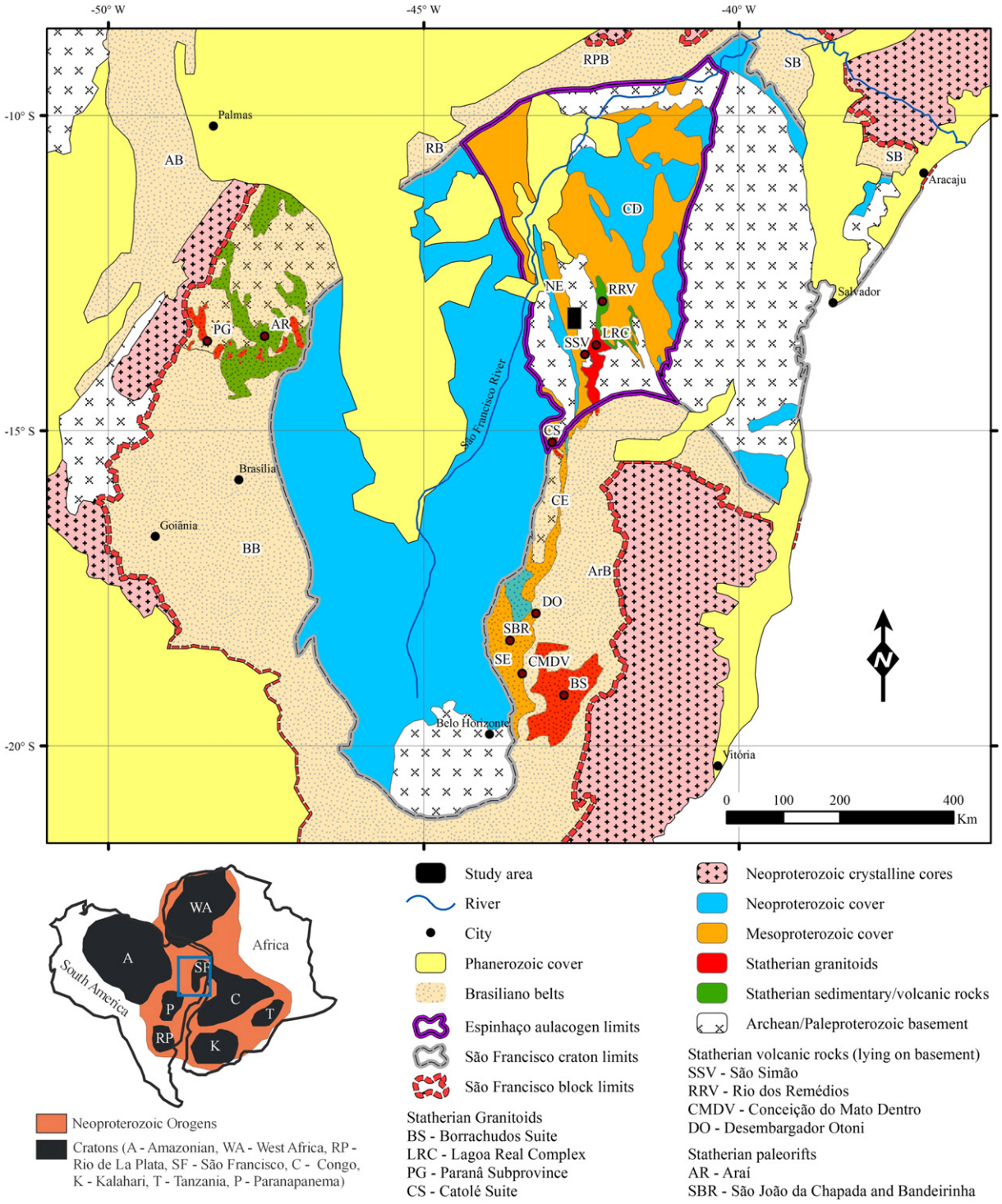

Fig. 1. Geological configuration of the Espinhaço aulacogen in the northern São Francisco craton that is bordered by Brasiliano fold-and-thrust belts: Araguaia (AB), Rio Preto (RB), Riacho do Pontal (RPB), Sergipano (SB), Araçuaí (ArB), and Brasília (BB). The inset caption indicates the location of the map in the tectonic scenario of West Gondwana (modified from Alkmim et al., 1993; Bizzi et al., 2003; Peres et al., 2004; Alkmim et al., 2006, 2007). The cover related to the so-called Espinhaço basin occurs in the following physiography domains: Chapada Diamantina (CD), Northern Espinhaço (NE), Central Espinhaço (CE) and Southern Espinhaço (SE).

Rhyacian orogeny and included Archean terranes, Paleoproterozoic sedimentary basins and magmatic rocks (older than 2.0 Ga). The consolidation of this basement was followed by several episodes of intraplate basin formation and related magmatism (e.g., Danderfer et al., 2009; Chemale et al., 2012; Santos et al., 2013), which must have occurred in a Paleo-Mesoproterozoic supercontinent, which is currently defined in the literature as the Columbia supercontinent (Rogers and Santosh, 2002; Zhao et al., 2002). However, although this subject has been discussed in the literature, there remains no consensus about the position of the SFCP in this huge landmass, and several hypotheses have been proposed since its definition (e.g., Rogers and Santosh, 2004; Zhao et al., 2004; Hou et al., 2008a; Yakubchuk, 2010; Meert, 2012; Zhang et al., 2012). A probable reason is the lack of reliable geological, geochronological and paleomagnetic data for the SFCP from the interval of 1.8–1.3 Ga, during which the Columbia supercontinent is believed to have existed.