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Zircon U–Pb ages of rocks from the Rio Apa Cratonic Terrane (Mato Grosso do Sul, Brazil): New insights for its connection with the Amazonian Craton in pre-Gondwana times

F.M. Faleiros [a,b,*], M. Pavan [a], M.J. Remédio [a], J.B. Rodrigues [c], V.V. Almeida [a], F.P. Caltabeloti [a], L.G.R. Pinto [a], A.A. Oliveira [a], E.J. Pinto de Azevedo [a], V.S. Costa [a]

[a] Geological Survey of Brazil (CPRM), Regional Superintendence of São Paulo, Rua Costa 55, São Paulo, SP 01304-010, Brazil
[b] Instituto de Geociências, Universidade de São Paulo, Rua do Lago, 562, Cidade Universitária, São Paulo, SP 05508-080, Brazil
[c] Geological Survey of Brazil (CPRM), SGAN 603, Conjunto J, Parte A, 1° andar, Brasília-DF 70830-030, Brazil

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ABSTRACT

This paper presents 14 zircon U–Pb determinations (SHRIMP and LA-MC-ICP-MS) for key geological units from the Rio Apa Cratonic Terrane (RACT), which is considered the southernmost exposed part of the Amazonian Craton in southwestern Brazil. The zircon U–Pb ages and geological data indicate that the RACT was formed by the accretion of magmatic arcs in a continental margin active from 1950 to 1720 Ma. The RACT is composed of three major terranes (Western, Eastern and Southeastern Terranes) with distinct evolution histories. The Western Terrane presents orthogneisses and granites formed at ~1950–1940 Ma and subduction-related granites and volcanic rocks formed at 1900–1880 Ma and 1840–1830 Ma. These basement rocks are covered by a greenschist facies metavolcano-sedimentary succession (Rio Naicata Formation) with basal volcanic rocks formed at 1813 ± 18 Ma. A gabbronoritic dyke of the Rio Perdido Suite hosted by the Rio Naitaca Formation yields an age of 1589 ± 44 Ma. The Eastern and Southeastern Terranes present deformed leucogranites generated within the intervals 1780–1720 Ma and 1810–1790 Ma, respectively. Both terranes are covered by a metavolcano-sedimentary succession (Alto Tererê Formation) dominated by Barrovian-type amphibolite facies metamorphic assemblages, suggestive of a collisional event. Available ^{40}Ar–^{39}Ar data (hornblende, muscovite and biotite) indicate that the proto-RACT evolved to a collisional orogen between 1310 and 1270 Ma and behaved as a cratonic mass after 1270 Ma, preceding the assembly of Rodinia. The available data allow us to interpret the RACT as a part of the Ventuari–Tapajós Province of the Amazonian Craton, which was fragmented and dispersed as a microcontinent. It was subsequently reincorporated into the SW Amazonian Craton, along the Sunsás Belt, as an allochthonous terrane. In a global perspective, the tectono-magmatic events of the RACT are consistent with a long-lived accretionary orogen possibly related to an active margin of Columbia.

1. Introduction

The Rio Apa Cratonic Terrane (RACT; Fig. 1) is a composite terrane that is considered the southernmost exposed part of the Amazonian Craton in southwestern Brazil (Mato Grosso do Sul State) and northern Paraguay (Ruiz et al., 2005; Lacerda Filho et al., 2006; Cordani et al., 2009; Godoy et al., 2009; Cordani et al., 2010a; Manzano et al., 2012; Brittes et al., 2013; Manzano, 2013; Plens et al., 2013; Teixeira et al., 2013). Thus, its evolutionary history is relevant to the reconstruction of the Gondwana and Rodinia supercontinents. The RACT–Amazonia connection is largely based on the positions of the Neoproterozoic Brasiliano/Pan African belts (Almeida and Hasui, 1984) and on the interpretation that the Tucavaca Belt, a Brasiliano feature that separates the RACT from the Amazonian Craton (Fig. 1), represents an aulacogenic feature (Brito Neves et al., 1985; Ávila-Salinas, 1992; Cordani et al., 2009, 2010a). Although the RACT-Amazonia connection within Gondwana is generally accepted, the pre-Gondwana relationship between these geotectonic entities is not yet properly understood.

Geochronological and geological data suggest that the RACT comprises a fragment of an Orosirian to Statherian active continental margin that was subsequently deformed and metamorphosed in a 1310–1270 Ma collisional event (Lacerda Filho et al., 2006; Cordani et al., 2010a; Manzano et al., 2012; Brittes et al., 2013; Manzano, 2013; Plens et al., 2013; Pavan and Faleiros, 2014). ^{40}Ar–^{39}Ar data (muscovite and biotite) indicate that the RACT behaved as a cratonic mass after 1310–1270 Ma (Cordani et al., 2010a) and was unaffected by tectonothermal events related to the assembly of Rodinia (ca. 1200–1000 Ma) and Gondwana (ca. 650–500 Ma). In this scenario, the role of prominent structures related to the Grenvillian Orogeny

* Corresponding author at: Instituto de Geociências, Universidade de São Paulo, Brazil.
E-mail address: ffalei@usp.br (F.M. Faleiros).

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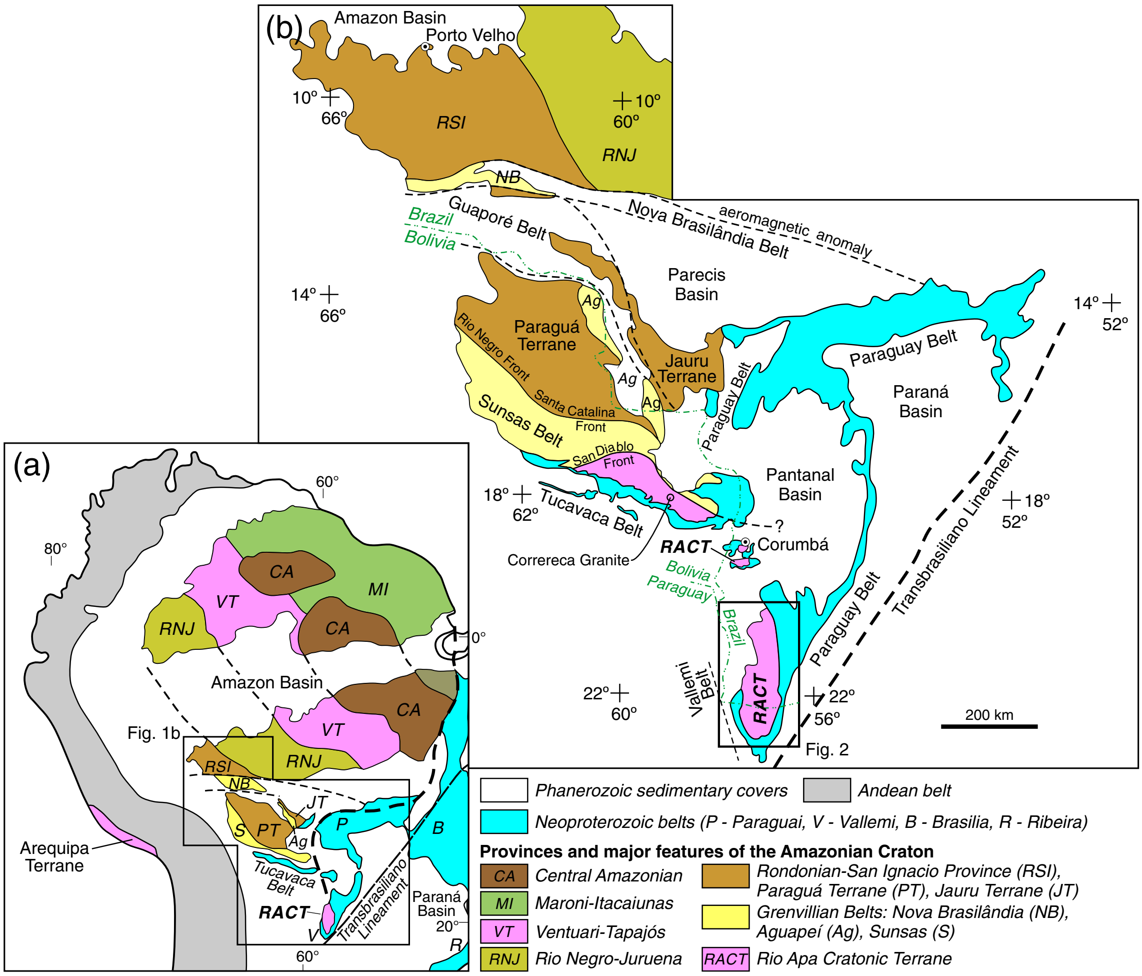

Fig. 1. Tectonic framework of part of South America with emphasis on the Amazonian Craton and its tectonic provinces: (a) adapted from Cordani et al. (2009), (b) adapted from Bettencourt et al. (2010), taking into account data from Hasui and Almeida (1970), Tohver et al. (2004), Vargas-Mattos et al. (2010), Rizzotto et al. (2013) and this work. Also shown is the location of Fig. 2.

(1200–1000 Ma) (the Sunsás, Aguapeí and Nova Brasilândia Belts; Sadowski and Bettencourt, 1996; Geraldes et al., 1997, 2001; Loewy et al., 2004; Tohver et al., 2004; Boger et al., 2005; Tohver et al., 2005a, b, 2006; Teixeira et al., 2010; Geraldes et al., 2014; Rizzotto et al., 2014) and the Rondonian–San Ignacio Orogeny (1560–1300 Ma) (the Guaporé Belt; Bettencourt et al., 2010; Rizzotto et al., 2013, 2014) are key issues that need to be addressed to securely establish the relationship between the RACT and the Amazonian Craton in pre-Gondwana times. Most authors consider the Sunsás Belt as a major suture zone related to the collision between the proto-Amazonian Craton and the Arequipa–Antofalla Terrane (Sadowski and Bettencourt, 1996; Loewy et al., 2004; Boger et al., 2005; Cordani et al., 2010b; Teixeira et al., 2010; Rizzotto et al., 2014), while others interpret it as an intracontinental belt (Santos et al., 2000, 2008). The role of the Nova Brasilândia Belt is also contentious, being inferred as the collisional suture zone between the Paraguá Terrane and the proto-Amazonian Craton (Tohver et al., 2004, 2005a,b, 2006; Boger et al., 2005) or as an intracontinental belt (Santos et al., 2000, 2008; Teixeira et al., 2010; Rizzotto et al., 2014). Rizzotto et al. (2013, 2014) interpret the collage between the Paraguá Terrane (Fig. 1) and the proto-Amazonian Craton to have occurred between 1430 and 1340 Ma along the Guaporé Belt.

In addition to Rodinia and Gondwana, the age (1950–1750 Ma) and tectonic setting of magmatic events recorded in the RACT basement (Lacerda Filho et al., 2006; Cordani et al., 2010a; Brittes et al., 2013; Plens et al., 2013) make its evolutionary history potentially relevant to the reconstruction of the Columbia supercontinent (Meert, 2002; Rogers and Santosh, 2002; Zhao et al., 2002, 2004, 2011; Roberts, 2012, 2013; Meert, 2014). However, this history has not been taken into account in recent Columbia reconstructions based on paleomagnetic data (Bispo-Santos et al., 2008, 2012, 2014a,b). The only exception is the Columbia reconstruction presented by Teixeira et al. (2013), where the RACT appears in a marginal position, suggesting that it was part of the proto-Amazonian Craton at ca. 1790 Ma.

The tectonic evolution of the RACT is reviewed by Cordani et al. (2010a). New data were recently obtained from systematic geological mapping at a 1:100,000 scale (Remédio et al., 2013; Faleiros et al., 2014; Pavan et al., 2014; Pinto de Azevedo et al., 2014). These data enable refinement of our understanding about the tectonic evolution of the RACT, with implications for the evolution of Proterozoic supercontinents (Columbia and Rodinia). In this paper we report 14 zircon U–Pb data obtained from magmatic rocks of different units from the RACT, eight analyses performed by sensitive high-resolution ion microprobe (SHRIMP), and six analyses by laser ablation-multicollector-inductively coupled plasma mass spectrometry (LA-MC-ICP-MS). These robust geochronological data were used to: (i) contribute to the recognition of terranes with distinct evolution histories prior to amalgamation of the RACT; (ii) understand the relationships between granitoids and supracrustal rocks that present ambiguous contact relationships; (iii) better recognize distinct magmatic events and their tectonic implications; and (iv) contribute to the understanding of the RACT–Amazonia connection history in pre-Gondwana times. The results from this work also aid in our understanding of Paleo-Mesoproterozoic-

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