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The position of the Amazonian Craton in supercontinents

U.G. Cordani [a,*], W. Teixeira [a], M.S. D'Agrella-Filho [b], R.I. Trindade [b]

[a] Institute of Geosciences, University of São Paulo (USP), Rua do Lago 562, Cidade Universitária, 05508-080, São Paulo, Brazil
[b] Institute of Astronomy, Geophysics and Atmospheric Sciences, University of São Paulo (USP), Rua do Matão 1226, Cidade Universitária, 05508-090, São Paulo, Brazil

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ABSTRACT

This paper examines the extensive regions of Proterozoic accretionary belts that either formed most of the Amazonian Craton, or are marginal to its southeastern border. Their overall geodynamic significance is considered taking into account the paleogeographic reconstruction of Columbia, Rodinia and Gondwana. Amazonia would be part of Columbia together with Laurentia, North China and Baltica, forming a continuous, continental landmass linked by the Paleo- to Mesoproterozoic mobile belts that constitute large portions of it. The Rodinia supercontinent was formed in the Mesoproterozoic by the agglutination of the existing cratonic fragments, such as Laurentia and Amazonia, during contemporary continental collisions worldwide. The available paleomagnetic data suggest that Laurentia and Amazonia remained attached until at least 600 Ma. Since all other cratonic units surrounding Laurentia have already rifted away by that time, the separation between Amazonia and Laurentia marks the final break-up of Rodinia with the opening of the Iapetus ocean.

1. Introduction

Supercontinents are formed by the amalgamation of pre-existing continental masses, with the concomitant disappearance of the intervening oceans. The reconstruction of their internal structure, with the proposed relative position of the crustal components, is based on the available tectonic correlations, such as terrain with similar structural trends, similar ages, or specific and distinctive geological features (see Rogers and Santosh, 2003, 2004; Rogers, 1996; Santosh et al., 2009 — this issue). Paleomagnetic evidence is also of capital importance in such reconstructions (e.g., Piper, 2007; Pisarevsky et al., 2008). However, paleomagnetic data are usually scanty, and they are normally affected by large uncertainties, especially regarding paleolongitudes.

Amazonia, in South America (Fig. 1), consists of the Amazonian Craton, a very large tectonic feature with more than 4.4 million square km, bounded to east by the Neoproterozoic Tocantins province, in which the active orogenic systems are the Araguaia and Paraguay mobile belts. Its tectonic provinces were formed prior to the Neoproterozoic, mainly through soft-collision/accretion events. In its central part the Amazonian Craton is covered by the Phanerozoic Amazon basin, and in its north-western, western and south-western parts it is covered by the foreland sedimentary basins connected with the Andean Chain.

In this work we wish to address the tectonic evolution of Amazonia, considering, for different time frames, its situation within supercontinents and its relative position towards other cratonic masses. Therefore, we will examine and interpret the overall geodynamic significance of the extensive regions of Proterozoic accretionary belts that formed the SW portion of the Amazonian Craton, as well as the ones that occur marginally to its southeastern border. Their tectonic evolution is indicated, by means of the available geochronological control. The pertinent paleomagnetic constraints are considered, as well as the convenient tectonic and geochronologic correlations, with the specific objective of outlining the possible position of Amazonia within the paleogeographic reconstructions of Rodinia, Gondwana and Pangea. An attempt will be given also for the time-frame of Columbia, and for the Amazonia-West Africa continental nucleus of the Paleoproterozoic.

2. Tectonic history of Amazonia

Fig. 2, adapted from Cordani et al. (2000), brings the subdivision of the Amazonian Craton into two Archean nuclei and five Proterozoic tectonic provinces, which show coherent structural and geochronological patterns. The account that follows is largely based on the recent synthesis made by Cordani and Teixeira (2007). In addition, Table 1 brings a short synthesis of the principal geologic features, and to some extent the related geochronological control, for the Archean and Proterozoic tectonic units of this Craton.

The ancient nuclei of the Central-Amazonian province consist of the large Carajás granite–greenstone terrain, and the Xingu–Iricoumé block, where the extensive Paleoproterozoic cratonic cover of the Roraima Supergroup occurs, overlying gneissic and granitoid rocks. However, clearly established Archean crust is restricted to the Carajás

* Corresponding author. Tel.: +55 11 3091 3933; fax: +55 11 3091 4207.
E-mail address: ucordani@usp.br (U.G. Cordani).

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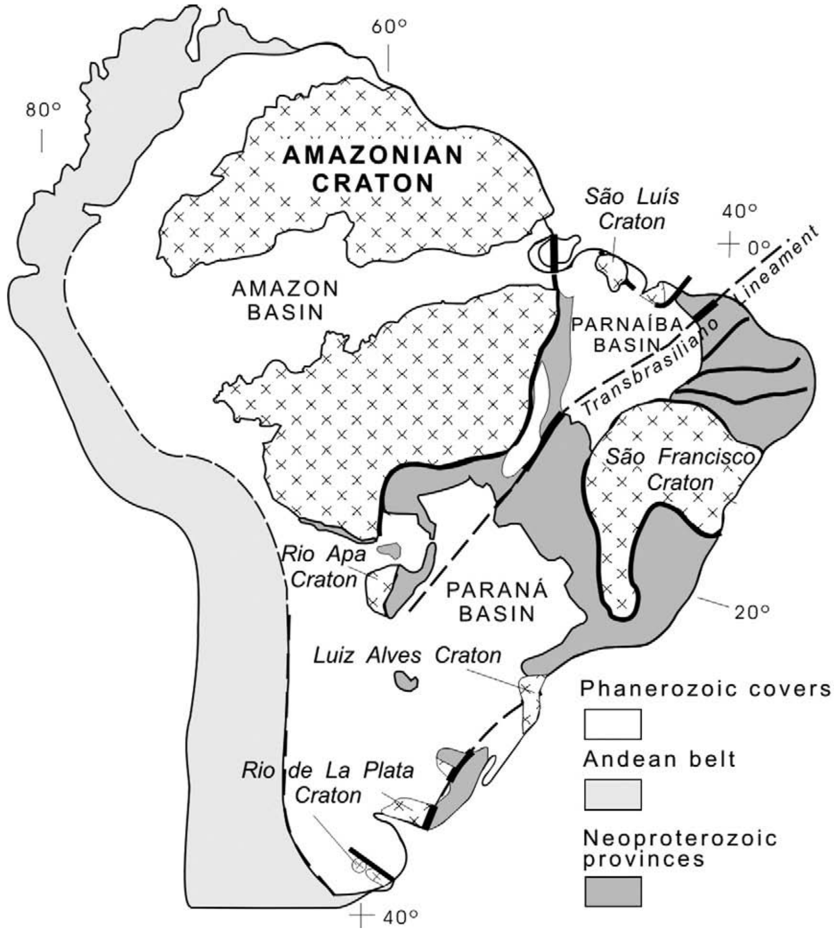

Fig. 1. Geotectonic provinces of South America.

region, southeast of the Amazon basin, whose rocks yielded radiometric ages between 2600 and 3200 Ma (Tassinari et al., 2000; Dall'Agnol et al., 2001; Santos, 2003).

The Paleoproterozoic Maroni-Itacaiunas province occurs to the north and to the northeast of the Central-Amazonian province. It consists of greenstone belts with clear oceanic affinity, associated with juvenile calc-alkaline granitoid rocks, presenting positive $\varepsilon_{Nd(T)}$ values and radiometric ages between 1950 and 2250 Ma. These rocks were deformed by the widespread Transamazonian orogeny (ca. 2.0 Ga; Hurley et al., 1967), which produced largely low to medium-grade metamorphic belts along the northern coast of South America, from Venezuela to the west to Guiana, Surinam, French Guiana and Brazil to the east (e.g. Gibbs and Barron, 1983). The Maroni-Itacaiunas province exhibits in part a reworked continental basement, the Amapá Block (Rosa-Costa et al., 2006), a Neoarchean fragment to the east, and another large Archean unit, the Imataca terrane at its western corner. The latter may represent an allochtonous crustal fragment that was juxtaposed to the Maroni-Itacaiunas province in the Paleoproterozoic. (Tassinari et al., 2004). High-grade metamorphic rocks are described in Suriname and Guyana, making up the Central Guyana Granulite Belt (e.g. Gibbs and Barron, 1983; Fraga, 2002). Their radiometric ages are slightly younger than typical Transamazonian ages, suggesting a collisional event that may have taken place during a late stage of that orogenic cycle (Tassinari et al., 2000). To the south, this high-grade terrain was intruded by anorogenic complexes of granite AMCG (anorthosite, mangerite, charnockite) type, of Mesoproterozoic age (Gaudette et al., 1978; Reis et al., 2000), and was also affected, later, by a strong deformation and heating at about 1300–1100 Ma, along cataclastic zones related to the so-called Nickerie or K'Mudku event (Snelling and Mc Connell, 1969; Priem et al., 1971). This event also reactivated the Guri fault zone that makes the tectonic limit between the Imataca terrane and the Maroni-Itacaiunas province (Tassinari et al., 2004).

In a broader context, the Maroni-Itacaiunas province correlates well with the Birimiam System in West Africa, affected by the Paleoproterozoic Eburnean orogeny, making up a large cratonic mass resulting from amalgamation of independent fragments of the proto-Amazonian and West African cratons, as suggested by the interpretation of paleomagnetic data (Onstott and Hargraves, 1981; Nomade et al., 2003), as well as by the coherent radiometric ages of the correlated units (e.g. Tassinari et al., 2000; Tassinari and Macambira, 2004). After the Transamazonian and Eburnean orogenies, this large continental mass acted as a tectonically stable foreland for the succeeding tectonic evolution. Fig. 3, adapted and modified from Nomade et al. (2003), shows a possible reconstruction of the cratonic mass in existence thereafter.

Beginning at ca. 2.0 Ga, a series of successive magmatic arcs started to be accreted along the southwestern margin of the tectonically stable Paleoproterozoic nucleus, giving rise to the Ventuari-Tapajós (VT) and Rio Negro-Juruena (RNJ) provinces. The continued soft-collision/accretion processes driven by subduction produced a very large "basement" domain, at least 2700 km long and about 1000 km wide, in which granites, gneisses and migmatites predominate. However the geologic knowledge of the VT province is not comprehensive enough to delineate well defined boundaries with the adjacent provinces. Calc-alkaline, granite–gneiss complexes and felsic volcanics (*sensu lato*), formed essentially between 2000 and 1800 Ma (Santos, 2003; Santos et al., 2004; Cordani and Teixeira, 2007), are the main constituents of this province, most of them with juvenile-like Nd isotopic signatures. Post-tectonic and anorogenic