Precambrian Research 286 (2016) 352–369

Contents lists available at ScienceDirect

Precambrian Research

journal homepage: www.elsevier.com/locate/precamres

550–490 Ma pre-to post-collisional shoshonitic rocks in the Ribeira Belt (SE Brazil) and their tectonic significance

G.G. Martins [a,*], J.C. Mendes [a], R.S. Schmitt [a], R. Armstrong [b], C.M. Valeriano [c]

[a] Universidade Federal do Rio de Janeiro – UFRJ, Brazil
[b] Autralian National University – ANU, Australia
[c] Universidade do Estado do Rio de Janeiro – UERJ, Brazil

ARTICLE INFO

Article history:
Received 25 May 2016
Revised 4 October 2016
Accepted 16 October 2016
Available online 22 October 2016

Keywords:
Central Ribeira Belt
Tectonic evolution
Shoshonite rocks
Buzios Orogeny

ABSTRACT

This work presents a detailed study in a new occurrence of shoshonite rocks in the central Ribeira Belt, SE Brazil. It is the Tinguí Unit, a (hornblende) biotite orthogneiss with shoshonitic affinity, and undeformed dykes of similar composition. They crop out along the contact between Costeiro (part of Oriental Terrane, Ribeira Belt) and Cabo Frio Tectonic Domains. The Tinguí Unit is represented by mesocratic orthogneiss, ranging from quartz-diorite to granodiorite in composition. Plagioclase, biotite, quartz, hornblende, microcline, titanite, apatite, allanite, zircon, and opaque minerals are the main minerals. Tonalitic to granodioritic dykes, with similar composition, cross cut the Tinguí orthogneiss. Besides mineralogical similarities, analyzed samples from both the orthogneiss and the dykes have shoshonitic signature with crustal and mantle Nd-Sr isotope nature. They are basic to intermediate rocks with low Fe contents and high alkalis, Ba, Rb, Sr, Zr, and LREE values. High K_2O/Na_2O (up to 2.06) and LREE/HREE ratios along with others geochemical parameters reinforce the shoshonitic signature. Sm-Nd data point to εNd values of −13.2 to −4.38, and 1.7 to 1.2G a T_{DM} Nd model ages. Although the 143Nd/144Nd ratios indicate a predominance of lower continental crust heritage, the 87Sr/86Sr ratios ranging from ca. 0.705 to 0.707 suggest an enriched mantle contribution. Nevertheless, geochronological data from Tingui orthogneiss and tonalitic dykes reveal a difference of ca. 50 m.y. in their crystallization ages: concordia ages of 551 ± 3 Ma, for the orthogneiss; 495 ± 4 Ma and 488 ± 4 Ma for the mesocratic and leucocratic tonalitic dykes, respectively. Comparing our new data and the tectonomagmatic events recorded in the Oriental Terrane, we propose a tectonic model emphasizing the role of this shoshonitic magma, interpreted as pre- and post-collisional intrusions regarding to the Buzios Orogeny, and possibly derived from the similar source. This magmatic activity is attributed to a long-term maintenance of high temperatures and low cooling rates in the Ribeira Belt, considered as a hot orogen. The 50 m.y. crystallization age gap between the studied rocks could be assigned to two periods of melting of a similar or even same source at different tectonic stages of the orogen, pre- and post-collisional.

1. Introduction

The shoshonitic association, proposed by Joplin (1965, 1968), includes silica saturated and subsaturated rocks. This author expanded the former classification as basaltic to rich potassium trachyandesitic rocks series, proposed by Iddings (1895). Shoshonitic rocks generally occur in recent orogens, like young island arcs, although rocks with similar chemical features are also reported in continental margins (Jakes and White, 1972). According to Müller et al. (1992), the geochemical parameters of continental magmatic arc and post-collisional rocks show subtle differences, in contrast to island arc and within-plate shoshonitic rocks that exhibit distinct signatures. In convergent settings, shoshonitic rocks can be associated with deformation of the arc at the end of subduction or during the transition between two subduction regimes with different orientation (Morrison, 1980).

The occurrence of shoshonitic rocks in Brasiliano/Neoproterozoic belts is relatively restricted. In the Dom Feliciano Belt (Fig. 1a) they are represented mainly by the Lavras do Sul Shoshonitic Association (Nardi and Lima, 1985). This association is mostly constituted by basic to intermediary volcanic rocks, plutonic bodies dominantly monzonitic, and monzogranites to granodioritic rocks, all associated with the coeval early post-collisional alkaline magmatism of the Brasiliano tectonic events. In the Borborema

* Corresponding author at: Carlos Vasconcelos Street, 122, apt 601, Postal Code 20521-050 Rio de Janeiro, RJ, Brazil.
E-mail address: guilhermemgeo@gmail.com (G.G. Martins).

http://dx.doi.org/10.1016/j.precamres.2016.10.010
0301-9268/

province (Fig. 1a), recent work (Ferreira et al., 2015) points to the existence of a post-collisional magmatism with shoshonitic affinity, represented by the Guarany Pluton. This magmatism is also related to the Brasiliano orogenic cycle, but associated with the convergence between the San Francisco Craton and Borborema block.

In the Oriental Terrane of the Ribeira Belt (Fig. 1a, b) shoshonitic rocks were only reported in the arc-related Rio Negro Complex, which includes plutonic rocks with calc-alkaline affinity and diverse geochemical signatures from low- to high-K, and a minor shoshonitic association (Tupinambá et al., 2012), attributed to the Trajano de Moraes Unit (Sad and Dutra, 1988).

In this same orogen, along the limit between the Oriental Terrane and the Cabo Frio Tectonic Domain, calc-alkaline orthoderived units with Ediacaran crystallization ages (570–540 Ma) occur (Fig. 1b). Among them, the basic to intermediate Tinguí orthogneiss (Ferrari et al., 1982) is the only unit with a shoshonitic affinity (Fig. 1b). This limit is interpreted as a collisional suture zone produced in the Cambrian during the Buzios Orogeny, which is the last collage event in Western Gondwana, assigned to the collision of the Cabo Frio Tectonic Domain and the Ribeira Belt at ca. 530 Ma. (Schmitt et al., 2004; Fernandes et al., 2015).

We present here a detailed study on these orogenic shoshonitic rocks (Tinguí orthogneiss and associated mafic dykes), including petrography, geochemistry, Sr-Nd isotope data and new U-Pb in zircon ages, in order to better constrain the tectonic setting for the Ediacaran magmatism in this collisional suture zone. A geotectonic insight considering the pre-, syn-, and post-collisional events related to the final Gondwana amalgamation in this region is proposed through a tectonic model for the emplacement of the Tinguí shoshonites.

2. Tectonic setting

The Ribeira Belt was a product of the convergence between São Francisco and Congo cratons, at the end of Neoproterozoic to the Cambrian involving a collage of the Serra do Mar microplate, continental magmatic arcs and island arcs during the Brasiliano Pan-African tectonic events (Tupinambá et al., 1998; Trouw et al., 2000; Heilbron et al., 2004). These events are related to the final stages of West Gondwana consolidation (Fig. 1a).

The study area is located at the central segment of the Ribeira Belt, more precisely in the Costeiro Domain of the Oriental Terrane near the contact with the Cabo Frio Tectonic Domain (Fig. 1b). This

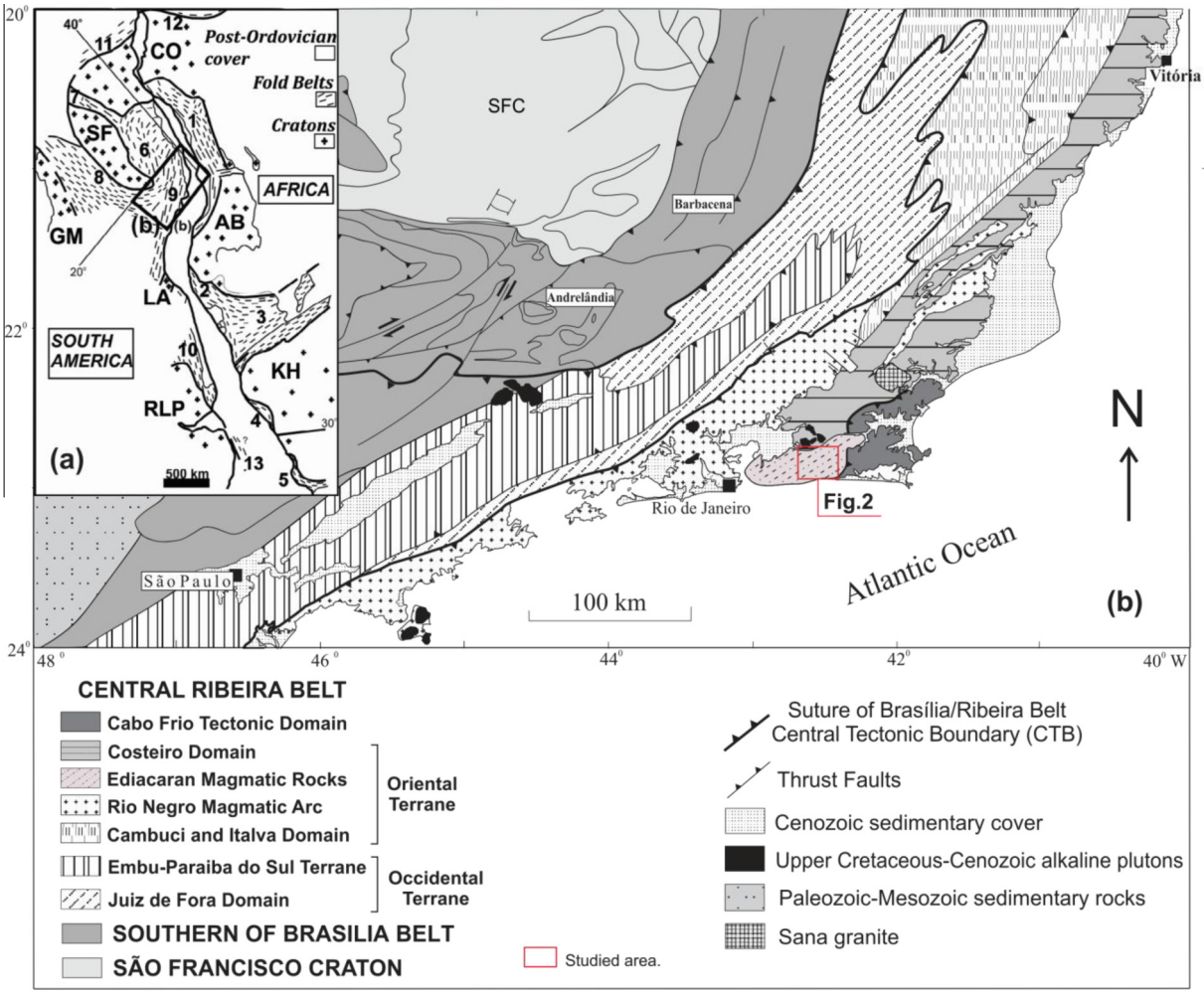

Fig. 1. (a): West Gondwana fit with cratons and Pan-African/Brasiliano belts fringing the South Atlantic Ocean (modified after Trompette, 1994). Main folds belts: (1) West Congo; (2) Kaoko; (3) Damara; (4) Gariep; (5) Saldania; (6) Araçuaí; (7) Paramirim aulacogen; (8) Brasília; (9) Ribeira; (10) Dom Feliciano; (11) part of the NE Brazilian province (Sergipano); (12) Oubanguides; (13) assumed Brasiliano metasedimentary rocks found in a drill-hole east of Mar del Plata. Main cratons and massifs: CO – Congo Craton (Gabon block), SF – Sao Francisco Craton, AB – Congo Craton (Angola Block), GM – Goias Massif, LA – Luis Alves block, RLP – Rio de La Plata Craton, KH – Kalahari Craton. (b): Tectonic map of the Central Ribeira Belt, the southern Brasília Belt and the southern part of the Sao Francisco Craton. Location in West Gondwana shown in Fig. 1a (modified after Trouw et al., 2013).