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Ages (U–Pb SHRIMP and LA ICPMS) and stratigraphic evolution of the Neoproterozoic volcano-sedimentary successions from the extensional Camaquã Basin, Southern Brazil

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ABSTRACT

During the Ediacaran, southern Brazil was the site of multiple episodes of volcanism and sedimentation, which are best preserved in the 3000 km^2 Camaquã Basin. The interlayered sedimentary and volcanic rocks record tectonic events and paleoenvironmental changes in a more than 10 km-thick succession. In this contribution, we report new U–Pb and Sm–Nd geochronological constraints for the 605 to 580 Ma Bom Jardim Group, the 570 Ma Acampamento Velho Formation, and a newly-recognized 544 Ma volcanism. Depositional patterns of these units reveal the transition from a restricted, fault-bounded basin into a wide, shallow basin. The expansion of the basin and diminished subsidence rates are demonstrated by increasing areal distribution and compressed isopachs and increasing onlap of sediments onto the basement to the west. The Sm–Nd isotopic composition of the volcanic rocks indicates mixed sources, including crustal rocks from the adjacent basement. Both Neoproterozoic and Paleoproterozoic sources are indicated for the western part of the basin, whereas only the older Paleoproterozoic signature can be discerned in the eastern part of the basin.

1. Introduction

A series of small fault-bounded relicts of sedimentary basins occur from southeastern Brazil to southern Uruguay, and expose unmetamorphosed sedimentary and volcanogenic successions of Ediacaran to Early Paleozoic age (see Fragoso-Cesar et al., 2000; Sánchez-Bettucci et al., 2001, 2004, 2009; Oyhantçabal et al., 2007; Almeida et al., 2010). These successions record the tectonic and paleoenvironmental evolution of the region during a period of important global changes and regional geotectonic events, which spans from the aftermath of the extreme glaciations of the Neoproterozoic to the Cambrian explosion of metazoans. The most complete and best preserved of these occurrences is the Camaquã Basin (Fig. 1), which hosts the well-dated Camaquã Supergroup (Ediacaran to Early Cambrian), exposed in the south-central region of the Rio Grande do Sul State (Southern Brazil).

The stratigraphic successions of the Camaquã Basin were deposited between ca. 610 and 535 Ma (Janikian et al., 2008; Almeida et al., 2010) and are frequently related to the main phase of the Brasiliano Orogeny, which is considered to have occurred between 650 and 550 Ma (Cordani et al., 2000). These previous models consider distinct Neoproterozoic tectono-magmatic events in Southern Brazil: an early one, consisting of juvenile magmatism and terrane accretion from ca. 900 to 700 Ma, and a later one, forming the Pelotas Batholith and the collisional Dom Feliciano Belt between 600 and 550 Ma (e.g. Babinski et al., 1996; Silva et al., 1999; Chemale, 2000; Gastal et al., 2005a,b). This general scenario masks some controversy over the early stages in the history of the basin, alternately considered to record an arc-related environment (e.g. Fragoso-Cesar et al., 1984; Fernandes et al., 1992; Gresse et al., 1996) or a foreland basin (e.g. Gresse et al., 1996; Chemale, 2000; Gastal et al., 2005a) generated by continent–continent collision (Fernandes et al., 1995; Leite et al., 2000). Other authors interpret a syn- to post-collisional strike-slip setting for the basin (e.g. Oliveira and Fernandes, 1992; Brito Neves et al., 1999; Sommer et al., 2006).

More recent work indicates an extensional tectonic regime for the formation of the Camaquã basin (e.g. Fragoso-Cesar et al., 2000, 2001; Almeida, 2001, 2005; Fambrini, 2003, 2005; Janikian et al., 2003, 2005; Pelosi and Fragoso-Cesar, 2003; Leitão et al., 2007; Almeida et al., 2009, 2010) and demonstrates that the recognized compressional deformation is limited to post-depositional strike-slip events (Almeida, 2005). Broadly speaking, the stratigraphic evolution for the volcano-

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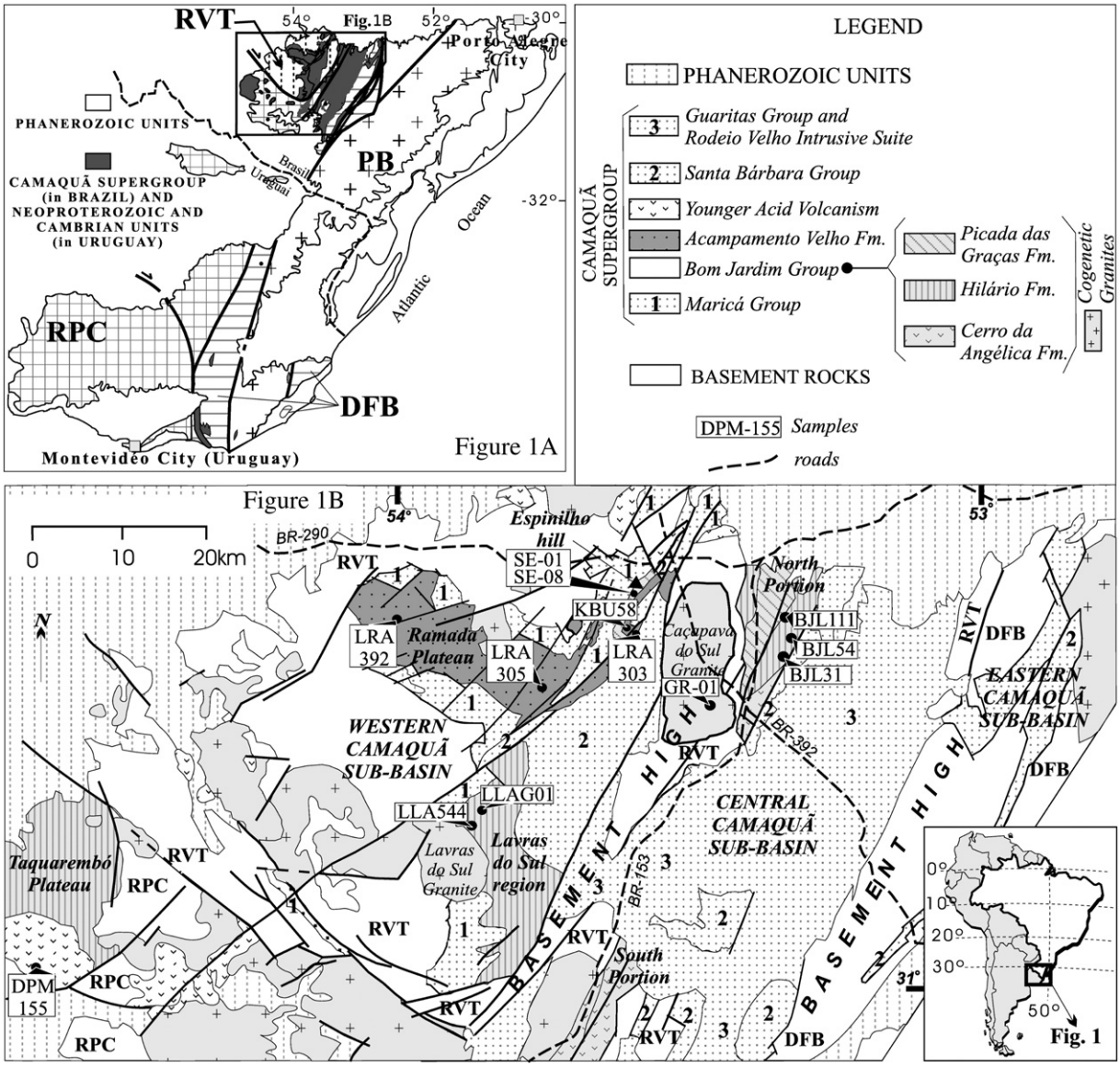

Fig. 1. A — Pre-Ediacaran and Ediacaran–Eocambrian successions of the Rio Grande do Sul State (Brazil) and Ediacaran–Cambrian volcanic and sedimentary units of Uruguay (modified from Fragoso-Cesar, 1991); RPC — Rio de La Plata Craton, DFB — Dom Feliciano Belt (sensu Fragoso-Cesar, 1991), PB — Pelotas Batolith, RVT — Rio Vacacaí Terrane. B — Camaquã Supergroup Units, located at the south-central part of Rio Grande do Sul State (modified from Fragoso-Cesar et al., 2000; Janikian et al., 2005).

sedimentary units of the Camaquã Supergroup, based on stratigraphic measurements, detailed geological mapping (Janikian, 2004), corroborate an extensional origin for the Camaquã Basin between ~605 and 544 Ma. The interpretation of the geotectonic setting of the events of subsidence, deformation, volcanism and related granitic emplacement for the Camaquã Basin as a whole is discussed elsewhere (Almeida et al., 2010).

To put constrains in the magmatic phases of each formation, we present new U–Pb zircon ages for the acid volcanogenic units of the Camaquã Supergroup and integrate these ages with previously obtained data from the Bom Jardim Group and the Acampamento Velho Formation (Janikian et al., 2008). We also performed a Sm–Nd isotopic study on the volcanic rocks, in order to test the hypothesis of different basement sources or contaminants in the genesis of volcanic rocks from distinct parts of the basin. Based on our results, we distinguish a younger acid volcanism, previously considered as part of the Acampamento Velho Formation.

2. The basement of the Camaquã Basin

The basement of the Camaquã Basin is composed of Proterozoic metamorphic and intrusive rocks that crop out in a structural high surrounded by Paleozoic and Mesozoic sedimentary rocks of the Paraná Intracratonic Basin (Fig. 1A). The Precambrian geology has been interpreted differently by various authors, with a conflicting nomenclature proposed for the different cratonic units, suspect terranes, and fold belts (e.g. Soliani, 1986; Chemale et al., 1995; Frantz et al., 1999; Chemale, 2000; Saalmann et al., 2005). The following discussion considers the main divisions proposed by Fragoso-Cesar (1991), as shown in Fig. 1A.

The basement of the Camaquã Basin comprises three main components: (i) the northern portion of the Rio de La Plata Craton, represented by Paleoproterozoic rocks of the Santa Maria Chico Granulite Complex; (ii) the eastern Dom Feliciano Belt, including Paleoproterozoic gneissic and granitic rocks covered by Neoproterozoic