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Precise ID-TIMS U–Pb baddeleyite ages (1110–1112 Ma) for the Rincón del Tigre–Huanchaca large igneous province (LIP) of the Amazonian Craton: Implications for the Rodinia supercontinent

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ABSTRACT

High quality U–Pb (ID-TIMS) baddeleyite ages define the timing of crystallization of the Rincón del Tigre layered intrusion (1110 ± 2 Ma) and the Huanchaca mafic suite (1112 ± 2 Ma) in the Bolivian Precambrian shield – SW portion of the Amazonian Craton. The identical ca. 1110–1112 Ma ages obtained for each (about 500 km apart) suggest these belong to a previously unrecognized LIP. The large area of distribution and the intraplate geochemistry for the 1110 Ma Huanchaca–Rincón del Tigre rocks support a relationship with mantle plume activity pre-dating Rodinia breakup. Contemporary anorogenic magmatism in Amazonia is probably linked to crustal melting caused by the LIP. The newly identified 1110 Ma LIP has a tight age match with intraplate magmatism in the Congo, Kalahari and Indian cratons, and the Keweenawan event of central Laurentia among others. While a reconstruction history of Amazonia and Laurentia is still a matter of debate on paleomagnetic grounds, a reconstruction link with other crustal blocks remains possible.

1. Introduction

Current knowledge of the Precambrian geology of Eastern Bolivia, SW portion of the Amazonian Craton, is largely a consequence of systematic mapping of the so-called *Proyecto Precambrico* – a British-Bolivian cooperative program of the 1980s. This program established the general geologic relations, structural framework and tectonic significance of the major lithostratigraphic units with the support of reconnaissance geochronological and chemical data (Litherland and Bloomfield, 1981; Berrangé, 1982; Litherland et al., 1986, 1989). Subsequent efforts have led to a better understanding of the timing and nature of the particular magmatic–tectonic events (e.g., Boger et al., 2005; Vargas-Mattos, 2006; Cordani and Teixeira, 2007; Santos et al., 2002, 2008; Cordani et al., 2009; Matos et al., 2009; Teixeira et al., 2010).

The geologic and tectonic history of Bolivia correlates well with that of the Brazilian portion of the SW Amazonian Craton where the magmatic, sedimentary, and metamorphic histories have revealed a polycyclic evolution of the continental crust, highlighted within the Mesoproterozoic Rondonian-San Ignacio and Sunsas-Aguapeí provinces (e.g., Sadowski and Bettencourt, 1996; Geraldes et al., 2001; Ruiz, 2005; Teixeira et al., 2010; Bettencourt et al., 2010; Rizzotto et al., 2014) – Fig. 1.

From a paleogeographic perspective, Amazonia is a key landmass within supercontinent cycles and for large igneous provinces – LIPs (e.g., Ernst et al., 2013a, 2014; Reis et al., 2013; Nance et al., 2014). Nevertheless, the position of the proto-Amazonian Craton in plate tectonic reconstructions is a matter of debate, such as within

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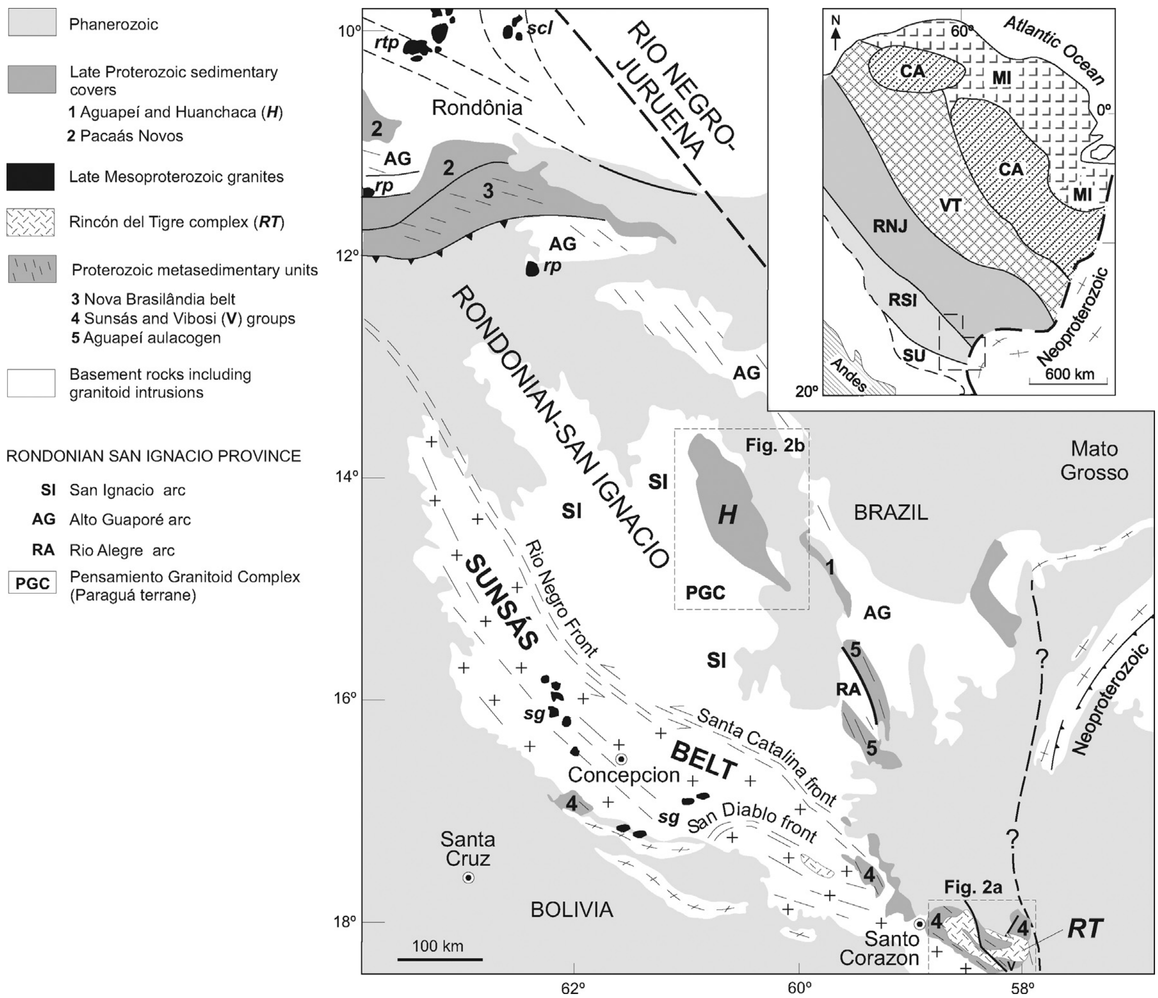

Fig. 1. Geologic–tectonic crustal architecture of the SW Amazonian Craton, showing the investigated areas (squares): the Rincón del Tigre layered intrusion and Huanchaca platform cover where mafic sills occur. The tectonic fronts that outline the northern limit between the Sunsas collisional belt (Sunsas-Aguapeí province) with the Rondonian-San Ignacio province (Pensamiento Granitoid Complex – PGC) are also shown. Geologic units assigned to the Sunsas-Aguapeí province: (a) the Vibosi and Sunsas metasedimentary sequences, the Nova Brasilândia supracrustal belt and Aguapeí aulacogen; (b) platform covers (e.g., Huanchaca, Aguapeí, Pacaás Novos); (c) granitic suites: scl = Santa Clara (1.08–1.07 Ga); sg = Sunsas granites (1.13–1.00 Ga); rp = Rio Pardo (1.05 Ga); rtp = Rondônia Tin Province (0.99–0.97 Ga); rp = Rio Pardo (1.05 Ga). Tectonic provinces (inset): CA = Central Amazonian (>2.6 Ga); MI = Maroni-Itaicaiunas (2.25–2.05 Ga); VT = Ventuari–Tapajós (2.00–1.81 Ga), RNJ = Rio Negro–Juruena (1.80–1.60 Ga), RSI = Rondonian–San Ignacio (1.56–1.30 Ga), SA = Sunsas–Aguapeí (1.20–0.97 Ga).

Adapted from Teixeira et al. (2010), Bettencourt et al. (2010) and Rizzotto et al. (2014).

Nuna (also known as Columbia) and Rodinia supercontinents (e.g., Sadowski, 2002; Tohver et al., 2002, 2006; Li et al., 2008; Fuck et al., 2008; Bispo-Santos et al., 2008; Cordani et al., 2009; Johansson, 2009; Casquet et al., 2010; D'Agrella-Filho et al., 2012; Reis et al., 2013).

The Proterozoic growth of Amazonia occurred through a long-lived soft accretion/collision regime from ca. 2.25 to 1.00 Ga, developed outboard from one Archean nucleus (>2.6 Ga; Central Amazonian province) – see Cordani and Teixeira (2007) for a review. As a consequence of this accretionary history, lithostratigraphic units and metamorphic episodes are progressively younger in time and space toward the SW portion of Amazonia. Hence, the Proterozoic crustal architecture encompasses five sub-parallel, NW-trending tectonic provinces, namely: Maroni-Itacaiúnas (2.25–2.00 Ga), Ventuari-Tapajós (1.98–1.81 Ga), Rio Negro-Juruena (1.78–1.60 Ga), Rondonian-San Ignacio (1.56–1.30 Ga), and Sunsas-Aguapeí (1.28–0.97 Ga) – see inset; Fig. 1. The youngest province – where the Rincón del Tigre–Huanchaca magmatism (the focus of this study) occurs – results from the 1.11–1.00 Ga Sunsas collisional orogeny (see Teixeira et al., 2010 for review). This orogeny marks the final amalgamation of the Amazonian Craton during the assembly of Rodinia, and overlaps in time with the Grenville Orogen of Laurentia (e.g., Tohver et al., 2004, 2006; Cordani et al., 2009; Chew et al., 2011).

Alternative scenarios have been put forward for the Precambrian architecture of Amazonia on the basis of geologic correlations of country rocks, U–Pb data, and regional structures and metamorphic patterns. For instance, a few models argue the Sunsas belt is autochthonous, and evolved from 1.45 to 1.10 Ga (e.g., Santos, 2003; Santos et al., 2000, 2008). Nevertheless, this idea contrasts with the observed allochtonous features of the Sunsás orogen (Litherland et al., 1986, 1989), such as the coherent transport of the folded strata of the main belt against the structurally defined Paraguá Craton or terrane as described below (e.g., Litherland and Bloomfield, 1981). In our view, the Paraguá terrane played an important role in the consolidation of the Rondonian-San Ignacio province according to geologic and tectonic evidence (Bettencourt et al., 2010; see Fig. 1). The Santos model is also inconsistent with the observed decrease in U–Pb ages of granitoid rocks in time and spatially, in coherence with coeval geologic units that are ascribed to the evolution of Paleo- to Mesoproterozoic tectonic provinces (see above). These facts are consistent with a stepwise accretionary outgrowth