OBSERVATIONS ON THE VOLCANISM OF THE TAPAJÓS PROVINCE: UNDERSTANDING OF THE VOLCANIC UNITS

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Introduction

Occurrences of volcanic rocks in several portions of the Amazon craton were generally grouped in the Uatumã supergroup, one of the most complete and best preserved Paleoproterozoic magmatic episodes within the Amazonian craton (Almeida et al., 1981; Costa and Hasui, 1997, Cordani and Brito Neves, 1982; Teixeira et al., 1989; Tassinari and Macambira, 1999; and Santos et al., 2000) This widespread large province outcrops in an area with more than 1,200,000 km^2, and is characterized mainly by intermediate to felsic volcanic sequences, anorogenic granitic intrusions and subordinate plutonic bodies. One region is considered in this preliminary work, the Tapajos Gold province (TGP) that is part of the Tapajós-Parina tectonic Amazon province (Tassinari and Macambri, 1999) that consists of metamorphic, igneous and sedimentary sequences resulted from a ca. 2.10-1.87 Ga oceancontinent orogeny. Massive, bedded, and foliated rhyolitic lava flows, large dikes of banded rhyolite and ignimbrite, highly rheomorphic felsic ignimbrite, ash-fall tuff, felsic crystal tuff, lapilli-tuff, co-ignimbritic breccias; pyroclastic flows, ash-falls, stocks and dikes of granitic porphyry, subordinate equi-granular granitic intrusions and volcanicalstic deposits are the lithotype volcanic sequences that characterized the Uatumã supergroup. Recent studies recognized high-sulfidation (HS) gold mineralization of ca. 1.87 Ga hosted in volcaniclastic deposits and hydrothermal breccias in post-caldera ring volcanoes associated with a nested ash-flow caldera system in the Tapajós Gold Province (Juliani et al., 2002, Juliani et al., 2005). The metallogenetic implications and importance, and the incomplete knowledge of the Amazon Craton, encourage us to continue to investigate the volcanic and geologic processes occurred in this still unknown area specially focusing on the detailed stratigraphic description and reconstruction of the volcanic and volcaniclastic sequences.

Geological framework

The TGP is located in the Central Brazilian Shield in southern Amazonian craton (Almeida et al., 1981; Fig. 1). The craton has been divided into several predominantly NW-oriented tectonic or geochronologic provinces (Tassinari and Macambira, 1999; Santos et al., 2000). The TGP is located on the boundary between the Central Amazonian Province (>2.3 Ga) and ~2.10-1.87 Ga Ventuari-Tapajo´s (Tassinari and Macambira, 1999; Fig. 1) or Tapajos/Parima (Santos et al., 2000) Province.

The Central Amazonian Province is mainly composed of felsic volcano-plutonic and sedimentary units, the Ventuari/Tapajós Province is related to an ocean/continent orogeny with shallow east-dipping subduction accompanied by sedimentation and intrusion of late- to post-tectonic calc-alkaline granites (Santos et al., 2000). The orogenic units are mainly composed of the Jacareacanga Group (~2.10 Ga detrital zircons), which is a low-grade metamorphic volcano-sedimentary sequence, and by the Cuiu´/Cuiu´ and Parauari calcalkaline magmatic arcs (Santos et al., 2000). The Cuiu´/Cuiu´ arc (~2.01-1.90 Ga) is composed of migmatites, gneisses, amphibolites and metasomatised granitoids and is cut by granites, granodiorites and tonalites of the Creporizão intrusive suite (1.97-1.90 Ga) (Ricci et al., 1999; Klein and Vasquez, 2000; Vasquez and Klein, 2000). All these rocks are intruded by granitoids of the Parauari intrusive suite (~1.92-1.88 Ga) and by gabbroic rocks of the

Ingarana intrusive suite (1.89 Ga) (Almeida et al., 2000; Bahia and Quadros, 2000). The late- to post-orogenic volcanic rocks of the TGP are represented by the Bom Jardim Formation followed by the Iriri Group; the latter is divided into the volcanic Salustiano and Aruri Formations dated at 1.88 Ga (Almeida et al., 2000; Klein and Vasquez, 2000). The basal Bom Jardim Formation is composed of andesitic and dacitic flow tuffs, which represent the precaldera phase. The overlying Salustiano and Aruri formations represent the caldera- related sequences with ash flow tuffs, rhyolitic flows, and rhyolitic epiclastic volcanic rocks. Postcaldera rocks have been formed mainly in rhyolitic composite volcanoes and domes, in which remains of radiating lava flows, crystal and welded tuffs, and breccias have been identified. These post-caldera units were cut by inverted cone shaped hydrothermal breccia bodies, where

the high-sulfidation epithermal gold deposit occurs (Juliani et al., 2005). Genetically linked to this mineralization, gold–copper and copper–molybdenum porphyry- type deposits were also recognized (Juliani et al., 2002, 2008).

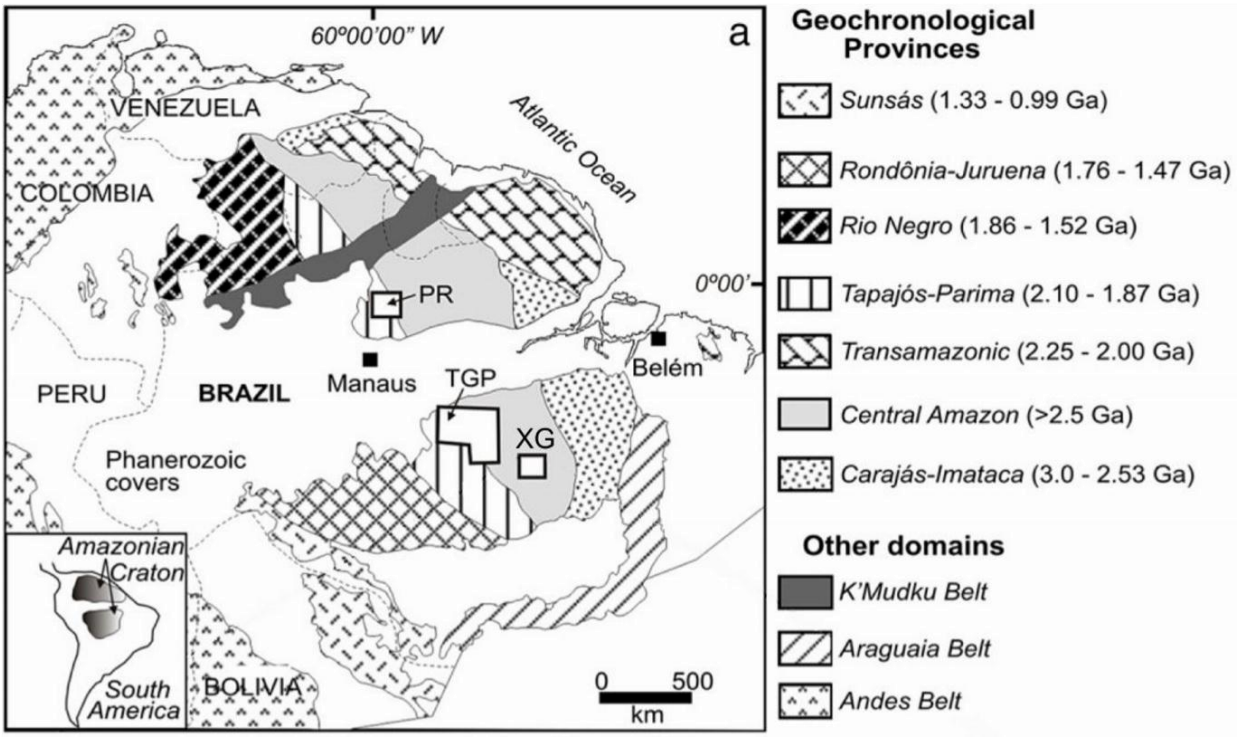

Fig. 1. Geochronological provinces of the Amazon Craton according to Santos et al. (2000). PT: Pitinga Region; TGP: Tapajós Gold Province; Xgú: Xingu Region.

Proposal

There is an ample literature on the Uatumã magmatism, but the conclusions concerning ages, composition, and stratigraphic correlation are still divergent. The Uatumá supergroup is heterogeneous and includes several volcanic units and according to the geographic area, received different denominations as we described above. We saw that the Tapajós Gold Province is related to a volcanic continental-arc tectonic setting but also with post-orogenic processes probably strongly related to extensional behavior. Intermediate to felsic volcanic sequences and plutonic bodies, andesitic and dacitic flow tuffs, rhyolitic flows, caldera-related sequences with ash flow tuffs and rhyolitic epiclastic volcanic rocks and A-type granitic intrusions are represented in this region. High-K to shoshonitic calc-alkaline signature of the Sobreiro Formation (Fernandes, 2011) suggests magmatism in a mature volcanic arc to postorogenic transitional scenario although an alternative model for generation of high-K calcalkaline magmas by anatexis of metaluminous metamorphic crustal rocks unrelated to subduction arises from experimental petrology (Roberts and Clemens, 1993; Clemens, 1999). On the other hand the evolution of the Santa Rosa Formation appears to be related to fissurefed eruption similar to the formation of the Sierra Madre Occidental in Mexico (AguierreDiaz and Labarthe-Hernandez, 2003). This mechanism could explain, in part, the origin of this giant felsic magmatic province. An important discovery in the last years is the recognition of large Silic Large Igneous provinces (SLIP) that represent a new class of large igneous provinces recognized in the past 25 yr (Bryan et al., 2013), where the scale of the silicic magmatism is similar to the better-known continental flood basalt provinces and basaltic volcanic rifted margins, and eruptive volumes are an order of magnitude larger than silicic volcanism generated in arc-rift to back-arc extensional settings (Bryan et al., 2002). We believe that part of the Amazon Craton could be a large paleoproterozoic Silicic LIP. The large volumes of rhyolite generated in these events require partial melting of the crust, and this is achieved by the underplating and intrusion of large igneous province–scale intraplate basaltic magmas, and thus silicic large igneous provinces can be thought of as "hidden" mafic large igneous provinces (Ernst, 2013). New researches are required to reinforce this concept but many

other data already collected point to this idea. The exploration of the old volcanism, present in the TGP will strongly contribute to the knowledge of several units that form the Uatumã supergroup, especially related to the different eruptive style that produced them. This job has the aim to give a preliminary overview of the stratigraphy, facies-description, and understanding of the volcanic units existing in the Tapajós region to better constrain their origin, genesis mechanisms, and stratigraphic relationship.

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