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Neoproterozoic subaqueous extrusive–intrusive rocks in the Playa Hermosa Formation in Uruguay: Regional and stratigraphic significance

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ABSTRACT

Volcanic rocks in southern Uruguay are linked to an extensional tectonic regime related to the post-collisional Brasiliano–Pan African orogenic cycle. The ca 580 Ma magmatic event is recorded in the Playa Hermosa Formation. In the upper section of this formation several units were defined. The basal unit is a quartz–syenite brecciated deposit, interpreted as the result of explosive episodes of shallow plutonic quartz–syenite intrusion with signs of hydrothermal alteration. Sedimentary and basaltic lithoclasts are occasionally present in the breccia, implying the emplacement of basalts before of that magmatic event. The middle unit is composed of trachytic hyaloclastites. Local distribution and textural evidence indicate that trachytic volcanic pulses have been followed by an explosive event that produced brecciated deposits. The upper unit of the studied sequence is composed of basalts with thin sedimentary intercalations. Most of the outcropping basalts display the typical micro- and macro-features of hyaloclastites; distinctive of extrusions occurred in wet sediments previous to lithification. Basaltic feeder dikes are common in the lower unit. The study of flow structures in the quartz–syenite brecciated deposits led to the recognition of two basaltic inputs. Such differences are related to the intensity of chloritic alteration, which would be related to water contamination. Basaltic peperites are one of the most impressive features of the Playa Hermosa Formation. Hyaloclastites and peperites largely represented among the studied volcanic rocks, and devitrification textures are all evidences of magma/seawater interactions. In the basaltic fragments of the peperites well preserved orange palagonite appears, while the sandstone fractions have lithic clasts of felsic volcanic rocks, such as rhyolitic lavas with perlitic cracks and lithophysae-like structures. Palagonite chemical analyses suggest marine environment and, at the same time, it proves that the studied section lacks of regional metamorphism. The felsic volcanic lithoclasts contained in sandstones could be related to the felsic volcanic lobes intercalations. The studied magmatic event is important in order to formulate correlations with other Neoproterozoic units distributed around the Dom Feliciano belt, like Camaquã and Campo Alegre basins (Brazil), and in the Kaoko belt (NW Namibia) in Africa. Also, Playa Hermosa Formation presents glacigenic features that are well documented, and reinforce the volcanism around 580 Ma in the Rio de la Plata Craton.

1. Introduction

The recognition of peperites and hyaloclastites (magma/wet sediment and/or water interaction, White et al., 2000) in the geological record is common and unequivocal way of confirming the simultaneous nature of sedimentation and volcanism. The Precambrian record has few references about these conspicuous structures, since they are generally affected by metamorphism and deformation, obliterating the original textures. There are examples in Paleoproterozoic rocks of Australia (Koongie Park Formation), where Orth and McPhie (2003) described interaction of magma (rhyolitic sills) and wet sediments (sand and mudstones). Calver et al. (2004) in Tasmania describes rhyodacite flows underlying deposits related to glacigenic episode around 580 Ma. In the Campo Alegre Neoproterozoic basin, southern Brazil, Citroni et al. (2001) mentioned a hyaloclastic fragmentation and possible peperites, and Janikian et al. (2003) described peperites in the Cerro da Angélica Formation (Bom Jardim Group) of the Camaquã Supergroup (sensu Fragoso Cesar et al., 2003) with an age ca. 590 Ma (Remus et al., 1999; Janikian et al., 2003, and references therein).

The present study is focused on the Playa Hermosa Formation (Playa Verde Basin), located in southern Uruguay near Piriápolis City, at 34°49′41″ S/55°19′00″ W (Fig. 1), which integrate the sedimentary cover of the Rio de la Plata craton. This Basin contains three units: the Playa Hermosa, Las Ventanas, and San Carlos Formations. Well preserved hyaloclastites and peperites are an evident feature of the Playa Verde Basin in Southern Uruguay (Figs. 2 and 3).

The Playa Hermosa Formation was defined by Masquelin and Sánchez Bettucci (1993) as a turbiditic sequence containing conglomerates

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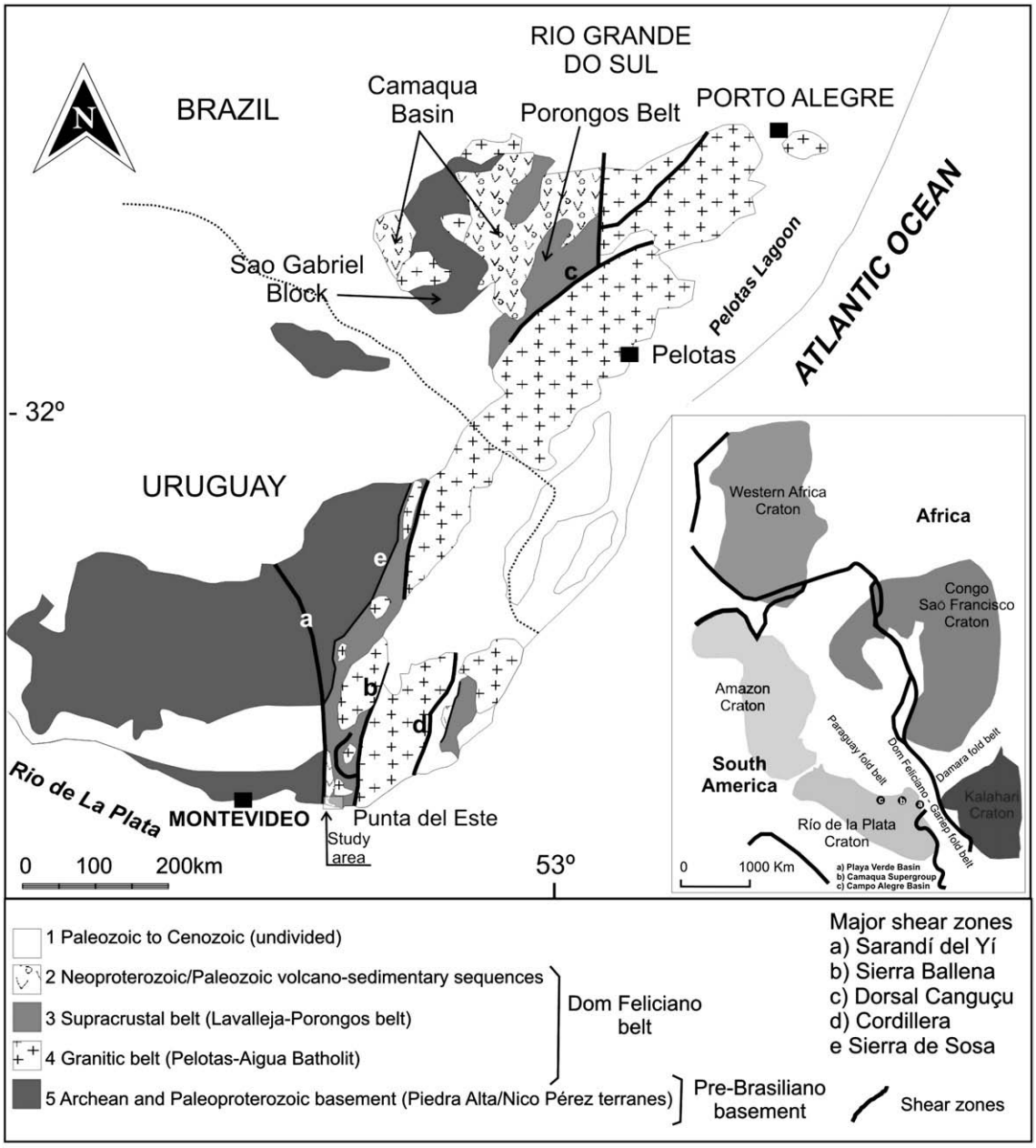

Fig. 1. Simplified geological sketch of Uruguay and Rio Grande do Sul, showing the distribution of Neoproterozoic/Paleozoic volcano–sedimentary sequences.

deposited in submarine fans and canyons. Pazos et al. (1998, 2003) suggested a fan delta system with subaqueous and sub-aerial facies related to a glacial input. According to Sánchez Bettucci and Pazos (1996), the Playa Verde Basin started the infilling in the late Neoproterozoic and it may have ended in the early Ordovician (e.g. San Carlos Formation). The Playa Hermosa Formation is divided into a lower and upper members (Sánchez Bettucci and Pazos, 1996). Pazos et al. (1998, 2003, 2008) described glacial influence in the lower member based on features like dropstones, diamictites, and rhythmites. Sánchez Bettucci and Pazos (1996) mentioned that the upper member of the Playa Hermosa Formation is composed of sandstones and conglomerates, and is cut by numerous dikes and sills. The upper part of the lower member, which is contemporary with the glacial-related deposits of the Playa Hermosa Formation, was developed during the volcanic event that conform the Sierra de Las Animas Complex (Sánchez Bettucci, 1997, 1998; Sánchez Bettucci et al., 2003). It consists of a bimodal volcanic and subvolcanic suite exposed close to Piriápolis City (Fig. 2). This magmatism is assigned to an extensional event that marks the end of the late Neoproterozoic Brasiliano–Pan African orogenic cycle (Sánchez Bettucci, 1997, 1998; Sánchez Bettucci et al. 2001, 2003; Sánchez-Bettucci et al. 2004). The volcanic complex consists of trachytes, rhyolites, ignimbrites, basalts and intercalated sediments. Conduits for these volcanic eruptions have not been identified, but the existence of numerous north–south trends of basic and acidic dikes suggests that the feeder fractures could have an equivalent orientation.

Isotopic ages for different rock types from the Sierra de Las Animas Complex range from 615 to 490 Ma (Sánchez Bettucci, 1997, and references therein; Sánchez Bettucci and Rapalini, 2002; Oyhantçabal et al., 2007).

The aim of this paper is the description of the products that resulted from the interaction between magmas and wet sediments and/or water. Also, the study of an important breccia deposit related