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# Paleomagnetic study on mid-Paleoproterozoic rocks from the Rio de la Plata craton: Implications for Atlantica

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## ABSTRACT

The first successful paleomagnetic study on middle Paleoproterozoic rocks from the Rio de la Plata craton is reported. Samples collected from the Soca and Isla Mala granitic bodies, located in southern Uruguay, provided characteristic remanences that were used to compute the first paleomagnetic poles for the craton for ca. 2.05–2.02 Ga. The poles were complemented by a virtual geomagnetic pole from the slightly older Marincho and Mahoma complexes. The paleomagnetic results suggest fast apparent polar wander at high paleolatitudes for the Rio de la Plata craton. Comparison with coeval poles from the Guiana, Congo–São Francisco and West African cratons indicates that a configuration of Atlantica that resembles their Western Gondwana fit is not supported by paleomagnetic data. The geologic similarities in these four cratons are supportive of a major crustal forming event between 2.2–2.0 Ga. A modified configuration for Atlantica is proposed that is consistent with our new (and older) paleomagnetic data. Atlantica was assembled at 2.1–2.05 Ga at polar latitudes and drifted towards the equator soon afterwards.

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## 1. Introduction

Scientific interpretation of the Precambrian geological record experienced a major step forward with the hypothesis of the Mesoproterozoic supercontinent of Rodinia proposed over twenty years ago (McMenamin and McMenamin, 1990; Dalziel, 1991; Hoffman, 1991). This generated great interest in paleogeographic reconstructions throughout the Precambrian and fostered the application of several different techniques to unravel the global paleogeographic and tectonic evolution along most of Earth history (Rogers and Santosh, 2002, 2004). Paleogeographic models for the Neoproterozoic have shown significant advances in the last decade (e.g. Meert and Torsvik, 2003; Li et al., 2008; Zhang et al., 2012), although important controversies remain (e.g. Evans, 2009; Meert, 2012; Piper, 2013). Precambrian paleogeographic reconstructions are hindered by several factors (Meert, 2014) including the scarcity and low reliability of paleomagnetic data. In particular, paleogeographic models for the Mesoproterozoic and Paleoproterozoic are still generally sketchy (e.g. Meert, 2002; Pesonen et al., 2003; Li et al., 2008; Meert, 2014). Besides the reliability of paleomagnetic data itself (e.g. Van der Voo, 1990), accurate and precise dating of the rocks is of paramount importance in Proterozoic paleomagnetism applied to

paleoreconstructions and has become a pre-requisite for any paleomagnetic data to be considered useful (e.g. Meert, 2003).

Precambrian paleomagnetic data for the Rio de la Plata craton are scarce. Rapalini et al. (2013) presented an updated database for the late Neoproterozoic and Teixeira et al. (2013) published the first pre-Neoproterozoic data from ca. 1.8 Ga tholeiitic dykes in the Piedra Alta terrane of Uruguay.

In order to provide the first paleomagnetic constraints for the paleogeographic position of the Rio de la Plata craton in the middle Paleoproterozoic (2.1–2.0 Ga), a reconnaissance paleomagnetic study was carried out on well-dated undeformed granitoids exposed in the Piedra Alta terrane (Bossi et al., 1993) of the Rio de la Plata craton in central southern Uruguay. In this paper, paleomagnetic results obtained from the 2.07 Ga Isla Mala and 2.05 Ga Soca granitic bodies along with preliminary results from the ca. 2.1 Ga Mahoma and Marincho granitoids provide the first paleomagnetic pole positions for Rio de la Plata in the middle Paleoproterozoic. These results are compared with approximately coeval data from other cratons in South America and Africa that have been interpreted as part of the hypothetical landmass called Atlantica (Ledru et al., 1994; Rogers, 1996; Rogers and Santosh, 2004).

## 2. Geologic background and sampling

The Rio de la Plata craton (RPC) is subdivided in Uruguay into two tectonostratigraphic units: the Piedra Alta (PAT) and Nico Pérez (NPT)

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terrane (Fig. 1). The Palaeoproterozoic PAT is constituted (Hasui et al., 1975) of plutonic, granite-gneissic terrains and volcano-sedimentary belts of low to medium metamorphic grade. The basement shows a well-defined E–W structural trend. Bossi et al. (1993) defined the PAT as that part of the RPC located to the west of the Sarandí del Yí shear zone (Fig. 1). Its extension towards the west is unknown where the

RPC is covered by the Chaco-Pampean plains in Uruguay and eastern Argentina. Limited geochronologic and isotopic data from oil-well samples suggest that it may extend up to the foothills of the Eastern Pampean ranges in central Argentina (Rapela et al., 2007). Peel and Preciozzi (2006) suggested that the PAT represents a juvenile Palaeoproterozoic unit that was tectonically stable from at least 1.7 Ga (i.e. was not

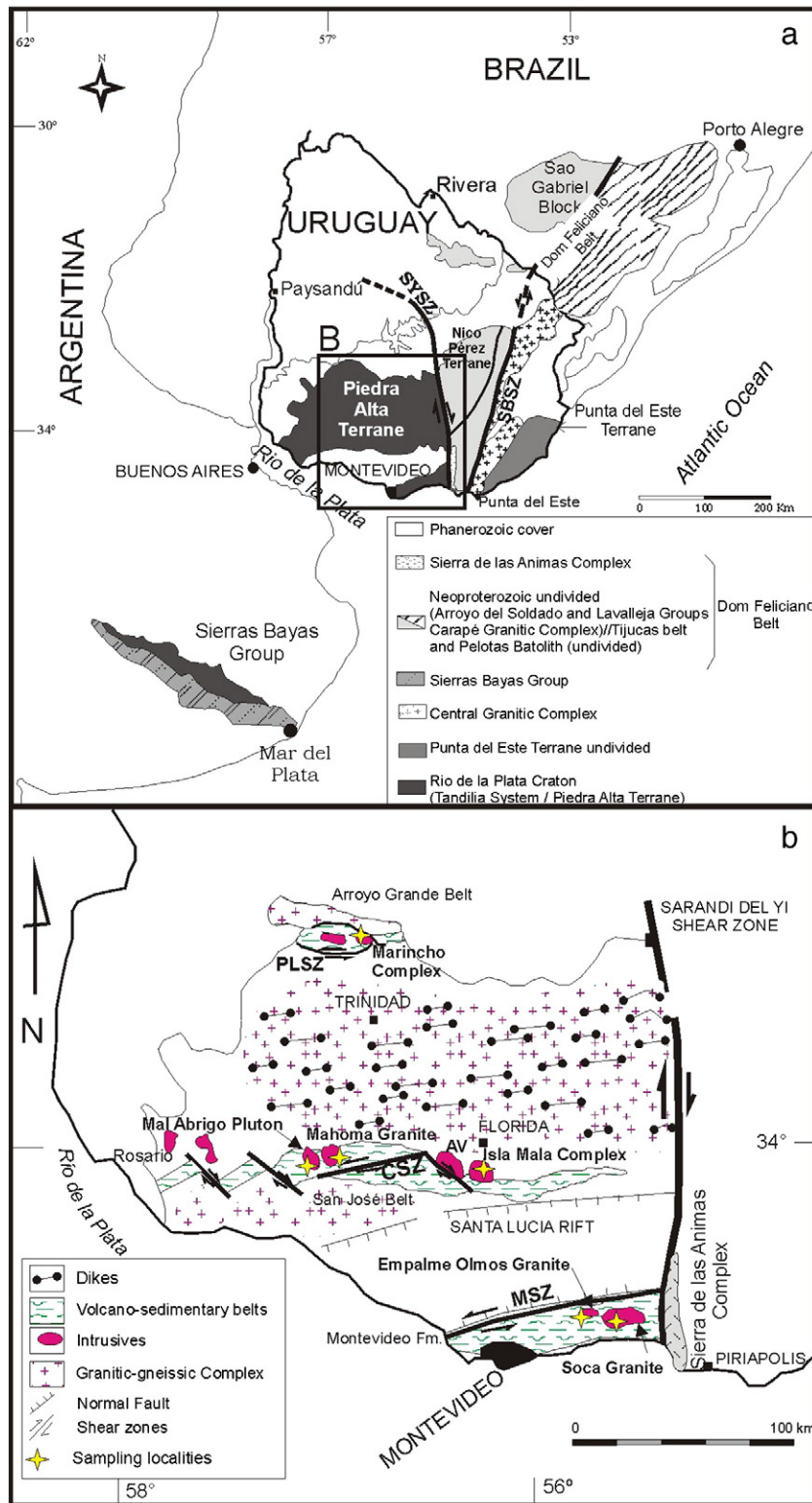


Fig. 1. a) Main morphotectonic units of eastern Argentina, Uruguay and southern Brazil encompassing the Río de la Plata craton. b) Geologic sketch of the Piedra Alta Terrane in western Uruguay with location of the main Paleoproterozoic intrusives. Stars indicate the sampling localities. AV: Arroyo de la Virgen pluton. MSZ: Montevideo shear zone; PLSZ: Paso Lugo shear zone.

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