



MESOZOIC PALEOMAGNETIC DATABASE FOR SOUTH AMERICA: GEOMAGNETISM AND TECTONICS

Invited

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Abstract

The Mesozoic era in South America was marked by two important tectonic events: the disclosure of Gondwana from Pangea, and the breakup of Western Gondwana. Both events started during Early Jurassic, and were preceded by intense magmatic activity. Besides the rift-related tholeiitic magmatism the South American plate was also affected by voluminous igneous activity mainly of alkaline character throughout the Mesozoic. All these rocks are important sources of paleomagnetic data as they may furnish absolute dated paleomagnetic poles. In spite of this, and the recent efforts of many authors, the post-Paleozoic paleomagnetic dataset for South America is still poor. We will present some new results from the Early Cretaceous Parana Magmatic Province (PMP), from the Early Jurassic of the northeastern border of the province, and the Permo-Triassic of the alkaline Alto Paraguay Province (APP). The former allows the construction of magnetostratigraphic sequences from which an anisotropic behavior of the virtual geomagnetic poles during reversals or excursions was inferred. In the APP rocks anomalous directions within dykes and in one flow suggest the record of at least one polarity inversion while the rocks were cooling.

Resumo

A era Mesozóica na América do Sul foi marcada por dois eventos tectônicos importantes: o desligamento do Gondwana do Pangea e a quebra do Gondwana ocidental. Ambos os eventos começaram durante o Jurássico Inferior e foram precedidos por intensa atividade magmática. Além do magmatismo toleítico relacionado a rift, a placa Sul Americana foi também afetada por atividade ígnea de caráter alcalino através do Mesozóico. Todas essas rochas são importantes fontes de dados paleomagnéticos pois podem fornecer pólos com idades absolutas controladas. Apesar disso e dos esforços recentes de vários autores, a base de dados mesozóicos para a América do Sul ainda é pobre. Apresentaremos aqui novos resultados do Cretáceo Inferior da Província Magmática do Paraná (PMP), do Jurássico Inferior da borda nordeste da



província e do Permo-Triássico da Província alcalina alto Paraguai (APP). Os primeiros permitem construir sequências magnetoestratigráficas das quais infere-se comportamento anisotrópico dos pólos geomagnéticos virtuais durante inversões de polaridade ou excursões. Nas rochas da APP direções anômalas registradas por diques e um derrame sugerem o registro de pelo menos uma inversão de polaridade à medida que as rochas esfriavam.

Introduction

The Mesozoic era in South America is marked by important tectonic events: the disclosure of Gondwana from Pangea, and the breakup of Western Gondwana. Both events started during Early Jurassic (Jokat et al., 2003), and were preceded by intense magmatic activity. The separation of South America from Africa progressed northwards and resulted in open marine conditions by about 110Ma. Besides the rift-related tholeiitic magmatism the South American plate was also affected by voluminous igneous activity mainly of alkaline character throughout the Mesozoic. All these rocks are important sources of paleomagnetic data for constructing and/or calibrating the apparent polar wander path as they may furnish absolute dated paleomagnetic poles. In spite of this, and the recent efforts of many authors, the post-Paleozoic paleomagnetic dataset for South America is still poor. The only well controlled period is the Lower Cretaceous for which a considerable number of high quality paleomagnetic poles are available (Font et al., 2009, and cited references).

The Parana Magmatic Province (PMP) and the surrounding associated intrusive rocks were the source of many paleomagnetic poles for the time interval of ~140-120Ma (Ernesto et al., 1990, 1996, 1999; Raposo et al., 1995; Raposo et al., 1998; Alva-Valdívia et al., 2003; Mena et al., 2006). Alkaline igneous activity of Permo-Triassic age (Comin-Chiaramonti et al., 2007) was reported on the western side of the PMP, and the northeastern border is characterized by abundant Late Cretaceous alkaline rocks. Recently, evidences of Lower Jurassic dykes in the area have also been reported (Guedes et al., 2005).

In this presentation we will review the Mesozoic database for South America, and discuss some implications for the paleogeographic reconstructions, particularly related to the South Atlantic opening. We will also present some geomagnetic characteristics displayed by some data collections.

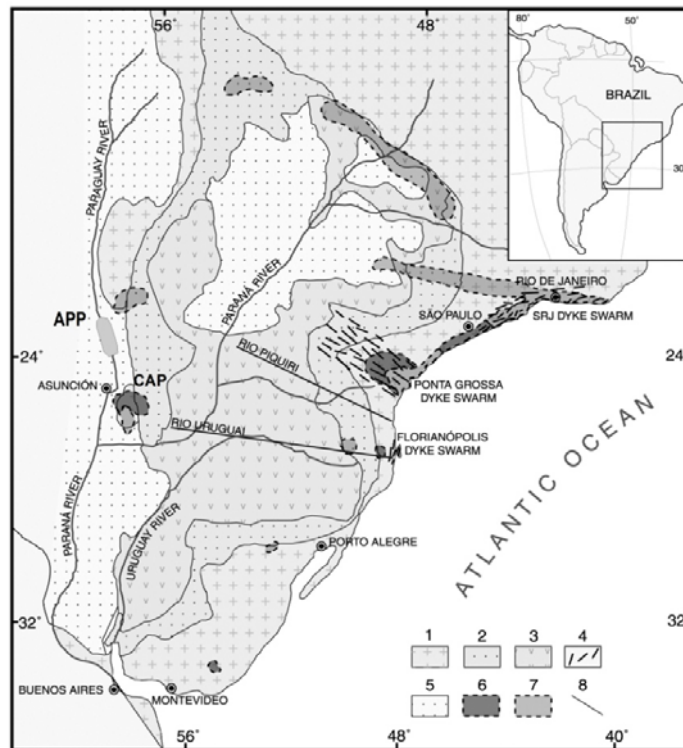


Figure 1. Generalized map of the Paraná Basin showing the location of the surrounding alkaline provinces from which paleomagnetic data are available. CAP = Central Alkaline Province of Paraguay; APP = Alto Paraguay Province. Other legends: 1) pre-Devonian crystalline basement; 2) pre-volcanic sediments; 3) flood volcanic of the Parana Basin; dyke swarms; 5) post-volcanic sediments; 6) main areas of Early Cretaceous alkaline rocks; 7) main areas of Late Cretaceous alkaline rocks; 8) tectonic and/or magnetic lineaments.

The new contributions

The Serra Geral Formation comprises the tholeiitic extrusive rocks of the PMP in the Brazilian territory, from which a large amount of paleomagnetic data was generated. The southern cliffs were most favorable for establishing magnetostratigraphic sections (Ernesto et al., 1990). However, the methodological procedures employed in that analysis are now old fashioned. Therefore, a considerable part of the old sample collection has been re-analyzed according to the modern methodologies. Furthermore, a new section (TS) more densely sampled has been analyzed. The new data does not introduce any substantial modification in the paleomagnetic pole parameters but makes the identified polarity intervals and transitional directions more reliable. An analysis of the virtual geomagnetic pole (VGP) paths indicates that they may follow an anisotropic or confined pattern.

The Serra do Mar Province includes the stocks and dykes in the São Sebastião Island, the dykes along the coast between the cities of Santos besides alkaline complexes with ages 90-70Ma. The dykes along the coast are of tholeiitic (Early Cretaceous) and alkaline (Late Cretaceous) compositions (Marques et al.,



1992). Most of the samples of the first group have the same geochemical signature as the Serra Geral rocks, however a smaller group show slight differences and paleomagnetic directions similar to the Early Jurassic rocks, and agree with the radiometric dating (Guedes et al., 2005). These data helps to define the Lower Jurassic segment of the APWP of South America but also put some new constraints on the breakup history of the western Gondwana.

The various alkaline plugs of the Alto Paraguay Province with ages of about 241 Ma gave a paleomagnetic pole for the Early Triassic. They show normal and reversed polarities and a large number of anomalous directions. Consistent direction variation patterns within some dykes and in one flow topping the Pao de Açucar hill suggest that actually at least one polarity transition was recorded as the rocks were cooling.

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