PRELIMINARY PALEOMAGNETIC POLE FROM SEDIMENTARY ROCKS OF RORAIMA SUPERGROUP, NORTHERN AMAZONIAN CRATON

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ABSTRACT

In this study, we present paleomagnetic data obtained for samples from sedimentary rocks belonging to the Roraima Supergroup, which crops out in northern Roraima State (Guiana Shield, Amazonian Craton). Its maximum age is constrained by the 1980-1960 Ma (U-Pb) basement volcanic rocks from the Surumu Group, and the ~1780 Ma mafic sills from Avanavero Event cutting them establish its minimum age. U-Pb dating carried on tuffs within the sediments best constrain the age of the Roraima sedimentary rocks at 1873 ±3 Ma. AF and thermal treatment revealed northwestern/northeastern directions with moderate upward inclinations for the analyzed samples. Site mean direction cluster around Dm = 1.2°, Im = -52.4° (α95 = 9.6°, N = 39), which yielded a preliminary paleomagnetic pole (SGR pole) for the Guiana Shield, located at 296.4°E, 53.2°S (dp = 9.1, dm = 13.2). Magnetic mineralogy experiments show that magnetization in these rocks is carried by magnetite and hematite. The SGR pole contributes to the APWP traced for the Guiana Shield during Paleoproterozoic and to understand the geodynamic evolution of this unit in the paleogeographic reconstructions of Columbia.

Keywords: Paleomagnetism, Amazonian Craton, Roraima Supergroup.

RESUMO

Neste estudo, apresentamos os dados paleomagnéticos obtidos para as rochas sedimentares pertencentes ao Supergrupo Roraima que afloram no norte do Estado de Roraima (Escudo das Guianas, Cráton Amazônico). A idade máxima destas rochas é definida pelas idades de 1980 Ma e 1960 Ma (U-Pb) obtidas para rochas vulcânicas do embasamento (Grupo Surumu) e a idade mínima é estabelecida pelas idades em torno de 1780 Ma obtidas para as soleiras máficas do Evento Avanavero, as quais intrudem estas rochas. Uma datação U-Pb realizada em tufos encontrados nos sedimentos define melhor a idade do Supergrupo Roraima em 1873 ±3 Ma. Os tratamentos por campos magneticos alternados (CA) e térmico revelaram direções noroeste/nordeste com inclinações negativas moderadas para as amostras analisadas. As direções médias por sítio está agrupada em torno da direção média Dm = 1.2 °, Im = -52.4 ° (α95 = 9.6 °, N = 39), que forneceu um polo paleomagnético preliminar (polo SGR) para o Escudo das Guianas, localizado em 296.4°E, 53.2°S (dp = 9.1, dm = 13.2). Experimentos de mineralogia magnética mostram que a magnetização dessas rochas é portada pelos minerais magnetita e hematita. O pólo SGR contribui para a extensão da CDPA traçada para o Escudo das Guianas durante o Paleoproterozoico e para a compreensão da evolução geodinâmica desta unidade nas reconstruções paleogeográficas do Supercontinente Columbia.

Palavras Chave: Paleomagnetismo, Cráton Amazônico, Supergrupo Roraima.

1. Introduction

The Amazonian Craton is considered one of the largest cratonic areas of the world and so, it is considered an important piece in paleogeographic reconstructions of supercontinents as, for example, Columbia.

Unfortunately, the quantity and quality of paleomagnetic data available for the Amazonian Craton are still scarce, mainly for the Paleoproterozoic. So, new key paleomagnetic poles for the Amazonian Craton are crucial to answer some questions concerning the formation of Columbia and the geodynamic evolution of the Amazonian Craton in global reconstructions. Here, we present new paleomagnetic data obtained for samples from sedimentary rocks belonging to Roraima Supergroup, which crops out in the northern Roraima State (Guiana Shield, Amazonian Craton).

2. Geological Setting

The Amazonian Craton is one of the greatest cratonic areas in the world. It is located in the northern part of South America, and comprises two small Archaean blocks encircled by a Paleoproterozoic mobile belt (Maroni-Itacaiunas Province). This land mass was subjected to a subduction-related processes in its southwestern part, where a succession of magmatic arcs with minor or major mantle-derived juvenile material developed the Ventuari-Tapajós Province (1950-1800 Ma), the Rio Negro-Juruena Province (1800-1550 Ma), and the Rondoniano-San Ignacio Province (1550-1300 Ma). A collisional event is related with the formation of the Sunsás Province, at *ca*. 1300-1000 Ma ago (Tassinari *et al*., 2000). Our investigated area is located inside the Ventuari-Tapajós Province. The Roraima Supergroup is the name given to several Paleoproterozoic sedimentary deposits that are distributed continuously and discontinuously in the Guiana Shield (Reis, Carvalho, 1996). This supergroup is composed predominantly by horizontal or slightly dipping fluvial sandstones, whose sediments are derived from Trans-Amazonian Mountains (Reis *et al*., 1990). Its maximum age is constrained by the basement of volcanic rocks from the Surumu Group, dated 1980-1960 Ma (U-Pb), and the minimum age by the mafic sills from the Avanavero Event that cut them, dated ~1780 Ma. The U-Pb dating carried on tuffs within the sediments constrain better the age of the Roraima sedimentary rocks at 1873 ±3 Ma (Santos *et al.*, 2003).

3. Methods

For the paleomagnetic study the cylindrical cores were cut into specimens 2.2 cm height. Specimens were submitted to conventional stepwise thermal and alternating magnetic field (AF) demagnetization to isolate the characteristic remanent magnetization (ChRM) component carried by the samples. Steps of 2.5 mT (up to 15 mT) and 5 mT (15 mT - 100 mT) were employed for AF demagnetization using a 2-axis tumbler Molspin AF demagnetizer, and steps of 50° C (from 150° C up to 500° C), and 20° C (from 500° C up to 700° C) for the thermal demagnetization using a Magnetic Measurements TD-48 furnace. Remanent magnetization was measured using a JR-6A spinner magnetometer (AGICO, Czech Republic). Orthogonal projections (Zijderveld, 1967) and principle components analysis (Kirschvink, 1980) were used to determine magnetization components. At least 4 demagnetization steps were used to calculate vectors and an upper limit for mean angular deviation (MAD) of 8° was used. Fisher's (1953) statistics was employed to calculate mean site directions and the paleomagnetic pole.

4. Preliminary results and discussions

Thermal demagnetization was usually effective in isolating northwestern/northeastern directions with moderate upward inclinations which represent the characteristic remanent magnetization (ChRM) direction for most of the analyzed specimens (Fig. 1a). Site mean directions cluster around the mean Dm = 1.2°, Im = -52.4° ($\alpha 95$ = 9.6°, N = 39), which yielded a preliminary paleomagnetic pole (SGR pole) for the Roraima Supergroup, located at 296.4° E, 53.2° S (dp = 9.1, dm = 13.2). Magnetic mineralogy experiments show that the magnetization of these rocks is carried by magnetite and hematite. As an example, the 'wasp-waisted' type hysteresis curves obtained for rock samples indicate the presence of a mixture of low and high coercivity minerals (Fig. 2). The presence of magnetite and hematite is also evidenced by the normalized intensity curves during thermal demagnetization (Fig. 1b).

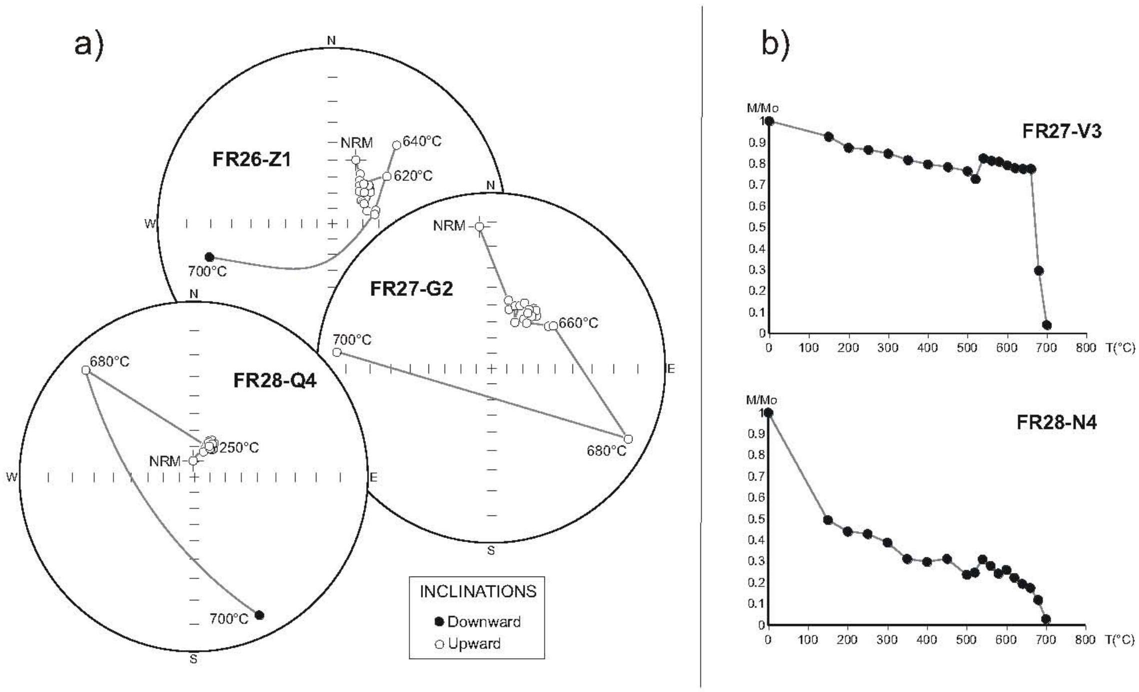

Figure 1. (a) Stereographic projections of examples of thermal demagnetization. Full (empty) circles represent downward (upward) inclinations; (b) examples of normalized intensity curves (M/Mo *vs*. temperature) showing the presence of magnetite and hematite.

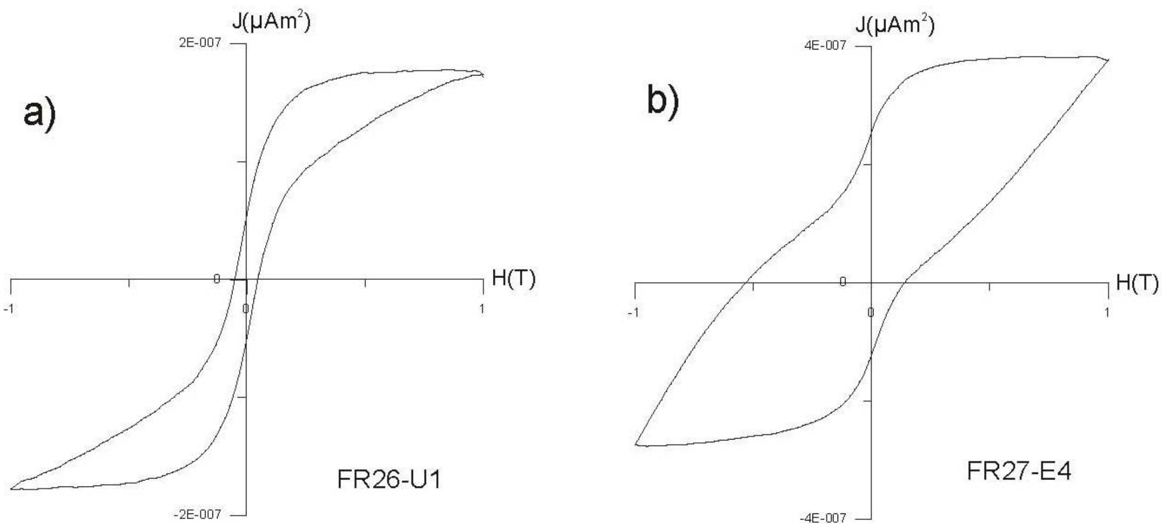

Figure 2. Hysteresis curves (magnetic moment (J) *vs*. magnetic field (H)) characteristic of mineral mixture, probably magnetite and hematite.

Regarding the paleomagnetic SGR pole obtained for Roraima Supergroup, its age may be constrained by the intercalated tuffs whose age is 1873 ±3 Ma (Santos *et al.,* 2003). Thus, the SGR pole may be used to extend the APW path traced for Guiana Shield between 2070 Ma and 1960 Ma (Bispo-Santos *et al*., 2014) (Fig. 3). However, as the ChRM directions are close to the present geomagnetic field, a detailed check of its primary nature will be performed by a fold test. Finally, it is expected that the preliminary paleomagnetic results of the Roraima Supergroup contribute to the elucidation of the geodynamic evolution of the Amazonian Craton in the Columbia paleogeographic reconstructions.

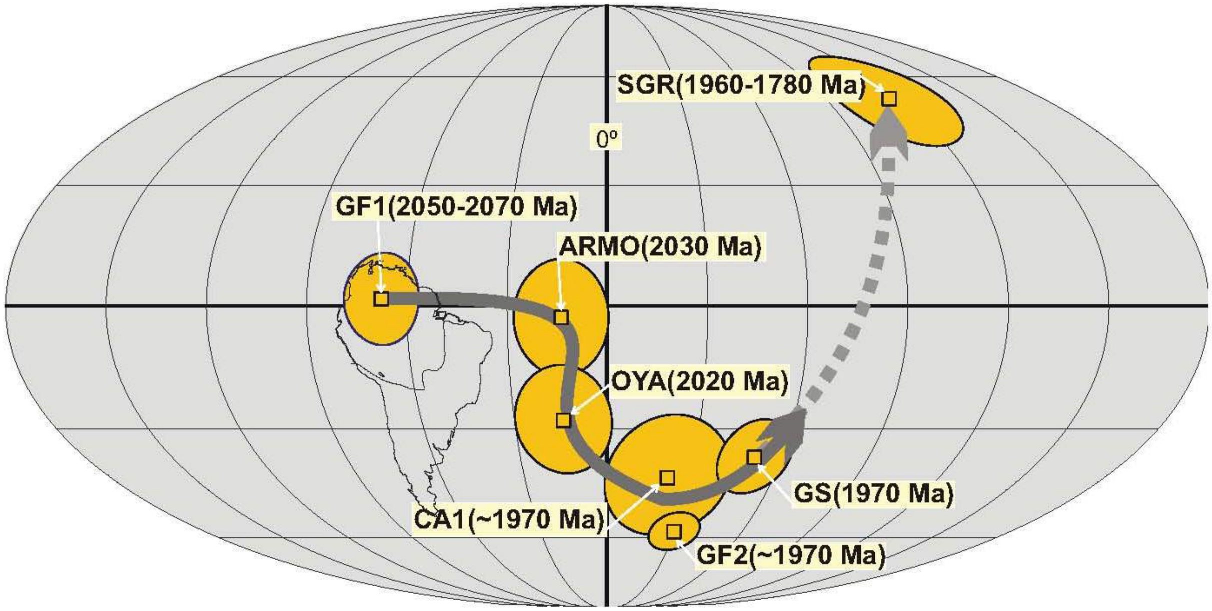

Figure 3. APW path traced for Amazonian Craton (Guiana Shield) between 2070 and 1875 Ma. Paleomagnetic poles: GF1 – average pole by D'Agrella-Filho *et al*. (2011) from Granites (Theveniaut et al., 2006); ARMO –Armontabo Granites (Theveniaut *et al*., 2006); OYA – Oyapok Granites (Nomade *et al*., 2001); CA1 – average pole by Bispo-Santos *et al*. (2014) from La Encruzijada Granites (Onsttot *et al*., 1984); GF2 - average pole by D'Agrella-Filho *et al*. (2011) from Pesa, Roco, Mati e Orga – Costal Late Granites (Theveniaut *et al*., 2006); SG –Surumu Group (Bispo-Santos *et al*., 2014); SGR – Roraima Supergroup (this work). Amazonian Craton in its present position. Figure modified after Bispo-Santos *et al*. (2014).

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