PALEOMAGNETIC RESULTS FROM THE SURUMU GROUP (1980-1960 Ma), NORTHERN AMAZONIAN CRATON: PALEOPROTEROZOIC GUIANA SHIELD APW PATH AND PALEOGEOGRAPHIC IMPLICATIONS

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ABSTRACT

The definition of continental paleogeography for the formation of the Columbia Supercontinent (1900-1850 Ma) is very complex, since some continental blocks of Earth were still in formation, as in the case of Laurentia, Baltica and Amazonian Cratons. So, paleogeographic models proposed for this time are still very speculative and/or subjective. The use of the paleomagnetic technique by construction of the apparent polar wander paths (APWP) for the various continental blocks can contribute to understanding the continental amalgamation and breakup, especially for Precambrian times when there are no more oceanic lithospheric features. In this study, we present the paleomagnetic data obtained in 39 sites collected from volcanic rocks belonging to the Surumu Group, outcropping in the northern Roraima State (Guiana Shield, Amazonian Craton), the ages of which are well-defined between 1980 Ma and 1960 Ma by U-Pb technique. AF and thermal treatment revealed northwestern directions with moderate downward inclinations on samples from 20 of the 39 sites analyzed. Site mean direction cluster around the Dm = 298.6°; Im = 39.4° (N = 20; a95 = 10.1°), which yielded a key paleomagnetic pole (SG pole) for the Guiana Shield, located at 234.8° E, 27.4° N (a95 = 9.8°). Magnetic mineralogy experiments show that the magnetization of these rocks, probably of primary origin, is carried by magnetite and hematite. The SG pole contributes to a better definition of the APWP traced for the Guiana Shield during the Paleoproterozoic (2070-1960 Ma). Comparing that with the APWP built for the West-Africa Craton for the same time suggests that these cratonic blocks were united for 2000-1960 Ma ago, forming a paleogeographic configuration in which the Guri (Guiana Shield) and Sassandra (West-Africa Craton) shear zones were aligned as suggested in previous geologic models.

Keywords: Paleoproterozoic, Paleomagnetism, APWP, Amazonian Craton, Surumu Group.

GEOLOGICAL SETTING AND SAMPLING

The Amazonian Craton (fig. 1) is one of the biggest 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 subduction-related processes in its southwestern part, where a succession of magmatic arcs with great quantities of mantle-derived juvenile material were emplaced developing 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 to 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 Surumu Group is composed mainly of volcanic lava flows associated with subordinate strata of pyroclastic nature. Corresponding to the extrusive Uatumã Supergroup phase, spills consist of acid and intermediate rocks and pyroclastics such as rhyodacites, rhyolites, dacites, trachytes, latites, andesites and tuffs. Embedded in these rocks, is the basic body of the Cotingo unit belonging to the Avanavero Event (Schobbenhaus *et al*., 1994). In this study area, 225 oriented cylindrical cores and two oriented block samples were collected from 39 well-exposed sites of acid to intermediate volcanic rocks from the Surumu Group close to the Amajari and Pacaraima towns, the Uiramutã and Surumu villages and the Tepequém Mountain (fig. 1). Both magnetic and solar magnetic compasses were used for orienting samples.

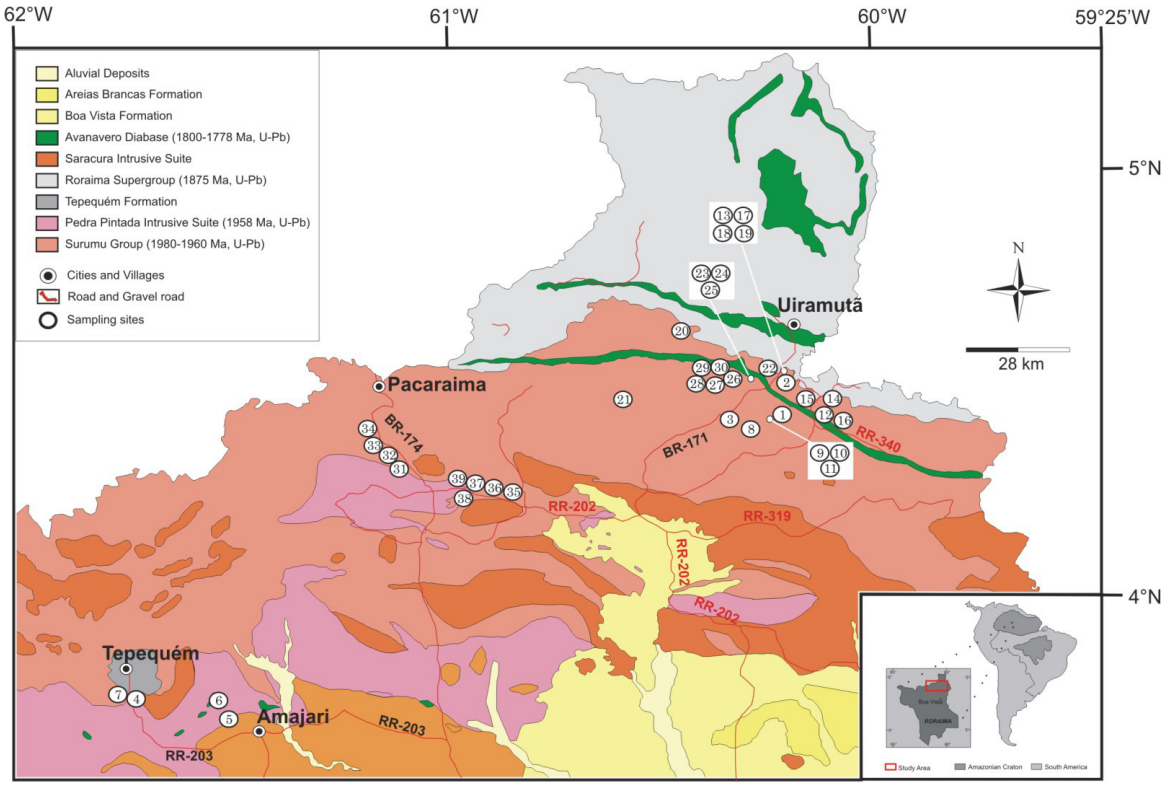

Figure 1. Simplified geological map of the studied area with location of sampling sites (circled numbers) (after Reis *et al.*, 2004). Inset - Amazonian Craton and their geochronological provinces (after Tassinari *et al*., 2000).

Methods

For the paleomagnetic study the cylindrical cores were cut into 2.2 cm height specimens, which 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 600° 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 used to calculate mean site directions and the paleomagnetic pole.

Paleomagnetic Results and Discussions

AF and thermal treatment revealed northwestern directions with moderate downward inclinations on samples from 20 of the analyzed sites (fig. 2). Site mean directions cluster around the mean D_m = 298.6°; I_m = 27.4° (α_{95} = 10.1; K = 12.1), which yielded a paleomagnetic pole (SG) at 234.8° E; 27.4° N (α_{95} = 9.8°). Magnetic mineralogy studies indicate that ChRM directions were mainly carried by high-coercivity and high-unblocking temperature, SD/PSD magnetites, although for some samples (acid rocks) hematite is also the main magnetic carrier. The Surumu rocks are cut by Mesozoic (*ca*. 200 Ma) mafic dykes. A positive baked contact test was obtained for one of these dykes cutting acid rocks from the Surumu Group, which attests the primary nature of the dyke's magnetization and also, that the Surumu mean characteristic remanent

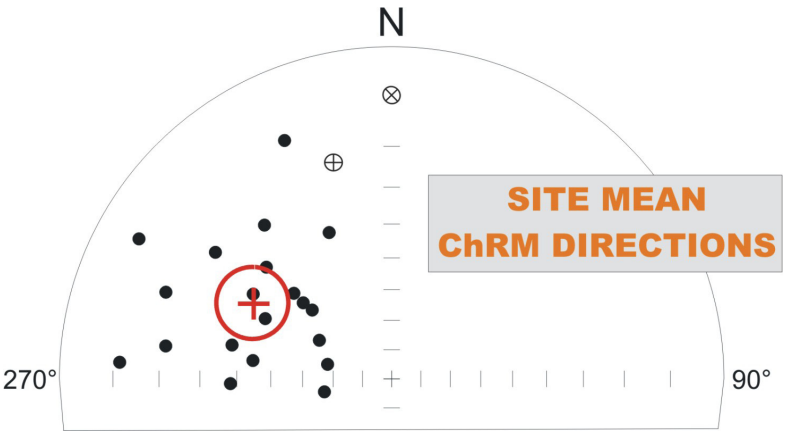

Figure 2. Site mean directions for the Surumu Group. Plus signal (and respective confidence circle - α_{95}) in red indicates the mean of site mean directions calculated for the Surumu Group. ⊕ - present geomagnetic field; ⊗ present geomagnetic dipolar field. Solid (open) symbols represent downward (upward) inclinations.

magnetization (ChRM) direction was not affected by this younger magmatic event. The Surumu pole is used to better constrain the APWP traced for the Guiana Shield for the time interval between 2070 Ma and 1960 Ma (Théveniaut *et al*., 2006). Comparison with the APWP traced for the West Africa Craton for the same time interval (Nomade *et al*., 2003) permit to test the paleogeography where proto-Amazonian Craton and West Africa were part of the same tectonic block at 2000-1970 Ma ago (fig. 3). In this reconstruction, the Guri (in Amazonian Craton) and the Sassandra (in West Africa Craton) shear zones are aligned as suggested by other authors (Onstott and Hargraves, 1981, Nomade *et al*., 2003, Evans and Mitchell, 2011).

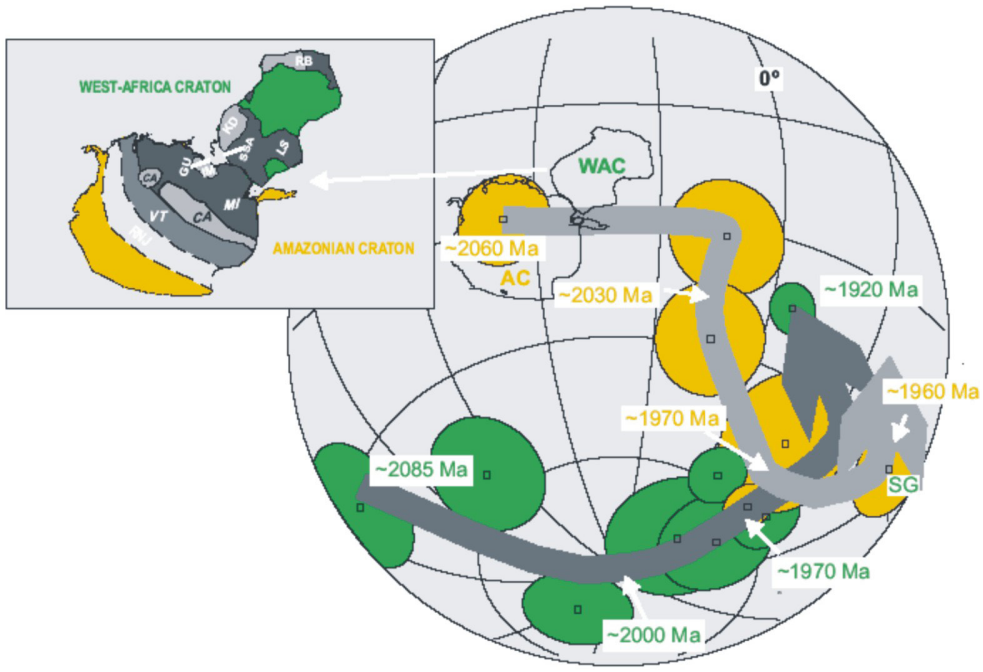

Figure 3. Comparison of the APW paths constructed for the Amazonian Craton (AC) and West Africa Craton (WAC) between ~2080 and ~1920 Ma. Poles from Amazonia (in yellow) and from West Africa (in green) are described in Théveniaut *et al*. (2006) and Nomade *et al*. (2003), respectively. Amazonian Craton in its present position; West Africa and respective poles rotated using the Euler rotation pole: 43.3° N; 330.5° E (-71.5°). Inset: Possible paleogeography of Amazonia (Guiana Shield) and West Africa at 1970 Ma ago. CA – Central Amazonia; MI – Maroni-Itacaiunas; VT – Ventuari-Tapajós; RNJ – Rio Negro-Juruena; IM – Imataca Complex; GU – Guri Lineament; LB – Leo Shield; KD – Kenemanan Domain; RB – Requibat Shield; SSA – Sassandra lineament. These lineaments were aligned at that time.

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