PALEOMAGNETIC STUDIES ON THE EDICACARAN-CAMBRIAN PUNCOVISCANA AND LATE CAMBRIAN CAMPANARIO FORMATIONS: NEW PALEOGEOGRAPHIC CONSTRAINTS FOR PAMPIA TERRANE

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ABSTRACT

A magnetofabric and paleomagnetic study was carried out in the latest Ediacaran – Early Cambrian Puncoviscana and the early Late Cambrian Campanario Formations, exposed in Santa Victoria Oeste, in northwestern Argentina. The anisotropy of magnetic susceptibility (AMS) allowed recognizing a pre-tectonic fabric in both formations indicating that it is previous to the Andean cycle. Reliable magnetic components were isolated in only two out of ten sites of the Puncoviscana Formation, *i.e*. on a tuff, dated as 537 Ma, and on a basaltic sill interbedded in the turbiditic sequence. The virtual geomagnetic poles (VGPs) for these sites are close to the apparent polar wander curve of Gondwana for the Late Neoproterozoic - Cambrian. The Campanario Formation was carrier of a pre-tectonic magnetic remanence slightly affected by compaction that was corrected with data obtained from directional IRM. Its paleomagnetic pole (18.3° S, 359.9° W, dp: 2.9°, dm: 5.2°) is close to, but does not coincide with those obtained previously in this formation at other locations. These have been used to propose a Cambrian accretion of Pampia to Gondwana by transcurrent displacements. However, the pole presented here is closer to the reference apparent polar wander path of Gondwana suggesting two possible interpretations; the presence of Andean tectonic rotations between different study locations or a record of rapid dextral displacement of Pampia along the Gondwana margin in Cambrian times.

Keywords: Puncoviscana Formation, Campanario Formation, Gondwana, Pampia, Paleomagnetism

Introduction

The relationship of the South American terrane known as Pampia (Ramos *et al*., 2010 and references therein) with the Río de la Plata craton has led to different tectonic models (Escayola *et al*., 1996; Rapela *et al*., 2007, 2015, Ramos *et al*., 2010, Spagnuolo *et al*. , 2012, and many others). In particular, Spagnuolo *et al*. (2012) proposed a lateral accretion of Pampia to the western margin of the Rio de la Plata craton in the late Cambrian, suggesting an origin of the terrane as a fragment of a continental shelf of the Kalahari craton. This was based on paleomagnetic results from the early Late Cambrian Campanario Formation, the poles of which were anomalous respect to the Cambrian-Ordovician reference poles for Gondwana. In order to test this hypothesis a new paleomagnetic study was carried out on the same Campanario Formation, at the Santa Victoria Oeste locality, Salta province, Argentina, over 60 km apart from where the previous studies were performed. This was complemented with the first paleomagnetic study on the underlying Puncoviscana Formation (late Ediacaran - early Cambrian) at the same locality.

Sampling and results

A magnetofabric and paleomagnetic study was carried out on 161 oriented specimens collected at 10 sites (P1, P2, P3, P4, P5, P6, P7, P8, P9 and P10) located in volcanic and volcaniclastic rocks of the Puncoviscana formation in the Santa Victoria Oeste locality (22° 15' 2.4'' S; 64° 57' 56'' W). At each site generally 10 independently oriented cores were collected with a portable drill. This sampling was complemented with 64 oriented specimens collected at three sites on the Campanario formation (M2, M3 and M4) spanning a stratigraphic interval exceeding 30 meters. Nine, twenty-seven and six independently oriented cores were collected from M2, M3 and M4 sites, respectively.

A detailed standard paleomagnetic study was carried out on all the specimens collected, choosing in each case the most effective method of demagnetization. With the exception of sites P1 and P5, demagnetized by AF technique, thermal treatment was more efficient for isolation of the magnetic components. Each specimen was analyzed individually and the components determined by principal component analysis (PCA, Kirschvink, 1980). Sites P2, P3, P5, P6, P8, P9 and P10 carried a magnetic component of low unblocking temperatures and/or coercive forces that was labeled as component "a" and usually isolated at fields under 20 mT and temperatures lower than 350° C. This component was interpreted as a recent overprint. A second component with higher unlocking temperatures and/or coercive forces, labelled component "b", was identified and defined with good within-site consistency at sites P1 (a basaltic sill) and P2 (a tuff) in the Puncoviscana Formation, although with significantly different mean directions.

All samples from the Campanario Formation exhibited good magnetic stability, and each magnetic component was determined with high precision. Unblocking temperatures and rock magnetic properties suggested hematite as the magnetic carrier. Considering that remanence directions may be affected by compaction and deformation, which tend to produce a bias towards lower inclination values, an experimental study was conducted to determine and quantify the inclination shallowing at different sites. This was applied at representative samples from sites P1 and P2 (Puncoviscana F.) and M3 and M4 (Campanario F.). The technique used involves the acquisition of isothermal remanent magnetization (IRM) at *ca*. 45° respect to the bedding plane and comparison of the IRM inclination with respect to the applied field (Hodych, 1994). These experimental values were used to correct the mean inclination values for each site, which was only significant at sites P2 and M3.

Conclusions

A new paleomagnetic pole for the Camapanario Formation was computed from corrected characteristic remanence directions form sites M3 and M4 (18.3° S, 359.9° W, dp: 2.9°, dm: 5.2°) and two virtual geomagnetic poles (VGP) were calculated for the Puncoviscan Formation from sites P1 and P2, respectively. The new paleomagnetic pole for the Campanario Formation differs from that obtained for the same unit in the Matancillas and Iruya localities, 60 km to the south (Spagnuolo *et al*., 2008, 2012). This could be interpreted as due to an *in situ* clockwise rotation of the southernmost localities with respect to the northern one. Large Andean rotations of the rocks at Matancillas and Iruya localities could explain most of the anomaly in the pole positions although a small paleolatitudinal anomaly would still remain. An alternative explanation involves the recording in the Campanario Formation rocks at different localities the hypothetical displacement of Pampia along the Rio de la Plata craton margin in the middle to late Cambrian. The paleomagnetic information provided by the Puncoviscana formation consists in only two VGPs, which do not coincide with each other and probably reflect different ages of magnetization. There is no overlap between these VGPs and the apparent polar wander path for the Río de la Plata craton and most of Gondwana between about 550 and 500 Ma, and do not provide a simple answer for the two alternatives presented above.

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