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KINEMATICS OF TECTONOSTRATIGRAPHIC UNITS: PALEOMAGNETIC INTERPRETATION FROM AZUERO PENINSULA, PANAMA.

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ABSTRACT

Tectonics and geology of the Caribbean Plate are not completely understood yet. Paleomagnetic studies are an important tool to understand more about the tectonic history of the Caribbean, because it provides important information on paleolatitudes and vertical axis rotation of blocks. Panama is an important part of the Caribbean geology, so the paleomagnetic data will give much information not only for local but also for regional geology. In this research a collection of samples was accomplished in the Azuero Peninsula (Panama). Sampling localities were distributed perpendicular to the ASFZ (Azuero Sona Fault Zone) with the purpose of finding a relation between distance to the fault zone and values of rotation. One hundred and fifty one cores (305 specimens) were collected mainly from basalts but also from tuffs and mudstones. One hundred and seventy four specimens were demagnetized, 133 samples by AF (alternating field) and 39 by thermal demagnetization. Additionally, measurements of the anisotropy of magnetic susceptibility were also performed to determine flow directions. Preliminary data suggest that analyzed rocks are promising for good paleomagnetic results.

Keywords: Paleomagnetism, Azuero Peninsula, ASFZ (Azuero-Sona Fault Zone).

Introduction

Previous paleomagnetic studies (Table 1) (Gose, 1985) carried out along the Caribbean area show different values and sense of rotation in several blocks of the Caribbean plate. These data have allowed different tectonic models for this region. Three main models attempt to explain the formation of the Caribbean plate; one suggests an origin from the Pacific (Pindell & Kennan, 2009), another suggests an intra-American origin (Meschede & Frisch, 1998) and the last one an *in situ* origin (James, 2009). The first two models are consistent with paleomagnetic data (Acton, 2000) and they are the most widely accepted, but as yet, neither of them has reached consensus. Panama is a key place in the Caribbean because it has an important record of the last geologic processes, *i.e.* Cretaceous to present. In the Azuero Peninsula, in Panama, Buchs (2011) describes several geologic units and processes related; igneous and volcanic rock-units are associated to subduction processes, accretion of seamounts, and the formation of the Caribbean Plateau. The sedimentary formations are associated to a forearc basin, derived from the erosion of seamounts and volcanic arc rocks. The Peninsula has an important fault zone called Azuero-Sona Fault Zone (ASFZ) which separates two of the main tectonostratigraphic units described by Buchs (2011); the first correspond to the Proto-arc, Arc and Caribbean Plateau; the second to an accretionary complex that is composed by seamounts.

A paleomagnetic study could find relations between kinematics and structural features, so in this research we seek to find a relation between the distance to a fault zone with the magnitude of tectonic rotation (Hernandez and Speranza, 2014). This information will be useful to refine the tectonic and structural models of the ASFZ, and to contribute with a better knowledge of the Caribbean geology.

Table 1. Values of tectonic rotations for some localities of the Caribbean. Taken from Gose (1985)

	Rotation	Time
Northern Caribbean		
Jamaica	−17°	Post 9.5 m.y.
Hispaniola	−75°	Post-Eocene
Puerto Rico (1)	−58°	Post-Cretaceous
(2)	−83°	Post-Eocene
Southern Caribbean		
Guajira	+80°	Post 120 m.y.
Caribbean Mtn.	+90°	From 100 to 70 m.y.
Aruba	+90°	Post 70 m.y.
Bonaire	+90°	Post-late Cretaceous
Los Roques	+90°	Post 66 m.y.
Los Frailes	+90°	Post 66 m.y.
Western Caribbean		
Honduras	+100°	During Lower Cretaceous
	−170°	Post-Albian
	−43°	Post 61 m.y.
Nicaragua (southwestern area)	0	Post-late Cretaceous
Costa-Rica (Pacific coastal zone)	0	(+ 14° change in latitude post-Eocene)

[a] Minus (plus) sign indicates counterclockwise (clockwise) rotation. All values are relative to geographic north.

Methodology

The present paleomagnetic sampling throughout the Azuero Peninsula considered the previous sampling performed by Rodriguez-Parra (unpublished) and DiMarco (1995) to get a better distribution of paleomagnetic data within the Peninsula. 15 sampling localities were distributed from the north to the south of the Peninsula (Fig. 1) along a line perpendicular to the fault zone with the purpose of investigate a relation between magnitude and sense of rotation of the blocks and, the distance to the ASFZ, using a similar methodology to that described by Hernandez and Speranza (2014). Since the previous sampling has more localities close to the fault, in this case we determined more localities at the north and south of the Peninsula to complement the previous sampling.

From the 15 localities, 13 are for determine paleolatitudes and possible rotations around vertical axis from the mean paleomagnetic vector, whereas the other two corresponded to field tests: a baked contact test and a conglomerate test. The majority of the cores were collected from basalts; however some of the cores were sampled from tuffs and even mudstones. A total of 151 oriented cores (approximately 10 per site) were collected. Paleomagnetic study was carried out at the Daniel Valencio Paleomagnetic laboratory of the University of Buenos Aires. Stepwise demagnetization was achieved by two techniques: AF (alternating fields) and thermal (high temperature) demagnetization. Taking into account previous results obtained by Rodriguez-Parra (unpublished), the AF process was the most widely used since it demonstrated to be more efficient to isolate the magnetic components. Thermal demagnetizations were used for comparison with the AF results. In these cases, the bulk magnetic susceptibility was measured at each demagnetization temperature in order to check potential chemical changes due to laboratory heating. Before paleomagnetic processing, anisotropy of magnetic susceptibility was measured for each specimen in order to test whether this carries information on the flow direction of some volcanic units. Since the whole collection has not yet been fully processed, the remaining specimens will be studied at the EAFIT laboratory.

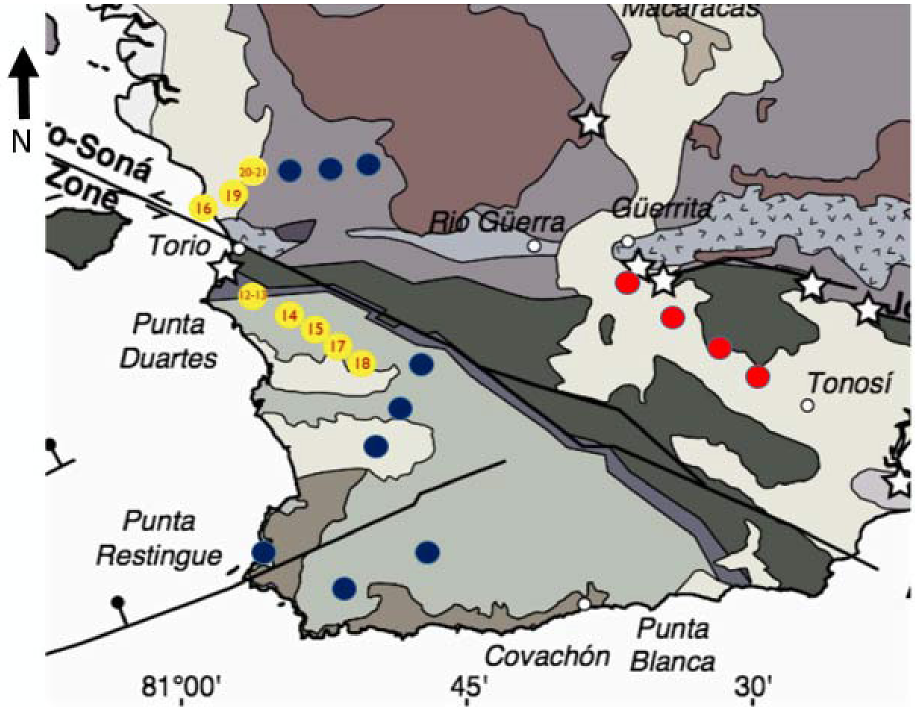


Figure 1. Map of the study area.

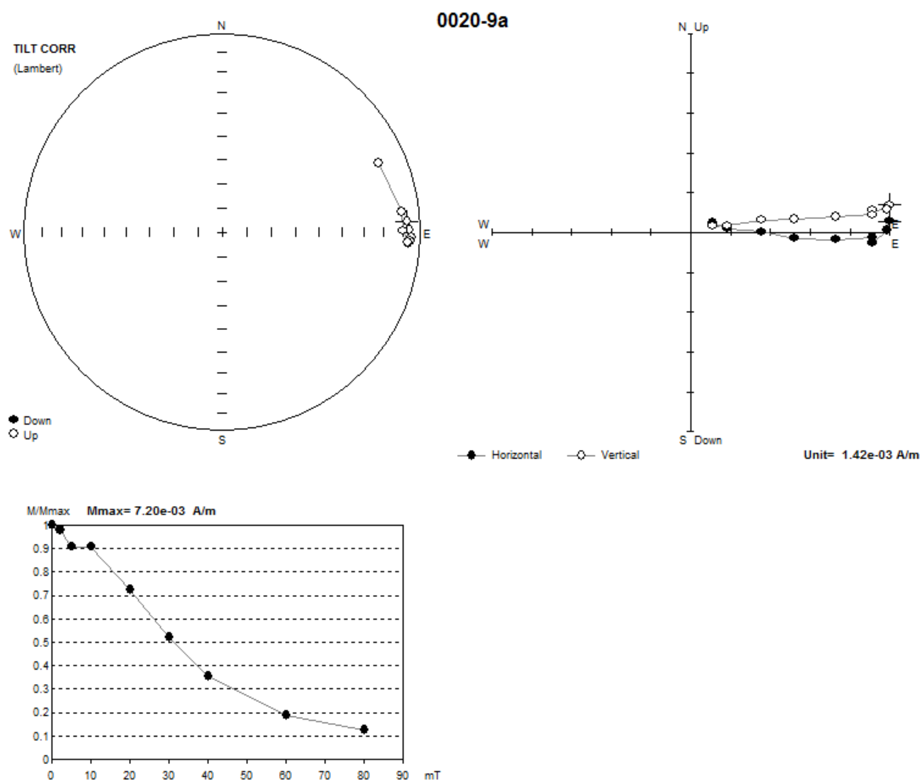
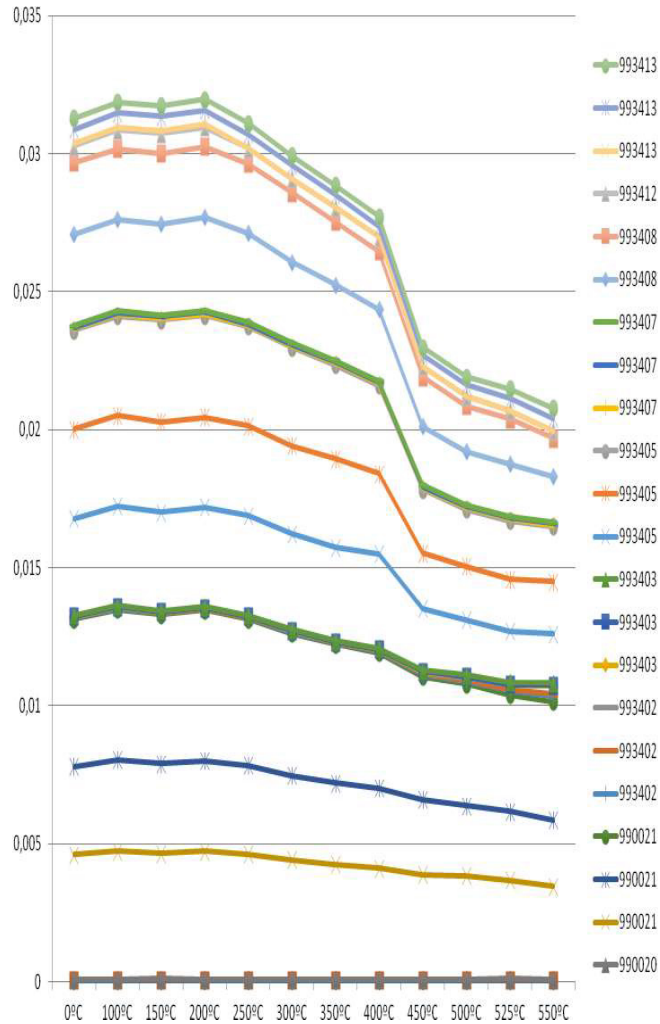


Figure 2. Example of demagnetization behavior of the studied samples. a) Stereonet projection. b) Zijderveld diagram showing univectorial decay of remanence. c) Remanence intensity decay diagram.



Results

From the 151 cores collected about 305 specimens were obtained, only 234 of them were available to be demagnetized. From these, 172 were demagnetized in this first stage of the study, 133 by AF (alternating fields) and 39 by thermal demagnetization. In general, the specimens yielded good patterns of demagnetization (Fig. 2) indicating that they are promising for obtaining stable magnetic components. Results of magnetic susceptibility against thermal treatment generally show decreasing patterns (Fig. 3), with one exception, suggesting minor chemical changes during heating.

Figure 3. Diagram showing bulk magnetic susceptibility *vs*. temperature steps during thermal demagnetization. Note lack of major changes during experimental heating.

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