VOLCANO-TECTONIC IMPLICATIONS FOR THE RUIZ-TOLIMA VOLCANIC COMPLEX BASED ON PALEOMAGNETIC DATA

Invited

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Abstract

Paloemagnetic data from the Ruiz-Tolima Volcanic Complex of Colombia (1.8 Ma to recent) collected for secular variation and time-averaged field analysis also help to shed light about the volcano-tectonic history of this volcanic chain. Paleomagnetic data from volcanic domes (e.g. San Cancio and Tesorito) and lavas (Lucitania) emplaced parallel to the Termales-Villamaria fault, related to this volcanic complex, help to constrain the age of their emplacement. Palemagnetic results, published radiometric dates and the presence of dykes intruding a very young avalanche flow, imply that the lapse of activity the mentioned fissure volcanism spans at least from 1.2 ± 0.8 Ma to < 38 ± 16 Ka. Based on the normal polarity and 1.2 ± 0.2 Ma K-Ar
age of the Tesorito Dome, it is believed that it formed during the Jaramillo paleomagnetic subchron. The reversed magnetized San Cancio Dome and its 1.2 ± 0.8 Ma (K-Ar) age, is consistent with a formation during the Matuyama Chron.

Introduction

Paleomagnetic studies performed for time-average and secular variation analysis of the Earth's magnetic field, can render important clues about the stratigraphy and tectonics of the sampled areas. This kind of studies bring with it, key information that can enhance the geologic knowledge of the sampled area.

The Ruiz – Tolima Volcanic Complex (Herd, 1972) is built as a consequence of the subduction of the Nazca Plate under northwest South America. According to Schaefer (1995), the activity of the Ruiz Volcano can be divided in three stages, all of them spanning 1.8 Ma – to the Recent. Two faults intersect in it: The Palestina Fault (Feininger, 1970) which has N20^{o}E direction, and the Termales-Villamaria Fault which has N75^{o}W direction, and extend from the Ruiz Volcano up to the city of Manizales. A series of volcanic domes (Toro et al., 2008 and 2010, Borrero et al., 2009) are aligned parallel to this fault.

This study provides important evidence about the age and range of time in which the hypoabysal activity related to the Termales-Villamaria fault were emplaced. This is achieved based on paleomagnetic and rock magnetic studies aimed at studying the above mentioned volcanics and on palemagnetic data contained in the dataset obtained by Sanchez-Duque et al. (in preparation) while undertaking secular variation and time-averaged field research in northern Andes of Colombia.

Methodology

Strict rock sampling, laboratory and data analysis procedures, used for studying the time-averaged Earth's paleomagetic field and its secular variation (Mejia et al., 2002) were performed on the San Cancio, Tesorito and Lusitania hypoabisal bodies by Sanchez-Duque et al. (in preparation).

After sampling the Lusitania lava, new outcrops were exposed as a result of the widening of the Panamericana road. The outcrops seemed to show the Lusitania lavas, intruding very young (38 ±16 Ka, ^{14}C) La Enea (a suburb from Manizales) avalanche-flow deposits (Naranjo and Ríos, 1989). In order to confirm this field interpretation additional paleomagnetic sampling was performed on the Lusitania lavas by obtaining eight additional oriented cores from the places where the lava flows appear to be intruding la Enea flows.

Further studies included magnetic hysteresis analysis, performed by using a VSM.

Figure 1. Dykes intruding very young (38 ± 16 Ka) La Enea avalanche flows.

Results and Conclusions

Paleomagnetic directions from the San Cancio dome and Lusitania lavas indicate reverse and normal Earth's magnetic field polarities, respectively. The Tesorito Dome indicates normal, possibly intermediate polarity (Table 1).

The studied paleomagentic and radiometric age data are consistent with the Tesorito Dome being emplaced during the Jaramillo Subchron (1.05 to 0.98 Ma, Cande and Kent, 1992), possibly close to a reversal boundary in which the Earth's magnetic field was relatively unstable. This is thought because the paleomagnetic direction of the Tesorito dome translates into a VGP (55.9^{o} Lat N, 113.6^{o} Long E) that could be considered as transitional (Vandamme, 1994) but locates nevertheless in the northern

hemisphere. Hysteresis loops performed along three axis of a small cubic sample reveal no anisotropic behavior.

The paleomagnetic and age data of the San Cancio dome is consistent with an emplacement during the Matuyama Chron (2.6-0.78 Ma, Cande and Kent, 1992).

Paleomagnetic data from the Lusitania lavas that seem to be intruding la Enea avalanche flows, have the same paleomagnetic directions of the lavas sampled hundreds of meters away from the same flow, confirming that they are in-situ. It is interpreted that the Lusitania Lavas, in some cases are dykes that intrude < 38 ± 16 Ka avalanche flow deposits.

These observations place the volcanic activity associated with the volcanic domes taking place during a considerable long period of time (Matuyama to Bruhnes chrons) implying an important influence of the Termales – Villamaria Fault in the volcanic activity of the Ruiz-Tolima Volcanic Complex.

Table 1. Paleomagnetic[1] and Age[2] Data of Some Volcanic Domes and Lavas Aligned with the Termales-Villamaria Fault

Domes/ Lavas	Declination (^{o})	Inclination (^{o})	α_{95} (^{o})	Polarity	Age[2]
Tesorito	354.2	-47.5	4.9	Normal or Transitional	1.2 ± 0.2 Ma
San Cancio	175.3	-22.3	1.8	Reversed	1.2 ± 0.8 Ma
Lucitania Lavas	344.1	6.6	3.5	Normal	< 38 ± 16 Ka

[1] Complete paleomagnetic statistics will be published elsewhere (Sanchez-Duque et al., in preparation).
[2] Radiometric dates for Tesorito and San Cancio domes are from Thouret et al. (1990). The age of the Lucitania lava is deduced from this study.

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