PALEOMAGNETISM OF LATE QUATERNARY VOLCANOES IN MEXICO

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ABSTRACT

As in some other regions of the world, there is a major effort going on in Mexico to build a master curve of secular variation for the Late Quaternary (Mahgoub *et al.*, 2019). To this end, a significant amount of paleomagnetic data has been generated. However, a larger amount still needs to be obtained to define a high-resolution secular variation curve (cSV). In the present study we show new paleomagnetic data (directions and intensities) from 14 volcanoes, distributed along the Trans Mexican Volcanic Belt (TMVB) with ages ranging from 2 to 25 thousand years. Some of these were radiocarbon-dated and one is of historical age. For this, 220 cores have been studied, belonging to 14 volcanoes from different regions of the TMVB. Among them are the Chichinautzin Volcanic Field, Michoacán-Guanajuato Volcanic Field, the Pico de Orizaba (Citlaltépetl) and the eastern Serdán basin.

Keywords: Trans Mexican Volcanic Belt, Paleomagnetism, Rock Magnetism, Paleointensity.

RESUMEN

Recientemente en México, como en algunas otras regiones del mundo, se está trabajando intensamente para tratar de construir una curva maestra de variación secular para el Cuaternario Tardío (Mahgoub et al., 2019). Para este fin, se ha generado una cantidad significativa de datos paleomagnéticos. Sin embargo, aún se necesita generar una cantidad mayor para definir una curva de variación secular (CSV) de alta resolución. En el presente estudio, se muestran nuevos datos paleomagnéticos (direcciones e intensidades) de 14 volcanes, distribuidos a lo largo del Cinturón Volcánico Trans Mexicano (TMVB) con edades que oscilan entre 2 y 25 mil años. Algunos de estos fueron fechados por radiocarbono y uno es de época histórica. Para esto, se han estudiado 220 testigos, pertenecientes a 14 volcanes de diferentes regiones de TMVB. Entre estas regiones se encuentra el campo volcánico Chichinautzin, el campo volcánico Michoacán-Guanajuato, el Pico de Orizaba (Citlaltépetl) y la cuenca oriental de Serdán.

Palabras Claves: Cinturón Volcánico Transmexicano, Paleomagnetismo, Magnetismo de Rocas, Paleointensidad.

1. Introduction

For the late Quaternary, there is still little data to build a high-resolution paleosecular variation curve of the geomagnetic field in Mexico. The present study shows paleomagnetic data from a set of 14 volcanoes belonging to the Transmexican Volcanic Belt (TMVB). Seven of them are radiocarbon-dated and one is of historical age. For the remaining six volcanoes, paleomagnetic dating using the secular variation curve generated by the geomagnetic model SHA.DIF.14k (Pavon-Carrasco *et al.,* 2014) will be attempted.

In this study, rock-magnetic measurements were performed (magnetic susceptibility, hysteresis loops analysis, thermomagnetic analyses). Paleodirections were determined using stepwise demagnetization protocols, and paleointensity determination were done by using the double heating IZZI-Thellier experiments (Tauxe and Staudigel, 2004). These new data may be useful for temporary records in the paleosecular variation curve for Mexico.

2. Methodology

Bulk magnetic susceptibility (κ) was measured with a ZHinstruments SM-150L/H and natural remanent magnetization (NRM) with an AGICO JR5 magnetometer. Stepwise alternating field (AF) demagnetization was carried out with an AGICO LDA-3 demagnetizer (maximum amplitude 100 mT), while thermal demagnetization was done with an ASC Scientific TD48 furnace. This furnace was equipped with a field coil for remanence acquisition as required during paleointensity experiments. A thermomagnetic analysis of induced magnetization was performed in a field of 0.5 T in temperatures up to 650° C. During heating and cooling (all in air) a change rate of 30° C per minute was maintained, with a horizontal Curie balance built in the laboratory. Magnetic hysteresis and isothermal remanence acquisition curves from three samples per site were measured with a Princeton Measurement Corp. model MicroMag 2900 instrument. Paleosecular variation curves of the past geomagnetic full-vector were established by using the bootstrap-resampling algorithm combined with cubic P-Splines for smoothing and interpolation. We have used paleomagnetic dating to compare with the age given by ^{14}C of the lava flow and with this try to date other lava flows. For this, the global geomagnetic model SHA.DIF.14k (Pavón-Carrasco *et al.*, 2014) was used.

3. Results and discussions

Rock magnetic experiments show that the dominant minerals are magnetite and titanomagnetite of pseudo single domain size. We present eight new paleomagnetic directions and absolute paleomagnetic intensities. With this, and previously published data (97 direction data and 97 paleointensity of which 59 archeointensities; Mahgoub *et al.*, 2019), a new secular variation curve was generated for the last 50 ka. Because there is no homogeneous distribution of the data over time, two successive periods were defined, between 2000 AD - 2000 BC and 2000 BC - 50000 BC. The constructed paleosecular variation curves for the region will help to perform paleomagnetic dating with greater precision.

Paleomagnetic dating was carried out by means of the Matlab tool archaeo_dating and using the global field model SHA.DIF.14k (Pavón- Carrasco *et al.*, 2014). This permited to achieve good results, being able to identify in some cases, the age of emplacement of lava flows from contemporary volcanoes (Larrea *et al.*, 2019).

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