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Preliminary Paleomagnetic Results from the Calimani Mountains, Romania

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SUMMARY

Paleomagnetic studies have been used for a long time to investigate the evolution of the magnetic field but also to obtain information about structural deformation, tectonic movements, magnetic mineralogy or geochronology. The studied area is the first magmatic episode from the Calimani-Gurghiu-Harghita volcanic chain. This volcanic arc that resulted once with the formation of the Carpathian orogen by the collision of the Alcapa and Tisia blocks with the European continent. The paper presents the polarity data obtained after the measurement of two pilot samples using the alternating field demagnetization (AF) and thermal demagnetization methods. Some samples revealed to be unsuitable for analysis and for further measurements, so the reason of their exclusions is discussed. The polarity distribution correlates with the K-Ar ages and matches with Middle-Late Miocene Polarity Time Scale

Introduction

The Carpathian orogen was formed by translational and rotational movements of the microplates trapped between the Eurasian and African Plate during Tertiary (e.g. Pecskey et al., 2006). Briefly, the Carpathians Mountains are the result of the collision of Alcapa and Tisia blocks with the European continent. The complex tectonics of these microplates (which include subduction followed by roll-back, collision, subducted slab break-off, rotations and extension) produced calc-alkaline magmatism in the northeastern part of the two blocks near the Carpathian Flysch (Seghedi et al., 2004). East Carpathian volcanic arc (Calimani-Gurghiu- Harghita) correspond to central and southern Tisia block and it is characterized by a migration of the volcanism from N to S between 10- <1 Ma.

The area investigated in this study is the Calimani Mountains and lies in the northern part of the previously mentioned volcanic arc. It is characterized by intermediate calc-alkaline rocks and the magmatic history of this volcanic system involves eruptions from multiple vents and was active between 11.3 and 6.7 Ma (Seghedi et al., 2005).

The aim of this paper is to present the preliminary results of the paleomagnetic investigations of the Calimani Mountains. The results are discussed in order to evaluate the possibilities of the further analysis methods having as final goal magnetic polarity data, paleosecular variation and time-average field and tectonic implication of paleomagnetic data.

Sampling and methods

Samples have been taken from 34 different sites (Fig. 1), the sampling strategy being based on the regional geologic map Toplita, scale 1:50000 and the volcanological study of Seghedi et al. (2005). The topography and the vegetation destructively interfered with our sampling work, but, where possible, the samples were taken from large fresh outcrops (such as quarries) and chemically unaltered. The drilling cores were 2.5 cm in diameter and were made with a handled gasoline-powered engine with a water pump. From each site 6 to 9 samples were collected and oriented using a Brunton magnetic compass and, where possible, a sun compass.

In the laboratory, the samples were cut in order to obtain standard paleomagnetic specimens of 11 cm³ each. This phase of the study implies the measurement of 2 pilot specimens: one of them was subjected to alternating field demagnetization (AF) and the other to thermal demagnetization. The AF demagnetization was performed with a Magnon International static AF demagnetizer with steps from 0 – 200mT with 5 to 15 steps per specimen and the thermal demagnetization with a home built furnace. The demagnetization steps were 50° C from 0 to 500°C followed by 25°C until the maximum blocking temperature. Magnetic susceptibility measurements were made after each step. The remanent magnetization was measured using a JR6A spinner magnetometer (AGICO).

Results

The demagnetization data were plotted in orthogonal demagnetization diagrams (Zijderveld diagrams) and spherical projections (Wulff) using Remasoft 3.0 software (Chadima & Hroudá, 2006). As a result of principle component analysis (PCA) and best-fit great circles we decided that only 22 from 34 samples gave useful results to be used for further measurements and analysis. The twelve samples were eliminated because for several reasons: a) the demagnetization data are heretic; b) the sample was probably affected by lightning strikes (the most obvious clue for this being the high values of the intensity of the magnetic field (Tauxe et.al., 2003) – 3 order of magnitude higher than normal); the outcrop from which the sample was taken was not in situ.

The PCA analysis (maximum angle deviation, MAD, was maximum 5°) of the 22 samples was successful in isolating the characteristic remanent magnetization (chRM). We found out the polarities of each site: 12 sites have normal and 10 sites have reversed (Fig. 1). According to Seghedi et al., 2005, the sampled sites belong to Rusca-Tihu Volcaniclastic Formation with andesitic and basaltic andesitic lava intercalations (8-10 Ma), Peripheral Domes (8.7-7.1 Ma) and Calimani Caldera (7.5-6.7 Ma)

Figure 1 Geological sketch of the central and southern part of the Calimani Mountains (after Seghedi et al., 2005 and geological map Toplita at scale of 1:50000) with the paleomagnetic sites and their polarity: NP – normal polarity, RP – reverse polarity, X – unreliable sites, 1 – andesites (α), 2 – andesites with amphiboles (ama), 3 – andesites with amphiboles and pyroxenes (ampya), 4 – basaltic andesites ($\alpha\beta$), 5 – α with am, biotite and quartz, 6 – α with py, 7 – β , 8 – Borsa sandstone, 9 – diorites, 10 – diorites and microdiorites, 11 – volcanogenic- sedimentary formation..

Conclusions

The magnetic polarity distribution observed correlates with the existing K-Ar ages (Seghedi et al., 2005 and Pécskay et al., 1995) and it matches with the Middle-Late Miocene Time Scale (Lourens et al., 2004). It is to notice that the polarities develop the tendency of grouping in different regions each formation having a corresponding polarity. These preliminary results show that most outcrops from the open alpine area are strongly affected by lightning strikes.

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