Paleomagnetic Study of the Miocene Volcanism in the Southern Part of the Gurghiu Mountains(Eastern Carpathians)

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INTRODUCTION

Gurghiu Montains represent the middle segment of the 160 km-long Calimani-Gurghiu-Harghita volcanic chain located along the inner (western) side of the East Carpathian orogenic zone (Fig. 1)

The volcanic chain of the Gurghiu Mountains are dominantly calc-alkaline displaying a subduction-type geochemical signature (Radulescu & Sandulescu 1973, Seghedi et al. 2004; Mason et al. 1996). The volcanic rocks are andesites and pyroxene andesite, with minor exceptions (basaltic andesites and dacites) (Seghedi et al. 2004).

The type of volcanic edifice in the Gurghiu Mountains include composite volcanoes with or without a caldera, shield volcanoes, and lava dome complexes. From north to south, there are five edifices of this kind, namely: **Jirca, Fancel-Lapusna, Seaca-Tataru, Sumuleu and Ciumani-Fierastraie (Fig. 2).** In addition, there are two lava dome complexes – **Borzont and Bacta**. Except for the late stage Fancel-Lapusna, all these are lava-dominated volcanoes (Seghedi et al, 2004).

Previous paleomagnetic results from the Gurghiu mountains have been published by Patrascu, 1976.

The present paleomagnetic study is focussed on the 6.8 – 7.1 Ma interval of volcanic activity. Sampling sites for paleomagnetic investigations cover the following structures: **Seaca-Tataru, Borzont, Sumuleu and Ciumani-Fierastraie (Fig. 2).**

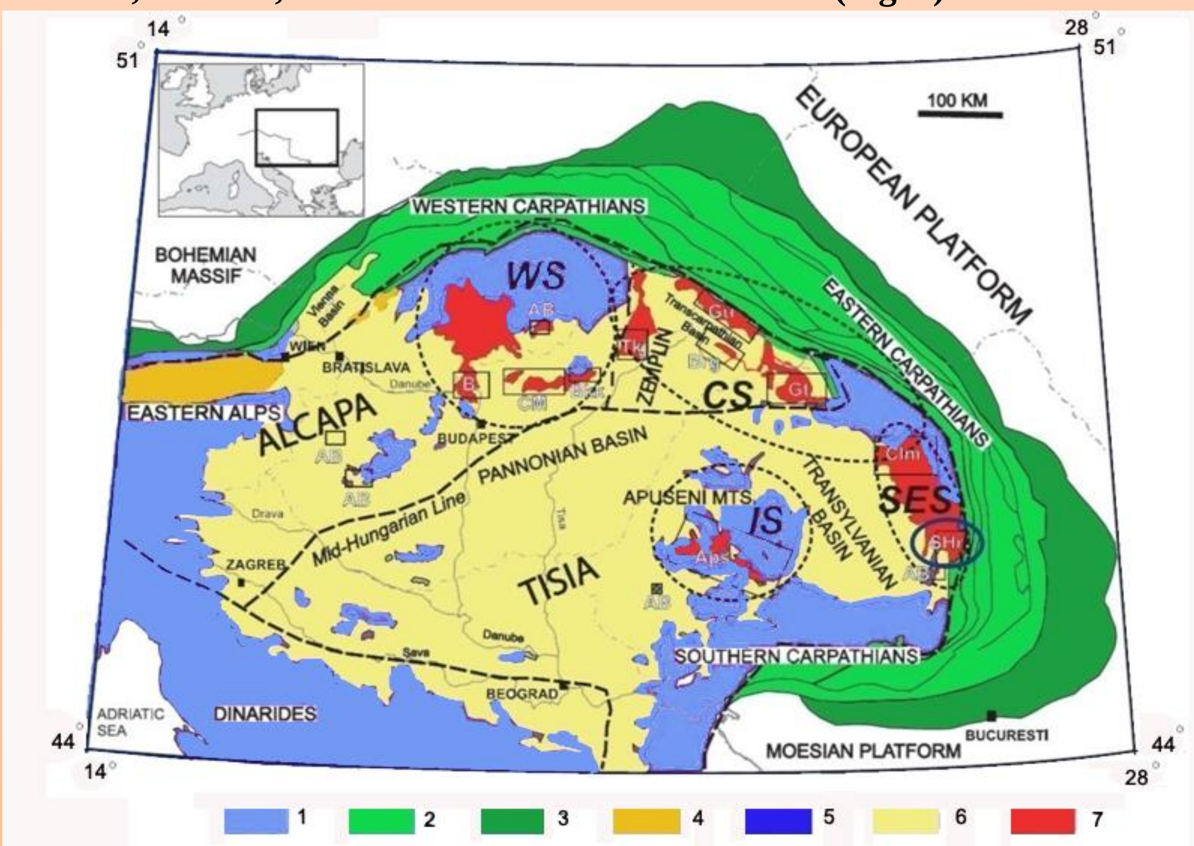


Fig 1: Geological sketch map of Carpathian–Pannonian region showing spatial distribution of the four defined segments (WS—Western segment; CS—Central segment; SES—Southeast segment; IS—Interior segment) and location of the calc-alkaline volcanic areas (B—Börzsöny, CM—Cserhát-Mátra; Bkk—Bükk foreland; Tkj—Tokaj; Gu—Gutinski; Brg—Beregovo; Gt—Gutâi; Clm—Calimani; SHr—South Harghita; Aps—Apuseni). Alkalic basaltic areas (AB) and Intracarpathian block boundaries (ALCAPA, Zemplin, TISIA) are also shown; Legend: 1: Inner Alpine Carpathian Mountain belt and Dinarides; 2: Alpine–Carpathian Flysch belt; 3: Carpathian Molasse belt; 4: Calcareous Alps; 5: Pieniny Klippen belt; 6: Neogene–Quaternary sedimentary deposits; 7: Outcropping calc-alkaline volcanic rocks. (Modified after Seghedi, 2004). Sampling area is marked by a blue ellipse.

SAMPLING AND METHODS

The oriented samples were collected from 37 sites **(Fig. 2).** They were obtained using a portable drill and oriented using both a magnetic and solar compass. Up to three standard 25x22mm cylinder specimens resulted from each core.

- **The structure of the natural remanent magnetization (NRM)** of pilot specimens was studied using both alternating field (AF) demagnetization and thermal demagnetization **(Fig. 3)**. The remanent magnetizations measurements were made with a JR-6A Dual Speed Spinner Magnetometer. The results of the gradual demagnetization were graphically represented by Zijderveld's method (Zijderveld J.D.A., 1967) wich permits the structural analysis of the NRM. The method consist in the reconstruction of fossil declination, fossil inclination and magnetization intensity wich remained after each demagnetization step, in orthogonal diagrams.
- On orthogonal demagnetization diagrams, individual magnetizations were identified as linear segments in both horizontal and vertical projections defined by three or more demagnetization steps. Characteristic directions were determined using principal component analysis. All accepted linear segments have maximum angular deviation (MAD) values of less than 5°. The method of Fisher, assuming circular distribution of individual magnetization directions about a true mean direction, was employed to estimate site-mean directions and associate statistics.

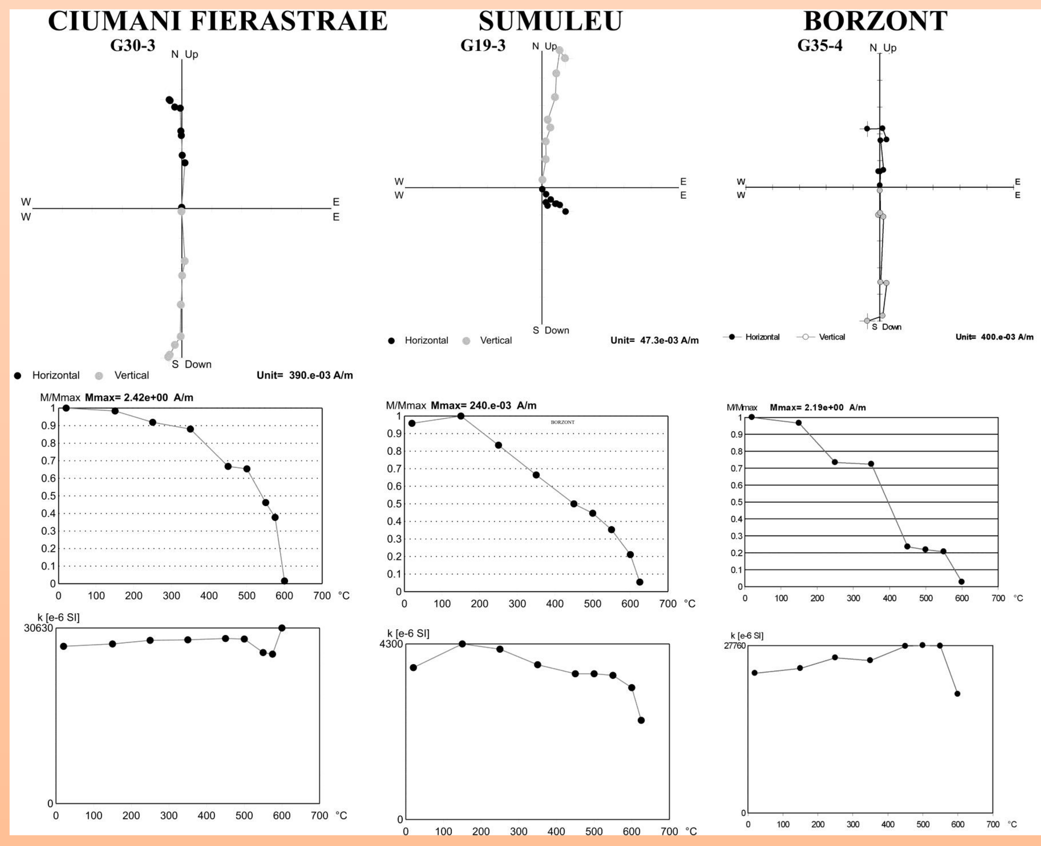
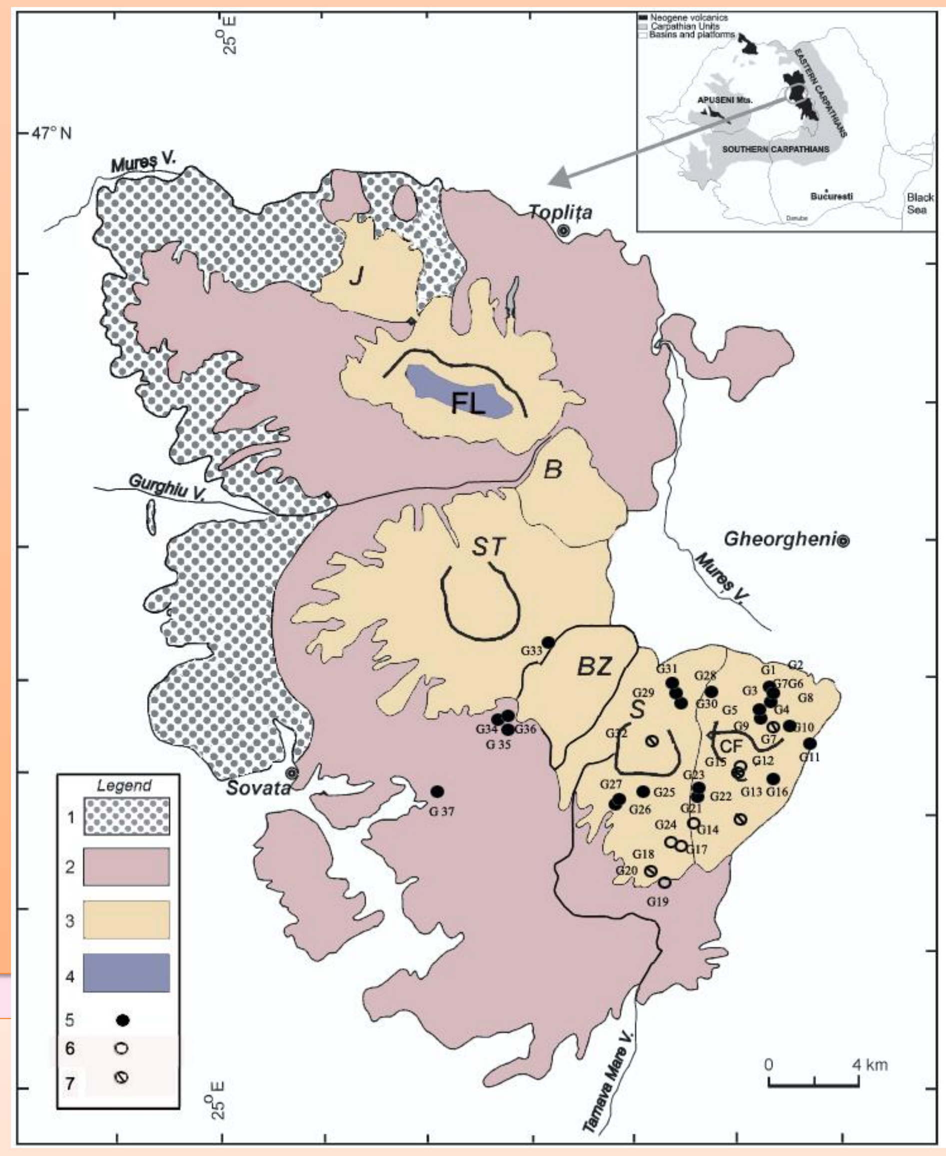


Fig. 3: Typical orthogonal diagrams and demagnetization curves of the studied samples during stepwise AF and thermal demagnetization of the NRM.



*...Seghedi et al. (2004). **1)** Volcaniclastic rocks originating from the main source ...ting mainly from Fancel-Lapusna, Seaca-Tatarca, Sumuleu and Ciumani- ...-type volcanoes (**J**= Jirca; **FL** = Fancel-Lapusna; **B** = Bacta; **ST** = Seaca – ...) **4)** Intrusuve complex inside Fancelu-Lapusna caldera; **5) site with positive***

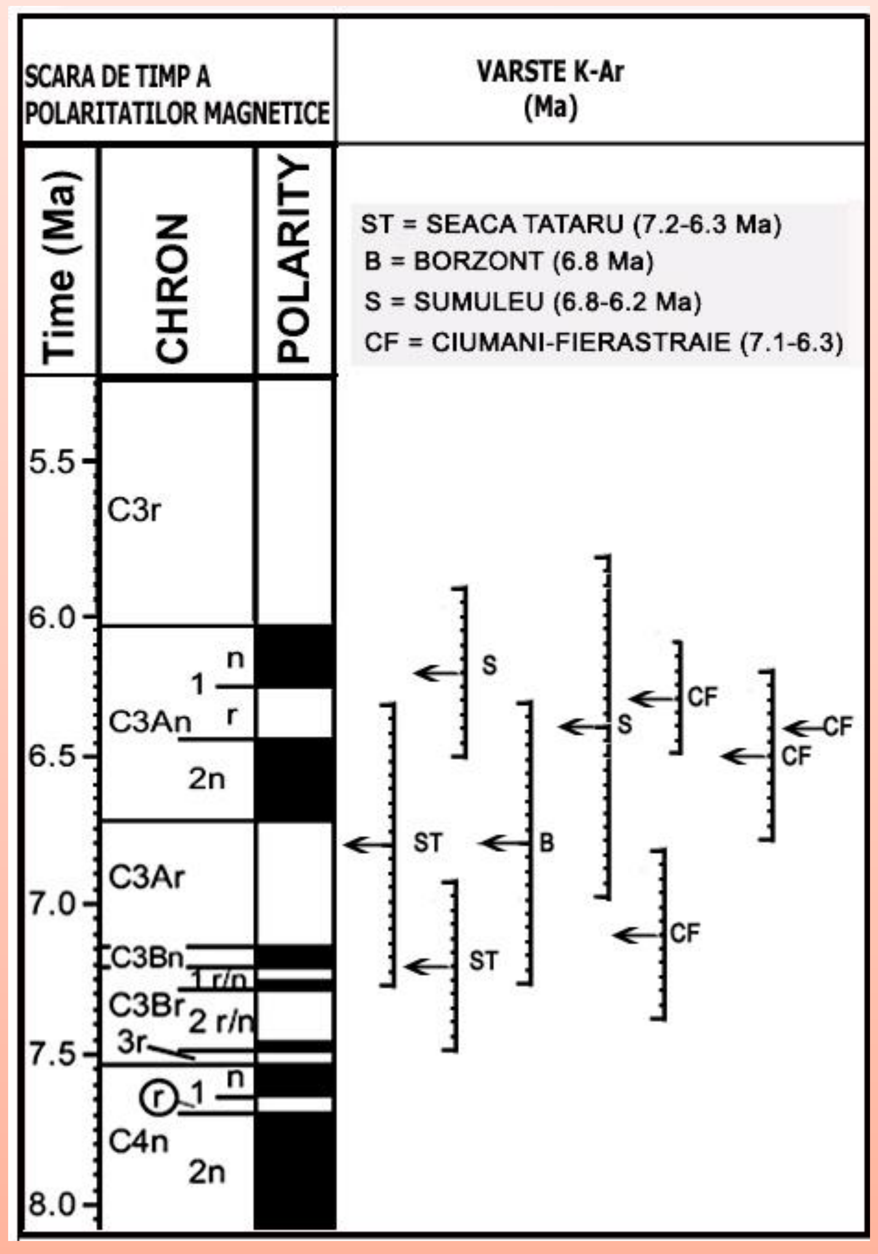


Fig. 6 . K-Ar ages of studied volcanic rocks with error -bar intervals : Geomagnetic polarity time scale after Lourens et al. (2004). K-Ar ages afte r Seghedi et al., (2004).

RESULTS

The structure of the NRM was identified both by AF and thermal demagnetizations. The characteristic remanent magnetization was identified successfully in 34 samples. Normal polarity was identified in 23 sites, 6 sites have reversed polarity and 5 sites have intermediate directions. (Fig . 4).

We rejected 5 sites (G8, G10. G13, G14, G20) because they do not follow the criteria for selecting data of Tauxe et al. (2003).

All the investigated rocks belong to non-weathered eruptive formations whose primary magnetizations must be thermoremanent magnetizations acquired during lava cooling in the presence of the geomagnetic field.

The average direction of magnetization for each sampling site and the positions of the paleomagnetic virtual poles were computed. The results concerning the poles are plotted on a stereographic projection (Fig5). For the determination of the position of the paleomagnetic poles there were computed: – the average magnetization direction of each unit; - the average paleomagnetic virtual poles of each sampling site; - the average paleomagnetic virtual poles for all sites.

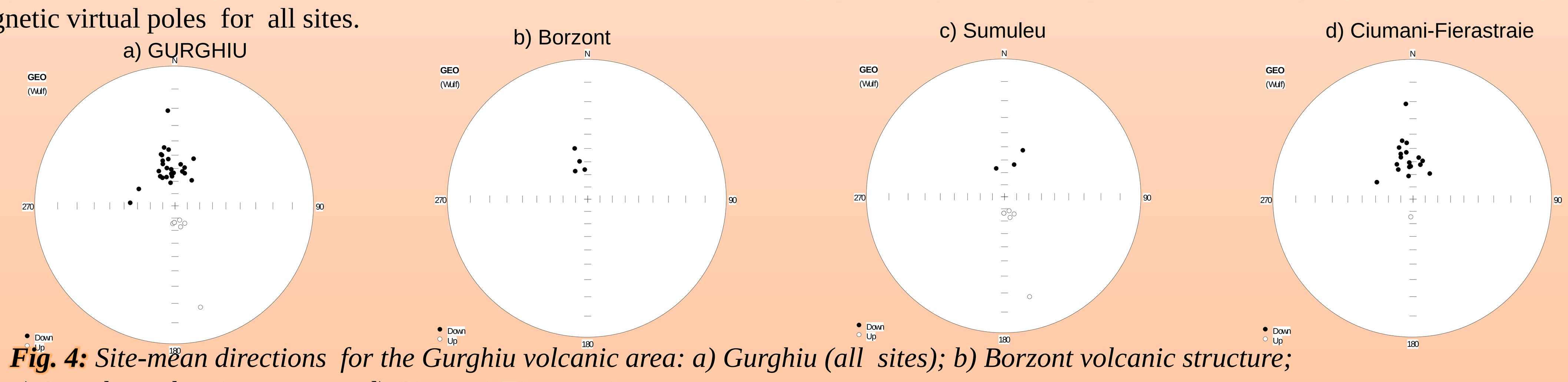


***Fig. 4:** Site-mean directions for the Gurghiu volcanic area: a) Gurghiu (all sites); b) Borzont volcanic structure; c) Sumuleu volcanic structure; d) Ciumani-Fierastraie*

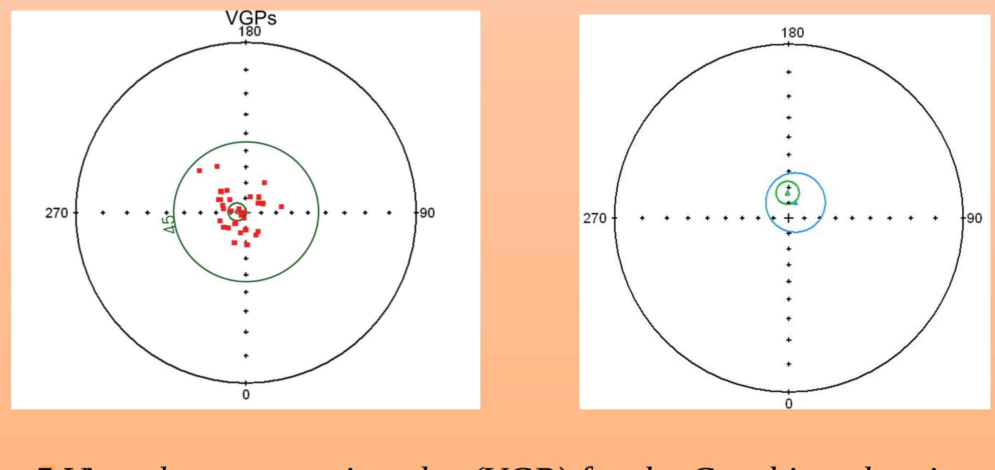


***Fig. 5** Virtual geomagnetic poles (VGP) for the Gurghiu volcanic area:*

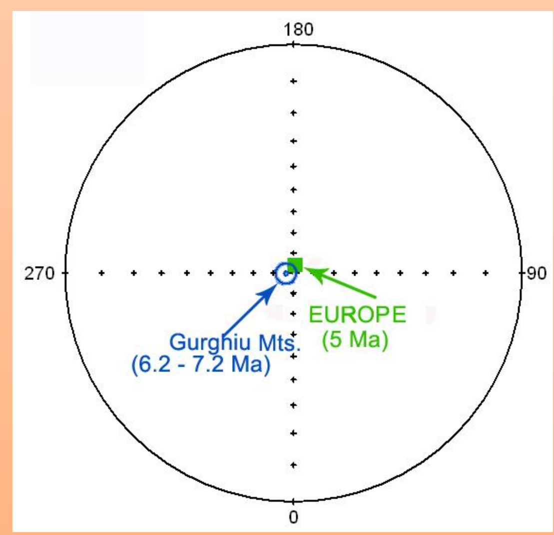


***Fig. 6** Stereographic projection of the area-mean paleomagnetic poles for Gurghiu Mountains and mean pole for Europe after Besse & Courtillot (2003). The circle around the symbol corresponds to the 95% confidence area around the mean.*

CONCLUSIONS

Distribution of magnetic polarities in the Gurghiu Mountains is in agreement with the K-Ar ages of the volcanism (Seghedi et al., 2004) **(Fig.5)**. The results are compatible with the accepted model of a progressive migration of volcanic activity from north to south. Area mean direction based on 32 sites is: declination = 253° and inclination = 84,6°.

The result shows the absence of important vertical axis rotation during the 6.8 – 7.1 Ma range **(Fig. 6)**. .

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Acknowledgements

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