Paleosecular variation in the last 6 Ma recorded by lava flows from the East Carpathians (Romania)

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Abstract: We present recent paleomagnetic results obtained from the volcanic rocks from the Gurghiu, Harghita and Perşani Mountains (East Carpathians, Romania). This volcanic chain is around 70 km long and, according to the K-Ar ages, the volcanic activity gradually migrated to the south between the 6 Ma and the Quaternary (~0.2 Ma). The areal distribution of sites with normal and reversed polarities is consistent with the currently accepted model of a progressive migration of the volcanic activity from North to the South, in time steps of around 1 Ma or less according to the magnetic polarity data. For the paleosecular variation study we have selected the sites following the criteria from Johnson et al. (2008): minimum 5 samples per site, dispersion parameter k > 50 and colatitude cutoff 45°. We selected a total of 146 sites divided in 3 age intervals: 0-1.1Ma (33 sites), 1.5-4 Ma (48 sites) and 4-6 Ma (65 sites). Average directions for these groups show small deviations from a geocentric axial dipole field, but these cannot be considered statistically significant. Paleosecular variation was characterized both by dispersion of virtual geomagnetic poles (S_B) or precision parameter k of VGP or directions (Lhuillier & Gilder, 2013). These statistics show a larger dispersion of VGPs for the 2-4 Ma group both than the global data base and the other two groups in this study (Fig. 1). This results is somehow similar to the Matuyama data set presented by Johnson et al. (2008) shows several estimates of S_B around 53°N latitude that are higher than during the Brunhes. The reversal test is negative for this group, but pozitive for the other two groups and the total data set. Numerical simulations from statistical paleosecular variation models and dynamo models indicate the need for several hundred paleomagnetic sites and more than 2 Ma to get an accurate determination of the VGPs dispersion (Tauxe et al, 2003; Lhuillier & Gilder, 2013). Only the total data set is near this condition and its dispersion is close to the global data and the predicted dispersions for Model TK03. The results from this study might imply an increase of VGP dispersion with time starting around 45°N, but more data are needed at a global level to determine if this reflects the behavior of the geomagnetic field, or an incomplete database.

Keywords: paleosecular variation, Neogene, igneous rocks, East Carpathians

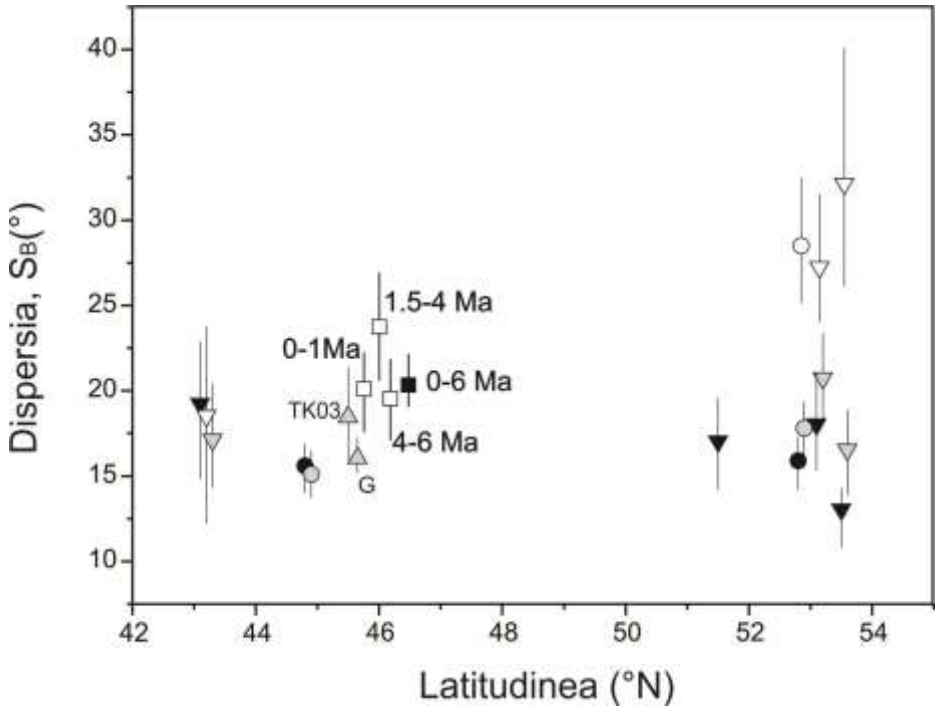

Figure 1: VGP dispersion from lavas and their 95% confidence intervals. Normal and reversed combined data from this study are represented with open square for age intervals and full square for all data. Data from Johnson et al. (2008) are represented with full symbols for Brunhes-age normal polarity, open symbols for Matuyama-age reversed polarity data and grey symbols for 0-5 Ma combined data set: inverted triangles represent data only from TAFI studies, circles are latitudinally binned global data. Predicted dispersions for Model G and TK03: triangles.

References :

Johnson, C. L., Constable, C. G., Tauxe, L., Barendregt, R., Brown, L. L., Coe, R. S., Layer, P., Mejia, V., Opdyke, N. D., Singer, B. S., Staudigel, H., Stone, D. B., 2008: Recent investigations of the 0–5 Ma geomagnetic field recorded by lava flows. Geochem. Geophys. Geosyst. 9, Q04032, doi:10.1029/2007GC001696.

Lhuillier, F., Gilder, S.A, 2013: Quantifying Paleosecular variation: Insights from numerical dynamo simulations. Earth and Planetary Science Letters, 382, 87–97

Tauxe, L., Constable, C., Johnson, C. L., Koppers, A. A. P., Miller, W. R., Staudigel, H., 2003. Paleomagnetism of the southwestern U.S.A. recorded by 0–5 Ma igneous rocks. Geochem. Geophys. Geosyst. 4(4), 8802, doi:10.1029/2002GC000343.