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Tectonic implications of the Miocene rotations of the Apuseni Mountains (Romania)

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Paleomagnetic measurements of essentially undeformed Miocene volcanic rocks in the Southern Apuseni Mountains (Romania) constrain rigid body rotations about vertical axes during Miocene in the central part of the Carpatho-Pannonian area. Thermal and alternating field demagnetization was carried out on samples from 41 sites in all major volcanic areas. The age of the sampled rocks range from 15 Ma to 7 Ma. Well-defined magnetic components were isolated, which are interpreted to represent the Earth's magnetic field at the time of volcanic activity. Combining our results with previous paleomagnetic data from the same volcanic area, we have obtained a set of 66 paleomagnetic directions: 32 with reversed polarity, 24 with normal polarity and 10 with intermediate directions. Statistical analysis of the VGPs of the 56 sites with normal and reversed polarity showed that colatitudes are Fisherian distributed, but longitudes fails the test at the 5% probability level. The mean latitude is around 43°N closed to the present day latitude of the sampling area. The declinations change gradually from 63° at 14-15 Ma to -10° around 10-11 Ma. We interpret this change as a continuous 70° clockwise rotation of the sampling area between 15 Ma and 14 Ma. The new aspect of this study is a final counterclockwise rotation of the Apuseni Mountains to reach present day position. The amplitude of this final rotation is around 15° with respect to the 10-11 Ma volcanic area from the Eastern Carpathians which show no rotation with respect to stable Europe. Reviewing the paleomagnetic results from the Carpatho-Pannonian area we suggest two periods of rotations with different driving mechanism. The first one start around 20 Ma and end around 11 Ma with the collision of the Eastern Carpathians with the East European platform. The spatial distribution of rotations and their migration in time is similar to those obtained in the upper plate during analogue experiments of a retreating plate boundary. We think that

during this period the Carpatho-Pannonian area has a continuum deformation and re-constructions based on rigid rotations of different units are questionable. The second period of rotation started after 10 Ma. These rotations are localized in the internal part of the Carpatho-Pannonian domain. The driving mechanism as it was suggested by several authors is probably the push of the Adriatic plate which deform the soft and hot central part of the Carpatho-Pannonian area.