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Kinematic evolution of Internal Getic nappes (Serbian Carpathians, eastern Serbia)

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The tectonic evolution of the Carpatho - Balkanides Mountains is less understood in the critical segment of the Serbian Carpathians due to lack of available kinematic data. We have performed a field kinematic analysis combined with existing information from previous local and regional studies by focusing on the internal part of this orogenic segment, where the three highest most units of the nappe stack are exposed and separated by large offsets thrusts, i.e. the Supragetic, Upper Getic and Lower Getic. These units expose their metamorphic basement and Permo-Mesozoic cover penetrated by syn- and post-kinematic plutons and overlain or otherwise in structural contact with the Neogene fill of intramontane basins and the one of the Morava river corridor located in the prolongation of the much larger Pannonian basin. The kinematic analysis demonstrates seven superposed tectonic events of variable magnitudes and effects. Available superposition criteria and the correlation with the regional evolution demonstrate that four events are major tectonic episodes, while three others have a more limited influence or are local effects of strain partitioning and rotations.

The first deformation event observed is the late Early Cretaceous cataclastic to brittle thrusting and shearing associated with the emplacement of the Supragetic nappe over the Getic unit. The observed paleostress NW-SE to SW-NE compressional directions were affected by the subsequent Cenozoic oroclinal bending of the Carpathians nappe stack. The first event was followed by Late Cretaceous ~E-W compression associated with significant strike-slip and transpression, the paleostress orientation being affected by the same subsequent rotations. The Paleogene - Early Miocene activation of the Cerna - Jiu and Timok faults system that cumulates an observed offset of 100 km is associated with large strikes-slip deformation with presently observed NNE-SSW oriented compressional directions in the study area. The formation of the Pannonian Basin and its prolongation in the Morava river corridor was associated at first with Early-Middle Miocene orogen-perpendicular extension, which was followed by orogen-parallel extension and strike-slip that started in the late Middle Miocene and lasted possibly until Pliocene times. This was followed by the Pliocene-Quaternary reactivation and thrusting of the Upper Getic thrust and strike slip with NNE-SSW to NNW-SSE oriented compression.

All these deformations demonstrate a complex poly-phase history characterized at first by Cretaceous nappe stacking and transpressional deformations. This nappe stacking was followed by Cenozoic oroclinal bending associated with large-offset strike slip faults during the translation and rotation associated with the gradual closure of the Carpathians embayment, which interacted in the Serbian Carpathians with the back-arc extension of the Pannonian basin. This was followed by the regional inversion of the larger Pannonian Basin often reactivating inherited major structures or nappe contacts. This complex interplay was associated with significant strain partitioning that resulted in local rotations and changes of the paleostress directions.