Geophysical Research Abstracts, Vol. 7, 08444, 2005
SRef-ID: 1607-7962/gra/EGU05-A-08444

Lithospheric state of stress, rheology and (neo)tectonic controls on the late stage evolution of the Pannonian-Carpathians system: post-orogenic folding and intraplate continental topography

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The Carpathians - Pannonian Basin system provides a natural laboratory for analyzing lithospheric to surface controls on tectonic topography development. To link processes taking place at depth and at the surface, recent research focused on the interplay between basin evolution, active tectonics, topography evolution and intraplate folding mechanisms. The principal aim is to understand and quantify neotectonic processes controlling landscape development and natural hazards during the late-stage (Late Neogene - Quaternary) evolution of the Carpathians - Pannonian Basin system. This system is a key location to reconstruct the response of topography to intraplate stresses, followed by modelling of neotectonic patterns and landscape forming processes in the aftermath of continental collision. Results obtained so far demonstrate the importance of the substantial differential vertical movements that have taken place during the Pliocene-Quaternary. A key element is the investigation of the mechanics of coupling between back-arc deformations in the Pannonian and Transylvania basins and inherited continental collision and foreland basin evolution along the Carpathian arc. To pursue this concept, a major challenge is to provide direct and well constrained links between lithosphere dynamics, neotectonics and surface and climatic processes through quantitative models with a multiple array of different datasets, covering different scales and aspects of these phenomena. A close relationship has been established between the timing and mechanisms of stress changes in the Pannonian and Transylvania basins and structural episodes in the surrounding thrust belts, pointing to an intrinsic mechanical coupling with these basins, the orogen and its foredeep. Basin

inversion taking place during the Pliocene-Quaternary times in the entire Pannonian - Carpathians system is related to changes in the regional stress field leading to differential vertical movements associated with a laterally variable folding mechanism active in the entire system. Short, crustal folding patterns alternate with lithospheric wavelengths in the SE Carpathians foreland, East and South Carpathians, Transylvania and Pannonian basins. The lateral variability is the result of a marked contrast in recent rheology between these areas, directly related to the crustal configuration, thermal properties and late stages collision kinematics with the Carpathians foreland. Strong and rigid buttresses such as the Bohemian Massif and East-European Platform are replaced laterally with weaker regions, such as the Moesian platform. As a result, lateral variations in the properties of the down going plates largely control the collision mode in the Carpathians and the post-collisional evolution of the entire system. The vertical movements associated with the later are highly asymmetric, generally increasing towards the SE Carpathians, where a genetic relationship with the intermediate mantle scale processes has been inferred. In this area, thermomechanical modeling demonstrates that the unusual character of subduction is governed by a thermal resettlement, the subducted lithosphere having enough time to interact with the mantle. This model results infer an effective top-down control on collision dynamics, accounting for a source-sink relationship between coevally uplifting Carpathians and rapidly subsiding Late Neogene - Quaternary basins.