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Motion of Adria and ongoing inversion of the Pannonian basin: inferences from stress and strain indicators

G. Bada (1,2), G. Windhoffer (2), L. Fodor (3), Gy. Grenerczy (4,5), L. Tóth (6), F. Horváth (2), S. Cloetingh (1)

(1) Netherlands Research Centre for Integrated Solid Earth Science, Vrije Universiteit Amsterdam, the Netherlands (bada@ludens.elte.hu), (2) Dept. of Geophysics, Eötvös University Budapest, Hungary, (3) Geological Institute of Hungary, (4) Dept. of Geology, Southern Illinois University, Carbondale, IL, USA, (5) FÖMI Satellite Geodetic Observatory, Penc, Hungary, (6) Seismological Observatory, Hungarian Academy of Sciences, Budapest, Hungary

This paper presents the latest compilation of data and models on the present-day stress and strain pattern in the Pannonian basin and its tectonic environment, the East Alpine-Dinaric orogens. Extensional formation- of the Pannonian basin system within the Alpine orogenic belt started in the early Miocene, whereas its structural reactivation has been taking place since late Pliocene-Quaternary times. Inversion is related to changes in the regional stress field from a state of tension that controlled basin formation and subsidence, to a state of compression, mainly governed by the motion of Adria ("Adria-push"). This has resulted in active faulting, seismicity, and overall contraction that led, eventually, to the folding of the lithosphere. Stress indicators, earthquake focal mechanisms, GPS measurements and the results of neotectonic studies indicate a well-defined spatial and temporal variation of both the stress and strain fields during the last stages of basin evolution. Earthquake data indicate that current deformation is mainly concentrated in the vicinity of the contact zone between Adria and the Alpine-Dinarides orogen where strong contraction is in combination with active strike-slip faulting (dextral transpressional corridor). Stresses and deformation are, however, transferred well into the Pannonian basin, resulting in a complex pattern of ongoing tectonic activity. From the frontal zone of "Adria-push" in the Dinarides towards the interior of the Pannonian basin the dominant style of deformation grad-

ually changes from pure contraction through transpression to strike-slip faulting. The overall shortening over the entire basin system is clearly evidenced by earthquake focal mechanism solutions and GPS data. Extensional basin formation led to significant weakening of the Pannonian lithosphere, allowing subsequent deformation to be localised at crustal discontinuities. In addition, the extended, hot, and hence weak lithosphere underlying sedimentary basins is prone to reactivation under relatively low compressional stresses. Due to its extremely low rigidity and the high level of intraplate compression concentrated in the thin elastic core of the Pannonian lithosphere, the area exhibits large-scale bending manifested in Quaternary subsidence and uplift anomalies. The Pannonian basin has been interpreted as a well documented case of irregular lithospheric folding, with a wavelength spectrum ranging from a few kilometres (local basin inversion) to hundreds of kilometres (whole lithospheric folding). Folding of the Pannonian lithosphere is often manifested in differential vertical motions with significant uplift at the basin margins and along some internal basement highs, and accelerated subsidence in localised depressions at the basin centre. The importance of late-stage compression in the Pannonian basin for explaining its anomalous topography and intraplate seismicity has been recognised, and a novel model for the structural reactivation of back-arc basins has been developed. Possible sources of compression in the context of basin inversion were investigated by means of numerical modelling. The state of recent stress and deformation in the Pannonian basin, particularly in its western and southern part, is controlled by the complex interaction of plate boundary and intraplate forces. These are the counterclockwise rotation and northward indentation of the Adriatic microplate as the dominant source of compression in combination with buoyancy forces associated with the elevated topography and crustal thickness variation along the Alpine, Carpathian and Dinaric orogens.