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On the formation and evolution of the Pannonian Basin: Constraints derived from the structure of the junction area between the Carpathians and Dinarides

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[1] The large number and distribution of rollback systems in Mediterranean orogens infer the possibility of interacting extensional back-arc deformation driven by different slabs. The formation of the Pannonian back-arc basin is generally related to the rapid Miocene rollback of a slab attached to the European continent. A key area of the entire system that is neglected by kinematic studies is the connection between the South Carpathians and Dinarides. In order to derive an evolutionary model, we interpreted regional seismic lines traversing the entire Serbian part of the Pannonian Basin. The observed deformation is dominantly expressed by the formation of Miocene extensional detachments and (half) grabens. The extensional geometries and associated synkinematic sedimentation that migrated in time and space allow the definition of a continuous and essentially asymmetric early to late Miocene extensional evolution. This evolution was followed by the formation of few uplifted areas during the subsequent latest Miocene–Quaternary inversion. The present-day extensional geometry changing the strike across the basin is an effect of the clockwise rotation of the South Carpathians and Apuseni Mountains in respect to the Dinarides. Our study infers that the Carpathian rollback is not the only mechanism responsible for the formation of the Pannonian Basin; an additional middle Miocene rollback of a Dinaridic slab is required to explain the observed structures. Furthermore, the study provides constraints for the pre-Neogene orogenic evolution of this junction zone, including the affinity of major crustal blocks, obducted ophiolitic sequences and the Sava suture zone.

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1. Introduction

[2] Extensional back-arc basins develop in the hinterland of active convergent areas in response to retreating subduction boundaries, their architecture being controlled by a large variety of parameters such as the age of subducted lithosphere, the subduction direction, the type of underlying crust or the uplift of the orogenic/magmatic arc [e.g., *Dewey*, 1981; *Doglioni et al.*, 2007; *Mathisen and Vondra*, 1983; *Uyeda and Kanamori*, 1979]. These parameters control the large variety of back-arc basins of various ages presently overlying different types of crust, such as the Caribbean, Banda-Sunda back arcs or the Black Sea Basin [e.g., *Hall*, 2011; *Meschede and Frisch*, 1998; *Munteanu et al.*, 2012; *Spakman and Hall*, 2010].

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[3] The Pannonian Basin of Central Europe (Figure 1a) is a classical back-arc basin, which is still underlain by highly thinned continental lithosphere that formed during Miocene times in response to the rapid rollback of a slab attached to the European continent [e.g., *Balla*, 1986; *Horváth et al.*, 2006; *Horváth*, 1993; *Royden*, 1988]. The rollback is partly responsible for the creation of the highly arcuate geometry of the Carpathian Mountains (Figure 1) [e.g., *Matenco et al.*, 2010], a process that is common with many other Mediterranean orogens [e.g., *Faccenna et al.*, 2004; *Jolivet and Faccenna*, 2000]. Evolutionary models of the Pannonian Basin assume the onset of extension at ~20 Ma, subsequently followed by a peak tectonic activity along normal faults during Middle Miocene times, which was subsequently followed by a post-rift, thermal sag phase starting in late Miocene times [e.g., *Tari et al.*, 1999, and references therein]. A latest Miocene–Quaternary contractional event has subsequently overprinted the basin during the translation and counterclockwise rotation of the Adriatic indenter [*Bada et al.*, 2007; *Fodor et al.*, 2005; *Horváth*, 1995; *Pinter et al.*, 2005].

[4] The timing of extension in the Pannonian Basin is best constrained in the area of the ALCAPA unit in the north,

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