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The evolution of a key segment in the Europe–Adria collision: The Fruška Gora of northern Serbia

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ABSTRACT

The large number of roll-back systems in Mediterranean orogens poses interesting questions concerning interacting extensional back-arc deformation driven by different slabs. One such area characterized by a critical lack of kinematic studies is the connection between the Carpathians and Dinarides, where the Fruška Gora is an isolated inselberg of basement and Mesozoic cover surrounded by Miocene sediments. This area recorded a complex evolution related to the Cretaceous–Paleogene collision between Europe- and Adria-derived tectonic units, the Miocene extension of the Pannonian Basin and its subsequent inversion. This evolution has been analysed in a kinematic study combined with biostratigraphic and Rb-Sr thermochronology of sediments and their metamorphism. Results demonstrate a poly-phase tectonic evolution and allowed the discrimination of deformation events and basement affinities. The protolith of the Fruška Gora metamorphic core contains a typical Triassic–Jurassic sequence of the distal Adriatic margin that is overlain by Upper Cretaceous–Paleogene sediments deposited in the Neotethys subduction zone. A part of this basement still records a Late Jurassic (~148 Ma) burial metamorphic event that is associated with the coeval structural emplacement of overlying oceanic crust. Three successive deformation events were associated with the Latest Cretaceous–Early Oligocene contraction. The subsequent exhumation of the Fruška Gora metamorphic core started at ~28 Ma in the footwall of a large extensional detachment and continued by normal faulting during Early–Middle Miocene times. The large-scale extension took place during the extension of the Pannonian Basin and was associated with coeval translations and clockwise rotations of the Fruška Gora. Its present-day antiformal geometry truncated by high-angle reverse faults with S-ward vergence was established during the inversion of the Pannonian Basin, an effect of the late stage Pliocene–Quaternary Adriatic indentation.

1. Introduction

The evolution of retreating subduction boundaries has been an element of wide interest since the observation of major subducted slabs that are shifted in space and time from the exposed location of genetically associated suture zones. This is the frequent situation of many Mediterranean orogens such as Hellenides, Dinarides, Apennines or Carpathians (Spakman, 1990; Faccenna et al., 2004, 2005; van Hinsbergen et al., 2005; Matenco et al., 2007). In all these mountain chains, collisional processes were often overprinted by back-arc extension driven by slab-retreat, preventing their accurate quantitative discrimination. Furthermore, often changes in subduction polarities across European orogens resulted in zones of interaction between back-arc processes that are driven by different slabs (e.g., Alpine versus Dinaridic polarity, Dinaridic versus Carpathians polarity, Bernoulli et al., 1990; Kissling et al., 2006; Ricou et al., 1986; Schmid et al., 2008).

One of the most interesting areas for the evolution of the Europe–Adria collision zone in terms of orogenic and back-arc interactions is the southern part of the Pannonian Basin near the junction between the Carpathians and Dinarides (Fig. 1). Situated at the connection between three continental blocks, Dinarides (i.e. Adria), Tisza and Dacia (i.e. Europe), this area recorded a late Jurassic–earliest Cretaceous obduction event that affected both European and Dinarides continental margins (e.g., Dimitrijević, 1997; Karamata, 2006). Following the Cretaceous docking between Tisza and Dacia, these margins and their obducted ophiolites were juxtaposed during the late Cretaceous formation of the Sava suture zone from a Neotethys remnant that was presumably subducted by the onset of collision during Maastrichtian times (e.g., Schmid et al., 2008; Ustaszewski et al., 2009). This orogenic evolution has been subsequently overprinted by the Miocene

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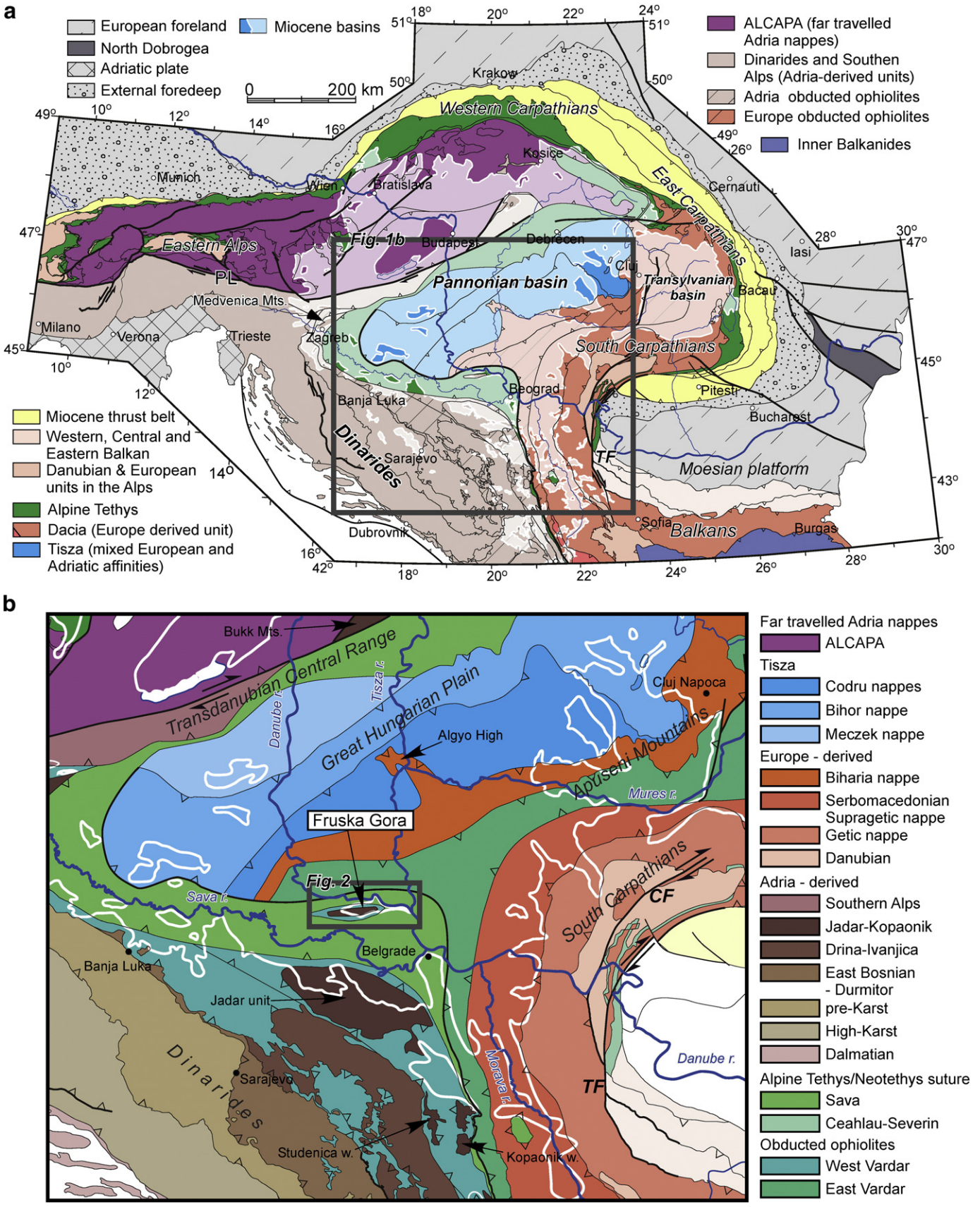

Fig. 1. a) Major tectonic units of Alps, Carpathians and Dinarides (simplified after Schmid et al., 2008). The white transparent areas mark the location of Miocene basins juxtaposed over an inherited orogenic structure. PL — Periadriatic Lineament; the grey inset is the location of Figure 1b; b) detailed tectonic map of the connection between the Dinarides and Carpathians (modified after Schmid et al., 2008 and complemented with data of Čanović and Kemenci, 1988). The white lines are the contours of the same Miocene basins as described above.