Kinematics and timing of convergence between the Tisza block and the internal Dinarides along the Sava-Zone: from Mid-Eocene collision to Mid-Miocene exhumation of post-collisional granites

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This structural and geochronological study aims at defining kinematics and timing of convergence between the Tisza block and the internal Dinarides along the so-called "Sava Zone", situated at the south-western margin of the Pannonian Basin. The Sava Zone represents a Late Cretaceous to Early Palaeogene volcanic (back)-arc basin that remained open until Mid-Eocene collision between the Dinarides and the northerly adjacent Tisza block and was interpreted to represent a Late Cretaceous to Early Palaeogene volcanic (back)-arc basin (Pamic et al., 2002),). This supposed suture zone and which underwent Early Tertiary regional metamorphism related to its closure. The Sava Zone is considered as both to represent a remnant of the Vardar ocean and as well as a continuation of the Solnok flysch basin along the Mid-Hungarian fault zone. Thus, it occupies the position of a suture that is of particular importance in unraveling the assembly of tectonic units in the Dinaric-Pannonian-Carpathian domain. Apart from bimodal volcanics of Late Cretaceous age, the Sava Zone is dominated by mostly terrigeneous, often volcanodetritic flysch series of Turonian to Mid-Eocene age (Sparica et al., 1984) that were deposited in an accretionary prism forming in the collision zone. The area investigated is situated in northernmost Bosnia-Hercegovina, where outcrops of pre-Neogene rocks are restricted to a few isolated hills. Mmetamorphismc overprint in the flysch series reaches from non-metamorphic conditions in the Sincreases towards the N from diagenetic (?) to greenschist-facies conditions in the N. Four deformation phases can be distinguished in the mount Motajica area.
A first deformation phase (D1), most likely concomitant with regional metamorphism, produced the main foliation. Top-to-the-S directed transport directions in garnet-bearing mica-schists are presumably related to thrusting of Tisza onto the internal Dinarides and progressive closure of the flysch basin of the Sava Zone. Quartz-mylonites with a pronounced shape-preferred orientation reveal dynamic recrystallizsation by grain boundary migration, indicative of upper greenschist facies conditions. The D1 structures as well as the isograds of regional metamorphism are crosscut by an S-type granitic intrusion D1 is followed by the intrusion of an S-type granitic plutonintrusion, which runs discordantly cuts to isograds of regional metamorphism. U-Pb dating of monazites from the granite yielded an 207Pb/235U age of c. 27 Ma. This result puts casts

severe doubts on earlier reported Rb-Sr whole rock isochron ages of 48 Ma (Lanphere & Pamic, 1992) highly into doubt, ages which may possibly reflect mixing with older crustal components in the anatectic granitic meltsare considered unreliable due to the s-type nature of the melt. In the light of our new data, the previously held opinion that regardsWe therefore suggest that the magmatism previously considered as syncollisional (Lanphere & Pamic, 1992) should perhaps be reconsidered as post-collisional. Effects of the contact aureole, foundContact metamorphism is only observed within c. 100 m proximity around the pluton, are evidencedby (a) in static growth of large white mica porphyroblasts that overgrow a main foliation in low-grade phyllites and (b) in annealing of mylonitic quartz textures.

A second deformation phase (D2) postdates the intrusion of the pluton, as it produced a foliation in both granite and dikes that discordantly cut regionally metamorphosed series. Occasionally, granitic dikes are found to be folded around WNW-ESE-trending fold axes. Also, the D1 foliation is seen to be overprinted by an axial plane cleavage associated with WNW-ESE-trending, N-facing folds. These observations suggest that N-S shortening prevailed throughout D2.

The third deformation phase (D3) is manifested in the boudinationby boudinage of granitic dikes and an "upwarping" of the foliation with increasing proximity to the pluton. Associated stretching lineations are WNW-ESE-trending (i.e. parallel to the general strike) and indicate transport directions away from the pluton center (i.e. top-to-the-W and top-to-the-E west and east of the pluton, respectively). Chloritisation of pre-kinematic garnet and growth of chlorite in shear bands at the expense of biotite, and together with the lack of dynamically recrystallized quartz, recrystallisation fabrics all point to the factindicate that D3 is related to the exhumation and concomitant cooling of the pluton. K-Ar-ages obtained from BiBt-concentrates from granitic samples (Lanphere & Pamic, 1992) indicate that cooling below c. 300 °C occurred at around 18 Ma. In combination with apatite fission track ages that areof around 16.5 Ma, this illustrates that the timing of exhumation is synchronous tocoeval with the Eggenburgian to Karpatian synrift phase of the Pannonian Basin. This suggests documents a major change from convergence to extension in the previously collisional Sava Zone. It is speculated that exhumation could have been achieved by isostatic footwall uplift below a WNW-ESE-trending, northerly dipping detachment fault that delineates the Sava depression immediately to the N of Motajica, where subsidence prevailed well into Pannonian times.

A fourth deformation phaseFinally (D4) is manifested inled to the formation of metric-scale, open folds in low-grade metamorphosed sandstones and phyllites. They, which refold an older axial plane cleavage and which are associated with c. E-W-trending crenulations and N-S-oriented bedding-slip lineations. This phaseD4 could beis most likely related to the Post-Pannonian compressional inversion of the Sava depression (Tari & Pamic, 1998).

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