Geophysical Research Abstracts
Vol. 12, EGU2010-7311, 2010
EGU General Assembly 2010

Evolution of the Alpine Tethys (Sava) suture zone in Fruška Gora Mountains (N Serbia): from orogenic building to tectonic omissions

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The Fruška Gora Mountains in northern Serbia offers an unique opportunity to study the Cretaceous-Eocene evolution of the NE part of the Dinarides, which is largely covered elsewhere beneath the thick Miocene sediments of the Pannonian basin, deposited during the back-arc collapse associated with the subduction and roll-back recorded in the external Carpathians.

The structural grain of the Fruška Gora Mountains is the one of a large scale antiform, exposing a complex puzzle of highly deformed metamorphic rocks in its centre and Triassic-Miocene sequence of non-metamorphosed sediments, ophiolites and volcanics along its flanks. The metamorphic rocks were the target of structural investigations coupled with paleontological dating (conodonts, palynomorphs and radiolarians) in an effort to unravel the geodynamic evolution of an area thought to be located near the suture zone between the Tisza upper plate and the Adriatic lower plate, i.e. the Sava subduction zone of the Dinarides (e.g., Pamic, 2002; Schmid et al., 2008). The existence of this subduction zone was previously inferred here by local observations, such as metamorphosed Mesozoic sediments containing Middle Triassic conodonts (Đurđanović, 1971) or Early Cretaceous blue schists metamorphism (123±5 Ma, Milovanović et al., 1995).

The metamorphic sequence is characterized by a Paleozoic age meta-sedimentary basement which contains palynomorphs of Upper Paleozoic – Carboniferous age and a meta-sedimentary and meta-volcanic sequence which contain a succession of contrasting metamorphosed lithologies such sandstones, black limestones, shallow water white limestones, basic volcanic sequences, deep nodular limestiones, radiolarites, meta-ophiolites and turbiditic sequences. The lower part of the sequence is contrastingly similar with the Triassic cover of the Drina-Ivanijca thrust sheet and its metamorphosed equivalent observed in the Kopaonik and Studenica series (Schefer et al., in press). This observation is supported by the newly found micro-fauna of Upper Triassic in age in the meta-sandstones associated with meta-volcanics on the SW slopes of the mountain. The upper part of the sequence display metamorphosed “flysh”-type of sequences and meta-basalts. In these deposits, slightly metamorphosed siliciclastics (lithic sandstones with volcanic-derived clasts) previously interpreted as Upper Jurassic mélange have proved to contain Upper Cretaceous palynomorphs.

Among the rocks exposed in the metamorphic core of the mountains, the SW slope of Fruška Gora offers the optimal locality for the study of the kinematic evolution. Here, four phases of folding have been mapped, being associated mainly with large-scale regional contraction. The first phase is characterized by isoclinal folding, with reconstructed SW vergence. The second generation of E-W oriented and coaxial folds is asymmetric and is up to metres in size, displaying a south vergence and has largely refolded the previous generation. The third event was responsible for the formation of upright folds, yet again E-W oriented, re-folding earlier structures. The first two phases of folding are associated with metamorphic conditions, while the third was apparently near the transition with the brittle domain. The relationship with a fourth folding event observed also in the non-metamorphosed clastic-carbonate rocks is rather uncertain, but is apparently associated with the present day antiformal structure of the Fuska Gora Mountains.

Interestingly, the metamorphosed Triassic and Upper Cretaceous carbonatic-clastic sequence in the core of the antiform is in structural contact along the antiformal flanks with Lower-Middle Triassic and Upper Cretaceous-Paleogene sediments which display the same facies, but these are not metamorphosed. This demonstrates a large scale tectonic omission along the flanks of the Fruška Gora antiform, 9-10km of rocks being removed by what we speculatively define as an extensional detachment exhuming the metamorphic core. This detachment has been subsequently folded into the present-day antiformal geometry of the Fruška Gora Mountains.

These findings demonstrate that the metamorphic and non-metamorphic Upper Cretaceous – Paleogene clastic-carbonate sediments belongs to the main Alpine Tethys (Sava) subduction zone of the Dinarides. The Paleozoic-Triassic metamorphic and non-metamorphic rocks belong to the distal Adriatic lower plate, or more precisely to the Jadar-Kopaonik composite thrust sheet (Schmid et al., 2008), while the layer of serpentinized peridotite found at their contact most probably belongs to the Western Vardar ophiolites obducted over the Adriatic plate during Late Jurassic – Earliest Cretaceous. The distal Jadar-Kopaonik composite unit was partly affected by strong contractional deformation and a Late Eocene greenschist facies metamorphism during the main phase of subduction and collision, similarly to what has been observed elsewhere in the Dinarides (Pamić, 2002; Schefer et al., in press). A Miocene phase of core-complex formation was responsible for the large tectonic omission observed, being probably followed by the formation of a wide open antiformal structure during the Pliocene-Quaternary inversion of the Pannonian basin.