Cenozoic evolution of the Adria–Europe plate boundary in the northern Dinarides (Croatia and Bosnia-Hercegovina) – kinematics, tectonometamorphism and neotectonics

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This study documents the Cenozoic to recent evolution of the Adria-Europe plate boundary zone, the Sava Zone, in the northern Dinarides. Late Cretaceous subduction of last remnants of Vardar oceanic lithosphere led to the formation of a suture, across which the upper plate Tisza-Dacia Mega-Unit (attached to Europe during the Early Cretaceous and therefore referred to as European Plate, for simplicity) was juxtaposed against the Adria-derived units of the Dinarides. The Dinarides reside in a lower plate position and include Vardar-derived ophiolites obducted in the Latest Jurassic. Late Cretaceous, largely siliciclastic sediments have been incorporated into an accretionary wedge that evolved during the initial stages of continent-continent collision. The structurally lowest parts of the presently exposed accretionary wedge underwent amphibolite grade metamorphism. Top-to-the-S-directed senses of shear in mylonites and south-facing folding in low-grade phyllites are consistent with the assumption that the European plate overthrusted the Adriatic units. $^{39}Ar/^{40}Ar$ amphibole ages indicate cooling from peak metamorphic conditions at ca. 55 Ma. Plate convergence continued throughout the Paleogene and gave rise to foreland propagation, i.e. southwest-directed thrusting within the Dinarides.

From the Late Oligocene onwards the Sava Zone underwent extension. Its early stages were accompanied by retrogression of peak-metamorphic mineral assemblages and footwall exhumation beneath a low-angle detachment. $^{39}Ar/^{40}Ar$ white mica cooling ages between 28 and 24 Ma date the initial stages of extensional unroofing. The low-angle detachment telescoped the metamorphic gradient, transposed an older metamorphic foliation and became in turn cut by late-stage brittle high-angle normal faults. S-type granitoids with $^{206}Pb/^{238}U$ zircon and $^{207}Pb/^{235}U$ monazite ages of 26.7 and 26.6 Ma were syn-tectonically emplaced and developed a solid-state foliation that formed under greenschist-facies conditions. Zircon and apatite fission track ages from both metamorphics and granitoids range between 21 and 14 Ma and indicate ongoing exhumation. Late-stage cooling is synchronous with the Ottnangian to Karpatian synrift phase of the Pannonian Basin. After the Pontian, the normal faults were inverted, creating the characteristic 'inselberg' morphology of the southwestern Pannonian Basin. At present, the area is governed by N-S compression and represents the seismically most active part of the Dinarides apart from the external-most thrusts in the Adriatic Sea.