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Timing, kinematics and mechanics of the Adriatic indentation: lessons from Dinarides-Pannonian observations and modelling

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Indentation is generally used to define the collisional mechanics of small plates flanked by large subduction systems creating significant thickening and lateral escape of continental units. The indentation of the Adriatic microplate has been described by studies in the Central and Eastern Alps, their connection with the Dinarides and the lateral escape into the Pannonian Basin. We know that this lateral escape was partly accommodated by the Pannonian extension that ceased once the Carpathians subduction system was locked at $\sim$ 8 Ma. In contrast, the kinematics and timing of deformation in the $\sim$600 km long bounding Dinarides segment is less known. It is generally over-simplified or looked through the present-day snapshot of horizontal movements, stress distribution or lithospheric structure, while this snapshot is not diagnostic in terms of orogenic mechanics and past kinematics. What do the Dinarides really tell us? One critical overlooked observation comes from the deformation mapped in the Dinarides Lakes System, a large number of endemic early-middle Miocene basins distributed throughout the entire orogen. Their study demonstrates a generalized phase of Miocene extension observed also in more external parts of the orogen, which was followed by inversion after 8 Ma by creating many large-offset faults that were previously thought to be formed during earlier orogenic events. The kinematics and amplitude of extension indicate lateral gradients in the gravitational potential of an overthickened orogenic wedge, possibly amplified in the internal NE areas by the back-arc extension of the Pannonian Basin. The post- 8 Ma Dinarides deformation was characterized by a coherent regional system of large offset dextral strike-slip faults, which transfer gradually their offsets to thrusts and high-angle reverse faults. This inversion system is oblique to the inherited orogenic nappe stack by transferring the large-offset deformation from internal orogenic areas in the NW to the (continental) subduction observed in the SE. These observations lead to the conclusion that the Adriatic indentation in the Alps was accommodated differently pre- and post- 8 Ma to the E and SE. As long as the Miocene Carpathians subduction system was active until 8 Ma, most of this indentation was accommodated by the lateral escape and Carpathians movement, while most of Dinarides recorded little to no deformation. After 8 Ma, deformation associated with the Adriatic indentation was partitioned mostly to oblique transpression in the Dinarides. This deformation accommodated the differential N- to NE-wards motion of Adria in respect to the rapid S- to SW- ward movement of a Hellenides area situated SE of the Kefalonia Fault, driven by the Aegean slab-roll back, facilitated by the thinned continental to oceanic nature of the Ionian lithosphere involved in the subduction system. The post- 8 Ma system of strike-slip, reverse and thrust faults mapped in the Dinarides must be nothing else but a large-scale crustal horizontal drag zone accommodating the differential motion between the Adriatic indentation and Aegean slab roll-back.