New constrains to the Mesozoic structural evolution of the Inner Western Carpathians achieved by metamorphic, structural and age data

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A complex thin-skinned nappe pile of the Inner Western Carpathians was studied in the central part of the Rudabánya Hills, NE Hungary. A new structural model and evolution were suggested on the basis of structural, metamorphic petrological, geochronological and paleontological data.

The investigated nappes derive from the Neotethys Ocean and its attenuated continental margins and built up by Triassic and/or Jurassic sedimentary rocks. The flysch-type, fine to coarse-grained sedimentary sequence of the Telekesoldal nappe (Meliata nappe system) has evidenced for Bajocian-Callovian sedimentary age (~160 – 170 Ma) and low-grade metamorphism (1.5-2.5 kbar and 300-350°C). The Torna nappe system built up by Triassic sedimentary cover rocks of an attenuated continental crust suffered low-grade overprint with 3-4.5 kbar and 300-350°C, corresponding to 10-15 km of burial. This tectonic burial resulted in S0-1 foliation in both tectonic units. Because of their very similar early deformational history (D1 foliation, D2 folding, D3 kink-type folding) and metamorphic degree, it is supposed that their tectonic contact is a pre-metamorphic nappe contact. Newly obtained K-Ar ages put a time constraint of 142 – 113 Ma for D1 phase.

The metamorphosed, deformed and exhumed Meliata and Torna rocks were emplaced onto non-metamorphic Triassic to Jurassic series (D4 phase). Outcrop- and map-scale structures refer to NW-SE shortening and southeast-vergent nappe emplacement.
Later, the metamorphosed over non-metamorphosed tectonic couplet was thrust again onto the metamorphic Meliata nappe system along E-W striking thrusts (D5 phase). Thrusting associated with reworking of the previous nappe contacts and map-scale F5 folding. Fold vergency indicates southward tectonic transport.

Research on the basal cataclastic breccias of the overthrusting units permits to establish a relative chronology of D4 and D5 thrust contacts and the p-T data of the movements. Trapped fluids in synkinematic minerals indicated temperature up to 200-320°C and pressure up to 3.6 kbar during the D4 nappe movements. Fluid inclusions from the D5 contact resulted in significantly lower p-T values (200-260°C, 0.3-1.0 kbar), indicating thrusts in shallower crustal level.

Migrating high temperature fluids along the nappe contacts caused partial or total reset of the K-Ar isotope system, thus the measured 87–94 Ma is suggested to be connected to nappe movements.

Geodynamic implication: 150-160 Ma southern directed subduction of the West Carpathian margin (marked by the blueschist-facies Bôrka nappe slice) continued at 140 Ma, when the uppermost, Mesozoic part of the thinned and already imbricated crust entered the subduction zone, indicated by the medium-pressure metamorphism of the Torna unit. Part of the Jurassic Meliata sediments submerged into the subduction zone, too. This is the time (D1) when the Torna structural unit underplates the tectonically buried Meliata sedimentary melange. Meanwhile, part of the already HP metamorphosed oceanic and continental crustal fragments (Bôrka nappe) exhumed to the foot of the buried Meliata sedimentary melange. Ongoing compression pushed tectonic slices of the HP unit into the Meliata unit as a tectonic matrix. Low-grade prograde metamorphism of the Torna and Meliata tectonic units and retrograde metamorphism of the Bôrka HP nappe were coeval, indicated by K-Ar data (140-120 Ma).

The mid-Cretaceous Eoalpine phase resulted in thick- and thin-skinned nappe movements (southeast- and south-vergent) in the Western Carpathians, dominating the present tectonic scene and being responsible for the former contradictory views on the structural setting.