



Oligocene to Miocene kinematics of the Outer West Carpathians and the Vienna Basin area

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Karpatian Tectonics Slovakia addresses the establishment of a coherent tectonic model for the Early Miocene in Vienna Basin and adjacent areas prior to the development of the Vienna pull-apart basin. Studies include interpretation of 2D and 3D seismic data within the Vienna Basin and structural fieldwork in the Outer Western Carpathians. Structural data comprises a total of 105 outcrops, including the NW-rim of the Pieniny Klippen Belt (PKB) and Outer West Carpathian Flysch units in Northwest Slovakia and Eastern Czech Republic.

Structural data obtained from the Magura Superunit and the Biele Karpaty Unit show NW to NNW directed shortening (DF1), which is related to the large-scale ENE-trending fold and thrust belt architecture. As indicated by crosscutting relationships, NW- to NNW-directed shortening is followed by NNE-directed shortening and sinistral strike-slip faulting parallel to the strike of the thrust belt (DF2). Major strike-slip faults occur at the front of Bystrica Unit and within the Biele Karpaty Unit.

In the Outer West Carpathians syntectonic "Krosno type" sedimentation into Cejc-Zajeci, Zdounky-, Fore Magura- and Silesian Units was supplied from the uplifted Magura Superunit. Termination of this syntectonic sedimentation in the external units during the Late Oligocene to Early Miocene indicates the termination of NNW-directed folding and thrusting within the Magura Superunit (DF1) and the propagation of thrusting to the external units. NNE-directed shortening within the Magura Superunit is also evident from NNE-striking sinistral strike slip faults, which cut and offset the fold and thrust structures of DF1 in map view. Hence NNE-directed shortening in the Magura nappes must be younger than Late Oligocene to Early Miocene, irrespective of whether NW- to NNW-directed shortening in more external units continues after that time or not.

Structures from the NW margin of the adjacent Pieniny Klippen Belt adjacent to the Magura Superunit and the Biele Karpaty Unit prove a complex polyphase deformation history, apparently including deformation events, which were not recorded in the flysch units. Multiple folding events including folding of ramp/flat structures and large scale overturning of strata complicate deciphering individual deformation events and their chronological relationships. However, a NNW-directed shortening event, which postdates large scale overturning of strata was identified in the region around the Middle Váh Valley. This shortening event is followed by NNE-directed shortening. Events are comparable with NNW-directed shortening (DF1) and subsequent NNE-directed shortening in the Magura units (DF2). Additionally ENE-striking sinistral strike slip faults are recorded at the border of the Klippen Belt to the Bystrica and Biele Karpaty unit.

The outcrop-derived deformation history of the Outer West Carpathians is compared to the tectonic evolution in the Vienna Basin area, which is perfectly dated by the ages of deformed sediments and growth strata seen in seismic data. There, data reveal out-of-sequence thrusting coeval with NE-striking sinistral strike-slip faulting in the Flysch units and Northern Calcareous Alps underneath the Vienna Basin during Early Miocene times. Out-of-sequence thrusting and strike-slip faulting occurs coeval with NW-directed shortening in the external Waschberg Unit in front of the Flysch units. The Early Miocene sinistral strike slip faults within the Vienna Basin are cut by NE-NNE striking sinistral faults, which are related to the pull-apart stage of the Vienna Basin during Middle to Upper Miocene times. NNE-directed shortening and sinistral strike-slip faulting along ENE-striking faults in the Pieniny Klippen Belt, the Magura Superunit and the Biele Karpaty Unit are therefore interpreted to be related to the eastward lateral extrusion of the Eastern Alps towards the Pannonian region. Early Miocene kinematics may be represented by sinistral ENE strike-slip faulting along the strike of the PKB, Biele Karpaty- and the Bystrica Unit of the Magura Superunit. Kinematics related to the pull-apart stage of the Vienna Basin are indi-

cated by structures of NNE directed shortening, accompanied by map scale NNE striking sinistral strike-slip faults.