Fig. 2. Geological profile of the Donovaly region.

Jurassic strata are represented by sandy limestones and massive marbles. Going from the south to the north, this Tatric cover (Donovaly Succession) is overridden by a crystalline basement rocks (orthogneisses, migmatites), Permian red-beds, Lower Triassic quartzites and shales, and finally directly by the Middle Triassic carbonates followed by the complete Upper Triassic to Lower Cretaceous Zliechov Succession (Fig. 2). Several imbricates are distinguished within the basement duplex, their boundaries are dipping to the north, i.e., towards the foreland. The nappe sole is accompanied by huge masses of overpressured cataclastic carbonate breccias (rauhwackes), which accommodated almost all deformation related to the final nappe-gliding event (Plašienka and Soták 1996; Milovský et al. 1999).

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Mesozoic Structural Evolution of the Central Western Carpathians

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The Central Western Carpathians (CWC), located between the Meliata and Penninic-Vahic oceanic sutures, originated by shortening and stacking of a continental domain which was related to Europe during the Late Paleozoic and Triassic and to Adria during the Cretaceous and Tertiary. The crustal-scale basement/cover sheets (Tatric, Veporic and Gemeric superunits) and

detached cover nappes (Fatric, Hronic and Silicic systems) build up altogether the Slovakocarpathian tectonic system that is well correlable with the Austroalpine system of the Alps. The Oravic units of the Pieniny Klippen Belt, along with the surrounding Vahic and Magura oceanic units are ranged to the Penninic tectonic system (Plašienka 1999).

The poorly consolidated epi-Variscan crust in the southern part of the CWC suffered Late Permian to Scythian rifting and late Anisian break-up of the Meliata ocean, followed by its Middle to Late Triassic spreading (Fig. 1). Opening of the Meliata ocean is attributed to back-arc rifting and extension triggered by the northward subduction of Paleotethys (Stampfli 1996). The northern, Slovakocarpathian shelf of the Meliata ocean was still attached to the stable North European platform and shows zoning from slope facies deposited on a transitional crust, carbonate reef bodies on a subsiding distal passive margin, and lagoonal to terrestrial environments landwards.

The Jurassic period was a time of extensive rifting of the northern, European passive margin of Tethys, which brought about drowning of Triassic carbonate platforms and finally lead to the disintegration of the European shelf crust into numerous elevated and subsiding domains, some of them presumably floored by a newly-formed oceanic crust. Based on the character and distribution of syn- and post-rift sedimentary sequences, essentially three rifting phases can be discerned within the Western Carpathian area. In the first lower Liassic phase, an initial symmetrical lithospheric extension occurred. It produced broad intracontinental extensional wide-rift type basins rimmed by half-graben systems trapping terrigenous material eroded from neighbouring uplifted rift shoulders. The second, upper Liassic–Dogger phase was restricted to a rift zone along the outer Tatric periphery with an asymmetrical final break-up followed by the oceanic spreading of the South Penninic-related trough (Vahic ocean), which definitely separated the Austroalpine-Slovakocar-

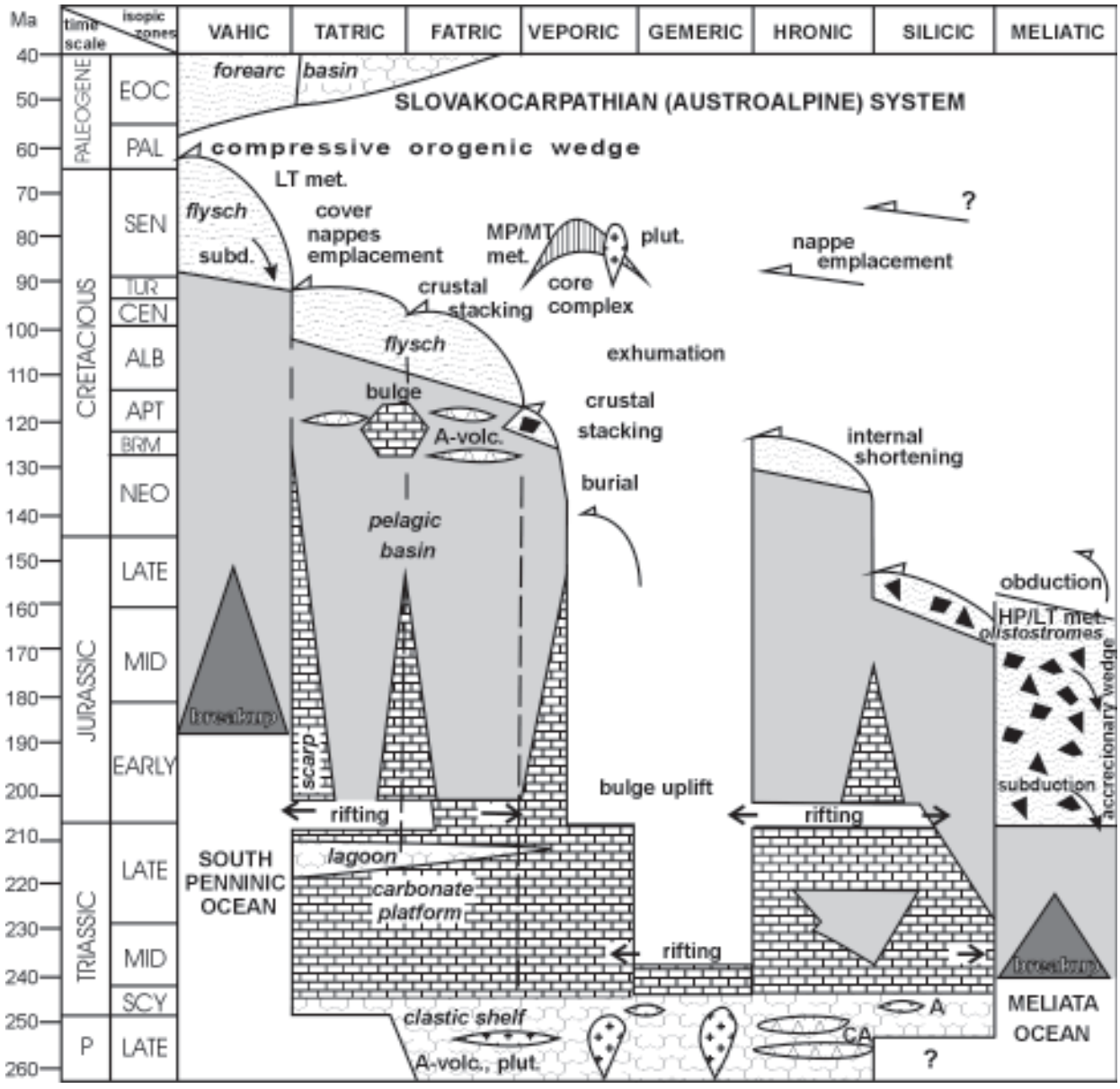

Fig. 1. Synoptic overview of the Mesozoic orogenic processes in the Central Western Carpathians. Sedimentary record is ornamented, non-deposition is blank.

pathian domain from the North European platform. The following very long, Middle Jurassic to Lower Cretaceous period is characterized by the post-rift thermal subsidence interrupted by occasional renewed rifting events within the Slovakocarpathian domain. The third, uppermost Jurassic––lowermost Cretaceous rifting phase separated the Oravic continental ribbon (Czorsztyn ridge) from the North European platform to open the North Penninic Magura oceanic basin.

The absence of any rifting-related volcanism and a persistence of extensional tectonic regime for many tens of Ma indicates a passive rifting mode generated by tensile deviatoric stresses within the European lithosphere. In the Alps, the Jurassic rifting is traditionally interpreted as a consequence of eastward drift of Adria and opening of the Central Atlantic ocean. In the Eastern Alps and Western Carpathians, however, Adria was separated from Europe by the Triassic Meliata-Hallstatt oceanic trough until the Late Jurassic. This ocean was subducted beneath the distal Adriatic margin during the Jurassic, therefore tensional forces could not be effectively transmitted across the subduction zone towards the European margin. It can be alternatively presumed that tensile stresses were generated by the subduction slab pull force of the Meliata-Hallstatt oceanic lithosphere operating within the lower plate of the convergence system along the NE Adriatic margin.

The Meliata ocean was gradually closing during the Jurassic, but the Szarvaskő back-arc basin opened in its place. The closure of the Meliata and related oceanic basins during the Late Jurassic welded the Slovakocarpathian domain with the Adria-related Hungarocarpathian tectonic system (Pelso megaunit) located presently south of the Meliata suture (Transdanubic and Bükkic terranes with South-Alpine and Dinaride paleogeographic connections, respectively). Initial collision and synorogenic sedimentation dominated by olistostromes affected this zone during the Late Jurassic.

The Cretaceous growth of the West Carpathian orogenic wedge shows a northward progradation from the Meliata suture and an episodic accretion of crustal material from its northern foreland. The first, latest Jurassic–earliest Cretaceous episode directly followed closure of the Meliata ocean. It was associated with an exhumation of the Meliatic blueschists (Bôrka nappe) and a deep burial of the Veporic domain below the accretion/collision stack. However, the distal northern lower plate was still subjected to post-rift thermal subsidence and mostly pelagic sedimentation. Episodic extensional events are ascribed to the B-subduction and persisting southward slab-pull of the Meliata oceanic lithosphere attached to the European lower plate. This indicates the growth of prowedge was halted for this moment and an episode of retrowedge development followed during the Early Cretaceous. This initiated diminition of the Szarvaskő back-arc basin and partial obduction of its oceanic crust southward over the Transdanubic-Bükkic hinterlands. Low degree of internal shortening of paraautochthonous complexes of these units indicates a presence of a stiff pre-Variscan basement in deeper crustal levels below detached Paleozoic-Mesozoic strata.

The second, mid-Cretaceous episode of the CWC prowedge growth was related to underplating of the Veporic wedge by the buoyant Tatric-Fatric crust that triggered the vertical extrusion of thermally softened material in the rear of the wedge, buttressed by the Pelso basement from the south. The inferred *P-T-t-D* path of the Veporic metamorphic core complex, unroofed by orogen-parallel extension, indicates its exhumation from lower crustal levels (peak metamorphic conditions: *T* about 600 °C, *P* up to 10 kbar – Plašienka et al., 1999; Janák et al., 2001) and cooling ages between 88 and 75 Ma. The foreland Tatric-Fatric area was seized by synorogenic flysch sedimentation during the Albian and Cenomanian, followed by the décollement cover nappe emplacement during the late Turonian (Fatric and Hronic nappe systems, Fig. 1). Contemporaneously and subsequently, the still weak Veporic sheet was squeezed between the Tatric and Pelso blocks, the latter indenting its rear to generate transpressional wrenching of the Veporic and a cleavage fan within the Gemeric sheet (Lexa and Schulmann 2000).

During the Late Cretaceous, the rear of the orogenic wedge cooled and hardened and contraction prograded to the zones at the northern Tatric (continental) and Penninic-Vahic (oceanic) interface, marked by a commencement of synorogenic flysch sedimentation in the subducting Vahic realm during the Senonian. However, only indistinct crustal thickening is indicated there and the northern Tatric edge became to act as the rear buttress for the developing External Carpathian accretionary wedge during the Paleogene. The Pieniny Klippen Belt between the Tatric backstop and the accretionary wedge represented a narrow dextral transpressive zone during the Paleogene and Early Miocene. It embraces detached cover units of two distinct provenances: (1) units representing an independent paleogeographic zone analogous to the Middle Penninic – the Oravic ribbon continent amalgamated with the CWC during the Paleogene (Czorsztyn and Kysuca-Pieniny principal units); (2) frontal partial units of the CWC cover nappe systems, predominantly of the Fatric (Krížna) superunit (e.g. Drietoma, Manín, Klape, Haligovce units). The latter were, after their Turonian nappe gliding over the subducting Vahic ocean, subjected to a renewed subsidence a synorogenic sedimentation during the Senonian, and incorporated into the klippen structure during the Paleogene.

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