POLYMETAMORPHIC EVOLUTION OF THE CRYSTALLINE COMPLEXES IN THE CENTRAL WESTERN CARPATHIANS (TATRIC AND VEPORIC UNITS)

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Abstract: Central Western Carpathians developed during several orogenic cycles. Pre- Variscan relics occur in polymetamorphic basement that underwent Variscan and Alpine tectonic events. Variscan HP/HT to MP/HT and LP/HT metamorphic events were connected to subduction, collision and granite intrusions in Devonian and Carbonferous time. Permian LP metamorphism occurred in extensional setting. Alpine MP/MT metamorphism was a consequence of Cretaceous collision, after closure of the Meliata ocean.

Pre-Alpine events

The Western Carpathians developed during several orogenic cycles. Pre-Alpine tectonometamorphic evolution of the Central Western Carpathians was related to subduction-collisional processes during Variscan orogeny in Central Europe (e.g. von Raumer & Neubauer, 1993; Plašienka et al., 1997; Bezák et al., 1997).

Pre-Variscan relics occur in polymetamorphic pre-Mesozoic basement that underwent Variscan and Alpine tectonic events. Proterozoic and Cambrian protoliths are inferred from the cores of magmatic zircons in granitoids (e.g. Poller et al., 2000) and clastic zircons in micaschists of the Western Tatra (Gurk, 1999). Metagranitoids of Late Cambrian (c. 514 Ma, zircons-upper intercept, Putiš et al., 2001) and Ordovician (c. 470 Ma, monazite, Janák et al., 2002) age, comprising strong Variscan (c. 340-350 Ma) recrystallization occur in the northern parts of the Veporic unit.

Variscan metamorphism is well documented in the crystalline complexes of the Tatric unit where Alpine recrystallization was relatively weak. Juxtaposition of high-grade rocks onto the lower-grade ones and inverted metamorphism due to Variscan mid-crustal thrusting were recognised in the Western Tatra (Janák, 1994). Garnet and clinopyroxene-bearing metabasites with high-pressure relics from several crystalline cores of the Tatric unit (e.g. Hovorka et al., 1992; Janák et al., 1996, 1997), as well as northern parts of the Veporic unit (Janák et al., 2002) are considered to be former eclogites related to Variscan subduction. During exhumation, these rocks were re-equilibrated at upper amphibolite/granulite facies conditions (750-850^{o}C; 10-14 kbar). Subsequently, they underwent retrogression at amphibolite to greenschist facies conditions. Variscan high-grade metamorphism is also recorded in the metapelites. Dehydration-melting of muscovite and biotite in these rocks led to generation of granitoid melts (Janák et al., 1999). Early Devonian (406 Ma) event is documented by U-Pb dating of zircons in the orthogneisses of the Western Tatra (Poller et al., 2000). Some zircons, however, record Late Devonian to Early Carboniferous (c. 360-340 Ma) recrystallization, coeval with intrusions of major granitoids. Exhumation and cooling of Variscan basement during Late Carboniferous (c. 330-300 Ma) is constrained by the $^{40}Ar/^{39}Ar$ dating of micas (e.g. Maluski et al., 1993; Janák, 1994; Dallmeyer et al., 1996).

Present data suggest that Variscan orogenic cycle involved several metamorphic stages. High-pressure rocks were strongly recrystallized due to heating during their exhumation. This was probably the thermal consequence of delamination of subducting lithosphere or slab breakoff. Locally, low-pressure contact metamorphism was connected to intrusions of granitoid magmas.

Permian metamorphism in the Central Western Carpathians is poorly recognised. Several indications suggest Permian metamorphism in the northern parts of Veporic unit. Here, andalusite and corundum-bearing assemblages in metapelites show low-pressure conditions of metamorphism. Preliminary dating of metamorphic monazite yields c. 260 Ma age. This Permian low-pressure metamorphism was most probably the consequence of heating associated with crustal extension and rifting after the collapse of Variscan orogen.

Alpine events

During *Mesozoic-Cenozoic times* the Western Carpathians evolved as a complex subduction-collisional orogenic belt. They resulted from collision of European and Apulian continental domains located between two oceanic sutures - Meliatic in the south and Penninic in the north (e.g. Plašienka et al., 1997). High-pressure, *blueschist facies metamorphism* was related to subduction of Meliatic ocean in Jurassic time (Faryad, 1995). Subsequent continental collision during Cretaceous caused regional metamorphism in the Central Western Carpathian zones.

Cretaceous (Eoalpine) metamorphism was most intense in the Veporic unit and Veporic/Gemeric boundary (e.g. Vrána, 1964; Vozárová, 1990; Méres & Hovorka, 1991). Present data (Plašienka et al., 1999; Lupták et al., 2000; Janák et al., 2001a,b) document that Cretaceous structures and metamorphism in the Veporic unit show typical features of the metamorphic core complex. Metamorphic zones reflect increasing metamorphic grade structurally downwards, metamorphic isograds are roughly parallel to the north-east dipping foliation related to extensional updoming along low-angle normal faults. Thermobarometric data document increasing *P-T* conditions from c. 500 °C and 7–8 kbar to c. 620 °C and 9–10 kbar, reflecting a coherent metamorphic field gradient from greenschist to middle amphibolite facies. Similar *P-T* conditions (c. 550±30ºC and 9±1 kbar) were reported from the southernmost part of the Veporic unit, investigated from drillholes in northern Hungary (KOROKNAI et al., 2001). Locally, intrusion of Cretaceous Rochovce granite caused contact metamorphism (Korikovsky et al., 1986). Geochronological data on Alpine metamorphism obtained from the $^{40}Ar/^{39}Ar$ dating (Maluski et al., 1993; Dallmeyer et al., 1996; Kováčik et al., 1996; Janák et al., 2001a; Koroknai et al., 2001) constrain the timing of cooling and exhumation mostly in the Late Cretaceous (70-90 Ma). Preliminary dating of monazite indicates c. 95-90 Ma age of metamorphic peak (Janák et al., 2001b).

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