Alpine low-thermal evolution of the Western Carpathian basement rock complexes: inferred from zircon and apatite fission track data

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Zircon and apatite fission track analyses have been used in order to refer quantitative constraints on the Mesozoic to Cenozoic low-thermal evolution of the Internal Western Carpathians immediately after the Eo-Alpine nappe stack and metamorphosis. For a case study on the low-thermal evolution, the Variscan consolidated crystalline basements of the Tatric, Veporic, and Gemeric tectonic units were chosen. The thick-skinned tectonic units provide a coherent natural laboratory where exhumation and burial processes controlling low-thermal and landscape evolution can be studied. New zircon and apatite fission track ages together with all available data enable to identify Alpine low-thermal phases of the Variscan crystalline basements. The Gemeric Unit, an upper most thick-skinned thrust sheet of the orogen inner part, cooled from depth levels of ~10 up to 2.5 km (temperature interval of ~250–60°C) about ~88–64 Ma ago, after the collapse of the overlying Meliata-Turňa-Silica Mesozoic accretionary prism. The middle and lower thick-skinned thrust sheets, so-called Veporic and Tatric units, cooled from the depths of ~10 up to 2.5 km about ~110–40 Ma ago. The process of exhumation was controlled by unroofing of footwall from beneath the Gemeric Unit and the Meliata-Turňa-Silica accretionary prism. The internal portion of the Tatric Unit was gradually exhumed to the depth less than ~2 km and some parts of the unit appeared at the erosional level and remained cold. However, this exhumation was replaced by the burial beneath the irregular in thickness Eocene to Lower Miocene (~45–20 Ma) strata that caused fully reheating of apatite single grain fission track ages in predominantly external part of the Tatric Unit close to the Pieniny Klippen Belt. According to apatite fission track data of ~21–8 Ma, the middle Miocene collision of Internal Western Carpathian orogen wedge with the European continental margin led to final exhumation of the most external horsts formed by the Tatric Unit ('Tatric core mountains'). Based on geomorphological markers, the final mountain morphology of the most external part of the Tatric Unit was formed since the Pliocene.

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