Variscan tectonic setting vs. Alpine overprint in Gemericum (Inner Western Carpathians): Their role in the recent distribution of tectonic units in the eastern part of the territory as expressed in significant localities

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Abstract

Eight localities in the eastern part of Gemericum (Inner Western Carpathians) are presented for explaining the multiple tectonic overprints of Paleozoic and Mesozoic rock sequences.

The south-vergent Variscan collisional closure of the Lower Paleozoic basin caused the origin of the *Rakovec suture zone* with exhumed dismembered ophiolitic suite. The Westphalian age of the collision was supposed by geological criteria, as well as the Westphalian cooling age of clastic mica in the post-collisional Upper Carboniferous (Stephanian) detrital sequence in the North-Gemeric zone.

Two principal Variscan deformation phases are distinguished in the Gemeric domain: VD_1 – the south-vergent Carboniferous exhumation and obduction in the North Gemeric zone (323–275 Ma; origin of the Rakovec geosuture). This phase ended after the pressure release by an extension episode with a less distinct north-vergent sliding/unroofing (275–262 Ma) and the establishing of the Permo-Mesozoic sedimentary basin in the North-Gemeric zone. The following era of dominant south-vergent unroofing (VD_2 phase, 262–216 Ma) resulted in the origin of extended Mesozoic Meliata-Hallstatt basin in the South-Gemeric zone.

The closure of the basin in the South-Gemeric zone (AD_1 phase; Lower Cretaceous; 141–114 Ma) caused the north-vergent imbrication of the Gemeric sequences, overthrusting of Gemericum as a basement nappe on Veporicum, but also a north-vergent transport of superficial nappes including the Meliatic nappe (Bôrka nappe) and Silicic nappe. The transpression kinematics at the beginning of the AD_1 collision prevailed, and the suture zone (Rožňava discontinuity zone) originated. The overthrusting of the basement nappe of Gemericum on Veporicum and the thermal consequences of the thickened crust caused the south-vergent unroofing of the overthrusted Gemeric sequences from Veporicum in the Upper Cretaceous phase AD_2 (107–82 Ma). Due to the recent arc-bending of the contact zone between both megaunits, caused by conjugate shearing in AD_3 phase (76 Ma-recent), the meso- and microstructural evidences of AD_2 unroofing demonstrate apparently opposing vergence – in the western contact zone the unroofing is towards the E and SE, and in the eastern contact zone to the SW. Among the principal conjugate AD_3 shear zones in the eastern part of Gemericum belong the sinistral ENE–WSW trending Transgemeric shear zone and the dextral NW–SE trending Košice–Margecany shear zone, playing the most important role in the recent tectonic setting of this territory.

Key words: tectonics, Variscan, Alpine, Rakovec suture zone, Rožňava discontinuity zone, Opátka, Margecany, Jaklovce, Gelnica, Závadka, Smolník, Šugovská dolina valley, Gemericum, Veporicum, Meliaticum, Silicicum, Western Carpathians

Short review of the geological and tectonic research in the Gemeric domain and its principal results

Long-lasting research in the territory of the Spiš-Gemer Ore Mts., done from the time of the famous Slovak geologist Dionýz Štúr (1868), resulted in the 1980s in establishing of two interpretations of the geological setting of Gemericum.

The results of the first research stream were summarized in the Explanations to the geological map of the Slovak Ore Mts. – Eastern part in the scale 1 : 50 000 (Bajaník and Vozárová, eds., 1983). The early evolution of Paleozoic sedimentary basin is characterized with cyclic flyschoid sedimentation accompanied with synchronous acid, resp. bimodal volcanism during Upper Cambrian to Lower Devonian. Products of this early evolutionary stage were included into the **Gelnica Group (Vlachovo, Bystrý potok and Drnava Fms.).** Younger Devonian-Lower Carboniferous? **Rakovec Group (Štós, Smrečinka and Sykavka Fms.)** consists of rocks originating during changed paleogeographic conditions of prevailing basalt volcanic activity. The volcanosedimentary evolution of the basin has been interrupted in Bretonian phase. Following Carboniferous transgression with shallow-marine sedimentation in the environment of delta fans was reflected in the **Črmeľ** and **Dobšiná Groups** (**Ochtiná, Rudňany, Zlatník** and **Hámor Fms.**), present in the area of the North Gemeric zone. Deepening of the sedimentary basin has activated the volcanic activity with the effusions of paleobasats and volcaniclastics. The termination of the Carboniferous sedimentation with the parallic sequences of **Hámor Fm.** was caused by Asturian phase of epeirogenic character. In Permian (**Krompachy Group; Knola, Petrova hora** and **Novoveská Huta Fms.**), the coarse--detritic material with two horizons of acid volcanism has deposited in differentiated basins in continental conditions. The end of the Permian sedimentation of lagoonal character was followed by the shallow marine sedimentation **(Stratená Group)** in the environment of stable shelf with locally developed zones of pelagic sedimentation.

Upper Paleozoic sedimentation on the south of **Gemericum (Rožňava Fm. of the Gočaltovo Group)** had firstly the character of wild rivers ramifying into alluvial lowland. The margin of the basin **(Štítnik Fm.)** was situated on faults with the occasional volcanic activity. The coastal sedimentation in the conditions of stable shelf continued till the Middle Anisian. In Pelsonian there occurred first tectonic activity, deepening of the sedimentary basin, basic volcanism and gradual sedimentation of rocks included into **Meliata Group**.

Recently the above described research stream has applied the terrane concept (Vozárová and Vozár, 1993, 1996; Vozár et al., 2010). According this, the Gemericum consists of the **Spiš Composite Terrane**, representing a relict of subducted oceanic to intermediate crust, and the **Gelnica Terrane**, being a relic of the forearc basin associated with ensialic volcanic arc on an active continental margin. Lithology and stratigraphy of the Carboniferous-Permian basins reflects the Late Variscan collisional events and southern polarity of Variscan orogeny in the Western Carpathians.

Synchronously with the above presented concept a model of continual Lower Paleozoic riftogenesis on continental crust with the stages of marine transgression, shelf development, rift activation

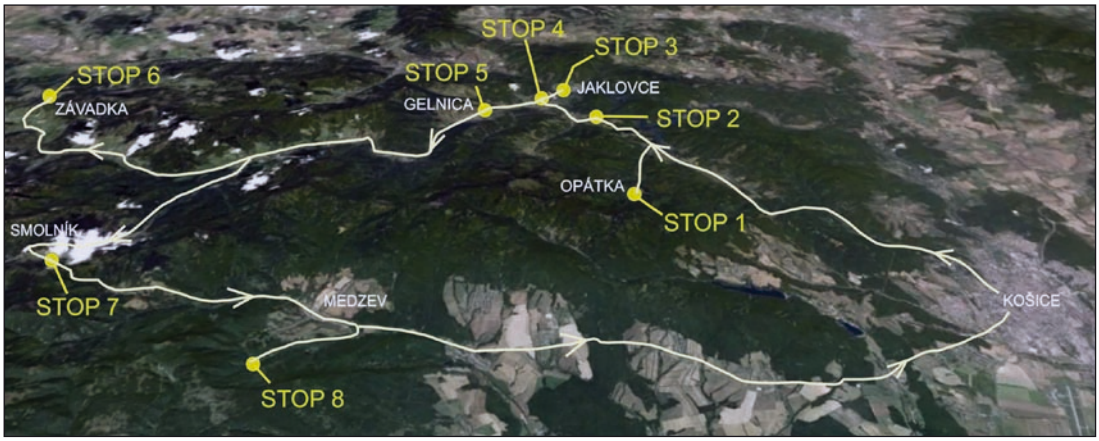

Fig. 1. The route focussed on Lower Paleozoic sequences of Gemericum (localities 1, 5, 7 – Opátka, Gelnica, Smolník), as well as the multiple overprint in the contact zone of Gemericum with Veporicum (3 – Margecany). The loc. 2 above the Veľký Folkmar village allows a general explanation of general tectonic setting with sceneric view on majority of tectonic units. The differing tectonometamorphic overprint of two types of conglomerates in the North-Gemeric zone is on display at Závadka village (loc. 6). The instructive localities of exhumed Meliaticum are accessible at Jaklovce village (4) in the North-Gemeric zone, as well as in the Šugovská dolina valley (8) in the Southern Gemericum. The base-map is taken from the Google Earth.

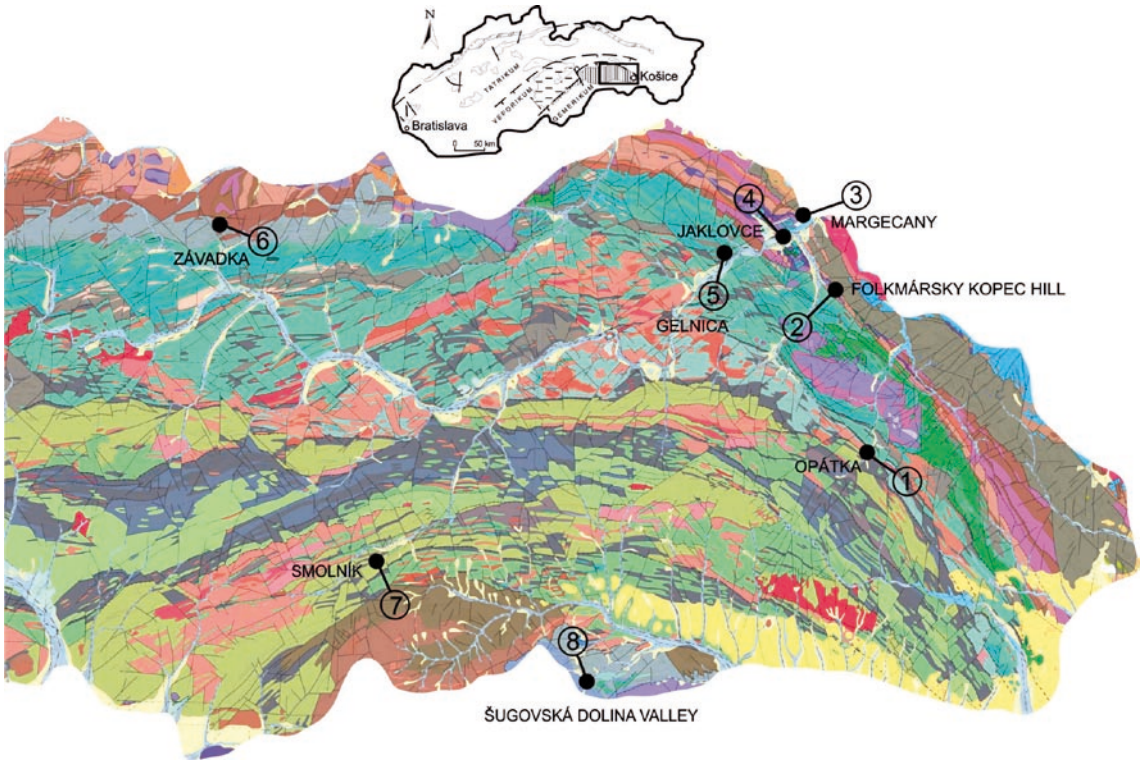

Fig. 2. Position of important geological localities of the eastern Gemericum in the General geological map of the Spiš-Gemer Ore Mts. (Grecula et al., 2009).

and rapid rifting has been developed (Grecula, 1982). Batygenetic phase has finished with volcanic phase. The ground for riftogenic model (l.c.) has been based on time-synchronization of the Lower Paleozoic sedimentary-volcanic activity with generally uniform facial development in the single Lower Paleozoic **Volovec Group**. Geodynamic evolution of sedimentary basin has been reflected in the uniformly distinguished formations for the whole sedimentary space. Lower **Betliar Fm.** is detritic, consisting from the black laminated pelitic-silty phyllites, with lydites and carbonates in the upper part of the formation **(Holec Beds)**. Middle, **Smolnik Fm.** consists of variegated green phyllites and flysch psammitic-pelitic sediments. Volcanic rocks of basalt-keratophyre formation are present at the base of the Smolnik Fm. (Lower Variegated Volcanic Complex). Upper, volcanic **Hnilec Fm.,** is formed with Upper Variegated Volcanic Complex at the base and spatially differentiated volcanic horizon in upper parts. On the north of Gemericum the basic volcanic products prevail, while in the middle and south of the territory the acid and intermediate volcanics of rhyolite, dacite and andesite nature are preferably present. The concept was made more detail in the General geological map of the Spiš-Gemer Ore Mts. at a scale 1 : 50 000 (Grecula et al., 2009) and accompanied Explanations to geological map (Grecula and Kobulský, 2011). The Volovec Group was upgraded to **Volovec Supergroup** consisting of Rakovec Group and Gelnica Group, though the lithological division on Betliar, Smolník and Hnilec Formations in both groups remained preserved after earlier concept (Grecula, 1982 a following works). This division we will apply in the following text.

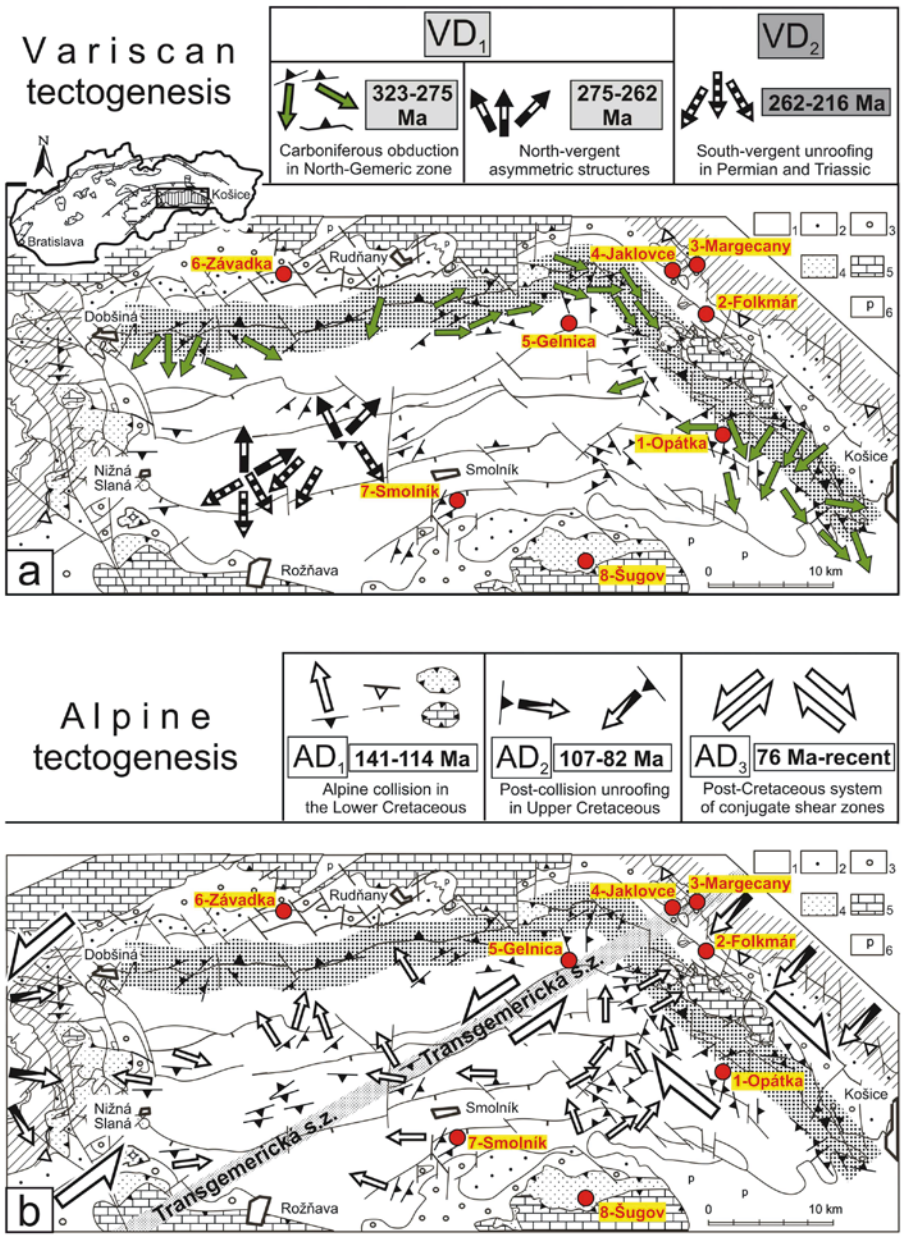

Fig. 3. Kinematics of Variscan and Alpine tectogeneses (Németh in Radvanec et al., 2007) and the position of instructive localities, related to Variscan and Alpine tectonic setting. 1 – Lower Paleozoic sequences of Gemericum; 2 – Carboniferous rocks of Gemericum and in the contact zone of Gemericum with Veporicum; 3 – Permian rocks of Gemericum; 4 – Upper Paleozoic and Mesozoic rocks of Meliaticum; 5 – Mesozoic rocks of Silicicum; 6 – Paleogene.

The south-vergent collisional closure of the Lower Paleozoic basin caused the origin of the Variscan *Rakovec suture zone* (Németh, 2002) with exhumed dismembered ophiolitic suite of the central part of former basin. The Westphalian age of the collision is supposed by geological criteria, as well as the Westphalian cooling age 314.1 Ma of detrital mica in post-collisional Upper Carboniferous (Stephanian) detrital sequence near the town of Dobšiná (Dallmeyer et al., 2006).

Two principal deformation phases were distinguished in the Variscan evolution of the Gemeric domain (Németh in Radvanec et al., 2007), being indicated by the monazite--uraninite isochrones (Konečný, ibid.): VD_1 – the south-vergent Carboniferous exhumation and obduction in the North Gemeric zone (323–275 Ma; origin of the Rakovec geosuture). At the end of this phase after the pressure release an extension episode initiated a less distinct north-vergent sliding/unroofing, revealed by microstructures (Németh in Radvanec et al., 2007; 275–262 Ma). It also indicated the beginning of the origin of the Permo-Mesozoic sedimentary basin in the North-Gemeric zone. The following era of dominant south-vergent unroofing (VD_2 phase, 262–216 Ma) resulted in the origin of extended Mesozoic sedimentary basin (Meliata-Hallstatt basin) in the South-Gemeric zone (Németh in l.c.).

As revealed by overprinting relations and geochronological data, the closure of the basin in the South-Gemeric zone (AD_1 phase; Lower Cretaceous; 141–114 Ma) caused the north-vergent imbrication of the Gemeric sequences, overthrusting of Gemericum as a basement nappe on Veporicum, but also a transport of superficial nappes including the Meliatic nappe (Bôrka nappe) and Silicic nappe. The sinistral transpression kinematics at the beginning of the AD_1 collision prevailed, and the suture zone (Rožňava discontinuity zone) originated. The overthrusting of the basement nappe of Gemericum on Veporicum and the thermal consequences of the thickened crust caused the south-vergent unroofing of the overthrusted Gemeric sequences from Veporicum in Upper Cretaceous phase AD_2 (107–82 Ma; cf. Maluski et al., 1993; Dallmeyer et al., 1996, 2006, a.o.). Because the recent arc--bending of the contact zone between both

megaunits, caused by conjugate shearing in AD_3 (76 Ma-recent), the meso- and microstructural evidences of AD_2 unroofing demonstrate apparently contradicting vergence – in the western contact zone the unroofing is towards east and south-east, but in eastern contact zone towards the south--west (Németh, 2002). From the conjugate AD_3 shear zones in presented area of the eastern part of Gemericum the sinistral ENE–WSW trending Transgeneric shear zone and the dextral Košice–Margecany shear zone trending NW–SE (cf. Grecula et al., 1990) play the most important role in the recent tectonic setting of this territory.

Important localities demonstrating the geological and tectonic evolution of the eastern part of Gemeric domain

1 – Opátka village – Outcrops of tectonized Lower Paleozoic metapyroclastics of intermediate and acid volcanism of the Hnilec Formation of Gelnica Group in closeness of the Rakovec suture zone. Location at the southern end of the village, 48°47'02.03" S, 21°03'15.04" E.

The rocks are located in the footwall position close to the Variscan overthrust plane of exhumed Rakovec Group. The Variscan exhumation is reflected in the NNE to NE dip of primary foliation with ESE trending lineations (VD_1). Numerous asymmetric structures produced in ductile régime demonstrate the dextral south-vergent exhumation. The Alpine AD_1 imbrication is relatively poor due to the rigid overprinted lithology and is observable by rare faults dipping to SW (Fig. 5).

2 – Folkmarský kopec hill – The saddle between the Ružín water reservoir and the village of Veľký Folkmar, the sceneric view from both sides of the state road, 48°50'58.13" N, 21°01'54.72" E (Fig. 6).

The view towards the NNW visualizes the position of four principal megatectonic units of the Western Carpathians: Gemericum (the surrounding of observation point), Meliaticum in the North-Gemeric zone in allochthonous position, as well as Veporicum and Tatricum in the backside (the Branisko Mts.). The view to E manifests the Veporicum with its Permo-Triassic and Jurassic cover, as well as Carboniferous and Permian sequences in the outliers of Hronicum located on Veporicum in the apical parts of the hills. The contact between both megaunits – Gemericum and Veporicum – demonstrates multiple overprint by the AD_1 (NE-vergent overthrusting) and AD_2 (SW-vergent unroofing) phases, and moreover it is sheared by the dextral Košice–Margecany (Fig. 7) shear zone of AD_3 phase. In classical interpretations the dividing line between both megaunits was represented by the Lubeník–Margecany line (e.g. Maheľ, 1986), having attributed only overthrusting kinematics (of AD_1 phase).

3 – Margecany – The immediate contact of overthrusted cover sequences of Gemericum on Veporic crystalline basement. The Veporic cover was removed by tectonic reduction during three deformation phases AD_{1-3}. The cut of the state road between Jaklovce and Krompachy near the Margecany church, 48°53'13.39" N, 21°00'22.27" E (Fig. 8).

The Veporicum of the Čierna hora Mts. manifests the highly sheared Alpine fold-thrust setting of NW–SE trend. The antiformal core consists of crystalline basement rocks, rimmed by the Upper Carboniferous, Permian, Triassic and Upper Jurassic cover formations. They are overlain by the Choč nappe (Carboniferous-Triassic of

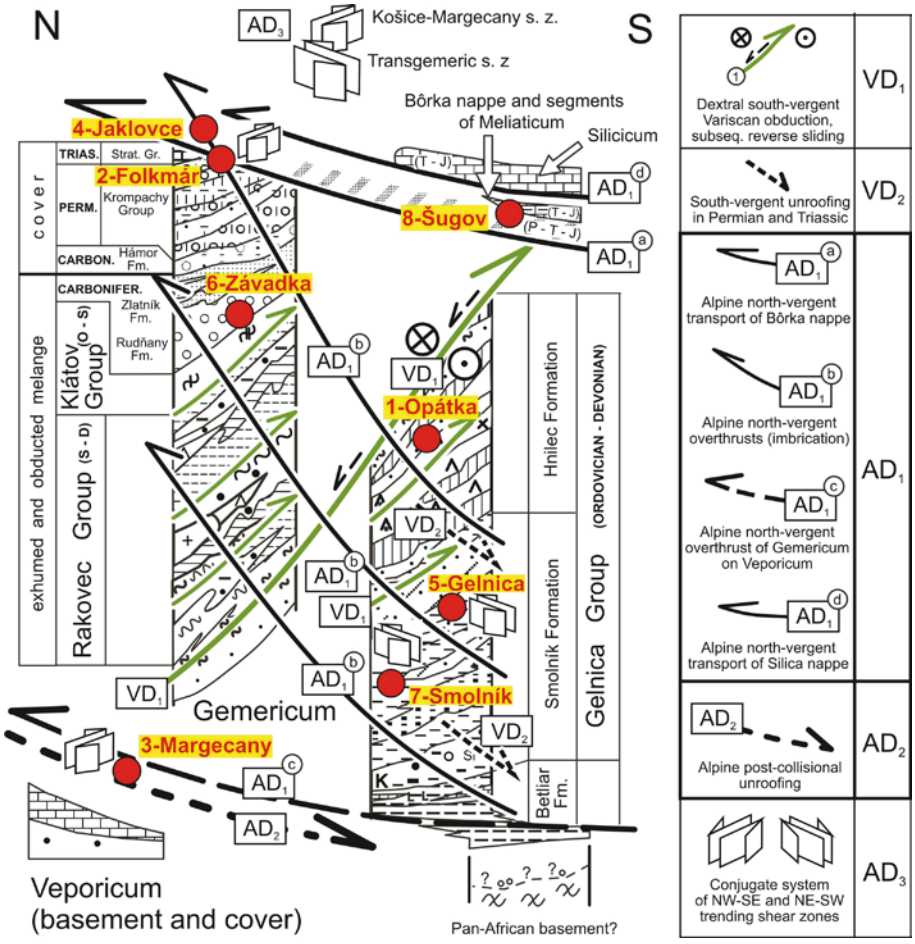

Fig. 4. Lithotectonic relations in the Gemeric domain (modified after Németh, 2005, and Németh in Radvanec et al., 2007) and position of instructive localities covering a wide range of lithotectonic relations.

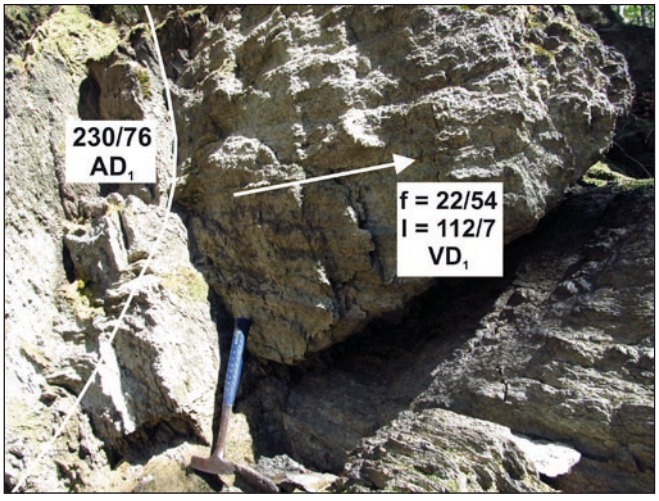

Fig. 5. Ductile VD_1 stretching lineations indicating tectonic transport to SE and brittle-ductile AD_1 faults penetrating earlier setting. Tectonized metapyroclastics of the upper parts of Gelnica Group at the southern end of Opátka village. Photo Z. Németh.

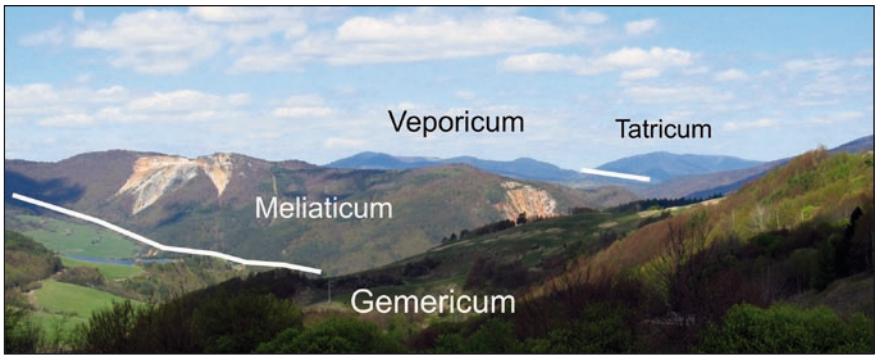

Fig. 6. Panoramatic view to NNW from the Folkmársky kopec hill demonstrates the zonality of the main megatectonic units of the Alpine setting of the Western Carpathians – the nappe outlier of Meliaticum in the North-Gemeric zone, as well as Veporicum and Tatricum in the Branisko Mts. Photo Z. Németh.

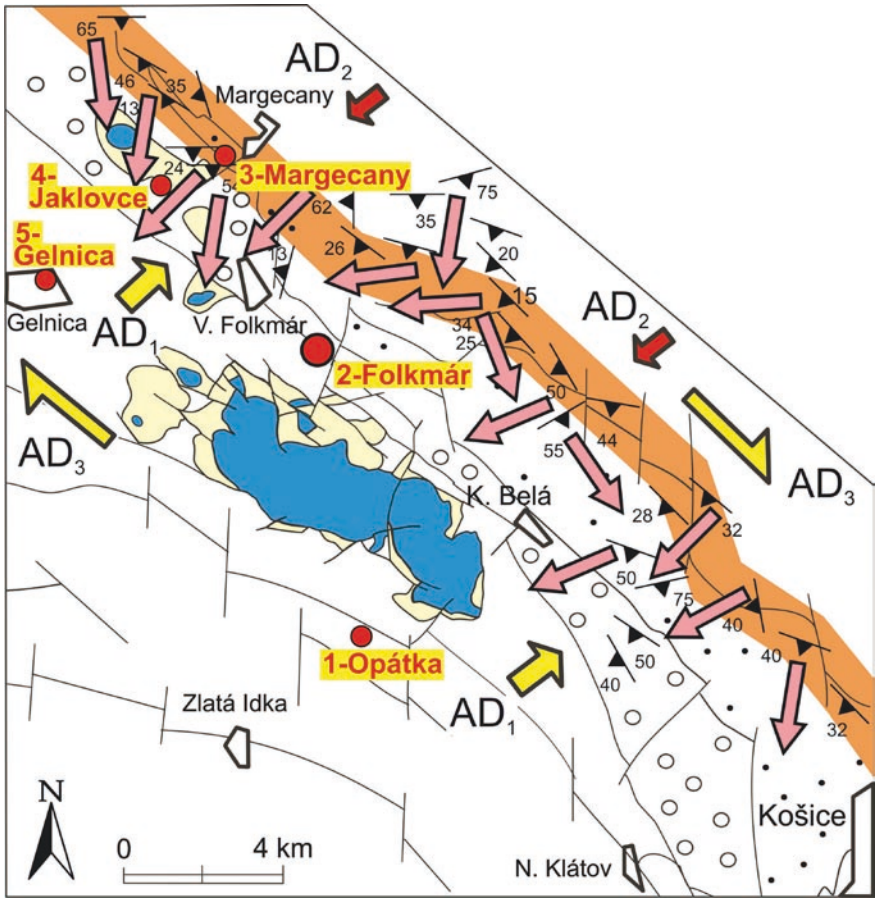

Fig. 7. The study of asymmetric mesostructures and microtectonic indicators, including the LPO of quartzites and calcitic marbles, has revealed the unroofing kinematics of the AD_2 phase, as prevailing ductile deformation regime in the monomineral lithologies of the Veporic cover (Németh, 2001). The lithology in the map corresponds with that in Fig. 3. Locality 2 – Folkmarský kopec hill is visualized by the red circle.

Fig. 8. The overthrust of Gemericum on Veporicum during AD_1 as manifested in the road cut trending SW–NE, i.e. being transversal to the contact zone. The overthrusting is indicated by pervasive mylonitization (S/C structures, porphyroclasts, mica-fishes, shear bands). Despite, also post-collision AD_2 unroofing is observable by asymmetric structures, but the dominating is the dextral shearing during AD_3 reactivating the earlier disjunctive structures. Veporic crystalline basement consists of the Bujanová Complex gneissose diaphtorites and migmatitic amphibolites, having locally preserved Variscan ductile deformation. The Gemericum in the cross-cut (left – SW part of the picture) is built of Upper Carboniferous conglomerates of Hámor Fm., intercalated by greywackes, sandstones and black schists. Height of the view is 6 m.

Fig. 9. In the SE part of the elongated outcrop near the directorate building of the lime-producing factory at the Jaklovce village, the exhumed Meliatic suite is affected by the AD_3 shearing trending ENE–WSW and dipping to SSE (148/60°). Contrary to this, the outcrop located 200 m to SW, as well as the suite in the upper parts of the sequence manifest the older cleavage dipping to NW (318/55°) and corresponding with the bedding and secondary foliation in the quarry in the upper part of the Kurtová skala hill (gen. 330/55°), having proved the position of the allochthonous outlier of Meliaticum (cf. Németh et al., 2012). Orientation of photographs is top to W. Photos by Z. Németh.

Hronicum). The position of this outlier indicates the most probable primary sedimentary area of the Hronicum in the suture between Gemericum and Veporicum, or less probable south of Gemericum.

The Veporic crystalline basement consists of three lithostratigraphical units (Jacko, 1985). The lowermost Lodina Complex is composed mainly of diaphtoritic gneisses (incl. phyllonites) intercalated by thin aphibolite bodies. The Miklušovce Complex is in tectonic overlier, consisting of migmatites and local aplitic-granite bodies. The highest positioned is the Bujanová Complex, rimming prevailingly the SW limb of the antiform (towards the Gemericum), and composed mainly of tabular granodiorite bodies intruded into the gneissose-migmatitic bodies and amphibolites.

Despite the strong Alpine shearing, also the Lower Paleozoic Ar/Ar plateau age was revealed from phyllonite muscovites (Dallmeyer et al., 2006; sample G-9 ibid.; 329.6 ± 0.2 Ma), indicating the preserved remnants of the Variscan south-vergent thrusting inside the crystalline basement – the overthrusting of the Miklušovce and Bujanová complexes on the Lodina Complex. The metamorphic paragenesis of the sample was quartz-muscovite-chlorite-epidote--ilmenite (diaphtorite of gneiss).

4 – Jaklovce – The artificial railway cut in the vicinity of the directorate building of the lime-producing factory, 48°52' 45.87'' N, 20°59'47.45'' E (Fig. 9).

The melange of Meliaticum in the North-Gemeric zone, consisting of ultramafic rocks, gabbros and basalts in the environment of radiolarites and marbles. The allochthonous position of the sequence in the area of the Kurtová skala hill was recently proved by paleopiezometry (Németh et al., 2012), as well as by the principal angular discordance of its NW-dipping exhumation setting, contrasting with the general NW–SE trending AD_{1-3} tectonic plan (l.c.). The internal setting of the succession of silicitic schists with basalt and diastrophic breccia in the Meliatic Jurassic accretion prism cropping out in the presented locality was published by Putiš et al. (2011), providing the new zircon U-Pb SIMS SHRIMP data.

The Middle Triassic beds of reddish and greenish cherty schists, marbles and radiolarites contain thin basaltic tuff interbeds and 3 m thick basaltic bed in the upper part of the sequence. A zircon concordant age of 359 ± 7 Ma is interpreted (l.c.) as the Lower Carboniferous source age of zircon grains, present in this Middle Triassic basalt, because its age is well constrained with the findings of Middle Triassic radiolarites in the hosting Middle Triassic cherty beds. Zircon morphology indicated the S-type (Gemeric) granites as the source rocks. Metabasalts, metadolerites and metacherts, with still preserved magmatic ophitic or amygdaloidal textures, contain actinolite rimmed by ferrowinchite/winchite/riebeckite in metamorphic veins. It indicates a higher-pressure metamorphic overprint that is well-known and dated from the Meliatic Bôrka nappe as the Upper Jurassic (l.c.). Similarly, the thin veinlets with the blue sodic amphibole compositionally close to magnesioriebeckite in this rock sequence were found by Ivan et al. (2009). Probably a short-lasting individual metamorphic phase at elevated pressure (~600 MPa) was responsible for the formation of the magnesioriebeckite/riebeckite veinlets, followed by the pressure relaxation and short metamorphic overprint in the greenschist facies conditions (300 MPa; l.c.). This metamorphic evolution can be interpreted as a manifestation of the Meliata ocean subduction in the Upper Jurassic, when the oceanic rocks were involved into the uppermost part of the subducting slab and subsequently exhumed and tectonized. Moreover, the concept of subduction, exhumation and transport of the rock sequence, recently located as a Meliatic outlier at the village of Jaklovce, is well confirmed by the finding of the highest until revealed differential stresses in calcitic marbles in this suite, reaching 429.55 MPa (Németh et al., 2012).

5 – Gelnica – Plastic deformation of the Lower Paleozoic chlorite-sericite phyllites of the greenschists facies of the Smolník Fm., Gelnica Group, reflects the sinistral shearing directly in the Transgemeric shear zone trending ENE–WSW. Extended outcrop with numerous kinematic indicators, including a-tectonites, allows to study mesostructures in two nearly perpendicular sections – parallel with the AD_3 shearing and perpendicular to this shearing. Road cut 360 m to SW of the main railway station in the town of Gelnica, 49°51'24.43'' N, 20°56'41.34'' E (Fig. 10).

6 – Závadka – Strongly contrasting tectonometamorphic overprint of two conglomeratic facies: the Carboniferous Rudňany Conglomerates (Westphalian) of the Rudňany Fm. of Dobšiná Group exhumed in VD_1 and the cover Permian conglomerates (Knola Fm., Krompachy Group), deformed during Alpine AD_1 imbrication. Outcrops at the Závadka village, north of the village of Nálepkovo. Old quarry in the Rudňany Conglomerates is located at the state road to SE of Závadka, 48°51'42.58''. Extended outcrops of the Permian conglomerates are located to SSW of Závadka, 48°51'42.51'' N, 20°36'53.54'' E (Figs. 11 and 12).

The peculiarity of the polymict Carboniferous Rudňany Conglomerates is their higher pressure metamorphism (Radvanec, 1998) and strong recrystallization, which is striking also in visited locality. In numerous cases the differences among particuliar clasts and the matrix are obscured to such level that a rock obtains an appearance resembling e.g. basalt. The conglomerate consists of clasts of crystalline basement (e.g. gneisses, mica-schists, amphibolites; the most probable is the Veporic basement), as well

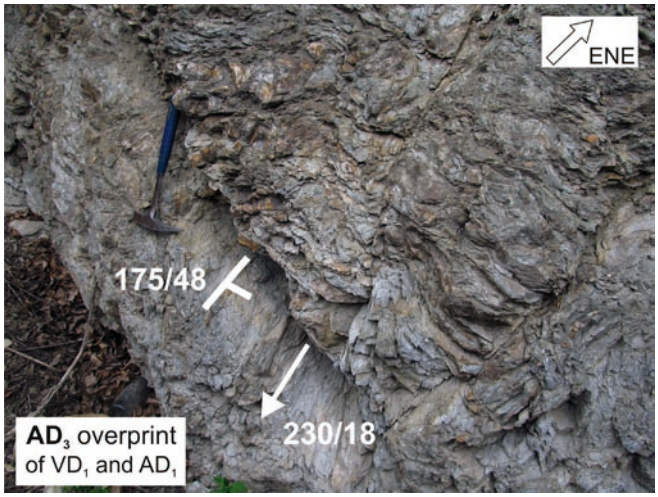

Fig. 10. Alpine AD_3 overprint of former Variscan VD_1 deformation, related to the ESE-vergent overthrusting of the exhumed Rakovec mélange in the hanging wall, and, moreover, being imbricated by the AD_1 north-vergent thrusting. Locality Gelnica. Photo Z. Németh.

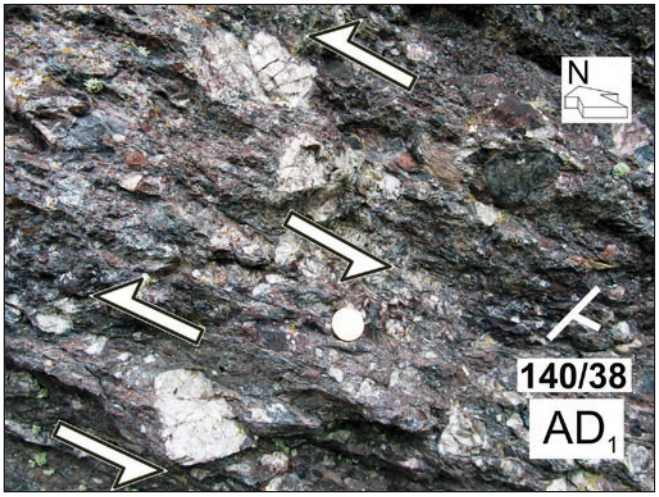

Fig. 12. Brittle-ductile Alpine overprint in Permian cover conglomerates indicates top-to-the NW tectonic imbrication during AD_1 phase Závadka.

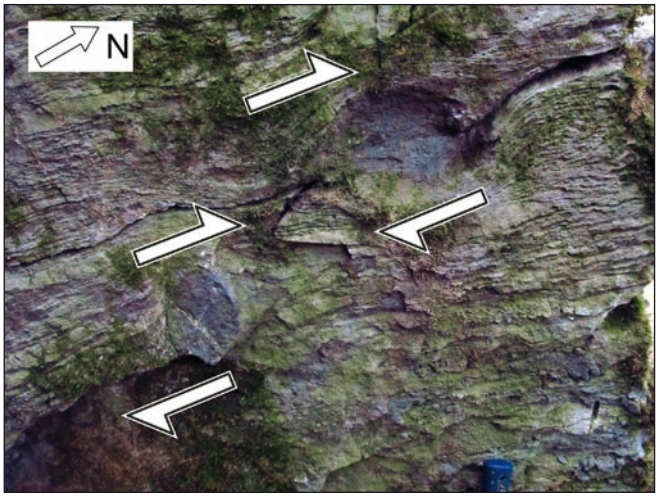

Fig. 13. Rotated porphyroclasts of glaucophanites in the calcitic marbles. Besides blue amphibole of glaucophane composition the metabasites contain albite, epidote, phengite, titanite and rarely also garnet, paragonite and Na-pyroxene. At the contact with marble they usually contain actinolite. Blue amphibole is zoned with purple-blue core rich in Fe^{3+} and pale-blue rim rich in Al. Na-pyroxene occurs in some coarse-grained unfoliated metabasites and it is mostly of aegirine composition. Maximum jadeite content found in pyroxene in this locality was 53 mol.% (Faryad and Henjes-Kunst, 1995). Locality Šugovská dolina valley. Photo Z. Németh.

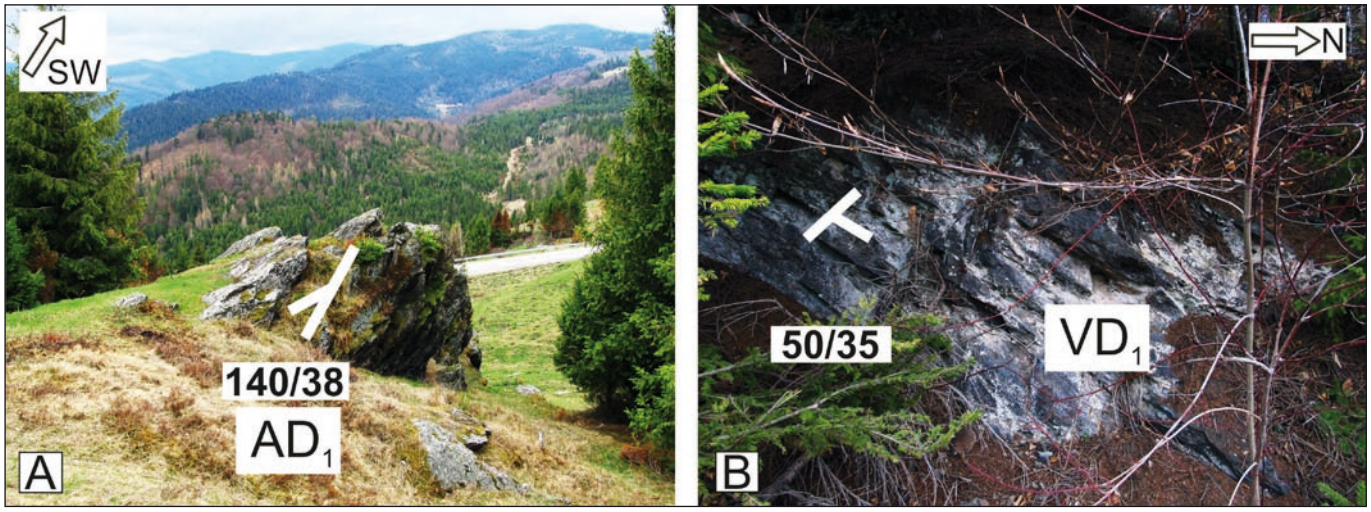

Fig. 11A, B. Contrasting dip of secondary foliation in the Permian conglomerates of the Knola Fm. (**A;** 140/38; imbrication during AD_1), and Carboniferous strongly recrystallized conglomerates of Rudňany Fm. (**B;** 50/35, deformation during Wesphalian exhumation). Locality Závadka.

as lithology close to Rakovec oceanic zone of Gemericum (basalts, green schists), but also of Lower Paleozoic Gelnica Group (e.g. quartz pebbles). The metaconglomerate occurs in two modes of mineral assemblages (l.c.): The first one of M1 metamorphism (Grt_{Alm} + Hbl + Png_1 + Pl_1 + Chl_1 + Rtl_1 + Spn_1 + Ilm_1 + Tur_1 + C + Ap + Qtz) is present in clasts. This mineral assemblage was stable in the younger M2 metamorphism. The second and younger mineral assemblage M2 (Act + Png_2 + Pl_2(Ab) + Chl_{2-3} + Hem + Ti-Hem + Psb + Psr + Ilm_2 + Rtl_2 + Spn_2 + inclusions of Cal in Hem + Tur_2 + Qtz) crystallized in the high-pressure metamorphism of P-T conditions around 12 Kbar, 600–550 °C. The retrograde metamorphism M2 stopped at 8 Kbar and 520–530 °C (l.c.).

There is necessary to mention that in the eastern part of Gemericum also facies of the Rudňany Conglomerates occur, which underwent only diagenesis and a weak metamorphic overprint of greenschists facies. The changes of metamorphic gradient along the strip of Rudňany Conglomerates agree with the concept of non-linearity of geological (convergent) boundaries (Németh, 2003), and indicate their M2 metamorphism as subduction one and a trench as the place where their detritus was cumulated.

7 – Smolník – The Lower Paleozoic chlorite-sericite schists of Smolník Fm. of Gelnica Group in the southern Gemericum, overprint by Alpine shearing and origin of steeply dipping secondary foliation. Outcrops at chapel near the state road app. 500 m south of the town of Smolník; 48°43'26.32'' N, 20°43'59.02'' E.

The outcrop behind the chapel manifests moderate dip to south (180-190/0-30) and numerous kinematic indicators. The double overprint relates to deformation phases VD_1 and AD_1. Following the road to SE the steeply dipping chlorite-sericite quartzy schists are observable of ENE–WSW trend (150/65-90). This position relates with a disjunctive shear zone of AD_3 phase.

8 – Šugovská dolina valley – Exhumed Mesozoic Meliatic suite of glaucophanites and marbles. Rotated glaucophanite porphyroclasts (diameter up to 12 cm) in marbles demonstrate the top-to-the north shearing.Termination of the Šugovská dolina valley app. 600 m to SSE of the Šugov ranch; 48°40'12.43'' N, 20°52'42.43'' E (Fig. 13).

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