mainly the lower part of the Zlín Formations, whereas the claystone facies is dominant in its upper part.

Krynica Unit is the southernmost tectono-lithofacies unit of the Magura nappe. Its lithostratigraphy is formed by three formations (from the oldest to youngest): Proč Fm., Strihovce Fm. and Malcov Fm. The geological setting of the Krynica Unit in the studied region has not a homogeneous character, therefore we distinguish there three segments: western (segment NW of the village Raslavice), middle (segment between the village Raslavice and the river Topľa) and eastern (segment east of the Topľa river). In the eastern part of the Krynica Unit there was not observed such facies variability than in the middle or western segments of this unit. In a segment east of the Topľa river the Krynica Unit is formed exclusively by the Strihovce Formation, while in the middle segment all three formations are present. For western segment there is characteristic a presence of the Malcov and in lower scale also of Strihovce formations.

Proč Formation (Upper Paleocene – ?Lower Eocene) locally outcrops at a southern margin of the studied region in the middle part of the Krynica Unit. In older works this formation was associated with the Paleogene of the Klippen Belt, in our study we interpret it as a part of Krynica Unit of the Magura nappe. Stratigraphic underlier and overlier of the Proč Formation were not observed in the investigated territory. Its contact with the Strihovce Formation is tectonic. Dominant and the only one distinguished facies of this formation are carbonate sandstones and sandy limestones with layers of claystones, marlstones and siltstones (32).

Strihovce Formation (Lower Eocene – Upper Eocene) represents massive, several 100 m thick complex of sandstones with interbeds of conglomerates and sporadic presence of claystones. A constituent part of this formation is formed by the quartz-greywacke (Strihovce) sandstones (27), containing layers of prevailingly oligomict conglomerates (27a). Significant, in the map a separately distinguished lithofacies is represented by the polymict conglomerates with pebbles of exotic rocks (29). A facies of sandy claystones (28) occurs in the overlier of polymict conglomerates. In the frame of the Strihovce Formation there are present also medium- to thin-bedded sandstones and claystones (flysch facies, 30) and variegated claystones (31).

Malcov Formation (Upper Eocene – ?Upper Oligocene) of the Krynica Unit forms several km thick zone along southern and south-western margins of the Bystrica Unit between the Topľa river valley in the east and the Sekčov stream valley in the west. It is a main building element of the Raslavice and Richvald synclinoria. Thickness of this formation we estimate to 800 – 1 200 m. Main, areally the most extended facies of this formation is represented by the grey calcareous claystones and siltstones with layers of quartz-carbonate sandstone (flysch facies, 23). In the several horizons there are present sandstones with layers of calcareous claystone and siltstone (24) and locally also with layers of conglomerate (24a). Lower part of the Malcov Formation is built with variegated claystones (26) and Menilite Member (25). Menilite Member is known also from the higher parts of this formation.

QUATERNARY

Quaternary sediments cover nearly whole studied territory in the variable, but prevailingly smaller thickness. In majority of investigated territory, these accumulations are genetically and typologically monotonous and less variegated.

The Lower Pleistocene accumulation was not preserved in the studied territory, resp. recorded were only its rudimentary occurrences. The presence of relics of the oldest Pliocene-Pleistocene peneplaining (Biber Glacial), recently being represented only by the flat ridges of former along-river plain, eventually slightly lower "plain terrace" in the relative altitude app. 150 – 170 m, is from the territory known, though the occurrence of the gravels of fluvial origin was not reliably confirmed in these places. Recently they are preserved neither the immediate younger fluvial gravel accumulations of the high terraces of the younger part of the Lower Pleistocene (Donau to Günz Glacial). Their former occurrence is indicated by the morphologically distinct erosion steps and levelled plains with the rare occurrence of remnants of weathered to disintegrating pebbles of quartz sandstones. The height of erosion surface of the high terraces varies between 80 – 90 m above the Topľa river flood-plain and 70 – 80 m above the Ondava river flood-plain. Nowhere it descends beneath 70 m.

The Middle Pleistocene accumulation in the territory is represented by the fluvial sediments in the terrace development. The sandy gravels of terraces outcrop in the studied region in 4 morphological steps. Two higher steps belong to undivided high terraces (Mindelian) and two lower levels to divided steps of 1. and 2. middle terrace (Lower and Upper Rissian), from which only upper middle terraces were preserved morphologically.

Upper Pleistocene accumulation is in the investigated territory represented by a larger number of genetic types of deposits and is preserved on larger and more continual areas. Laterally along the main water flows at junctions with tributary streams occur proluvial deposits in the form of lower alluvial fans and sporadically bilaterally age corresponding fluvial sediments of the lower terraces. In the underlier of the Holocene alluvial floodplains they simultaneously form the bottom sediments of the main water flows and some their bigger tributaries, being designated as bottom accumulation. At the foot parts of the slopes, but also on larger spaces (e.g. on the surface of the middle and lower fluvial terraces) loess series and their derivates have developed. They are formed mainly by the loessy loams and resedimented loesses – the calcareous and non-calcareous loessy loams.

Transitional period of the Late Glacial and Early Post-Glacial is in the region represented by the wider spectrum of transitional types of deluvial sediments – deluviums and debrises as well as their combinations with proluvial and fluvial sediments. These facies are accompanied with the eluvial weathered rocks and an enormous number of landslides. Deluvial sediments from the viewpoint of the matter volume and the areal extent dominate in the region territory. Besides then into this transitional period also some proluvial sediments of so-called above floodplain fans are assigned, rimming the floodplains of the main as well as adjacent water-flows in places of inflows of smaller lateral tributaries. The accumulation of the stated sediment types has started in the final part of the Upper Pleistocene, continued to the Lower Holocene era and into the recent.

Holocene accumulation in the investigated area is formed by fluvial sediments of the flood-plains of all water flows. With mentioned sediments there are in the close genetic relation the proluvial sediments of alluvial fans and fluvial-organic sediments of the abandoned meander loops and wetlands transiting to organogene sediments of peatbogs, connected with the surface of the bottom accumulation in the range of river floodplanes. Relative common are the occurrences of chemogene sediments (calcareous tufas and alms) occurring in bottoms and slopes of small mountain valleys and in the surrounding of spring areas. In the Holocene the processes of the slope modelation have continued, forming deluvial sediments, debrises and landslides. Unnegligible are also the recent anthropogeneous sediments (mainly dumps and landfills), which interaction with the natural environment causes the increasing environmental load.

TECTONICS

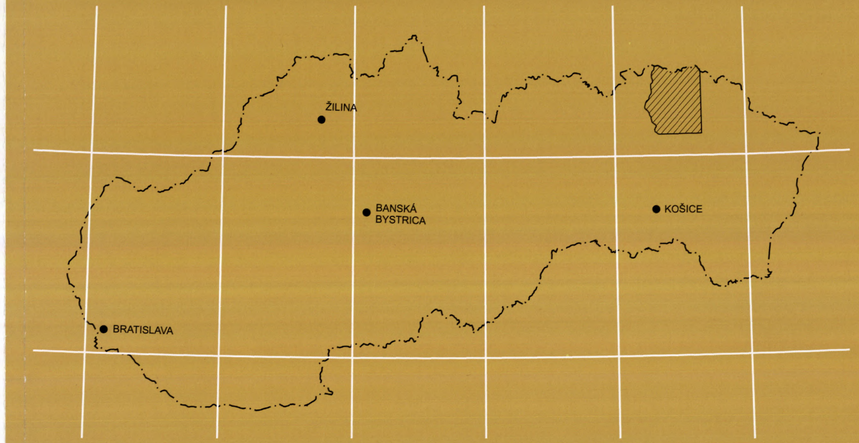
The Magura (shear) nappe, being a part of accretion prism of the Carpathian orogene, consists of several partial tectono-lithofacies extended overthrust units. From the north southward we distinguish outer and inner Rača, Bystrica and Krynica units. The internal setting of stated partial units is generally north-vergent. It is built by the system of partial tectonic slices of general NW-SE to WNW-ESE directions, mutually divided by the overthrust faults. Particular fold-slice structures demonstrate a distinctive tectonic style, being a reflection of lithological composition, which cannot be constant in the whole course. The south-vergent setting was observed in the southern, resp. SW part of the Bystrica Unit. Tectonic setting of this unit by this way obtains a character of the structural fan.

During the displacement of the Magura nappe through the more external zones of the Flysch Belt the "torn off fold slice" of the Grybow Unit was tectonically implemented – infolded – into the Inner Rača Unit (in its NW part), outcropping in the axis elevation of the Smilno tectonic window between the villages Smilno and Nižný Mirošov.

The longitudinal setting of the Magura nappe and its hierarchical lower structural zones, as well as longitudinal elevation of the Grybow Unit are segmented by the transversal fault tectonics with distinguished two important dislocation systems. The first group consists of structures of the general NE-SW (NNE – SSW to ENE – WSW) direction, where the characteristic movement component is formed by the pure to inclined normal faults and sinistral displacements. Second group is formed by the system of faults of general N-S trend with azimuthal spread in the interval NNW – SSW to NNW – SSE. These fault structures have the most significant dextral, directional to oblique displacements, but observed were also normal fault structures.

The origin of overthrust faults relates with the evolution of tectonic slices being caused by the tectonic reduction of the space and the axis of maximum compression ?1 was oriented perpendicularly to the course of structures in the direction NNE – SSW to NE – SW (?3 was subvertical). Directional, eventually also oblique offsets eliminating stress in the studied area, were caused in Sarmatian and apparently also during Pannonian by the compression-extension paleostress field with the axis of maximum compression ?1 oriented generally in the direction NNE – SSW (?3 is trending WNW-ESE).

The more significant normal faults on earlier described dislocation and simultaneously the origin of newly-formed structures in following phase of tectonic evolution could be initiated by the extension paleostress field affecting generally in the direction E – W from the end of Miocene and during Quaternary.



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REGIONÁLNE GEOLOGICKÉ MAPY SLOVENSKA

1 : 50 000

MARTIN KOVÁČIK ET AL. - 2011

GEOLOGICKÁ MAPA NÍZKYCH BESKÝD – ZÁPADNÁ ČASŤ

GEOLOGICAL MAP OF THE NÍZKE BESKYDY MTS. – WESTERN PART

ŠTÁTNY GEOLOGICKÝ ÚSTAV DIONÝZA ŠTÚRA - BRATISLAVA

STRUČNÝ PREHLAD GEOLÓGIE REGIÓNU NÍZKE BESKYDY – ZÁPADNÁ ČASŤ

Územie zobrazené na geologickej mape zaberá plochu o rozlohe 1015 km2 v západnej časti Nízkych Beskýd. Zobrazené je na mapovom liste 28-31 (Svidník) a častiach mapových listov 27-24 (Zborov), 27-42 (Bardejov), 27-44 (Sabinov), 28-13 (Vyšný Mirošov) a 28-33 (Giraltovce) v mierke 1 : 50 000.

Na geologickej stavbe regiónu sa podielajú jednotky flyšového pásma vonkajších Západných Karpát, na ktorých sú erozívne a diskordantne uložené kvartérne sedimenty.

FLYŠOVÉ PÁSMO

Flyšové pásmo pozostáva z niekoľkých bezkorenných príkrovov presunutých k severu od predmetne molasové sedimenty karpatskej predhlbne. V skúmanom území je zastúpené magurským príkrovom a grybowskou jednotkou vystupujúcou na povrch v sminiianskom tektonickom okne spod k severu presunutej račianskej jednotky magurského príkrovu. Litologicky nápln týchto jednotiek tvoria hibokomorské, prevažne siliciklastické sedimenty.

Grybowská jednotka vystupujúca v sminiianskom tektonickom okne

Grybowská tektonicko-litofaciálna jednotka je súčastou predmagurskej skupiny príkrovov. Vrstvový slep tejto jednotky je zložený z niekoľkých sústrav usporiadaných odpodu nahor nasledovne: podsminiianske, sminiianske a krosnianske sústrvste. Stratigrafický rozsah zachovaných sedimentov je stredný eocén (?) až spodný oligocén.

Podsminiianske sústrvste (stredný eocén ? – mladší eocén) je najstarším sústrvstím grybowskej jednotky. Je pritomné v dolinách severne od obce Cigla, v Dubovej a jej blízkom okolí a západne od Nižného Mirošova. Hrúbku podsminiianskeho sústrvste dohadujeme na 150 – 200 m. Je tvorené fáciou (65) tenko- až stredne vrstvovitých zelených a tmavosivých ílovcov s polohami kremenného až kremenno-karbonatického pieskovca. Spodná hranica sústvrstia nie je známa. Vrchná je pozvoľná a charakteristická pribúdaním tmavých vápenatých ílovcov smerom k sústrvstiu.

Sminiianske sústrvstie (mladší eocén – starší oligocén) je pritomné medzi Smilnom a Nižným Mirošovom a jeho hrúbku odhadujeme na 450 – 550 m. Členíme ho na spodné a vrchné (menilitové) sminiianske vrstvy. Dominantnou fáciou spodných sminiianskych vrstiev sú tmavosivé až čierne vápnité ílovce a sliefovce (64). Ďalšími samostatne vyčleneným fáciami týchto vrstiev sú karbonáty (64a), tmavé kremenné až kremenno-drobové pieskovce (63) a svetlé kremenné (klivské) pieskovce (62). Vrchné sminiianske (menilitové) vrstvy (61) vystupujú vo vrchnej časti sminiianskeho sústrvstia, kde tvoria výrazný korelačný horizont pozorovateľný hlavne v juižnom ramene brachyantiklinálnej štruktúry sminiianskeho tektonického okna. Typickým prínosom tejto fácie je pritomnosť vrstiev silicitov a menilitových rohovcov čiernej farby vystupujúcich v rámci sledu čiernych kremitých „bridlic", resp. ílovcov menilitového typu. Uvedené vrstvy dosahujú hrúbku od niekoľkých metrov do oca 85 m a ich kontakt s podložnými spodnými sminiianskymi vrstvami a nadložným krosnianskym sústrvstím je pozvoľný.

Najmladším členom grybowskej jednotky je *krosnianske sústrvstie* (starší oligocén), ktoré má najväčšie rozšírenie v juižnej časti sminiianskeho tektonického okna, kde dosahuje hrúbku cca 450 – 550 m. Jeho vrchná hranica je nejasná a sústrvstie je v tektonickom kontakte s fáciami kurimského sústrvstia vnútornej račianskej jednotky. Členíme ho na 2 fácie: tenko- až stredne vrstvovité vápnité ílovce, prachovce a pieskovce (60, dominantnými vrstvami flyš), stredno- až veľmi hrubo vrstvovité slivé vápenaté ílovce, prachovce a kremenno-karbonatické pieskovce (61).

Magurský príkrov

Magurský príkrov tvorí podstatnú časť študovaného územia a na základe litofaciálnych a litostratigrafických odlišností vrstvových sledov čiastkových štruktúr sa delí na 3 základné tektonicko-litofaciálne jednotky (od juhu na sever): krynickú, bystrickú a račiansku. Na juhu je magurský príkrov tektonicky ohraničený bradlovým pásmom, na severe prechádza na územie Poľska a na SV sa tektonicky stýka s dukliansku jednotkou patriacou do vonkajšej (krosnianskej) skupiny príkrovov flyšového pásma. Kontakt so spomenutými susednými jednotkami je mimo študovaného územia.

Račianska jednotka predstavuje najsevernejšiu tektonicko-litofaciálnu jednotku magurského príkrovu v skúmanom území. Na základe litofaciálnych odlišností hlavne zlínskeho vývoja v jej severnej a juižnej časti vyčleňujeme dve zóny: vonkajšiu a vnútornú. Pre vnútornú zónu je charakteristická pritomnosť makovických pieskovcov v spodnej časti zlínskeho súvrstvia, kým vo vonkajšej zóne dominujú glaukonitové litofácie a vývoj je viac pelitický. Tieto zóny sú oddelené násunovou líniou Krivej Orky.

Vonkajšia račianska jednotka je pritomná severne od línie Krivej Orky a na jej horninovej náplni sa podieľa belovežské a zlínske súvrstvie. Belovežské súvrstvie (starší eocén – stredný eocén) je tvorené 2 fáciami, ktorými sú: tenkovrstvovité ílovce až siltovce s polohami pieskovcov (58, tzv. drobnorytmický flyš) a pestré ílovce (58a). Zlínske súvrstvie (stredný eocén až starší oligocén) tvorí prevažnú časť tejto jednotky v študovanom území a členíme ho na 4 hlavné fácie: 57 – kremenné, ankerové a glaukonitové pieskovce s polohami olivovozelených vápnitých ílovcov až prachovcov (glaukonitovo-pieskovcová fácia), 56 – hrubozrnné pieskovce a zlepence (bežne s glaukonitom), 55 – olivovozelené vápnité ílovce (zlínsky litotyp) až prachovce s polohami glaukonitových pieskovcov (ílovcová fácia), 55a - hnedé silicifikované ílovce a prachovce, 54 – tmavosivé a olivovozelené vápnité ílovce, kremenno-karbonátové a glaukonitové pieskovce. Celková hrúbka súvrstvia je značná, dosahuje 1500 – 2500 m. Všeobecne platí, že spodnú časť zlínskeho súvrstvia vo vonkajšej račianskej jednotke tvorí prevažne glaukonitovo-pieskovcová fácia. V rámci tejto fácie sú rôzne typy pieskovcov s glaukonitom a tiež kremenno-drobové pieskovce majúce rovnakú stratigrafickú polohu a petrografický charakter ako makovické pieskovce, ale podstatne menšiu hrúbku ako samostatne vyčlenené makovické pieskovce vo vnútornej zóne račianskej jednotky. Vrchnú časť zlínskeho súvrstvia tvorí zvyčajne ílovcová fácia, v ktorej sa vyskytujú tenšie polohy (max. niekoľko 10-tok m hrubé) glaukonitovo-pieskovcovej fácie a hnedé silicifikované ílovce a prachovce (55a). Tmavé ílovce tvoria aj v strednej alebo západnej časti tejto jednotky. V úseku východne od Tople je krynická jednotka tvorená výhradne strihovským súvrstvím, zatiaľ čo v strednej časti sú zastúpené všetky tri súvrstvia a západná časť je charakteristická pritomnostou malcovského a v menšej miere aj strihovského súvrstvia.

Pročské súvrstvie (mladší paleocén – ?starší eocén) vystupuje lokálne pri juižnom okraji študovaného regiónu v strednej časti krynickej jednotky. V starších prácach bolo toto súvrstvie radené k paleogénu bradlového pásma, v tejto práci ho považujeme za súčasť krynickej jednotky magurského príkrovu. Stratigrafické podložie a nadložie pročského súvrstvia nie je známe v skúmanom území pozorované. Jeho kontakt so strihovským súvrstvím je tektonický. Dominantnou a jedinou vyčlenenou fáciou súvrstvia sú karbonátové pieskovce a piesčité vápence s polohami ílovcov, slieňovcov a prachovcov (32).

Strihovské súvrstvie (starší eocén – mladší eocén) predstavuje mohutný, niekoľko 100 m hrubý komplex pieskovcov, ílov kremenno-drobové pieskovce s podradným zastúpením ílovcov. Podstatnú časť tohto súvrstvia tvoria kremenno-drobové (strihovské) pieskovce (27), v ktorých sú pritomné polohy prevažne monomiktných zlepencov (27a). Významnou, na mape samostatne vyčlenenou litofáciou sú polymiktné zlepence s obliakmi exotických hornín (29). V nadloží polymiktných zlepencov vystupuje fácia piesčitých ílovcov (28). V rámci pieskovcovo-ílovcovitého súvrstvia sú zastúpené aj stredno- až tenkovrstvovité pieskovce a ílovce (flyšová fácia, 30) a pestré ílovce (31).

Malcovské súvrstvie (mladší eocén – mladší oligocén) krynickej jednotky tvorí niekoľko km široký pás pozdĺž j. a jz. okraja bystrickej jednotky medzi údolím Tople na východe a údolím Ondavky na západe. Je hlavným stavebným prvkom raslavického a richvalského synklinória. Hrúbku tohto súvrstvia odhadujeme na 800 – 1200 m. Hlavnou, plošne najrozsiahlejšou fáciou tohto súvrstvia sú sivé vápnité ílovce a prachovce s polohami kremenno-karbonátového pieskovca (flyšová fácia, 23). V niekoľkých horizontoch sú pritomné tenšie pieskovce s polohami vápnitého ílovca a prachovca (23) a lokálne aj s polohami zlepenca (24a). V spodnej časti malcovského súvrstvia sú vyvinuté pestré ílovce (26) a menilitové vrstvy (25). Menilitové vrstvy sú známe aj z vyšších častí tohto súvrstvia.

KVARTÉR

Magurský (strižný) príkrov, ktorý je súčastou akrečnej prizmy karpatského orogénu, pozostáva z niekoľkých čiastkových tektonicko-litofaciálnych rozsiahlych násunových jednotiek. Od severu k juhu odlišujeme: vonkajšiu a vnútornú račianku, bystrickú a krynickú jednotku. Vnútorná stavba uvedených čiastkových jednotiek je vo všeobecnosti severovergentná, tvorená šústavou dielčích tektonických šupín generálne sz.-jv. až zsz.-vjv. smeru navzájom oddelených násunovými zlomami. Jednotlivé vrásovo-šupinové štruktúry majú svoj osobitý štýl tektoniky, ktorý je odrazom litológie a nemusí byť konštantný v celom ich priebehu. Juhovergentná stavba bola pozorovaná v juižnej, resp. jz. časti bystrickej jednotky. Stavba uvedenej jednotky tak nadobúda v reze charakter štruktúrneho vejára.

Pri presune magurského príkrovu cez externejšie zóny flyšového pásma bola do stavby vnútornej račianskej jednotky (v jej sz. časti) tektonicky implementovaná – zaviesnená „odtrhnutá vrásová šupina" grybowskej jednotky vystupujúca v osovej elevácii sminiianskeho tektonického okna medzi Smilnom a Nižným Mirošovom.

Pozdĺžna stavba magurského príkrovu a jeho hierarchicky nižších štruktúrnych pásiem a takiež pozdĺžna elevácia grybowskej jednotky je segmentovaná priečnou zlomovou tektonikou, v rámci ktorej odlišujeme dva vyznačné systémy dislokácií. V prvom rade ide o štruktúry principiálne sv.-jz. (ssv.-jjz. až vsv.-zjz.) smeru, kde charakteristickú zložku pohybu tvoria čisté až šikmé poklesy a sinistrálne posuny. Druhú skupinu tvorí systém zlomov generálne s.-j. smeru s azimutálnym rozptylom variujúcim v intervale ssv.-jjz. až ssz.-jjv. U týchto zlomových štruktúr je najmarkantnejší dextrálny smerne až šikmo posuvný režim, avšak pozorované boli aj poklesové štruktúry.

Vznik násunových zlomov súvisí s vývojom tektonických šupín, kedy dochádzalo k tektonickej redukcii priestoru a os max. kompresie ?1 bola orientovaná kolmo na priebeh štruktúr a to v smere SSZ-JJV až SV-JZ (?3 pôsobí v advertikálne). Smerné, prípadne až šikmé posuny, ktorými sa v študovanom priestore relaxovali napätia, vyvolalo v sarmate a zrejme aj počas panónu pôsobenie kompresno-extenzorného paleonapäťového poľa s osou max. kompresie ?1 orientovanou generálne v smere SSV-JJZ (?3 pôsobí v smere ZSZ-VJV).

Významnejšie poklesy na staršie založených vyššie opisovaných dislokáciách a zároveň tvorbu novovzniknutých štruktúr v následnej etape tektonického vývoja mohlo inicioval extenzné pole paleonapätia pôsobiaceho generálne v smere V – Z už od konca miocénu a počas kvartéru.

OUTLINE OF GEOLOGY OF THE REGION NÍZKE BESKYDY MTS. – WESTERN PART

Presented geological map displays the territory in the western part of the Nízke Beskyd Mts. having the areal extent of 1 015 km2. It is shown on the map sheets 28-31 (Svidník) and parts of the map sheets 27-24 (Zborov), 27-42 (Bardejov), 27-44 (Sabinov), 28-13 (Vyšný Mirošov) and 28-33 (Giraltovce) at a scale 1 : 50 000.

The geological setting of the region consists of units of the Flysch Belt of Outer Western Carpathians, being covered by the Quaternary sediments in the erosive and discordant position.

FLYSCH BELT

Flysch Belt consists of several rootless nappes displaced northward on Neogene molasse sediments of the Carpathian Foredeep. In investigated area it is represented by the Magura nappe and the Grybow Unit outcropping in the Smilno tectonic window beneath the overlier there was found its transition into the Beloveža Formation. In details the formation is divided into flysch beds (fine- to medium-bedded green and grey claystones with layers of quartz to quartz-carbonate sandstone, 52) and sandstone facies (quartz-greywacke sandstones, locally with glauconite, 53). The thickness of the Kurimka Formation is estimated to 500 – 800 m.

Beloveža Formation (Paleocene – Middle Eocene) outcrops in the frontal parts of particular slices (resp. in cores of anticlinal structures) of the Inner Rača Unit. In lower part it is formed by the Mrázovce Beds (51), in the upper part by the thick-bedded claystones and sandstones (50), having in some places the interbeds of variegated claystones (50a). The Mrázovce Member are present only in the south-eastern part of the territory – in the slice zone of the Makovce hill. The thickness of the Mrázovce Beds is variegated and the thickness of the Beloveža Formation in the south-eastern part of the studied territory it is thinner, app. 200 – 250 m. The formation is thickest in the north-western part of the region – in the Zborov anticlinorium, with estimated thickness up to 1 300 m (this value is obscured by the distinct deformation of particular facies of the Beloveža Formation). The lower boundary of the formation was caught by the drill hole in the depth 1 500 m and it is not known. Upper boundary is gradual and characteristic by the crestent amount of calcareous claystones of the Smilno Formation.

Smilno Formation (Upper Eocene – ?Upper Oligocene) is present between villages Smilno and Nižný Mirošov. Its thickness is estimated to 450 – 550 m. It is divided to Lower and Upper (Menilite) Smilno Member. A dominant facies of the Lower Smilno Member is represented by the dark-grey to black calcareous claystones and marlstones (64). Next, separately distinguished facies in these beds are carbonates (64a), dark-quartz to quartz-greywacke sandstones (63) and light quartz sandstones (Kliwa sandstones, 62). The Upper Smilno (Menilite) Member (61) is presented in the upper part of the Smilno Formation, where it forms distinct correlation horizon, observable mainly in southern limb of the brachyanticlinal structure of the Smilno tectonic window. A typical sign of this facies is a presence of the silicite beds and menilite cherts of the black colour. The formation is in the frame of succession of the black quartz "shales", resp. claystones of menilite type. The beds reach the thickness from some metres to app. 85 m and their contact with underlying Lower Smilno Member and overlying Krosno Formation is gradual.

Krosno Formation (Lower Oligocene) is the youngest formation of the Grybow Unit. The largest extent it has in southern part of the Smilno tectonic window, where it reach the thickness around 450 – 550 m. Its upper boundary is not clear. Formation is in tectonic contact with facies of the Kurimka Formation of the Inner Rača Unit. It is divided on two facies: thin-bedded grey calcareous claystones, siltstones and sandstones (60, fine-rhythmical flysch) and on the medium- to very thick-bedded grey calcareous claystones, siltstones and quartz-carbonate sandstones (61).

Magura nappe

Magura nappe forms a substantial part of the studied territory. Based on lithofacies and lithostratigraphic differences of the bed successions of partial structures it is divided on 3 principal tectono-lithofacies units (from the south to north): Krynica, Bystrica and Rača units. In the south the Magura nappe is tectonically bounded by the Klippen Belt, in the north it continues on the territory of Poland and north-eastward it is in tectonic contact with the Dukla Unit belonging to outer (Krosno) group of nappes of the Flysch Belt. Contact with the mentioned neighbouring units is located away of the studied territory.

Rača Unit represents the southernmost tectono-lithofacies unit of the Magura nappe in the investigated area. Based on lithofacies differences mainly of the Zlín Formation in its northern and southern parts, two zones are distinguished: outer and inner. For the inner zone the presence of the Makovica Sandstones in the lower part of the Zlín Formation is characteristic, whereas in the outer zone there dominate the glauconite lithofacies and the development is more pelitic. These zones are separated by the Krivá Orka overthrust line.

Outer Rača Unit is present north of the Krivá Orka line, consisting of the Beloveža and Zlín formations. The Beloveža Formation (Lower Eocene – Middle Eocene) is formed by two facies: thin-bedded claystones to siltstones with layers of sandstones (58, so-called fine-rhythmical flysch) and variegated claystones (58a). Zlín Formation (Middle Eocene – Lower Oligocene) forms the prevailing part of this unit in the studied territory. It is divided into several facies: 57 – quartz, ankerite and glauconite sandstones with layers of olive-green calcareous claystones and siltstones (glauconite-sandstone facies), 56 – coarse-grained sandstones and conglomerates (commonly with glauconite), 55 – olive-green calcareous claystones (Zlín-type) to siltstones with layers of glauconitic sandstones (claystone facies), 55a – brown siliceous claystones and siltstones, 54 – dark-grey and olive-green calcareous claystones, quartz-carbonate and glauconitic sandstones. The total thickness of the formation is considerable, reaching 1 500 – 2 500 m. There is generally valid that the lower part of the Zlín Formation in the Outer Rača Unit is formed prevailingly by the glauconite-sandstone facies. In the frame of this facies various sandstone types with glauconite and quartz-greywacke sandstones are present with the same stratigraphic position and the same petrographic character as the Makovica Sandstones, but with considerably smaller thickness as separately distinguished Makovica Sandstones in the Inner Rača Unit. The upper part of the Zlín Formation is usually formed by the claystone facies, containing thinner interbeds (maximum thickness of several tens of m) of glauconite-sandstone facies and brown silicified claystones and siltstones (55a). Dark calcareous claystones in association with the Zlín lithotypes (54) are locally present in the uppermost part of the bed succession of the Outer Rača Unit.

Inner Rača Unit outcrops south of the Krivá Orka line between the Outer Rača Unit in the north-east and the Bystrica Unit in the south-west. It has wider stratigraphic range, superficially covering considerably larger area and in comparison with the Outer Rača Unit has more variegated facies content. From its base upwards it is built by following formations: Kurimka Fm., Beloveža Fm., Zlín Fm. and Malcov Fm.

Kurimka Formation (Upper Cretaceous – Lower Eocene) represents stratigraphically the oldest formation of the Inner Rača Unit. It outcrops south of the Smilno tectonic window between villages Šariškké Čierne and Vyšný Orlík. Its underlier is not known, towards the overlier there was found its transition into the Beloveža Formation. In details the formation is divided into flysch beds (fine- to medium-bedded green and grey claystones with layers of quartz to quartz-carbonate sandstone, 52) and sandstone facies (quartz-greywacke sandstones, locally with glauconite, 53). The thickness of the Kurimka Formation is estimated to 500 – 800 m.

Beloveža Formation (Paleocene – Middle Eocene) outcrops in the frontal parts of particular slices (resp. in cores of anticlinal structures) of the Inner Rača Unit. In lower part it is formed by the Mrázovce Beds (51), in the upper part by the thick-bedded claystones and sandstones (50), having in some places the interbeds of variegated claystones (50a). The Mrázovce Member are present only in the south-eastern part of the territory – in the slice zone of the Makovce hill. The thickness of the Mrázovce Beds is variegated and the thickness of the Beloveža Formation in the south-eastern part of the studied territory it is thinner, app. 200 – 250 m. The formation is thickest in the north-western part of the region – in the Zborov anticlinorium, with estimated thickness up to 1 300 m (this value is obscured by the distinct deformation of particular facies of the Beloveža Formation). The lower boundary of the formation was caught by the drill hole in the depth 1 500 m and it is not known. Upper boundary is gradual and characteristic by the crestent amount of calcareous claystones of the Smilno Formation.

Smilno Formation (Upper Eocene – ?Upper Oligocene) is present between villages Smilno and Nižný Mirošov. Its thickness is estimated to 450 – 550 m. It is divided to Lower and Upper (Menilite) Smilno Member. A dominant facies of the Lower Smilno Member is represented by the dark-grey to black calcareous claystones and marlstones (64). Next, separately distinguished facies in these beds are carbonates (64a), dark-quartz to quartz-greywacke sandstones (63) and light quartz sandstones (Kliwa sandstones, 62). The Upper Smilno (Menilite) Member (61) is presented in the upper part of the Smilno Formation, where it forms distinct correlation horizon, observable mainly in southern limb of the brachyanticlinal structure of the Smilno tectonic window. A typical sign of this facies is a presence of the silicite beds and menilite cherts of the black colour. The formation is in the frame of succession of the black quartz "shales", resp. claystones of menilite type. The beds reach the thickness from some metres to app. 85 m and their contact with underlying Lower Smilno Member and overlying Krosno Formation is gradual.

Krosno Formation (Lower Oligocene) is the youngest formation of the Grybow Unit. The largest extent it has in southern part of the Smilno tectonic window, where it reach the thickness around 450 – 550 m. Its upper boundary is not clear. Formation is in tectonic contact with facies of the Kurimka Formation of the Inner Rača Unit. It is divided on two facies: thin-bedded grey calcareous claystones, siltstones and sandstones (60, fine-rhythmical flysch) and on the medium- to very thick-bedded grey calcareous claystones, siltstones and quartz-carbonate sandstones (61).

Magura nappe

Magura nappe forms a substantial part of the studied territory. Based on lithofacies and lithostratigraphic differences of the bed successions of partial structures it is divided on 3 principal tectono-lithofacies units (from the south to north): Krynica, Bystrica and Rača units. In the south the Magura nappe is tectonically bounded by the Klippen Belt, in the north it continues on the territory of Poland and north-eastward it is in tectonic contact with the Dukla Unit belonging to outer (Krosno) group of nappes of the Flysch Belt. Contact with the mentioned neighbouring units is located away of the studied territory.

Rača Unit represents the southernmost tectono-lithofacies unit of the Magura nappe in the investigated area. Based on lithofacies differences mainly of the Zlín Formation in its northern and southern parts, two zones are distinguished: outer and inner. For the inner zone the presence of the Makovica Sandstones in the lower part of the Zlín Formation is characteristic, whereas in the outer zone there dominate the glauconite lithofacies and the development is more pelitic. These zones are separated by the Krivá Orka overthrust line.

Bystrica Unit outcrops in a zone trending NW-SE between the town Bardejov and the village Lomné. In the north-eastern side it is overthrusted on the Inner Rača Unit, in the south it is in tectonic contact with the Krynica Unit. The Bystrica Unit is formed in its lower part by the Beloveža Fm. and in upper part by the Zlín Formation of the Bystrica provenance.

The oldest lithostratigraphic unit of the Bystrica Unit is *the Beloveža Formation* (Paleocene – Middle Eocene), being divided into two parts. A lower part is represented by the sandstones with layers of claystones and siltstones (sandstone facies, 37). Upper part is formed by the thin-bedded claystones and siltstones with layers of sandstones (fine-rhythmical flysch, 36) with interbeds of variegated claystones (36a). A stratigraphic underlier of the Beloveža Fm. of Bystrica Unit is not known. Upwards it gradually develops to prevailingly sandstone facies of the Zlín Formation. Thickness of this formation is estimated to 50 – 200 m.

Zlín Formation (Middle Eocene – Upper Eocene) is formed prevailingly by the sandstone facies, dominating mainly in the lower part of the formation. In the frame of this facies the map presents the interbeds of the coarse-grained greywacke sandstones and conglomerates (35a) and interbeds with pebbles and boulders of the exotic rocks (35b). The claystone facies occurs in several discontinuous zones, reaching a thickness of several tens to hundreds of metres. Locally in the narrow, several metres thick beds silicified claystones to siltstones (33) were determined. There is generally valid that sandstone facies is forming

GEOLOGY OF THE REGION NÍZKE BESKYDY MTS.

Quaternary sediments are developed in the form of the Fore-Magura group of nappes. The bed succession of this unit consists of several formations, being arranged upwards as follows: Subsmilno, Smilno and Krosno formations. The stratigraphic range of preserved sediments is Middle Eocene(?) to Lower Oligocene.

Subsmilno Formation (Middle Eocene? – Lower Eocene) is the oldest formation of the Grybow Unit. It outcrops in the valleys north of the village Cigla, in Dubová and its close surrounding and west of Nižný Mirošov. The thickness of the Subsmilno Formation is estimated to 150 – 200 m. It is formed by the facies (65) of thin- to medium-bedded green to dark-grey claystones with layers of quartz to quartz-carbonate sandstone. The lower boundary of the formation is not known. Upper boundary is gradual and characteristic by the crestent amount of calcareous claystones of the Smilno Formation.

Smilno Formation (Upper Eocene – ?Upper Oligocene) is present between villages Smilno and Nižný Mirošov. Its thickness is estimated to 450 – 550 m. It is divided to Lower and Upper (Menilite) Smilno Member. A dominant facies of the Lower Smilno Member is represented by the dark-grey to black calcareous claystones and marlstones (64). Next, separately distinguished facies in these beds are carbonates (64a), dark-quartz to quartz-greywacke sandstones (63) and light quartz sandstones (Kliwa sandstones, 62). The Upper Smilno (Menilite) Member (61) is presented in the upper part of the Smilno Formation, where it forms distinct correlation horizon, observable mainly in southern limb of the brachyanticlinal structure of the Smilno tectonic window. A typical sign of this facies is a presence of the silicite beds and menilite cherts of the black colour. The formation is in the frame of succession of the black quartz "shales", resp. claystones of menilite type. The beds reach the thickness from some metres to app. 85 m and their contact with underlying Lower Smilno Member and overlying Krosno Formation is gradual.

Krosno Formation (Lower Oligocene) is the youngest formation of the Grybow Unit. The largest extent it has in southern part of the Smilno tectonic window, where it reach the thickness around 450 – 550 m. Its upper boundary is not clear. Formation is in tectonic contact with facies of the Kurimka Formation of the Inner Rača Unit. It is divided on two facies: thin-bedded grey calcareous claystones, siltstones and sandstones (60, fine-rhythmical flysch) and on the medium- to very thick-bedded grey calcareous claystones, siltstones and quartz-carbonate sandstones (61).

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Rača Unit represents the southernmost tectono-lithofacies unit of the Magura nappe in the investigated area. Based on lithofacies differences mainly of the Zlín Formation in its northern and southern parts, two zones are distinguished: outer and inner. For the inner zone the presence of the Makovica Sandstones in the lower part of the Zlín Formation is characteristic, whereas in the outer zone there dominate the glauconite lithofacies and the development is more pelitic. These zones are separated by the Krivá Orka overthrust line.

Outer Rača Unit is present north of the Krivá Orka line, consisting of the Beloveža and Zlín formations. The Beloveža Formation (Lower Eocene – Middle Eocene) is formed by two facies: thin-bedded claystones to siltstones with layers of sandstones (58, so-called fine-rhythmical flysch) and variegated claystones (58a). Zlín Formation (Middle Eocene – Lower Oligocene) forms the prevailing part of this unit in the studied territory. It is divided into several facies: 57 – quartz, ankerite and glauconite sandstones with layers of olive-green calcareous claystones and siltstones (glauconite-sandstone facies), 56 – coarse-grained sandstones and conglomerates (commonly with glauconite), 55 – olive-green calcareous claystones (Zlín-type) to siltstones with layers of glauconitic sandstones (claystone facies), 55a – brown siliceous claystones and siltstones, 54 – dark-grey and olive-green calcareous claystones, quartz-carbonate and glauconitic sandstones. The total thickness of the formation is considerable, reaching 1 500 – 2 500 m. There is generally valid that the lower part of the Zlín Formation in the Outer Rača Unit is formed prevailingly by the glauconite-sandstone facies. In the frame of this facies various sandstone types with glauconite and quartz-greywacke sandstones are present with the same stratigraphic position and the same