Mineralia Slovaca, Web ISSN 1338-3523, ISSN 0369-2086
50 (2018), 125 – 136,

New structural and lithological concept of the Turňa Unit in the vicinity of Striežovce (Hrušovo village; Revúcka vrchovina Highlands)

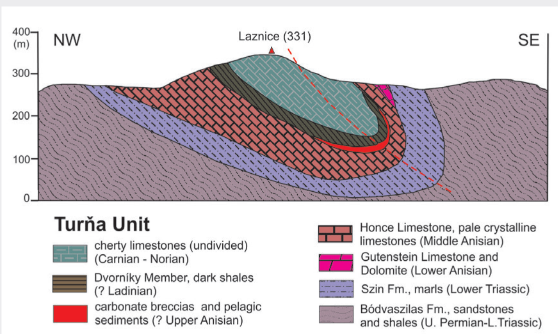
ALEXANDER LAČNÝ[1,2], RASTISLAV VOJTKO[1], ŠTEFAN MÉRES[3]
MILAN SÝKORA[1] and ĽUDOVÍT GAÁL[4]

[1]Comenius University in Bratislava, Faculty of Natural Sciences, Department of Geology and Paleontology, Ilkovičova 6, SK-842 15 Bratislava, Slovakia; alexander.lacny@uniba.sk, rastislav.vojtko@uniba.sk; milan.sykora@uniba.sk
[2]State Nature Conservancy of the Slovak Republic, Little Carpathians Protected Landscape Area, Štúrova 115, SK-900 01 Modra, Slovakia
[3]Comenius University in Bratislava, Faculty of Natural Sciences, Department of Geochemistry, Ilkovičova 6, SK-842 15 Bratislava, Slovakia; stefan.meres@uniba.sk
[4]State Nature Conservancy of the Slovak Republic, Slovak Caves Administration, Hodžova 11, SK-031 01 Liptovský Mikuláš, Slovakia; ludovit.gaal@ssj.sk

Abstract: The study area is located between Hrušovo and Striežovce villages in the Rimavská Sobota district and is characterized by the occurrence of anchimetamorphosed siliciclastic, carbonate and pelagic deposits. This structure was differently interpreted in the past, when these rocks were included into either the Meliata or Turňa tectonic units. Based on our research we can consider that the sedimentary succession belongs to the Turňa Unit. The lithostratigraphy of the succession is formed of synsedimentary breccias, which later pass into the deep-water sediments during the Middle Triassic. We interpret the breccias as a reflection of the Pelsonian break-off of the Meliata Ocean (synrift sedimentary breccias). The breccias are followed by the phyllitic black shales sedimentation, and are considered to represent the Dvorníky Member, indicating deeper-water sedimentation in comparison with the remaining parts of the Slovenská skala nappe. The Upper Triassic sequence is predominantly represented by cherty limestone, and the younger rocks as Norian are not known in the area. Paleogeographically, it can be assumed that the study area was located somewhere between the Meliata and Turňa sedimentation area. Based on the aforementioned data, it is possible to interpret the study area as the Striežovce syncline, which is the part of the synclinal-anticlinal structure of the Slovenská skala nappe.

Key words: Dvorníky Member, Turňa Unit, Striežovce syncline, Western Carpathians

Graphical abstract



Highlights

- Presented new concept of synclinal setting of the Turňa Unit near the westernmost part of the contact zone of Gemeric and Veporic units (the Striežovce syncline)
- First discovery of radiolarites and deep-water sediments in the Middle- and Upper Triassic succession of the Turňa Unit

1 Introduction

The inner zones of the Central Western Carpathians (Vepor-Gemer area) are closely linked to the outer zones of the Inner Western Carpathians (Meliata-Turňa-Silica nappe stack). This nappe pile is interpreted as being closely related to the north-western branch of the Neotethys (Meliata Ocean). However, there are still many uncertainties concerning the original geological structure of the Meliata-Turňa-Silica nappe system. Basically the lowermost position is occupied by the Meliata Unit s.l., the middle position belongs to the Turňa Unit, and the uppermost position is reserved for the superficial Silica nappe system. Nevertheless, it remains uncertain if this structural arrangement reflects also the original palinspastic positions of the units involved, it means whether the overriding Turňa and Silica nappes were derived from the southern (e.g., Vozárová & Vozár, 1992; Hók et al. 1995; Rakús 1996;

Mello et al. 1997; Lexa et al. 2003; Csontos & Vörös 2004; Dallmeyer et al. 2008) or the northern (e.g., Mandl 2000; Gaál 2008; Schmid et al. 2008; Gawlick et al. 2012) margin of the Meliata Ocean. The complicated geological structure in the southern zones of the Western Carpathians together with poorly exposed important rock complexes represent the basic problems for understanding the tectonic structure of the territory.

One of the classical locality of the Meliata-Turňa-Silica relationships is the area in the Revúcka vrchovina Highlands (Mazúr & Lukniš, 1986) between Hrušovo and Striežovce villages in the Rimavská Sobota district (Fig. 1). This area includes Middle–Upper Triassic sediments surrounded by Lower Triassic strata, but the nature of this tectonic structure – either syncline, or anticline – was not clearly documented in previous research. The first possibility, preferred in the present article, would mean their Turnaic assignment; whereas the second option would indicate their Meliatic provenance (e.g. Gaál, 1982). Therefore, the aim of this study was to apply systematic structural and sedimentary petrological investigations to resolve the geological structure and tectonic affiliation of the Middle–Upper Triassic rocks in this area.

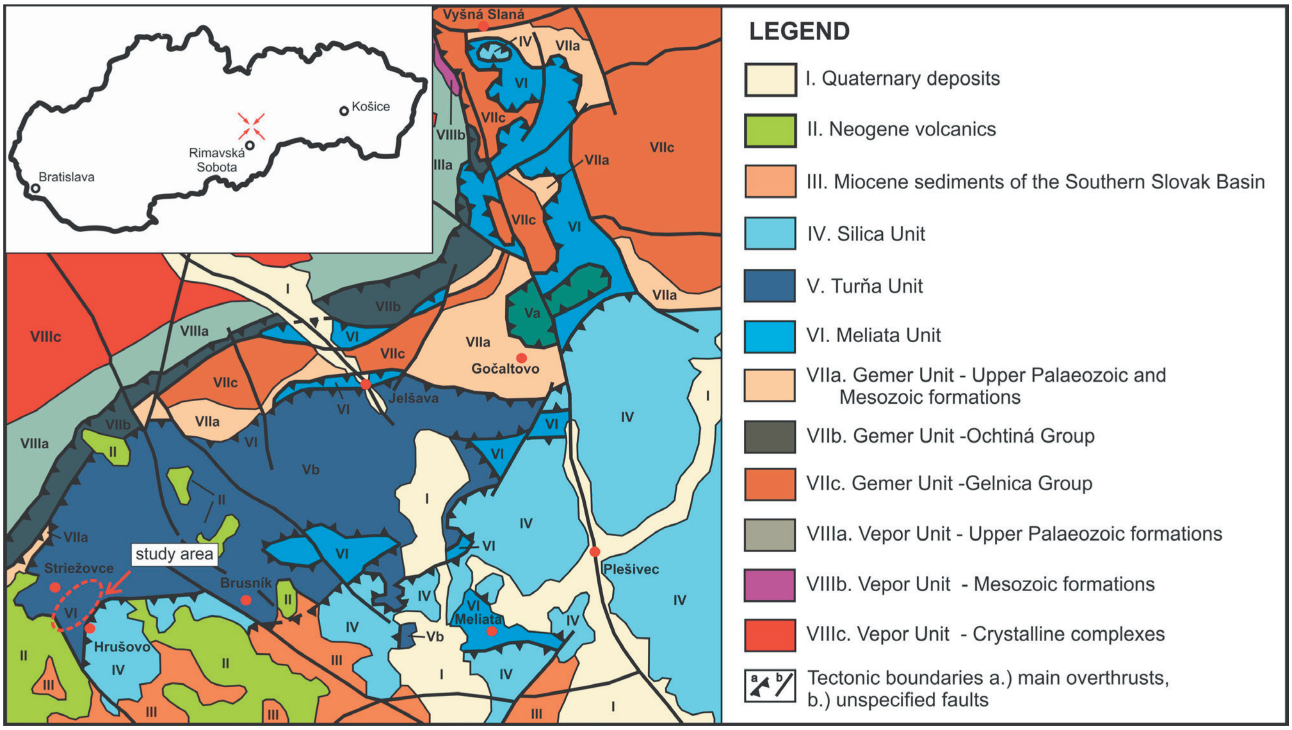


Fig. 1. Tectonic scheme with a delineation of the study area according Lačný et al. (2016).

2 Review of previous investigations

In the oldest geological maps after the Second World War, the anchimetamorphosed sedimentary sequences were considered to be a Late Paleozoic to Mesozoic sedimentary cover of the thick-skinned Gemeric Unit (e.g., Fusán et al., 1962). Later on, they were described as the "Rudabánya Triassic" (cf. Bystrický et al., 1956; Bystrický, 1964) and anchimetamorphosed succession near Jelšava town as the Tri peniažky – Slovenská skala zone (Bystrický, 1954, 1964). After defining the Meliata Unit and Silica Nappe (Kozur and Mock, 1973a, 1973b), the rock presently affiliated with the Turnaic Unit were described as an anchimetamorphosed part of the Silica nappe stack (Slovenská skala slice), which is lying directly on the Meliata and/or Bôrka Unit and immediately below the main, unmetamorphosed part of the Silica Nappe s.s. (e.g. Mello, 1979). Based on the results of the Brusník BRU-1 borehole Vozárová & Vozár (1992), the Slovenská skala slice was assigned to the independent Turnaic (Tornaic) nappe system and correlated with its analogous units cropping out in the Hungarian-Slovak territory.

For the first time, the study area was described by Gaál (1982) in detail, who suggested its analogy with the Meliata series (*sensu* Kozur & Mock, 1973a, b). Further studies were only sporadic, and Gaál's (1982) results were often adopted and interpreted differently. On the geological map of Elečko et al. (1985), the study area was interpreted as a tectonic slice of the Meliata Unit. However, in 1997, the region was included into the Turňa Unit (Mello et al., 1997) without any discussion. Later, within the geological maps of the Gemer-Bűkk region, it is considered to be a detached mass of an overthrust sheet of the Turňa Unit (Less et al., 2004). In the geological map at a scale of 1:200,000 by Mello et al. (2008) it is interpreted again as a tectonic inlier of the Meliata Unit. These inconsistent classifications into the Meliata or Turňa units demonstrate the complexity of the study area and an absence of modern research.

3 Lithostratigraphy

The area of the Striežovce-Hrušovo is composed of several sedimentary formations, which were identified by previous investigations and by our field mapping. The sedimentary sequence is metamorphosed under very low to low grade conditions (lower part of greeschist facies), but often highly deformed with well-developed penetrative metamorphic foliation, younger cleavages, and fold-and-thrust structures (cf. Lačný et al., 2016). Deformation and metamorphic recrystallization of carbonates almost entirely caused overprint of primary sedimentary structures. The fossil record is often completely lost except of conodonts, which were less sensitive for a higher degree of thermal alteration and recrystallization process during the Alpine metamorphism. Despite these problems, it was possible to reconstruct lithostratigraphic succession in the investigated area. Only the Upper Permian to Triassic metasediments have been distinguished.

3.1 Bódvaszilas Formation

The Bódvaszilas Formation (Hips 1996, 2001) consists of metamorphosed purplish-red, greenish-grey to dark-grey sandstones, siltstones, and shales. Conglomerates are very rare. In general, the sequence of these sedimentary rock is finning upwards. The possible age of formation is Late Permian to early Early Triassic on the basis of comparison with other occurrences of similar rock sequences in the inner zones of the Western Carpathians and very rare findings of *Claraya* species and *Eumorfotis* sp. The thickness of the formation is several hundred of metres and is overlain by the Szin Formation.

3.2 Szin Formation

The Szin Formation (Hips 1996, 2001; late Early Triassic) is composed of alternating layers of metamorphosed and completely recrystallized limestones and shales. The formation is developed from the underlying Bódvaszilas Formation and is overlain by the Gutenstein Formation. At the boundary of shally horizons and carbonate breccias the rauhwackes are occasionally present, possibly reflecting reactivation of this lithological boundary during thrusting. The rock of the formation have well developed penetrative metamorphic foliation and locally also secondary cleavage parallel to axial planes of mesoscopic folds.

3.3 Gutenstein Formation

The Szin Formation successively passes to metamorphosed dark-grey limestones and dolomites of the Lower Anisian Gutenstein Formation. Dolomites are mostly massive or thick-bedded, while limestones often have well developed foliation. The stratigraphic age has never been proved by any fossils.

3.4 Honce Limestones, breccias and red shales

The Gutenstein Formation is superposed by the Honce Limestones of Middle Anisian age. These limestones are weakly to severely recrystallized, anchimetamorphosed and intensively deformed. These rocks are best exposed at the edge of the road in a small quarry between the Hrušovo and Potok villages. In this area, in overlier of the Honce Limestones it was possible to locate new layers that have not previously been described in the Turňa Unit. They are built of carbonate breccias (“Late Anisian” in age), which gradually pass into the red shales. In the northern limb of the syncline some of these rocks even contain radiolarian fragments. In the overlier the red shales pass into black shales, which are considered to belong to the Dvorníky Member.

During the field geological survey, a condensed horizon of carbonate breccias and red shales was ascertained in the south-eastern branch of the Striežovce Syncline (N48° 31′ 12.5″ E020° 02′ 55.9″; north of the Hrušovo settlement). Their lower stratigraphic position seems to be clear and these rocks are located above the Honce Limestones. The upper boundary is ambiguous because of debris on the slope. However, fragments of fine-grained black shale layers of the Dvorníky Member were found, and this points to their possible continental origin. Thickness of exposed layers is less than 5 metres. In the form of clasts, the layers were also found more northward in the vicinity of the Honce Limestones. Cherty limestones and fragments of radiolarites also occur. The general position and the repetition of lithology is explained by the syncline structure of the territory (see Fig. 2).

On the contact with the lagoonal facies of Honce Limestone, the overlying sedimentary beds begin with carbonate breccias of predominantly fine-grained limestones (Fig. 3A). The limestone interbeds reach up to 4 cm in thickness. They were intensively recrystallized and anchimetamorphosed, despite still containing occasional allochems, but it yielded no possibility of their further identification. However, one sample contained a uniserial foraminifera of Earlandinita? sp., which is facial fossils of Steinalm and Wetterstein limestones (nodosary type), but this does not allowed to reveal any age (Fig. 4A).

The breccias gradually pass into more fine-grained beds (Fig. 3B). In the undetermined part of the examined lithotype, rose to red colour radiolarian limestones to radi-

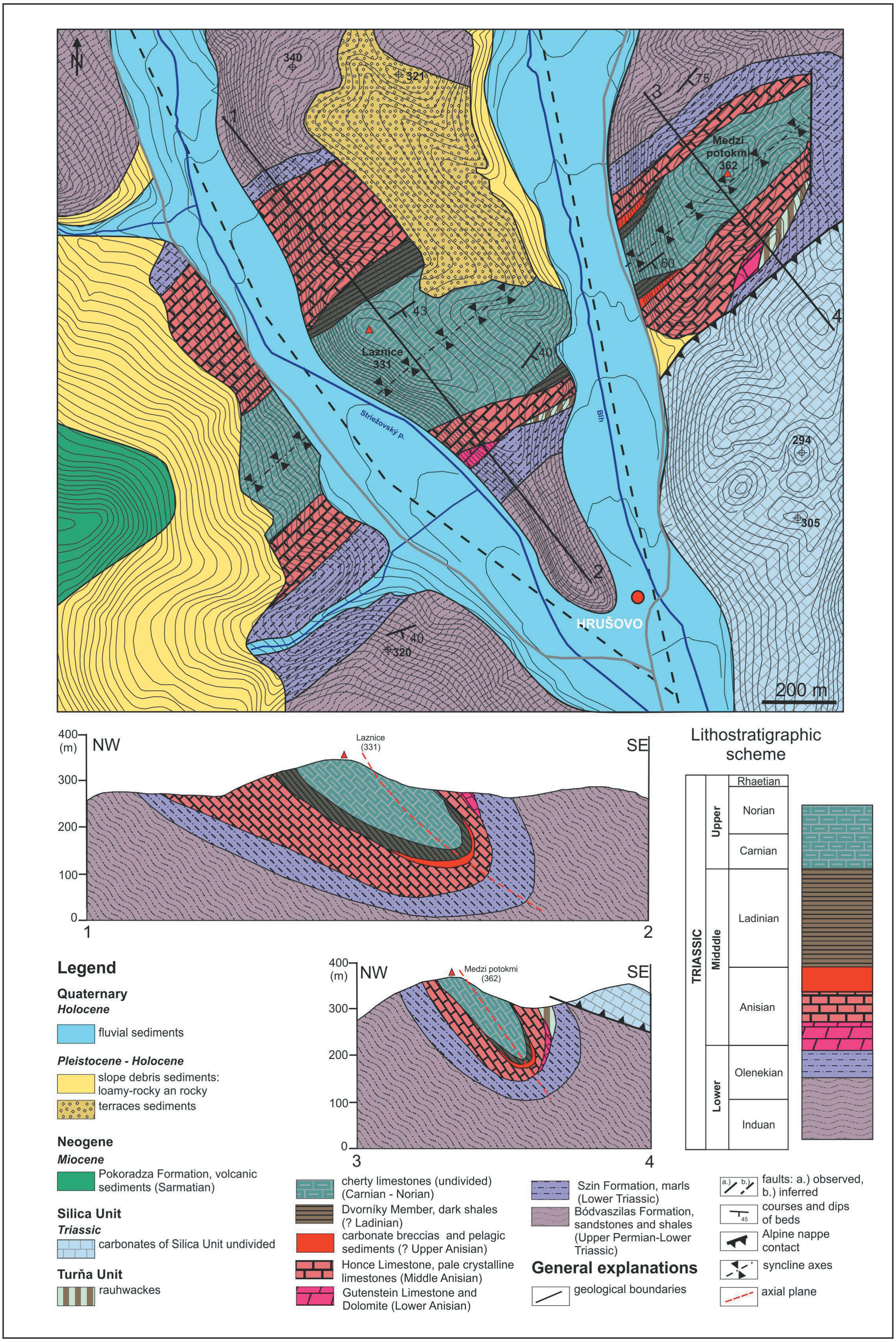


Fig. 2. A new geological map and a lithostratigraphic chart of the Turňa Unit in the Striežovce area.

olarites dominate (Fig. 3C). Clasts of these decimated rocks were found scattered in the area of both arms of the Striežovce Syncline together with the shales of the Dvorníky Member. Moreover some radiolarian tests were determined by microscopy (Fig. 4B). The Si-component increases in the groundmass. Originally, the clasts of breccias were probably bioclasts deposited in the deeper part of the basin (Fig. 4C). In the groundmass of the breccias, the autigenic plagioclases indicate a higher degree of diagenesis to anchimetamorphism (Fig. 4D). Their size gradually decreases towards the overlier. The breccia is bonded by a very fine-grained material, which forms continuous layers. The breccia is built of very fine-grained detritic dolomites (< 25 μm), originally bonded by Fe-Mn oxides/hydroxides and calcite mud (Fig. 5). The Fe-Mn oxides/hydroxides are typical components of deep-water sediments. The Fe and Mn is derived from chemically-weathered mafic volcanic/plutonic minerals, and these elements typically occur in the form of Fe^{3+} and Mn^{4+}. In dolomites, the Mn^{2+} is replaced by Mg^{2+}, which resulted in the formation of zonal carbonates (dolomite-kutnohorite trend) during the higher diagenesis and metamorphosis. The core is made up of dolomite $CaMg(CO_3)_2$, which is coated with Fe-Mn-Ca-Mg carbonates. The margins of dolomites and carbonates in the original matrix are composed of Mn-rich calcite. In the rocks (very fine-grained calcite and Fe-Mn oxihydroxides) Mn-calcite a green schist facies paragenesis is present: albite,

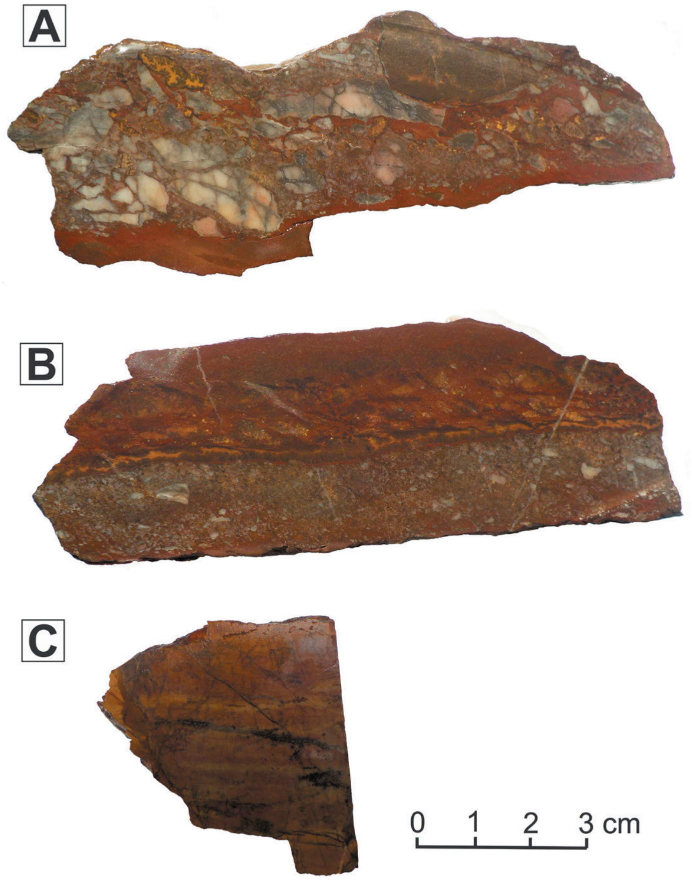


Fig. 3. A) Carbonate breccia in clay carbonate matrix. B) Transition from carbonate breccia to more finer-grained layers. C) Massive red silicites.

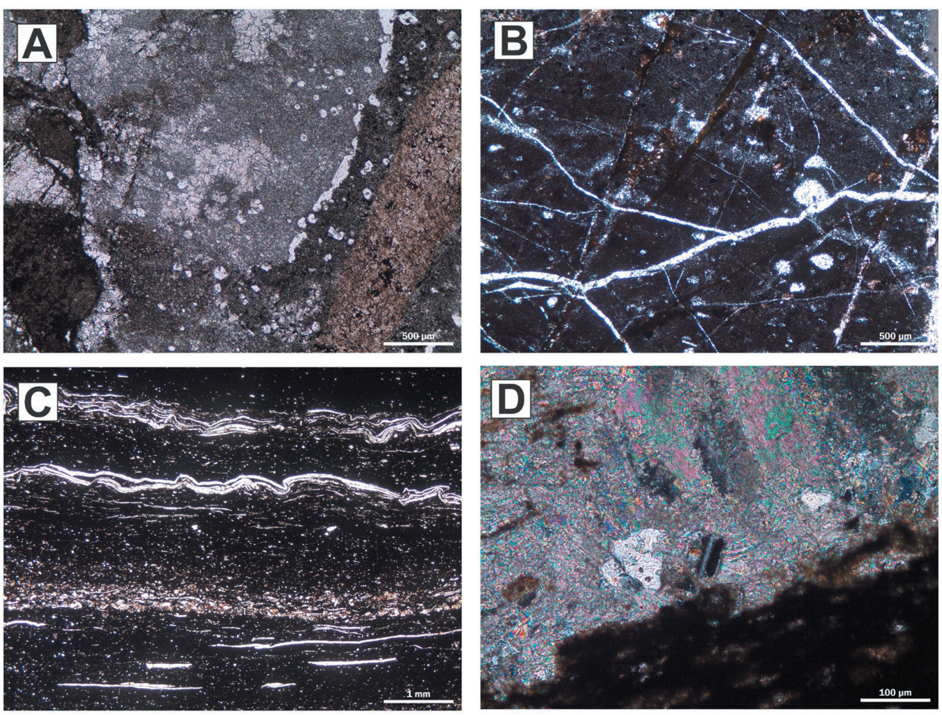


Fig. 4. A - Carbonate clast with uniserial foraminifera of Earlandinita? sp. B - Cherts with relics of radiolarites. C - Mudstone with calciclastic laminas and phylosillicate bends in intervals with normal grain-size gradation. D - Authigenic plagioclase in the middle of carbonate-pelitic sediment sample.

quartz, chlorite, biotite, sericite, Fe and Mn oxides ± apatite and ± monazite.

A substantial part of the studied horizon consists of metamorphosed very fine-grained (below 25 μm) macroscopically red-brown deep-water sediments. The original main components of the deep-water sediments are: (a) limestone mud (bio-muds); b) Fe and Mn oxides/hydroxides; (c) siliciclastic material (predominantly quartz, mica, kaolinite, zeolite, and rarely also zircon). The siliciclastic rocks were probably generated by intense weathering of pyroclastic material from acidic to intermediate volcanic rocks. The siliciclastic component increases upwards. Part of the studied horizon is also formed by a grey- to black-coloured graphite-mica-sericite shale, layers of redeposited kaolinite, and analcime, which was altered to albite. Such association of sediments are typical for sedimentary environments at continental slopes. The grey to black graphite-mica-sericite shale contain monazites, what allowed to use the U-Th-Pb dating method (EMPA; 25 analysis; Méres et al., 2017) to determine numerical ages. The initial results point to three different age groups: (1) monazite age 325 ± 20 Ma; (2) monazites age 246 ± 19 Ma and (3) monazite age 205 ± 16 Ma, which were analysed according to the method of Montel et al. (1996). The first two age groups represent detrital monazites that may have been redeposited from Carboniferous and Permian-Lower Triassic rocks, which were redeposited into as intra- or extraclasts to investigated sediment. The third and youngest age group of monazites corresponds to the diagenesis or a low-level metamorphism of the protolith layer of the Dvorníky Member induced by their burial beneath overlying strata or heating during increasing rifting processes in the Meliata Ocean.

In the undetermined part of the examined lithotype, pinkish to reddish radiolarian limestone to hemipelagic silicite dominate (Fig. 5C). A clasts of these decimated rocks were found scattered in the area of both arms of the Striežovce Syncline together with the shales of the Dvorníky Member. Moreover, some radiolaria tests were determined by microscopy (Fig. 6D). They do not provide any further age determination. However, based on their similar morphology, they can be correlated with the radiolarians from the Ladinian pelagic sediments of the Meliata Unit (Mello et al., 1997). The study samples have a shape similar to a spherical radiolarians with a slightly more pronounced head with indistinct pores. However, no diagnostic features were found. Based on these similar features, we assume a smooth transition of the sediments into the overlying black shales. Unfortunately, the continuation of the profile is covered by debris.

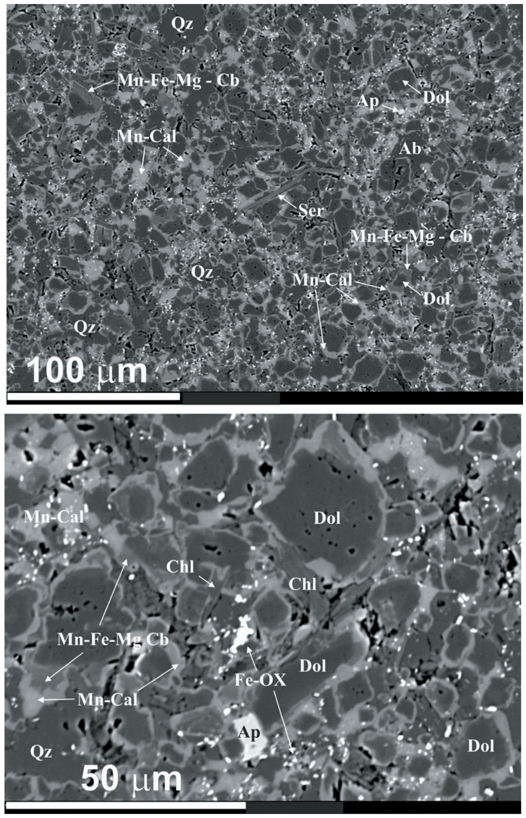


Fig. 5. BSE Image of the fine-grained sediment with the dominance of Fe-Mn-Ca-Mg carbonate and Fe-Mn oxide. Accessory minerals: quartz, albite, carbonate, apatite, and monazite. Abbreviations: Ap – apatite, Chl – chlorite, Qz – quartz, Dol – dolomite, Cb – carbonate, Ser – sericite, OX – oxides.

3.5 Dvorníky Member

The Dvorníky Member consists of shale, phyllite with sandstone, silicite, grainy limestone and occasionally mafic volcanoclastic rocks (though not present in the study area; for further information see Mello, 1979). A set of these dark phyllite shales is located above the Middle Triassic Honce Limestone and beneath overlying Carnian limestones. The thickness of these layers varies from a few meters to about 300 m in the Turňa Unit (Mello et al., 1997). Perhaps, the best documented outcrop is located near Hrušovo settlement directly in the road cut leading to the Blh valley. In the outcrops, it is possible to see black fine-grained sericitic phyllites (Fig. 6). The black colour of the shales is a reflection of the presence of organic matter content. However, no fossils were found and the age is not proved. However, Upper Anisian to Ladinian sporomorphs were found there in the past (Mello et al., 1980; Gaál, 1982).

3.6 Reifling and Pötschen limestones

The Dvorníky Member is almost exclusively superposed by the Carnian to Norian limestone with the thickness of a several tens of metres. The age was determined by conodont fauna Gaál (1982). The limestone can be characterized as dark-grey, grey to pale grey cherty plate-like limestone, which are analogous to Reifling and/or Pötschen limestones. Because of anchimetamorphism,

Fig. 6. Outcrop in black shales in the road cut between the Hrušovo and Potok village.

recrystallization, and sporadic occurrence of conodont's fauna, it was not possible to seriously distinguish these carbonates in the map. The division of these limestones is also complicated due to the lack of siliciclastic sediments or other carbonates like the Leckogel Formation, belonging to the Julian pluvial event.

4. Interpretation and discussion

New geological mapping with the focus onto the problematic parts of the territory was necessary to understand the geological-tectonic setting of the study area. The new concept, which is based on the field investigation and was roughly described in Lačný et al. (2016) is presented on a new geological map.

4.3 Note to the lithostratigraphy

The lithostratigraphy of sedimentary succession between Hrušovo and Striežovce settlements is generally based on comparison with other Meliata related units such as the Silica, Muráň, Stratená nappes, Turňa and Meliata units). The lowermost part of the sequence is characterized by siliciclastic sediments, which are considered to be the Bódvaszilas and Szin formations. Based on the petrology and sedimentary succession we think that there is no doubt about it and our research is in line with the previous data. Unfortunately, the succession is composed of anchimetamorphosed, intensely deformed, fine-grained siliciclastic rocks, what caused overprint of primary sedimentary structures and textures. For this reason, these rocks practically do not contain any fossils.

The carbonate sedimentation started by the dark-grey to black limestones with well-developed penetrative metamorphic foliation. Based on the stratigraphic position we assume that these carbonates can be related to the Gutenstein Fm. Unfortunately, the exact age is unknown and has never been determined because no fossil remnants have preserved in the limestone. The same problem was registered in the overlying Honce Limestones, which are sterile to fossils because of total recrystallization during the metamorphisms. The upper section is composed of reddish breccia and it is assumed that the breccia could be a reflection of the Pelsonian rifting of the Meliata Ocean. Therefore, the breccia is interpreted as a synrift sedimentary breccia. Such breccia may point to a chaotic deposition of poorly sorted clasts into a very fine-grained sediment.

The Ladinian age of the shales (microfossil based) has not yet been confirmed in the Turňa Unit (except sporadic palynological data; see Mello, 1979) nor in its vicinity and the Jurassic age cannot be excluded, however (Mello et al., 1997). In the Turňa Unit within the Hungarian territory, only the Upper Anisian to Ladinian Bódvarakó, Szárhegy, and Szentjánoshegy formations are known (Kovács et al. 1989, 1997; Kovács and Haas 1997a, 1997b). In the Slovak part of the Turňa Unit, the dark-shales could be correlated with the shales of the Slovenská skala nappe, where allodapic layers occur within the crinoidal limestone (Mello et al., 1983). The Dvorníky Member could also include the medium-dark to dark-shales which crop out at the Slovenská skala hill, and near the Tri peniažky and Stráne sites (Gaál & Mello, 1983). These rocks can also be related to the so-called Reingraben event with considerable input of terrestrial siliciclastic material into the basin. It is defined as a sharp lithological turn from high-productive Ladinian and Lower Carnian carbonate sequences to predominantly terrestrial sediments. They are a characteristic feature of the northern shelf of Neotethys during the Middle Carnian (Julian). For this reversal, the term Reingraben event was introduced (Schlager & Schöllnberger, 1974), which is defined by a abrupt sedimentary change during the Triassic period. At present, we cannot confirm or deny whether the above-mentioned shales belong to the same stratigraphic age and formation. However, the latest Anisian to Ladinian is more likely than Julian age.

The siliciclastic sedimentation was replaced by the carbonate, which is represented by two types of low-grade metamorphosed dark cherty limestones related to the Refling Formation and the Pötschen Limestone at the top of the sequence. Maybe some of the layers at the base of carbonate sedimentation belong to the Wetterstein Limestone. However, deformation and recrystallization in some places considerable overprinted primary sedimentary structures and it is impossible to divide them into individual groups. Furthermore, parts of the structure are covered with soil and river terrace sediments. Therefore the area around the Laznice (331 m asl.), did not allow determination of individual boundaries between formations. In the profile 1-2 (Fig. 2) it is indicated that the Dvorníky Member continues into the depth and into the synclinal structure, as well. The second, northwest shoulder was mapped only based on poorly preserved shale clusters scattered across the surface. Additionally the shale layers inside the carbonate complexes were deformed and their surfaces were possibly subject to movement during deformation events. Therefore, we do not exclude their thrust slice character and their removal in some parts of the study area.

4.4 New concept of the synclinal structure

If the reconstruction of litostratigraphy in the area near Striežovce and Hrušovo settlements as is presented above, then the study area can be interpreted as a synclinal structure. Further detailed structural research has brought new findings that potentially verified the overturned synclinal structure; now referred to as the Striežovce syncline (Fig. 2).

The first argument for the synclinal structure may be the boundary of the whole study area (not including the overlying Silica Unit and the Miocene volcano-sedimentary cover), which is formed by the Bódvaszilas and Szin formations of the Turňa Unit. The Szin Formation seems to be surrounding the entire structure and continues in a narrow belt all around the structure. If this would be a detached trust or a thrust slice of the Turňa Unit or Meliata Unit, such preservation of surrounding structures would be very unlikely. Similar ring-like boundary with the Szin Formation around, in the form of arm-like structures can be seen in the Sása syncline or Rybník syncline, which are located in the vicinity of the study area. We assume that these synclines were formed during the same tectonic stage (cf. Lačný et al., 2016).

On the other hand, the situation is more complicated in the area of Držkovce (cf. Mello et al., 1994). The thrust slices of the Turňa and Meliata units are layered on top of each other, and the formations of the Meliata Unit even crop out onto the surface. Such chaotic composition is a good indication for a thrust slice structure.

In the vicinity of Striežovce and Hrušovo villages, the syncline is a reflection of the deformation processes related to compressional tectonic regime (principal maximum stress axis in the NW–SE direction) with movement top to the north-westward. The fold hinge zone of the syncline structure is formed by the youngest rocks – the Upper Triassic cherty limestones (Reifling Lm. and Pötschen Lm.). These are surrounded by the Middle and Lower Triassic/Upper Permian rocks. Three sets of planar structures were identified (Fig. 7). Surface S_0 is characterized by often overprinted primary foliation in the sedimentary rocks. The preferred structure is unknown because the bedding is folded and overprinted by the penetrative metamorphic foliation (S_1). The spatial relationship between the S_0 and S_1 foliations is from subparallel to subvertical, based on the position in folded system. However, the S_0 bedding is often parallel to the S_1 foliation. The S_1 foliation with dip direction south-eastward is related to a very low-grade metamorphism (cf. Lačný et al., 2016) and it is the most visible fabric in the rocks of the Turňa Unit.

The S_0 (bedding) and S_1 (metamorphic foliation) planes are disrupted by a system of subvertical cleavage planes S_2 of the NW–SE direction, which indicates a compressional tectonic regime with the NE–SW trending principal compressional axis (σ_1).

The compression (σ_1 in the NW-SE direction) is accompanied by a system of subvertical cleavage planes S_2 of NW-SE direction. The last measured structures are the planes S_3, which also considered to be a cleavage, which is visible only localy, however. The measured deformation structures correspond to the previous results and are distinctive for the entire territory of the Slovenská skala nappe system (cf. Lačný et al., 2016). The syncline is closed, the fold axial plane is NE–SW striking with the inclination to the south-eastward. The whole Striežovce overturned syncline is further deformed by younger Cainozoic fault systems. In the northeast (near Medzi potokmi hill, 362 m a.s.l.), the syncline is distinctly tighter. The rocks are inclined south-eastward with a dip of up to 60°. This can

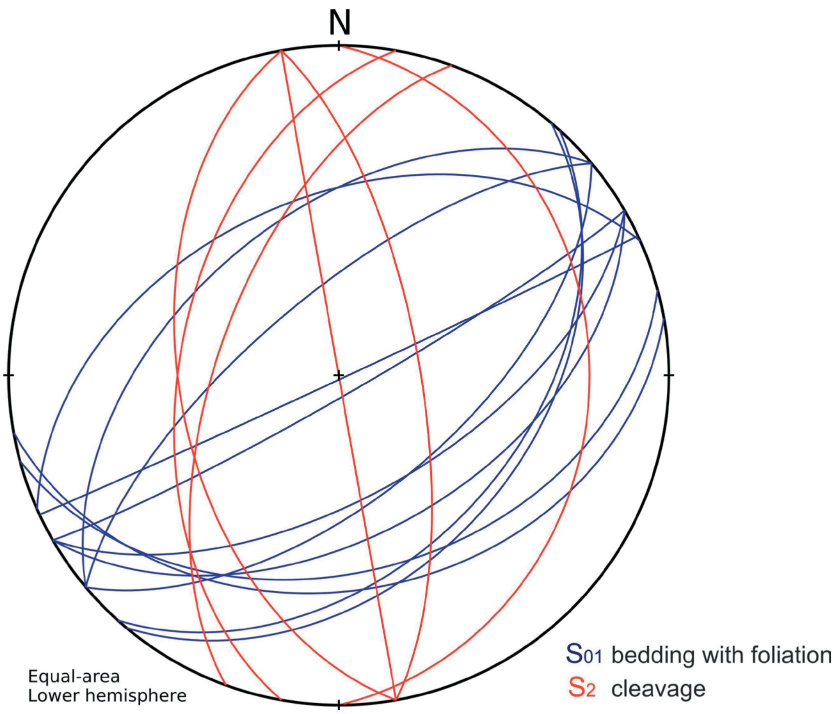


Fig. 7. Tectonogram of the measured structures.

be caused by the over thrusting carbonate complex of the Silica Unit with the thrust direction from the southeast to the northwest. The situation is different between the Striežovce and Blh streams, where the syncline axis falls much flatter, with a dip of about 40° to the southeast. In addition, in the northwest of the structure, the entire syncline structure is arranged in a thrust slices, what is evidenced by repeating rock sequences. These are changes within several dozens of meters, and therefore they were not included into geological map.

5 Conclusion

Based on the aforementioned data, it is possible to interpret the study area as the Striežovce syncline, which is the part of the synclinal-anticlinical structure of the Slovenská skala nappe. This statement is supported by lithostratigraphy and structural measurements. The most important issue of this study is finding of carbonate breccias and deep-water sediments of the Dvorníky Member in studied area. We presume that the breccias are the reflection of the Pelsonian break-off of the Meliata Ocean (synrift sedimentary breccia). The red shales similar to the studied ones were first identified in the locality of the Dvorníky Member in the Dvorníky village. The sedimentary strata in the Striežovce – Hrušovo area indicates a more deep-water nature of sedimentation then it was found in the remaining parts of the Slovenská skala nappe.

Paleogeographically, it can be assumed that the studied area was located somewhere between the Meliata and Turňa sedimentation area. The currently accepted concept of the Meliata Unit s.s., which is of melange or olistostrome nature, does not allow to include the study area into the Meliata Unit and so it must be ranked to the Turňa Unit. Despite the fact that the rocks are in the area in a sequence, their similarity to the Meliata sedimentary sequence is very distinct. However, this brings up a new problem about the age classification and lithology of the Dvorníky Member. Since at this point their age range is in the sense of Mello et al. (1997) very wide (Ladinian - Middle Carnian, ? occasionally Jurassic). We assume that the layers are a Ladinian in age according to lithostratigraphic position in the section. However, the exact age has not been proved yet. These new lithotypes in form of synsedimentary breccias, radiolarian limestones and radiolarites of Anisian to Ladinian age may spark up a discussion about the future understanding of the Dvorníky Member.

Acknowledgement

This work was financially supported by the Slovak Research and Development Agency under the contract Nos. APVV-16-0146, APVV-0315-12, and APVV-0212-12. It is also an outcome of the research projects VEGA 1/0193/13 and VEGA 1/0085/17.

References

Bystrický, J., Fusán, O. & Mahel', M., 1956: Prehľadná geologická mapa Spišsko-gemerského rudohoria v M 1 : 100 000. *Bratislava, Geol. Úst. D. Štúra.*

Bystrický, J., 1954: Geologické pomery v oblasti južne od Jelšavy. *Geol. Sbor. Slov. Akad. Vied, 5, 1 – 4, 122 – 140.*

Bystrický, J., 1964: Stratigraphie und Dasycladaceen des Gebirges Slovenský kras. *Bratislava, Ústr. Úst. geol., 1 – 204 (in Slovak with German summary).*

Elečko, M., Gaál, Ľ., Lexa, J., Mello, J., Pristaš, J., Vass, D. & Vozárová, A., 1985: Geological map of Rimavská kotlina depression and the adjacent part of the Slovak Rudohorie 1 : 50 000. *Bratislava, Geol. Inst. D. Štúr.*

Csontos, L. & Vörös, A., 2004: Mesozoic plate-tectonic reconstruction of the Carpathian region. *Palaeogeogr. Palaeoclimatol. Palaeoecol., 210, 1 – 56.*

Dallmeyer, R. D., Neubauer, F. & Fritz, H., 2008: The Meliata suture in the Carpathians: Regional significance and implications for the evolution of high-pressure wedges within collisional orogens. In: Siegesmund, S., Fügenschuh, B. & Froitzheim, N. (Eds.): Tectonic aspects of the Alpine-Dinaride-Carpathian system. *Geol. Soc. London, Spec. Publ., 298, 101 – 115.*

Fusán, O., Bystrický, J., Čechovič, V., Franko, O., Hanáček, J., Ilavský, J., Kullman, E., Kuthan, M., Lukniš, M. & Regásek, F., 1962: Vysvetlivky k prehľadnej geologickej mape ČSSR 1 : 200 000, M – 34 – XXXIII, list Rimavská Sobota. *Bratislava, Geofond, 5 – 123.*

Gaál, Ľ., 1982: Meliata Group near Striežovce. *Geol. Práce, Spr., 78, 71 – 83 (in Slovak with English summary).*

Gaál, Ľ. & Mello, J., 1983: New data to the stratigraphy of Triassic limestones in the western part of the Silica nappe and their consequence for tectonic subdivision. *Miner. Slov., 15, 4, 303 – 330 (in Slovak with English summary).*

Gaál, Ľ., 2008: Geodynamics and development of caves in the Slovak Karst. *Speleologia Slov., 1 – 166 (in Slovak with English summary).*

Gawlick, H.-J., Missoni, S., Schlagintweit, F. & Suzuki, H., 2012: Jurassic active continental margin deep-water basin and carbonate platform formation in the north-western Tethyan realm (Austria, Germany). Field Trip Guide, 29th IAS Meeting of Sedimentology, Schladming, Austria. *J. Alpine Geol., 54, 189 – 291.*

Hips, K., 1996: Stratigraphic and facies evaluation of the Lower Triassic formations in the Aggtelek-Rudabánya Mountains, NE Hungary. *Acta geol. hung., 39, 4, 369 – 411.*

Hips, K., 2001: The structural setting of Lower Triassic formations in the Aggtelek-Rudabánya Mountains (northeastern Hungary) as revealed by geological mapping. *Geol. Carpath., 52, 287 – 299.*

Hók, J., Kováč, P. & Rakús, M., 1995: Structural investigations of the Inner Carpathians – results and interpretation. *Miner. Slov., 27, 231 – 235 (in Slovak with English summary).*

Kovács, S. & Haas, J., 1997a: Szárhegy Radiolarite Formation. In: Császár, G. (Ed.): Basic litostratigraphic units of Hungary (Charts and short descriptions). *Budapest, PR press, 58 p.*

Kovács, S. & Haas, J., 1997b: Szentjánoshegy Limestone Formation. In: Császár, G. (Ed.): Basic litostratigraphic units of

Hungary (Charts and short descriptions). *Budapest, PR press, 59 p.*

Kovács, S., Less, G., Piros, O., Réti, Z. & Róth, L., 1989: Triassic Formations of the Aggtelek-Rudabánya Mountains (Northeastern Hungary). *Acta geol. hung., 33/1 – 2, 31 – 63.*

Kovács, S., Less, Gy. & Haas, J., 1997: Bódvarákó Formation. In: Császár, G. (Ed.): Basic litostratigraphic units of Hungary (Charts and short descriptions*). Budapest, PR press, 60 p.*

Kozur, H. & Mock, R., 1973a: Zum Alter und zur tektonischen Stellung der Meliata-Serie des Slowakischen Karstes. *Geol. Carpath., 24, 2, 365 – 374.*

Kozur, H. & Mock, R., 1973b: Die bedeutung der Trias-Conodonten für die Stratigraphie und Tektonik der Trias in den Westkarpaten. *Geol. paläont. Mitt., 3, 2, 1 – 14.*

Lačný, A., Plašienka, D. & Vojtko, R., 2016: Structural evolution of the Turňa Unit constrained by fold and cleavage analyses and its consequences for the regional tectonic models of the Western Carpathians. *Geol. Carpath., 67, 2, 177 – 193.*

Less, Gy., Mello, J., Elečko, M., Kovács, S., Pelikán, P., Pentelényi, L., Peregi, Z., Pristaš, J., Radócz, G., Szentpétery, I., Vass, D., Vozár, J. & Vozárová, A., 2004: Geological map of the Gemer-Bükk area 1 : 100 000. *Budapest, Geol. Inst. Hungary.*

Lexa, O., Schulmann, K. & Ježek, J., 2003: Cretaceous collision and indentation in the West Carpathians: View based on structural analysis and numerical modeling. *Tectonics, 22, 6, 1 066.*

Mandl, G. W., 2000: The Alpine sector of the Tethyan shelf – Examples of Triassic to Jurassic sedimentation and deformation from the Northern Calcareous Alps. *Mitt. Österr. geol. Gesell., 92 (1999), 61 – 77.*

Mazúr, E. & Lukniš, M., 1986: Geomorphological division of SSR and ČSSR. Part of Slovakia. *Bratislava, Slovenská kartografia.*

Mello, J., 1979: Meliatska séria v turnianskom tektonickom okne (Slovenský kras, Západ. Karpaty). *Geol. Práce, Spr,, 72, 61 – 76.*

Mello, J., Mock, R., Planderová, E. & Gaál, Ľ., 1983: New stratigraphic findings about the Meliata Group. *Geol. Práce, Spr., 79, 55 – 81 (in Slovak with English summary).*

Mello, J., Vozárová, A., Vozár, J., Gargulák, M., Hanzel, V., Káčer, Š., Karoli, S., Molák, B., Šucha, V. & Širáňová, V., 1994: Interpretation of the structural borehole DRŽ-1 (Držkovce). *Manuscript. Bratislava, archive St. Geol. Inst. D. Štúr, 104 p. (in Slovak).*

Mello, J., Elečko, M., Pristaš, J., Reichwalder, P., Snopko, L., Vass, D., Vozárová, A., Gaál, Ľ., Hanzel, V., Hók, J., Kováč, P., Slavkay , M. & Steiner, A., 1997: Vysvetlivky ku geologickej mape Slovenského krasu 1 : 50 000 (Explanations to the geological map of the Slovenský kras Mts 1 : 50,000). Bratislava, GS SR, *Vyd. D. Štúra, 225 p. (in Slovak with English summary).*

Mello, J., Ivanička, J., Grecula, P., Janočko, J., Jacko st., S., Elečko, M., Pristaš, J.,Vass, D., Polák, M., Vozár, J., Vozárová, A., Hraško, Ľ., Kováčik, M., Bezák, V., Biely, A., Németh, Z., Kobulský, J., Gazdačko, Ľ., Madarás, J. & Olšavský, M., 2008: General Geological Map of Slovak Republic (1 : 200 000), map sheet: 37 – Košice. *Bratislava, Geol. Inst. D. Štúr.*

Méres, Š., Lačný, A., Plašienka, D. & Vojtko, R., 2017: Occurrence of three monazite age groups in the metamorphosed deep-marine sediments of the Dvorníky Formation (Turňa Unit, Western Carpathians) – preliminary results. *Acta mineral. petrogr., Field guide ser., 32, 27 – 28.*

Montel, J. M., Foret, S., Veschambre, M., Nicollet, C. & Provost, A., 1996: Electron microprobe dating of monazite. *Chem. Geol., 131, 37 – 53.*

Rakús, M., 1996: Jurassic of the innermost Western Carpathians zones – its importance and influence on the geodynamic evolution of the area. *Slovak Geol. Mag., 3 – 4/96, 311 – 317.*

Schlager, W. & Schöllnberger, W., 1974: Das Prinzip stratigraphischer, Wenden in der Schichtfolge der Nördlichen Kalkalpen. *Mitt. geol. gesell., 66/67, 165 – 193.*

Schmid, S. M., Bernoulli, D., Fügenschuh, B., Matenco, L., Schefer, S., Schuster, R., Tischler, M. & Ustaszewski, K., 2008: The Alpine-Carpathian-Dinaridic orogenic system: Correlation and evolution of tectonic units. *Swiss J. Geosci., 101, 1, 139 – 183.*

Vozárová, A. & Vozár, J., 1992: Tornaicum and Meliaticum in borehole Brusník BRU-1, Southern Slovakia. *Acta geol. hung., 35, 2, 97 – 116.*

Nová štruktúrna a litologická koncepcia turnianskej jednotky v oblasti Striežoviec (obec Hrušovo, Revúcka vrchovina)

Komplikovaná geologická stavba v južných zónach turnaika v kombinácii so zlou odkrytosťou terénu predstavuje problém pri interpretácii častí tohto územia. Cieľom nášho výskumu bolo rozšíriť poznanie týchto častí o systematickú štruktúrnu analýzu a riešiť problémy litologickej náplne a štruktúrneho vývoja tejto oblasti. Jednou z nich je aj oblasť v blízkosti Striežoviec (časť obce Hrušovo) nachádzajúcich sa 15 km severne od Rimavskej Soboty. Problematické zaraďovanie tejto jednotky do meliatika či turnaika viedlo k rekognoskácii tohto územia. Kvôli pochopeniu a zaradeniu skúmaného územia bola reambulovaná geologická mapa na problematických úsekoch s výskytmi karbonátových hornín pri Striežovciach. Nová koncepcia geologickej mapy vychádza zo synklinálnej stavby, ktorá bola v hrubých črtách predstavená v práci Lačného et al. (2016). Ďalší detailný výskum priniesol nové poznatky, ktoré verifikovali synklinálnu stavbu skúmanej oblasti označenej ako striežovská synklinála. Za dôležitý argument v prospech synklinálnej stavby možno považovať ohraničenie celej štruktúry (okrem prekryvu nadložnej jednotky silicika a mladších kenozoických sedimentov a vulkanitov) szinským a bódvaszilašským súvrstvím turnaika. Szinské súvrstvie tu tvorí akoby prstenec ohraničujúci celú štruktúru, ďalej pokračujúci v úzkom pruhu na SV. V prípade trosky alebo šupiny, či už turnaika alebo meliatika, takéto zachovanie okolitých štruktúr nepredpokladáme. Veľmi podobné prstencové ohraničenie szinskými vrstvami v podobe ramien má napríklad aj sásanská či rybnícka synklinála neďaleko od skúmaného územia. V okolí Striežoviec je synklinála odrazom deformačných procesov súvisiach so sunutím turnianskeho príkrovu s. l. smerom na SZ. Nález sedimentárnych karbonátových brekcií a hlbokovodných sedimentov na báze hončianskych vápencov naznačuje hlbokovodnejší litostratigrafický charakter oproti ostatným častiam príkrovu Slovenskej skaly. Predpokladáme, že brekcie sú odrazom extenznej tektoniky počas pelsónskeho riftingu meliatskeho oceánu (synriftové sedimentárne brekcie). Červené bridlice podobné tým zo skúmanej lokality boli po prvýkrát identifikované aj na typovej lokalite dvorníckych vrstiev v Dvorníkoch. Z hľadiska paleogeografie sa dá teda usudzovať, že študované územie v minulosti ležalo niekde na rozhraní sedimentačnej oblasti budúceho meliatika a turnaika. V súčasnosti akceptovaná predstava meliatskej jednotky s. s., ktorá má melanžový či olistostrómový charakter, nám nedovoľuje zaradiť študované územie do meliatika, ale do turnaika. Napriek tomu, že horniny v oblasti sú vo vrstvovom slede, ich podobnosť s horninami meliatika je analogická. Vynára sa takisto problém s vekovým zaradením a litologickou náplňou dvorníckych vrstiev. Vekové rozpätie v zmysle Mella et al. (1997) je veľmi široké (?ladin – stredný karn, ?miestami jura). Ak uvažujeme tak, že vrstvy by mali byť odrazom „lunzského eventu“, potom horniny ladinu ani jury by nemali byť súčasťou týchto vrstiev. Takisto nové litotypy v podobe sysnsedimentárnych brekcií, rádioláriových vápencov či silicitov, ktoré na základe pozície vo vrstvovom slede zaraďujeme do obdobia vrchného anisu, môžu rozprúdiť odbornú diskusiu, ako do budúcnosti chápať dvornícke vrstvy.

Doručené / Received: 21. 6. 2018
Prijaté na publikovanie / Accepted: 3. 12. 2018