Reinterpretation of the lithostratigraphy and tectonic position of the Mariková Klippen (Middle Váh Valley, western Slovakia)

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Reinterpretácia litostratigrafie a tektonickej pozície marikovských bradiel (stredné Považie, Slovensko)

Abstract: Tectonic position and lithostratigraphic content of the Mariková Klippen group, occurring around the Michalová Hill near Dolná Mariková village in western Slovakia, were revised. New mapping and sampling showed that the Mariková Klippen consist of the Kysuca Unit and the newly defined Mariková Unit. Both are interpreted as being originally Oravic units of the Pieniny Klippen Belt (PKB). They form a tectonic outlier inserted into an imbricated zone within the Magura Belt of the Outer Western Carpathians, about 2 km north of the PKB s.s. The Mariková Unit consists of Triassic dolomites and quartzites, Middle Jurassic crinoidal limestone (Smolegowa Limestone Fm.), grey, massive microoncoidal limestone (Mariková Limestone Fm. – new name) and dark spotted mid-Cretaceous marlstones (Kapuśnica Fm.). The Mariková Succession shows close relations to the widespread Czorsztyn Unit of the PKB. Its position within the Magura Belt is explained by nappe thrusting of Oravic units over the Magura Unit and then their incorporation into an imbricated transpression zone.

Key words: Western Carpathians, Pieniny Klippen Belt, Mariková Klippen, lithostratigraphy, tectonics

1. INTRODUCTION

The Pieniny Klippen Belt (PKB) is a structurally complex zone situated at the boundary between the Inner and Outer Western Carpathians. The group of Mesozoic klippen around the Michalová Hill near Dolná Mariková village (about 1.5 km WNW from the church; NW from the town of Považská Bystrica), known as the Mariková Klippen, is interesting for several reasons. First of all, they are situated externally, about 2 km far from the northern boundary of the PKB, where they are surrounded by the Palaeogene flysch complexes of the Outer Carpathian Magura Unit (Fig. 1). The narrow zone between the Mariková Klippen and the PKB itself is build by an imbricated system of slices composed of the Bystrica Member of the Magura Unit alternating with Palaeocene calcareous shales and sandstones of uncertain position (Potfaj in Mello ed., 2005 ranged them to the Proč Fm. belonging to the Brvnište slice of the Biele Karpaty group of nappes). Position of the Mariková Klippen was explained either as an erosional window (Andrusov, 1931; Matějka & Roth, 1956), or as a tectonic window of the Magura basement bounded by backthrusts (Salaj, 1991), or as fragments of the PKB Czorsztyn Unit incorporated into the Outer Carpathian Flysch Belt (Andrusov, 1957).

Another interesting point is a presence of Triassic dolomites in the Mariková Klippen which are otherwise extremely rare in the PKB. The third unusual feature is the platform character of the Middle – Upper Jurassic limestones at the Michalová Hill.

This paper brings a detailed description of the lithostratigraphic content of the newly distinguished Mariková Unit, as well as arguments for the nappe tectonic position of the Mariková Klippen.

2. METHODS OF RESEARCH

The research methods applied involved revision of the geological maps of the studied area, structural investigations and detailed sectioning of the Mariková Klippen (GPS coordinates of the section: N 49°12'34.5'', E 18°20'03.5'') and sampling of all the important lithostratigraphic units for petrographic and biostratigraphic evidence.

3. MESOZOIC UNITS FORMING THE STUDIED AREA

Two separate successions were distinguished in the area of the Mariková Klippen. The majority of this about 4 km long and 1 km wide area is formed by sedimentary strata that may be classified as the Kysuca Unit (Fig. 1). This consists of small lensoid bodies

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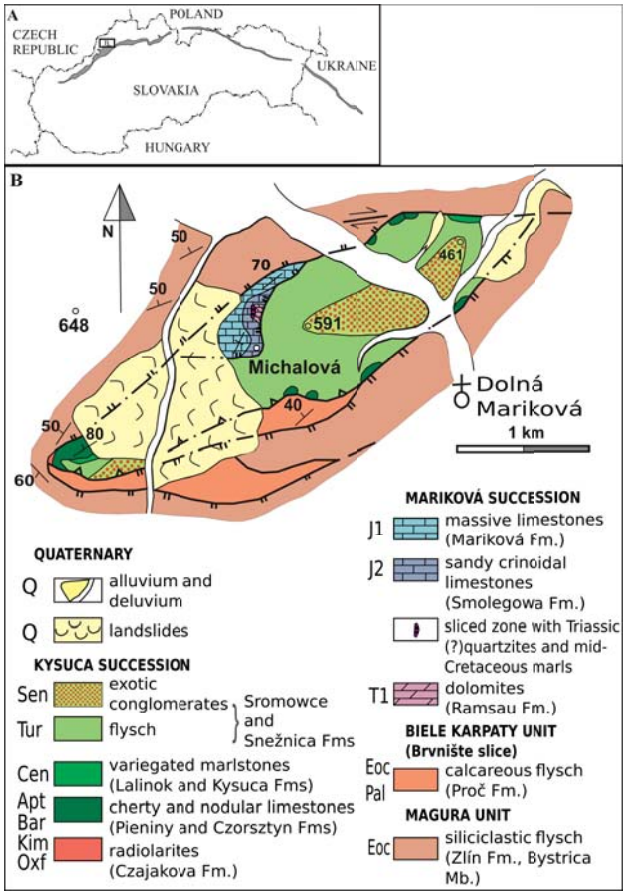

Fig. 1. Geological structure of the studied area. A – position of the examined area with respect to the Pieniny Klippen Belt. B – geological map of the examined area (enlarged rectangle indicated in the map A).
Obr. 1. Geologická stavba predmetnej oblasti. A – pozícia študovanej oblasti vzhľadom na priebeh bradlového pásma. B – geologická mapa predmetnej oblasti (zväčšený obdĺžnik z mapy A).

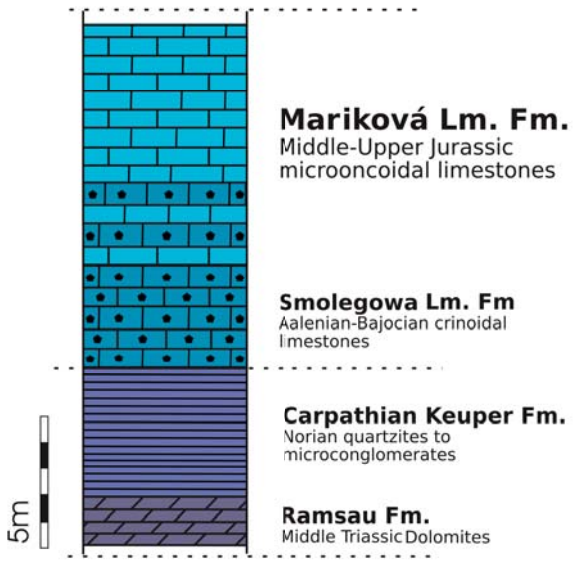

Fig. 2. Lithostratigraphic profile of the Mariková Succession.
Obr. 2. Litostratigrafický profil marikovskej sukcesie.

(klippen) of Jurassic – Lower Cretaceous formations typical for the Kysuca Succession and a thick sequence of Upper Cretaceous pelagic marlstones and distal to proximal flysch sequence of the same unit. The Kysuca Succession includes: Jurassic radiolarites (Czajakowa Fm.), Tithonian – Lower Cretaceous cherty Calpionella limestones (Pieniny Fm.), mid-Cretaceous black and variegated pelagic sediments (Tissalo, Lalinok and Kysuca Fms) and Senonian coarsening-upward flysch sequence terminating with some 200–300 m thick body of conglomerates including "exotic" pebbles. Previously, the age of this conglomerate-bearing flysch formation was regarded as mid-Cretaceous (Albian – Cenomanian), thus belonging to the Klape or Drietoma Unit (Salaj, 1990; Mello ed., 2005). Our samples from variegated marlstones in the lower part of the flysch sequence contain scarce planktonic foraminifers. Associations are poorly preserved, but contain mainly Globotruncanids ranging from the middle Turonian onward (from *Helvetoglobotruncana helvetica* zone). Consequently, we correlate this Senonian flysch sequence with the Snežnica and/or Sromowce Formations of the Kysuca Unit.

A different succession, which is described here as the Mariková Succession (Fig. 2), builds a group of large cliffy klippen around the Michalová Hill (Fig. 3A). Structurally it forms an independent slice juxtaposed to, and partly overlying the Upper Cretaceous deep marine clastics of the Kysuca Unit in the NW part of the Mariková Klippen area (Fig. 1). Salaj (1991) regarded them as olistolites. The Mariková Succession at the locality called Šimunky contains an isometric body (about 100 m in diameter) of dolomites (GPS coordinates: N 49°12'31.5", E 18°20'07.5"). These are mostly dolosparites with pseudomorphs after gypsum crystals (Fig. 3C), locally also dolopelmicrites (Fig. 3D). They may belong either to the Middle Triassic Ramsau Formation, or to the Upper Triassic Carpathian Keuper Fm. In the vicinity of dolomites, there occurs a strongly tectonized layer of whitish quartzites. Their stratigraphic position is uncertain; they may represent either Upper Triassic Carpathian Keuper or Lower Jurassic Gresten Formation. The rocks are mostly coarse-grained arkosic quartzites with angular grains (Fig. 3E). Along with quartz grains, some calcitized K-feldspars and plagioclases occur, too. They contain a heavy mineral assemblage dominated by garnet (50%), with lesser amount of zircon (12%), rutile (10%), tourmaline (16%) and apatite (5%), together with rare sphene, staurolite and Cr-spinels (all below 2%). The dolomites are in places unconformably overlain by grey spotted marlstones containing microfauna of planktonic foraminifera (Fig. 4A, B) probably of Upper Albian – Lower Cenomanian age (*Rotalipora appenninica – Rotalipora globotruncanoides* zones). The rocks are greenish-grey to dark-grey, fine-grained wackestones. Except of foraminifers they contain thin-shelled bivalves, inoceramids and ostracods. The position of these mid-Cretaceous marlstones with relation to the other klippen in the area is not clear, they might represent the same formation which fills clefts in crinoidal limestones described below (Tissalo Formation).

The overlying, about 100 m thick, complex of light massive or thick-bedded limestones can be subdivided into two formations: 1. light-grey crinoidal and sandy-crinoidal limestones, 2. grey, massive calcareous mudstones dissected with calcite veinlets (the newly defined Mariková Limestone Formation).

4. PETROGRAPHICAL DESCRIPTION AND PALAEONTOLOGICAL CONTENTS OF THE MIDDLE TO UPPER JURASSIC LIMESTONES OF THE MARIKOVÁ SUCCESSION

Light-grey crinoidal limestone is dominantly composed of echinoderm fragments (crinoids, less echinoids) with ubiquitous syntaxial rims (Fig. 3F); gastropods and bivalves were found as well. Foraminifers are very rare. Besides the skeletal fragments, some sandy quartz admixture and rare heavy minerals (rutile, tourmaline) are present. Some lithoclasts of sandy limestones to calcareous sandstones were also found. Ten brachiopod specimens of the following species were found in this unit: *Cymatorhynchia quadriplicata* (Zieten) (Fig. 5A-G) – 3 specimens; *Antiptychina bivallata* (Deslongschamps) (Fig. 5H-J) – 1 specimen; *„Rhynchonella" obsoleta* (Sowerby) (Fig. 5P-T) – 2 specimens; *Parvirhynchia balinensis* Suess (Fig. 5L-O) – 3 specimens; *Septocrurella defluxa* (Oppel) – 1 specimen; ?*Caucasella trigona* (Quenstedt) (Fig. 5K) – 1 specimen (cast). All the species belong to the Bajocian – Bathonian time interval. In the Pieniny Klippen Belt, they are known only from the Bajocian crinoidal limestones (Krobicki & Wierzbowski, 2004). Therefore, the studied crinoidal limestones most probably correspond to the Smolegowa Fm. (Bajocian). In the crinoidal limestone, thin neptunian dykes filled with sandy limestone were observed (Fig. 6A). The original cleft walls were first covered with carbonate sinter. The remaining space was filled with lithic sandstone. The sandstone is poorly sorted, with grains (mostly subangular to semioval) having 0.07–6 mm in diameter. It is formed mainly by quartz grains, lithoclasts of limestones, dedolomitized dolomites, phosphatic rocks and clastic feldspars (calcitized K-feldpsars and plagioclases), rare glauconite grains, chlorite and heavy minerals (zircon, rutile, epidote). Rarely also bioclasts (fragments of echinoderm ossicles, bivalve shells and silicisponge spicules) can be found. The clastic admixture also involves small lithoclasts of phosphates, in which some planktonic foraminifers with sphaerical chambers (probably hedbergelids) were found (Fig. 4C, D). They indicate that the filling may be of Cretaceous age (most likely Aptian to Albian).

Mariková Limestone Formation as a newly defined formation is closely related to the previous one, from which it gradually evolves through an irregular transitional zone. It forms distinctive chain of klippen (with or without crinoidal limestones – Fig. 3A).

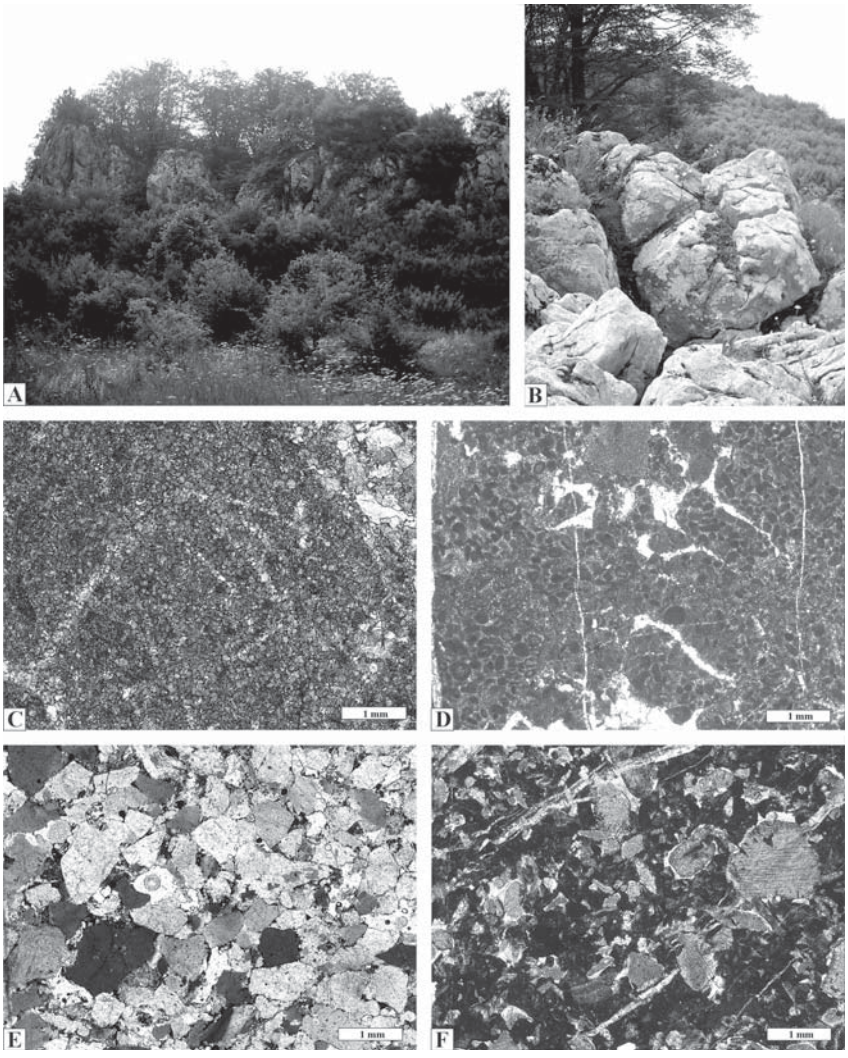

Fig. 3. A – View on the Mariková klippen. B – Top of the Mariková klippen is formed by the grey, massive Mariková Limestone. C – Dolosparite with pseudomorphs after gypsum crystals. Michalová – Šimunky. D – Dolopelmicrite – another microfacies in the dolomites. E – Microphoto of the arkosic quartzite. Michalová – Šimunky. F – Crinoidal packstone to wackestone. Some crinoidal ossicles are partly overgrown by clear syntaxial calcite rims.
Obr. 3. A – Pohľad na marikovské bradlá. B – Vrchná časť bradiel je tvorená sivým masívnym marikovským vápencom. C – Dolosparit s pseudomorfózami po kryštálikoch sadrovca. Michalová – Šimunky. D – Dolopelmikrit – ďalšia mikrofácia v dolomitoch. E – Mikrofoto arkózového kremenca. Michalová – Šimunky. F – Krinoidový packston až wackeston. Niektoré krinoidové články sú čiastočne obrastené čírym syntaxiálnym kalcitovým cementom.

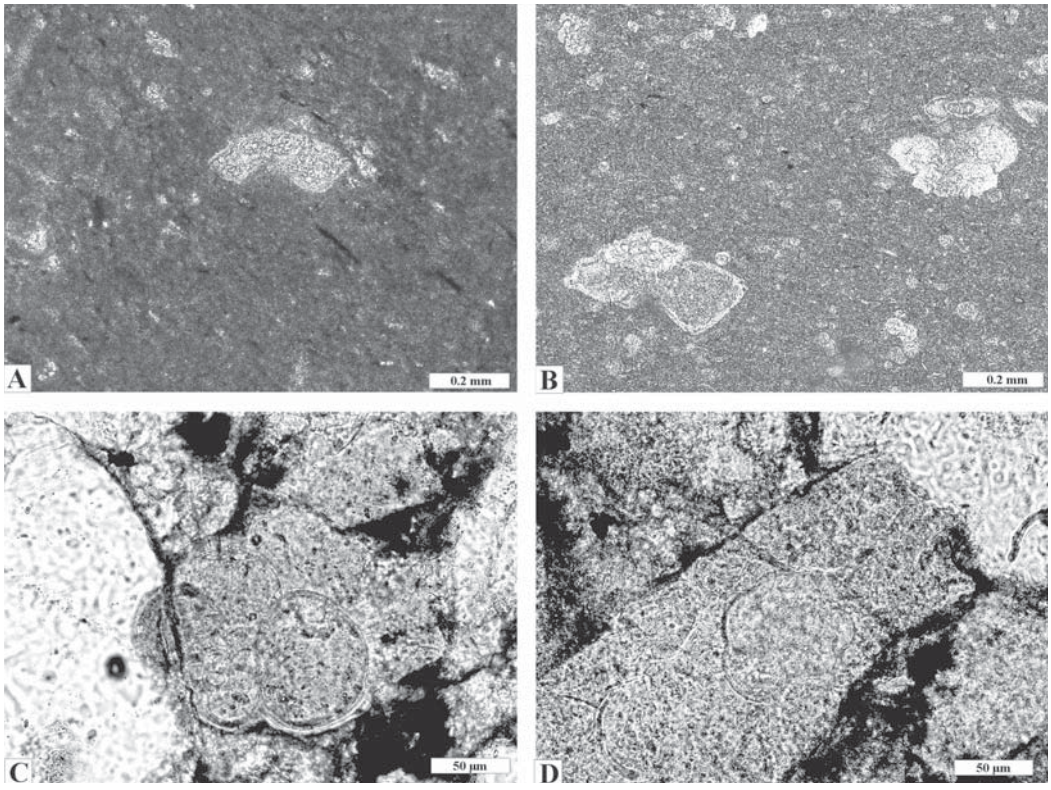

Fig. 4. A, B – Planktonic foraminifers from the spotted marlstones of the Tissalo Formation: A – Strongly abraded muricocarinate globotruncanid foraminifera. B – *Rotalipora* sp. (left) and *?Praeglobotruncana* cf. *gibba* KLAUS (right). C, D – Mid-Cretaceous hedbergellid foraminifers in the phosphatic clasts in the small neptunian dykes cutting the crinoidal limestones.
Obr. 4. A, B – Planktonické foraminifery zo škvrnitých slieňovcov tisalského súvrstvia: A – Silne abradovaná murikokarinátna globotrunkanidná foraminifera. B – *Rotalipora* sp. (vľavo) a *?Praeglobotruncana* cf. *gibba* KLAUS (vpravo). C, D – Strednokriedové hedbergelidné foraminifery vo fosfatických klastoch z výplne drobných neptunických dajok pretínajúcich krinoidové vápence.

The formation forms an 8–10 m thick pile of pale-grey, fractured limestone formed by two main end-member facies with mutual transitions. The first facies are grainstones with microoncoids (Fig. 6B, C), intraclasts, bioclasts and locally with detrital quartz. The bioclasts also form oncoid cores (ostracods, foraminifers, echinoderm plates). Fossils free of any micritic coatings are rare. Intraclasts of bioclastic wackestones and microoncoidal packstones (or even grainstones) are common and important components. At the summit of Michalová Hill, the intraclasts can reach up to 1 cm in diameter. They document bottom erosion due to sea-level oscillations or due to changes in current velocities.

The second facies is represented by bioclastic wackestones to packstones with variable distribution of allochems: frequent echinoderm plates, ostracods, foraminifers *Globuligerina* sp. (Fig. 6D, E), *Ophthalmidium* sp. (Fig. 6F), *Lenticulina* sp. (Fig. 6G), *Patellina* sp. and *Tetrataxis* sp. In addition to these, *Globochaete alpina* LOMB., ophiurian ossicles and calcified sponge spicules can be found as well. Aptychi, juvenile ammonoids (Fig. 6H), bryozoan fragments, bivalve shells and gastropods occur rarely. Besides the bioclasts, peloidal grains also occur frequently. The latter, as a rule, coat tiny skeletal fragments. The mentioned assemblage is typical for the Upper Dogger – Lower Malm limestones, which is also the most probable age of the Mariková Fm. The second facies does not contain microoncoids and likely represents a sediment deposited in an open-marine environment below the wave-base. A characteristic feature of both facies is presence of irregular cavities filled with mosaic of fibrous calcite. Some voids are filled with a different limestone, analogous to the first described facies.

The Mariková Limestone is locally cut by small neptunian dykes similar to those that are penetrating the underlying crinoidal limestones, but they lack phosphatic clasts and have a slightly different composition of the clastic material. However, they can also belong to the same mid-Cretaceous event.

5. TECTONIC STRUCTURE OF THE STUDIED AREA

The Kysuca and Mariková Units, together with the underlying slices of the Proč Fm., are localized within a complicated structure which can be interpreted as an imbricated synform, surrounded by the Bystrica Member of the Zlín Fm. of the Magura Unit. Both the Kysuca Unit and Proč Fm. are either superposed above the Magura complexes, or were juxtaposed by a lateral shift during the Tertiary transpression along the PKB. The syn-

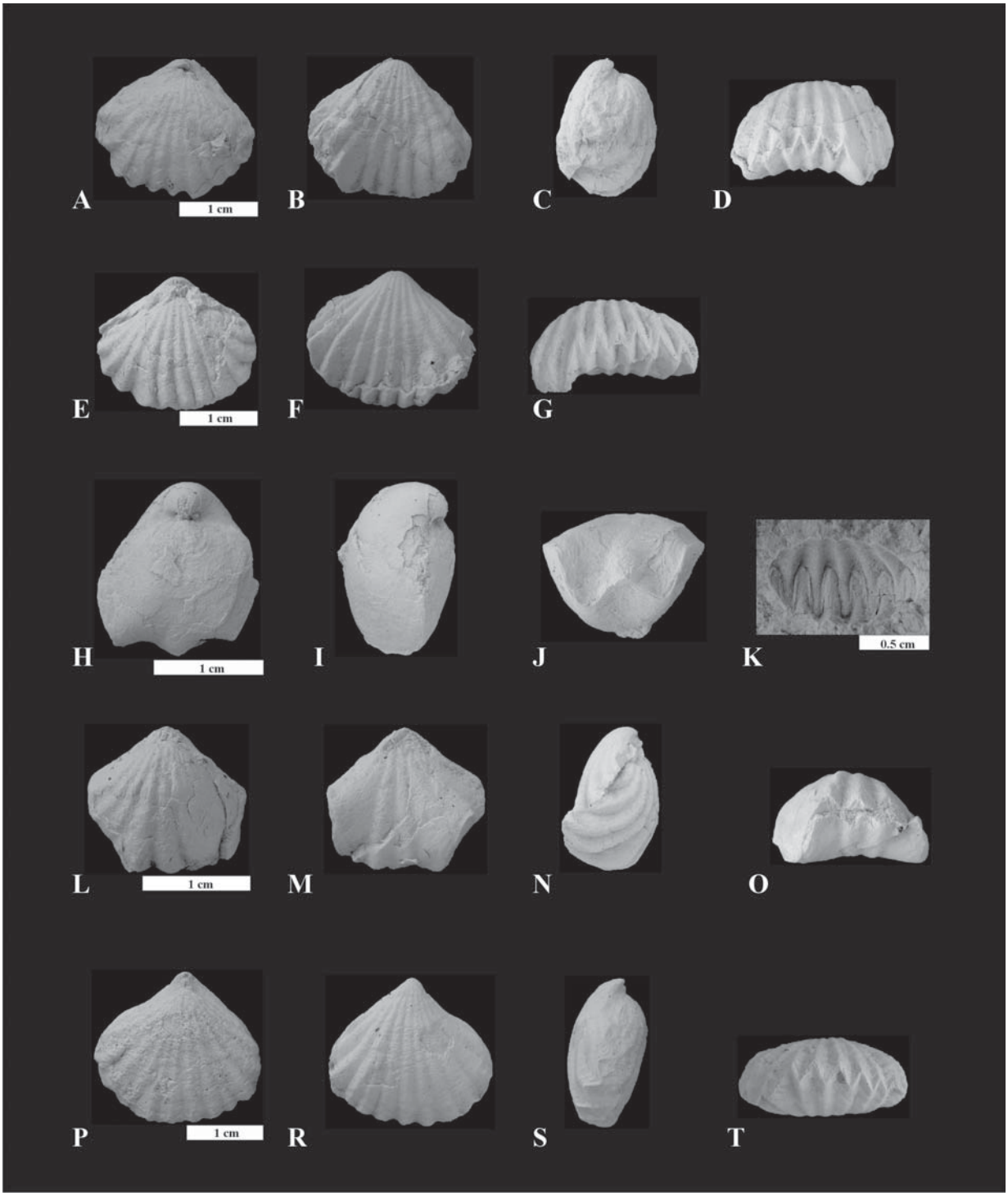

Fig. 5. Brachiopods from the crinoidal limestones: A-D – *Cymatorhynchia quadriplicata* (Zieten): A – dorsal view, B – ventral view, C – lateral view, D – anterior view (the same scales for all views of the individual specimens). E-G – Another specimen of *Cymatorhynchia quadriplicata* (Zieten): E – dorsal view, F – ventral view, G – anterior view. H-J – *Antiptychina bivallata* (Deslongschamps): H – dorsal view, I – lateral view, G – anterior view. K – *Caucasella trigona* (Quenstedt) – anterior view (cast). L-O – *Parvirhynchia balinensis* Suess: L – dorsal view, M – ventral view, N – lateral view, O – anterior view. P-T – *„Rhynchonella" obsoleta* (Sowerby): P – dorsal view, R – ventral view, S – lateral view, T – anterior view.

Obr. 5. Brachiopódy z krinoidových vápencov: A-D – *Cymatorhynchia quadriplicata* (Zieten): A – dorzálny pohľad, B – ventrálny pohľad, C – bočný pohľad, D – predný pohľad (mierky sú rovnaké pre všetky pohľady v rámci daného jedinca). E-G – Ďalší exemplár *Cymatorhynchia quadriplicata* (Zieten): E – dorzálny pohľad, F – ventrálny pohľad, G – predný pohľad. H-J – *Antiptychina bivallata* (Deslongschamps): H – dorzálny pohľad, I – bočný pohľad, G – predný pohľad. K – *Caucasella trigona* (Quenstedt) – predný pohľad (odliatok). L-O – *Parvirhynchia balinensis* Suess: L – dorzálny pohľad, M – ventrálny pohľad, N – bočný pohľad, O – predný pohľad. P-T – *„Rhynchonella" obsoleta* (Sowerby): P – dorzálny pohľad, R – ventrálny pohľad, S – bočný pohľad, T – predný pohľad.

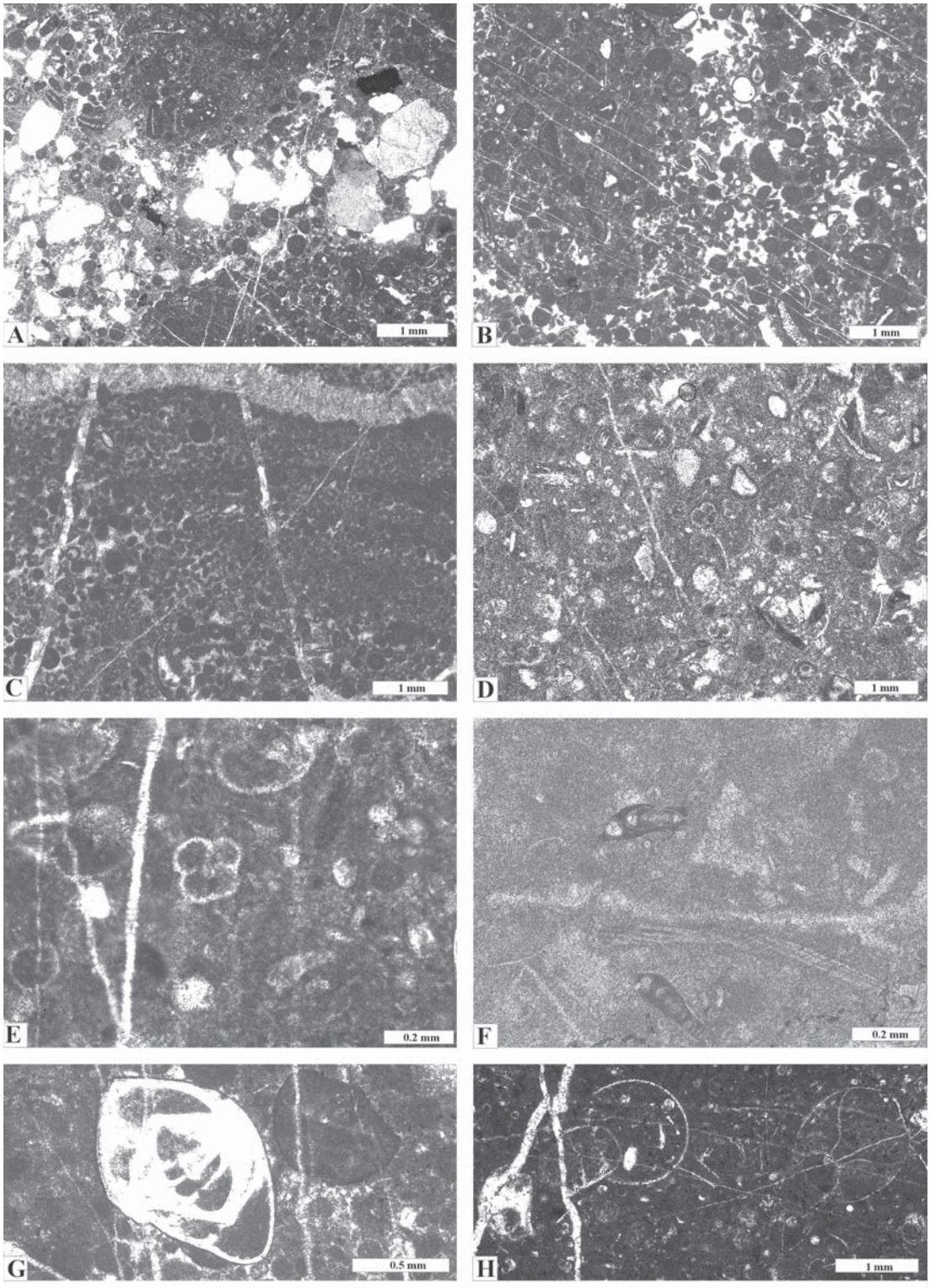

Fig. 6. A – Microphoto of the sandy filling of a small neptunian dyke at the base of the Mariková Limestone. B, C – Microoncoidal packstones – dominant microfacies of the Mariková Limestone. D – Organodetritic wackestone within the Mariková Limestone. Note planktonic foraminifers *Globuligerina* sp. which indicate Middle to Late Jurassic age of the limestone. E – Another specimen of *Globuligerina* sp. F – Two specimens of agglutinated foraminifers *Ophthalmidium* sp. in the Mariková Limestone. G – Benthic foraminifer *Lenticulina* sp. in the Mariková Limestone. H – Juvenile ammonite shells in the Mariková Limestone.

Obr. 6. A – Mikrofoto piesčitej výplne malej neptunickej dajky na báze marikovského vápenca. B, C – Mikroonkoidový packtson – prevládajúca mikrofácia marikovského vápenca. D – Organodetritický wackeston v marikovskom vápenci. Planktonická foraminifera *Globuligerina* sp. indikuje stredno – až vrchnojurský vek vápenca. E – Iný jedinec *Globuligerina* sp. F – Dve aglutinované foraminifery Ophthalmidium sp. v marikovskom vápenci. G – Bentická foraminifera *Lenticulina* sp. v marikovskom vápenci. H – Schránky juvenilných amonitov v marikovskom vápenci.

form is asymmetric, with its axis striking SW-NE. Its southeastern limb is moderately to steeply NW-dipping, while the northwestern limb is truncated by a steeply NW-dipping oblique-slip fault (Fig. 1). Beds of the Bystrica Member north of it are steeply NW-dipping, folded, and mostly overturned. The tapering SW termination of the synform shows a brachysynclinal closure. Northern margin of the synform is truncated by W-E trending, probably dextral strike-slip fault of the Bytča fault zone, as inferred from the map-scale structural pattern (Fig. 1).

The synform margins are rimmed by several small lensoid klippen of Upper Jurassic – Lower Cretaceous strata of the Kysuca Unit. These pass, in places gradually, into mid-Cretaceous marly formations and then into Senonian coarsening-upward flysch sequence with conglomerates forming the core of the synform. The Mariková Succession builds an independent scale in the NW part of the synform. Its strata are steeply NW-dipping, i.e. they structurally overlie the Kysuca Unit. However, this is most probably not a primary nappe position and rather resulted from later backthrusting within a transpressional flower structure

6. DISCUSSION

Lithostratigraphic contents of the Mariková Unit

The newly described Mariková Succession can be considered either as a new development of the Czorsztyn Unit tectonically incorporated to the Flysch Belt, or as an independent, so far unknown unit derived from the base of the of the Outer Carpathians nappes. In spite of some differences in the Middle to Upper Jurassic formations, we consider the first possibility as a more feasible, which is consistent with the opinion of Andrusov (1957). On the other hand, our results are inconsistent with those of Salaj (1991) who assigned the Mariková Limestone to the Middle Triassic Raming Fm.

If we consider the Oravic affiliation of the Mariková Succession (either Czorsztyn, or some "transitional"), occurrence of Triassic strata would be still exceptional. The first information on the occurrence of Triassic carbonates near Dolná Mariková village comes from the geological map 1 : 25,000, sheet Bytča (Andrusov, 1957 – Michalová Hill and its surroundings). There are indicated some grey dolomites of probable Triassic age, but without palaeontological evidence. In the close vicinity, the Czorsztyn nodular limestone and the crinoidal limestones (Bajocian – Bathonian) are drawn, together with "Opalinum" Beds (Aalenian). However, the rocks mapped as the Czorsztyn Limestone are actually light-grey, fine-grained, thick-bedded to massive limestone (Mariková Limestone). The microscopical investigations showed their unique character in the entire Western Carpathians. The only reference to such limestones at other locality came from a klippe in the Bolešov Valley (Aubrecht et al., 1998).

The Mariková Limestone is supposed to be an age equivalent of the Czorsztyn and Bohunice Limestone Formations (Mišík et al., 1994). The microfacies investigation indicates that the sedimentation of the Mariková Fm. took place in a shallower environment than the above mentioned limestones. Such accumulations of oncoids and microoncoids, which are dominant components of the Mariková Limestone, are typical for the shallow-marine, but quiet sedimentary environments (Tucker & Wright, 1990). Therefore we suppose environs of the Czorsztyn Ridge as the most probable original place where the Mariková Succession was deposited during the Middle – Upper Jurassic. (Fig. 7).

Tectonic position of the Mariková Klippen

Based on the new observations, we interpret the Mariková Klippen area as a tectonic slice of the Oravic Kysuca and Mariková Units inserted into an imbricated zone within the Magura Belt of the Outer Carpathians. The most internal Magura element – the Oravská Magura (Krynica) Unit is missing here either primarily, or due to a tectonic reduction. At the same time, the tectonic circumstances of the area allow for a tentative interpretation of the Oravic Mariková Klippen as a nappe outlier. In this view, the Oravic Mariková Klippen would have overridden the Magura Unit in post-Middle Eocene times and were subsequently incorporated into a fold-thrust belt with predominant oblique reverse faults – backthrusts. These occur within a wide dextral transpression zone marked by a positive structural flower developed in the rear part of the Outer Carpathian accretionary wedge, in the near vicinity of the Pieniny Klippen Belt. The Kysuca and Mariková Units were tectonically trans-

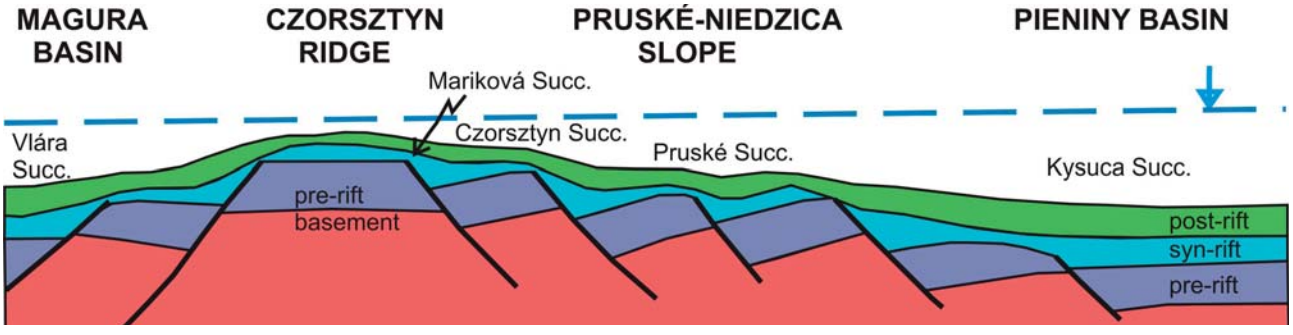

Fig. 7. Probable paleotectonic position of the Mariková Unit.

Obr. 7. Pravdepodobná paleotektonická pozícia marikovskej jednotky.

ported and imbricated together; therefore their relative position in the original deposition area is difficult to reconstruct. However, it can be tentatively assumed that the Kysuca Unit was derived from a basinal area south of the Czorsztyn Ridge, shoals of which were occupied by the present Mariková Succession (Fig. 7). The presence of Triassic rocks in the Mariková Unit may be explained by the footwall-shortcut type of detachment fault, which interconnected neighbouring décollement faults and truncated the edge of a tilted underlying block, which was built by pre-rift Triassic sediments of the Czorsztyn Ridge.

7. CONCLUSIONS

1. The klippen around Michalová Hill near the village of Dolná Mariková most probably represent a tectonic slice of the Oravic Kysuca and Mariková Units inserted into an imbricated zone within the Magura Belt just north of the PKB s.s.
2. The newly distinguished Mariková Succession consists of Middle Triassic dolomites, Upper Triassic (?) quartzites (Carpathian Keuper), Middle Jurassic crinoidal limestone (Smolegowa Limestone Fm.), grey massive microoncoidal limestone (Mariková Limestone Formation – new name) and dark spotted marlstones (probably Tissalo Formation).
3. The Mariková Limestone is supposed to be a stratigraphic equivalent of the Czorsztyn and Bohunice Limestone Formations of the Czorsztyn Succession.

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Resumé: Skupina bradiel v okolí vrchu Michalová neďaleko obce Dolná Mariková (Obr. 1, 3A, B) je veľmi zaujímavá z viacerých hľadísk. V prvom rade je to ich tektonická pozícia – nachádzajú sa okolo 2 km od severného okraja bradlového pásma, vnútri bystrickej jednotky magurskej skupiny príkrovov, t.j. uprostred paleogénnych flyšových komplexov vonkajších Západných Karpát (flyšové pásmo – Obr. 1). Táto pozícia bola vysvetľovaná či už ako tektonické okno podložia flyšového pásma ohraničené spätnými násunmi (Salaj, 1991), alebo ako fragment čorštynskej jednotky bradlového pásma zavrásnený do flyšového pásma (Andrusov, 1957). Článok podáva argumenty v prospech druhej, ale pozmenenej verzie. Ďalšou zvláštnosťou je prítomnosť triasových dolomitov v rámci marikovských bradiel. Ak sa vezme do úvahy možný oravický pôvod tejto jednotky (či už ako čorštynská jednotka, či jedna z tzv. prechodných jednotiek), výskyt triasových hornín je výnimočný. Treťou nezvyčajnou črtou je platformový charakter stredno až vrchnojurských vápencov, ktoré boli v minulosti dokonca považované za triasové raminské vápence (Salaj, 1991). Tieto vápence doposiaľ nemali litostratigrafický názov a preto sú v článku vyčlenené ako nová formácia pod názvom marikovské vápencové súvrstvie.

V spomínanej skupine bradiel vystupujú dve jednotky. Väčšina je tvorená kysuckou jednotkou, ktorú tvoria šošovkovité telesá (bradlá) jursko-kriedových súvrství typických pre kysuckú jednotku a hrubé sekvencie vrchnokriedových pelagických slieňovcov, ako aj distálnych a proximálnych flyšových sedimentov. V rámci kysuckej jednotky vystupujú jurské radiolarity (čajakovské), titónsko-spodnokriedové rohovcové kalpionelové vápence (pieninské), strednokriedové čierne a pestré slieňovce (koňhorské, tisalské a kysucké vrstvy) a nahor-hrubnúca turbiditová sekvencia, zakončená 200-300 m hrubými telesami chaotických konglomerátov s exotickým klastickým materiálom. Tieto exotické zlepence boli v minulosti považované za strednokriedové (alb – cenoman), patriace klapskej alebo drietomskej jednotke (Salaj, 1991; Mello ed., 2005). Nové vzorky z pestrých slieňovcov z podložia turbiditového súvrstvia však obsahujú globotrunkanidné foraminifery, čo ho umožňuje korelovať so snežnickým, či sromovským súvrstvím kysuckej jednotky.

Menšia, avšak dosť výrazná časť marikovských bradiel je tvorená novovyčlenenou marikovskou jednotkou. Táto vystupuje v samostatnej šupine v čiastočnej superpozícii nad kysuckou jednotkou v sz. časti územia (Obr. 1). Salaj (1991) považoval tieto bradlá za olistolity. Marikovská jednotka (Obr. 2) obsahuje izometrické teleso pravdepodobne strednotriasových dolomitov (asi 100 m v priemere; Obr. 3C, D), v nadloží ktorého vystupujú tmavosivé škvrnité slieňovce strednej kriedy (prevdepodobne tisalské súvrstvie; Obr. 4A, B) a pomerne tenká, silne tektonizovaná poloha svetlých kremencov (zrejme súvrstvie karpatského keupru; Obr. 3E). V nadloží vystupuje niekoľko desiatok metrov hrubý komplex svetlých masívnych až hrubolavicových vápencov, ktoré možno rozčleniť do dvoch súvrství (Obr. 2).

Svetlosivé krinoidové vápence sú prevažne tvorené fragmentami echinodermátov (hlavne krinoidov, menej ježoviek) s častými dorastenými syntaxiálnymi lemami (Obr. 3F). Ďalej sa v nich vyskytujú gastropódy, lastúrniky, brachiopódy a zriedkavé foraminifery. Vyskytuje sa aj pomerne malá prímes klastického kremeňa a zriedkavých ťažkých minerálov, ako napr. rutil a turmalín. Našli sa aj litoklasty piesčitých vápencov a vápnitých pieskovcov. Fauna brachiopódov *Cymatorhynchia quadriplicata* (Zieten) (Obr. 5A-G); *Antiptychina bivallata* (Deslongschamps) (Obr. 5H-J); „*Rhynchonella*" *obsoleta* (Sowerby) (Fig. 5P-T); *Parvirhynchia balinensis* Suess (Obr. 5L-O); *Septocrurella defluxa* (Oppel) a ?*Caucasella trigona* (Quenstedt) (Obr. 5K) poukazuje na najpravdepodobnejší vek vápenca – bajok. S najväčšou pravdepodobnosťou ide o smolegovský vápenec, typický pre čorštynskú jednotku bradlového pásma. V krinoidovom vápenci sú drobné neptunické dajky s piesčitou výplňou (Obr. 6A). Úlomky fosfátov a foraminifery prezrádzajú, že dajky môžu byť strednokriedového veku (Obr. 4C, D).

Marikovský vápenec je úzko spätý s predchádzajúcim súvrstvím, z ktorého sa postupne vyvíja cez nepravidelný, ale plynulý prechod. Marikovský vápenec je prevažne biomikrit (menej biosparit) – wackestone (Obr. 6B, C). Veľmi charakteristický pre tento vápenec je častý výskyt mikroonkoidov. Našli sa aj niektoré mikrofosílie, ako echinodermové články, schránky ostrakódov, foraminifery *Globuligerina* sp. (Obr. 6D, E), *Ophthalmidium* sp. (Obr. 6F), *Lenticulina* sp. (Obr. 6G), *Patellina* sp. a *Tetrataxis* sp., stielky planktonických vápnitých rias *Globochaete alpina* Lomb. a kalcifikované ihlice hubiek. Zriedkavo sa vyskytujú aj aptychy, juvenilné schránky amonitov (Obr. 6H), úlomky machoviek, lastúrnikov a gastropódov. Okrem skeletálnych úlomkov možno pozorovať peloidy a spomínané mikroonkoidy. Mikroonkoidy spravidla narastajú na drobných skeletálnych úlomkoch. Spomínaná asociácia mikrofosílií a z nich najmä *Globuligerina* sp. poukazuje na vyššiu strednú až vrchnú juru.

Marikovský vápenec je pravdepodobne vekovým ekvivalentom čorštynského a bohunického vápenca (Mišík et al., 1994). Mikrofaciálna analýza indikuje jeho sedimentáciu v plytšom prostredí než spomínané súvrstvia, pravdepodobne na úzkom podmorskom chrbte.

Kysucká a marikovská jednotka vystupujú v brachysynformnej štruktúre v rámci bystrickej jednotky patriacej do magurskej skupiny príkrovov. V južnej časti synformy kysucká jednotka prekrýva paleogénne vápnité bridlice a pieskovce, ktoré boli priradené k pročskému súvrstviu brvništskej šupiny bielokarpatskej jednotky (Mello ed., 2005). Kysucká spolu s marikovskou jednotkou a aj podložnou brvništskou šupinou tvoria príkrovovú trosku ležiacu na strednoeocénnom distálnom nevápnitom flyši bystrických vrstiev (zlínske súvrstvie). Synforma je asymetrická, s osou JZ-SV smeru. Jej južná vetva je stredne až strmo sklonená smerom na SZ, zatiaľ čo severná vetva je uťatá strmo na sever ukloneným šikmým posunom. Bystrické vrstvy ležiace severnejšie sú prevrátené a skláňajú sa stredne až strmo na SZ, čiže synformu podstieľajú. Severný okraj synformy je uťatý V-Z orientovaným, pravdepodobne dextrálnym smerným posunom na bytčianskom zlomovom systéme (Obr. 1).

Okraje synformy sú lemované šošovkovitými bradlami vrchnej jury až spodnej kriedy kysuckej jednotky, ktoré niekedy prechádzajú do strednokriedových slienitých súvrství a následne do vrchnokriedových flyšových sekvencií, ktoré tvoria jadro synformy. Marikovské bradlá tvoria nezávislú šošovkovitú šupinu v SZ časti synformy. Ich vrstvy sa strmo skláňajú na SZ, čiže štruktúrne ležia nad kysuckou jednotkou.

Na základe vyššie uvedených pozorovaní možno interpretovať oblasť marikovských bradiel ako tektonickú trosku oravika (kysuckej a marikovskej jednotky), ležiaceho na magurskej jednotke. K jej umiestneniu do tejto pozície došlo po eocéne a následne bola inkorporovaná do vrásovo-násunového systému s prevažujúcimi spätnými násunmi v rámci širokej dextrálno-transpresnej zóny vyvinutej v tyle akrečnej prizmy externých Karpát. Kysucká jednotka bola tektonicky transportovaná a imbrikovaná spolu s marikovskou jednotkou, čiže ich pôvodné sedimentačné oblasti ležali asi pomerne neďaleko. Kysucká jednotka pravdepodobne pochádzala z trógu južne od čorštynského chrbta, na ktorom sedimentovala dnešná marikovská jednotka (Obr.7). Prítomnosť triasových sedimentov v marikovskej jednotke možno vysvetliť funkciou zlomu typu "footwall-shortcut", ktorý spájajúc susediace madzivrstvové zlomy odlepenia amputoval vyčnievajúcu hranu nakloneného podložného bloku budovanú predriftovými sedimentmi čorštynského chrbta.