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Upper Cretaceous limestone olistoliths in the Rázová Formation (Horné Belice Group), Považský Inovec Mts. (Western Carpathians)

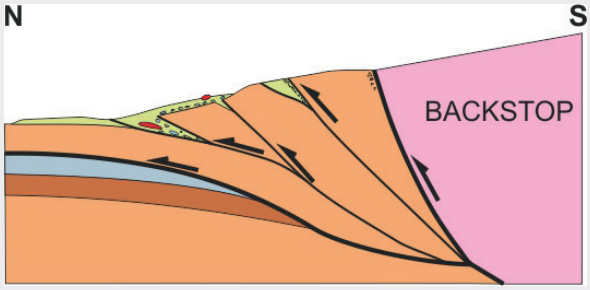
Ondrej Pelech[1], Daniela Boorová[1], Jozef Hók[2] and Miloš Rakús[1†]

[1] State Geological Institute of Dionýz Štúr, Mlynská dolina 1, SK-817 04 Bratislava
[2] Comenius University in Bratislava, Natural Sciences Faculty, Department of Geology and Paleontology, Ilkovičova 6, SK-842 15 Bratislava
[†] Deceased 23 May 2005

Abstract: The Horné Belice Group of the Považský Inovec Mts. represents a tectonic mélange containing numerous native and exotic olistoliths that accumulated on the outer Tatric active margin during the stacking of the Western Carpathian Middle Group of Nappes. Thin-section samples of the pelagic limestones from 3 different olistoliths located on the NE slopes of the Humienec elevation point in the Rázová Formation were studied and analysed. Two limestone samples represent foraminifera biomicrite (foraminifera wackestone). The sample HR1 contained *Globotruncana* cf. *linneiana* (d´ Orbigny), *Globotruncana* cf. *arca* (Cushman), *Globotruncana ventricosa* White, *Globotruncana* sp., *Globotruncanita stuartiformis* (Dalbiez), *Globotruncanita subspinosa* (Pessagno), *Falsomarginotruncana* cf. *desioi* (Gandolfi), *Muricohedbergella* sp. and *Heterohelix* sp. The sample PI4 contained *Globotruncana ventricosa* White, *Globotruncana* sp., *Globotruncanita* cf. *subspinosa* (Pessagno), and most commonly form *Globotruncanita calcarata* (Cushman), *Globotruncanella havanensis* (Voorwijk), *Muricohedbergella* cf. *monmouthensis* (Olsson) and *Heterohelix* sp. Microfauna from both samples points to late Campanian age of the pelagic limestones. New results confirm diachronity of Rázová and Hranty formations (at least during Campanian) and tectonic activity leading to formation of the olistoliths after Campanian.

Key words: biostratigraphy, foraminifera, Late Cretaceous, tectonic mélange, Tatricum, Western Carpathians

Graphical abstract



Highlights

- The Horné Belice Group represents tectonic mélange containing numerous intrabasinal and exotic olistoliths that accumulated due to thrusting on the outer Tatric active margin during the Late Cretaceous
- Samples from grey pelagic limestone olistoliths from the Rázová Formation contain globotruncanid planktonic foraminifera indicating Campanian age
- New results confirm diachronity of Rázová and Hranty formations during Campanian and tectonic activity leading to formation of the olistoliths after Campanian

Introduction

The Tethyan orogenic belts often contain zones of mélanges and/or disrupted formations typical for chaotic structure formed by various sedimentary and tectonic processes (e.g. Festa et al., 2010, 2012). In the Western Carpathians such formations are very common in the Meliaticum and Pieniny Klippen Belt (e.g. Mock et al., 1998; Plašienka, 2018).

The Považský Inovec Mts. (Fig. 1) is unique among the Core mountains Belt of the Western Carpathians due to the presence of the Late Cretaceous sediments which are located in different structural positions, overlying the Tatric tectonic unit, or folded and sheared between the particular Tatric thrust slices (Kullmanová & Gašpariková, 1982; Havrila & Vaškovský, 1983; Plašienka et al., 1994; Havrila in Pristaš et al., 2000; Pelech et al., 2016a, b; Pelech et al., 2017a; Figs. 1–3). The Upper Cretaceous formations represent very unique syn-orogenic sediments which are due to their character and structural position comparable to typical tectonic mélange (Fig. 6). The numerous olistoliths are large enough to be shown in geological map at a scale 1 : 50 000 (Ivanička et al., 2007). The formations of Late Cretaceous age are the most widespread in the northern portion of the mountain range – in the so-called Selec Block (sensu Maheľ, 1986), where they were discovered

by Kullmanová & Gašpariková (1982) and later together with other Jurassic formations formally included into the Belice Succession (Plašienka et al., 1994). Continuation of detailed geological mapping later proved that concept of the Belice Unit is incorrect and was abandoned. The Upper Cretaceous formations of the Belice Succession were redefined as the Horné Belice Group (Rakús in Ivanička et al., 2011). The sediments of the Horné Belice Group (Fig. 3) are divided into the Rázová Formation ("grey flysch" of Coniacian – late Campanian age) and the Hranty Formation ("red flysch" of Campanian – ?Maastrichtian age). Both formations contain blocks/olistoliths of various rocks, including underlying micaschists, Permian basalts and different sediments of Mesozoic age, ranging from the Early Triassic to Late Cretaceous (Ivanička et al., 2011) and forming tectonic mélange (sensu Festa et al., 2019). The composite sedimentary sequence assembled from the more or less exotic material of different blocks/olistoliths in the Upper Cretaceous syn-orogenic "flysch" was defined as the Humienec Succession (Plašienka et al., 1994) and considered as former sedimentary cover of the Selec Block crystalline basement. It should be, however, noted that Selec Block contains apart of crystalline basement also an autochthonous sedimentary cover, the so-called Selec Succession ranging from Late Carboniferous to Early Jurassic (Ivanička et al., 2007, 2011). The relationship between Selec Succession and Humienec Sucession is not straightforward. Both have several common members (Late Paleozoic volcanites, Triassic quartzites and carbonates), and the composite sequence of the Humienec Succession could represent continuation of the Selec Succession (e.g., Jurassic radiolarites, metamorphosed Albian and Upper Cretaceous pelagic limestones; Hók et al., 2006).

Two distinct types of Upper Cretaceous pelagic limestones are known from the olistoliths in the Rázová Formation. The first type is represented by the so-called Svinica Marlstone – pelagic, clayey often pink laminated limestones containing Turonian foraminifera (Plašienka et al., 1994; Putiš et al., 2008) found in the wider area of Humienec elevation point (609.0 m a. s. l.), SW of Mníchova Lehota village. The second type represents fragments up to blocks (max. 0.5 m in diameter) of light grey massive fine-grained limestones occurring on the northern slope of the Humienec elevation point. The aforementioned limestones were due to the lithological appearance formerly considered as calpionellid limestones since similar calpionellid limestones occur as blocks in the Horné Belice Group at the Belice locality (NE of Selec village). Thin section study, however, revealed that limestones yielded upper Campanian foraminifera (Rakús et al., 2006). Research has, however, not been published as Miloš Rakús succumbed to a serious illness. Therefore, localization and detailed biostratigraphic documentation were missing. The main aim of this paper is to provide a more detailed knowledge including localization, lithological description and biostratigraphic evaluation of the Upper Cretaceous limestone olistoliths.

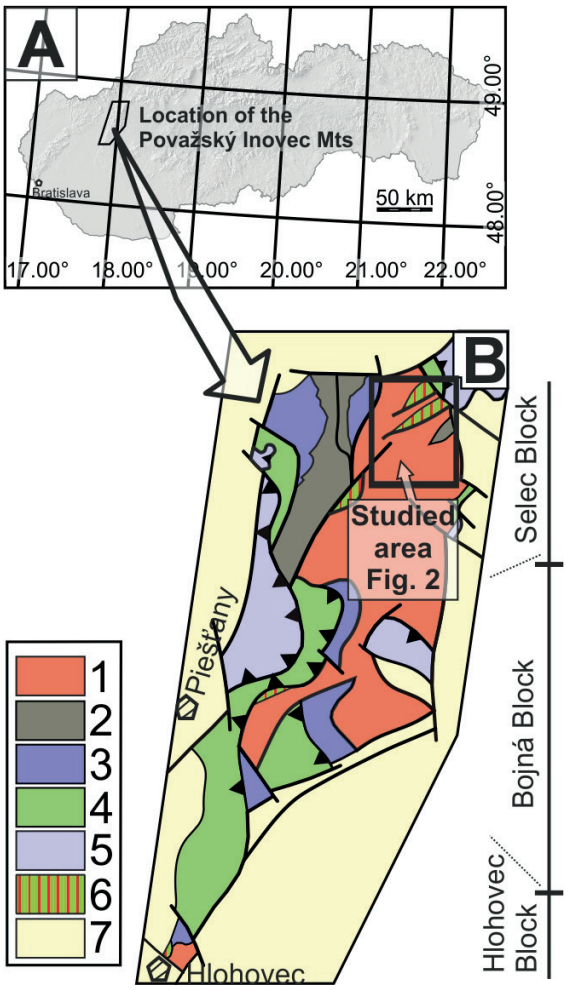


Fig. 1. Location of the investigated area within Slovakia (A) and Považský Inovec Mts. (B). 1 – Tatric Crystalline basement (Carboniferous); 2 – Tatric Kálnica Group (Upper Carboniferous – Permian); 3 – Tatric Mesozoic sedimentary cover successions; 4 – Fatricum; 5 – Hronicum; 6 – Horné Belice Group (Late Cretaceous sediments); 7 – Cenozoic sediments. Tectonic map modified from Bezák et al. (2011).

Methods

The work is based partly on the results of older geological mapping performed for the preparation of the geological map of Považský Inovec 1 : 50 000 (Ivanička et al., 2007, 2011) and later geological mapping (Pelech et al., 2016b). New rock samples from olistoliths were obtained during field research in 2020 from the Rázová Fm. The samples were processed by standard methods. Additional 4 covered thin-sections were studied. Planktonic foraminifera zones were classified according to Caron (1975), Robaszynski et al. (1984) and Sliter (1989). A combined classification

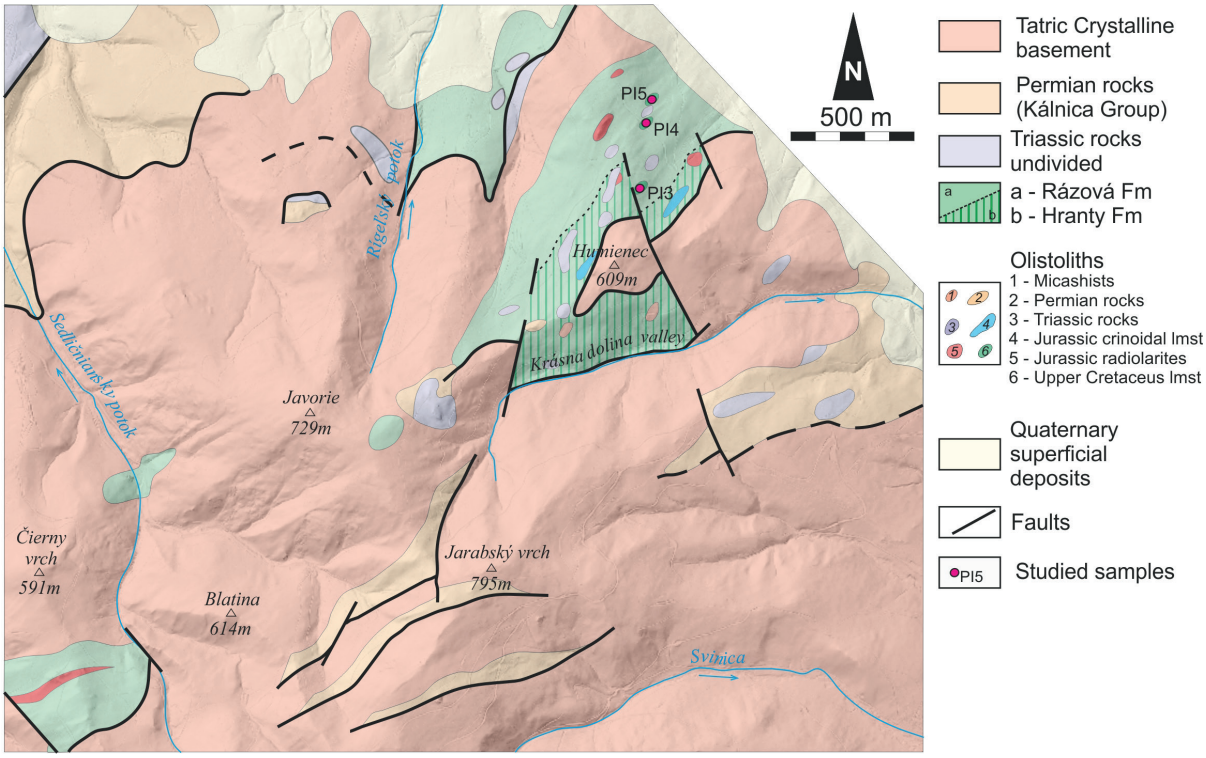


Fig. 2. Geological map of the wider area of the Humienec elevation point (609 m a.s.l.) with the marked studied outcrops and localities (for details see Tab. 1). [Background Relief model DMR 5.0 courtesy of Geodesy, Cartography and Cadastre Authority of the Slovak Republic, geological map based on Ivanička et al. (2007) and Pelech et al. (2016b)].

of Folk (1959, 1962) and Dunham (1962) was used to describe the carbonate microstructures.

Results

The area to the NW of the Humienec elevation point (609.0 m a. s. l.; Fig. 2) is poorly exposed. The limestone olistoliths are situated within the grey quartz-carbonate sandstones and claystones (or shales) of the Rázová Formation (grey "flysch") which does not form natural exposures. The observed olistoliths form blocks up to 0.5 m in diameter and represent varied lithology. At the site PI4 ("under the spring", Fig. 2, Tab. 1) various blocks including Triassic Gutenstein type limestones, grey crinoidal limestones similar to the Trlenská Formation and particularly the studied pale grey clayey limestones (sample PI4) are present. This site was the place where blocks were originally found by M. Rakús (sample HR1, Rakús et al., 2006).

Other localities include isolated blocks of grey-green clayey limestones with slaty cleavage resembling the Svinica Marlstone (in the forest road cut near lumber logs stockpile at site PI3), as well as an isolated block of fine-grained massive pale grey to pinkish limestone (sample PI5; Fig. 2, Tab. 1), which could be also possibly correlated with Svinica Marlstone.

The age of studied olistoliths was determined, based on planktonic foraminifera recognized in the thin-sections.

The sample HR1 (Tab. 1) from the original material of Miloš Rakús collected in 2005 has been revised. Microstructurally, it represents foraminifera biomicrite (foraminifer wackestone) with observed deformation and directional arrangement of allochems. Significantly recrystallized planktonic foraminifera represent *Globotruncana* cf. *linneiana* (D´ Orbigny) (Fig. 5B), *Globotruncana* cf. *arca* (Cushman), *Globotruncana ventricosa* White (Fig. 5C), *Globotruncana* sp. (Fig. 5E), *Globotruncanita stuartiformis* (Dalbiez) (Fig. 5A), *Globotruncanita subspinosa* (Pessagno) (Fig. 5D), *Falsomarginotruncana* cf. *desioi* (Gandolfi) (Fig. 5F), *Muricohedbergella* sp. and *Heterohelix* sp. The foraminifera community indicates the middle to lower part of the late Campanian. Most likely it represents the Globotruncana ventricosa zone. Other microfossils are represented by irregularly "scattered" prisms of *Inoceramus* sp. Indeterminable recrystallized biodetritus and authigenic quartz are present as well.

The sample PI4 gathered during the field investigation in 2020 (for localization see Fig. 2 and Tab.1) represents limestone with deformed and partly recrystallized components. Microstructuraly, it is a foraminifera biomicrite (foraminifera wackestone). Locally, there are more pronounced recrystallized domains of the matrix formed by

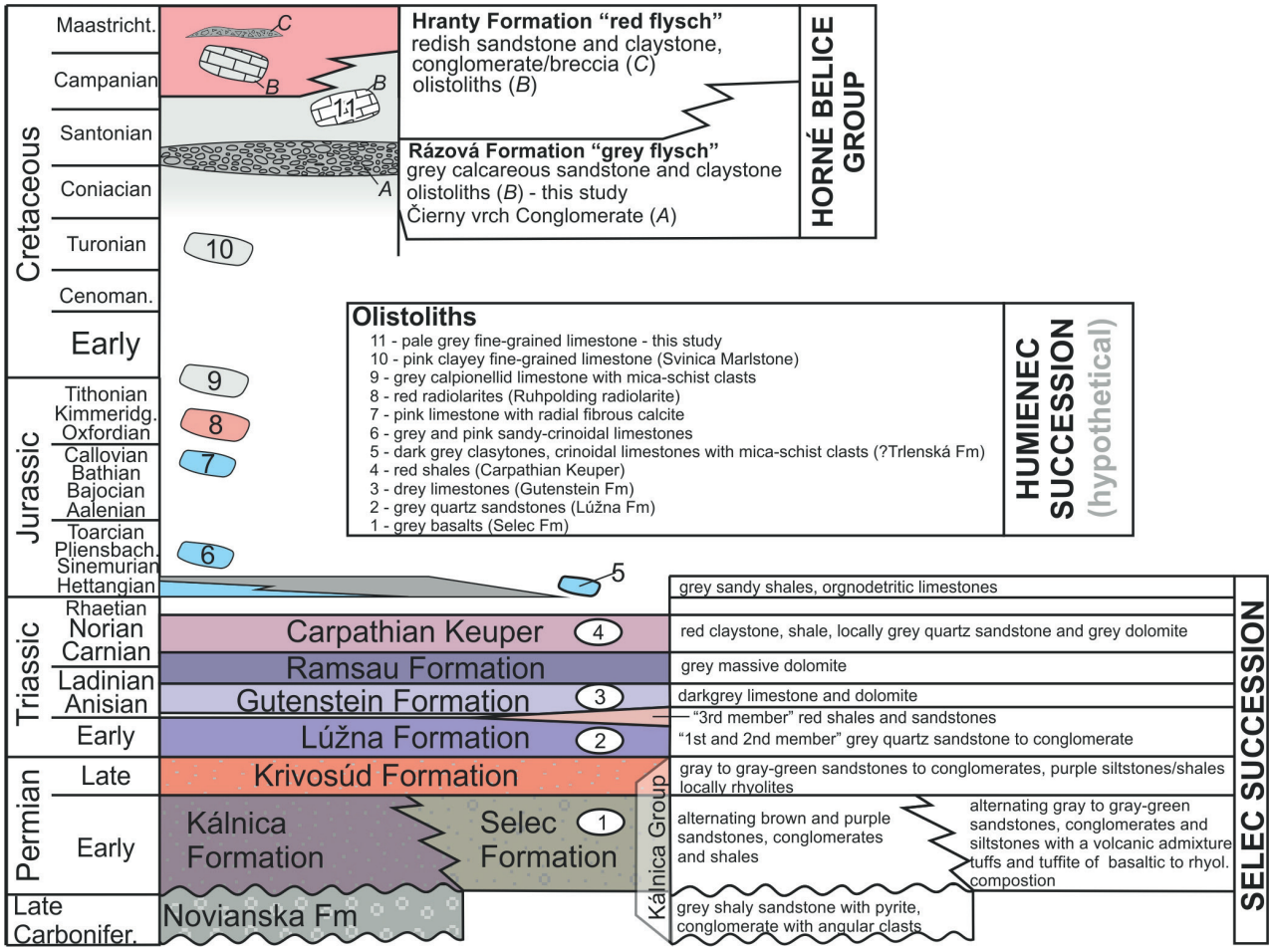


Fig. 3. Lithostratigraphic scheme of Selec Succession (Late Paleozoic – Early Jurassic), composite sequence of hypothetical Humienec Succession (from olistoliths) and Horné Belice Group (lithostratigraphy according to Olšavský, 2008; Ivanička et al., 2011; Pelech et al., 2016b).

a pseudosparite with micrite/microspartite residues, which gives the sediment a "schlieren" character. Microfossils are significantly recrystallized; the planktonic foraminifers dominate. Foraminifera tests are commonly amputated or represented only by fragments. Tests are usually filled with crystalline calcite. Foraminifera form sporadically small accumulations (clusters) (Fig. 5H). Identified microfauna is represented by the *Globotruncana ventricosa* White, *Globotruncana* sp., *Globotruncanita* cf. *subspinosa* (Pessagno), and most commonly form *Globotruncanita calcarata* (Cushman) (Fig. 5G), *Globotruncanella havanensis* (Voorwijk) (Fig. 5I), *Muricohedbergella* cf. *monmouthensis* (Olsson) and *Heterohelix* sp. The community of planktonic foraminifera represents the Zone Globotruncanita calcarata, which indicates the late Campanian. Other preserved organic detritus is mostly recrystallized, only rarely small fragment of bivalve was observed. Exceptionally, an authigenic quartz and mica are present. A brown substance probably representing insoluble clay and opaque minerals is concentrated on the foliation surfaces.

The oldest rock type of the studied olistoliths is represented by massive grey limestone samples PI5A and PI5B. The limestone is recrystallized with signs of ductile deformation and stylolites. Microstructurally, it is radiolaria-foraminifera biomicrite/biomicrosparite (radiolaria-foraminifera wackstone) gradually passing into microsparite/micrite (mudstone). Allochems are poorly sorted, irregularly arranged, more or less directionally oriented. The material was obviously redeposited. Recrystallized fossils are represented by the *Spumellaria* type radiolarians filled by crystalline calcite, echinoderm, lamellibranchiata and possibly also brachiopod fragments. Other fossil fragments include sponge spicules, rare aptychus fragments, an ammonite shell and, last but not least, sporadic poorly preserved planktonic foraminifera. The presence of rare one keel forms represented by the *Parathalmanninella* sp., or *Rotalipora* sp., as well as *Praeglobotruncana* sp. and *Muricohedbergella delrioensis* (Carsey) has been identified. Benthic foraminifera are represented by rare fragments of the nodosaride forms. Due to the poor preservation and ambiguity of their

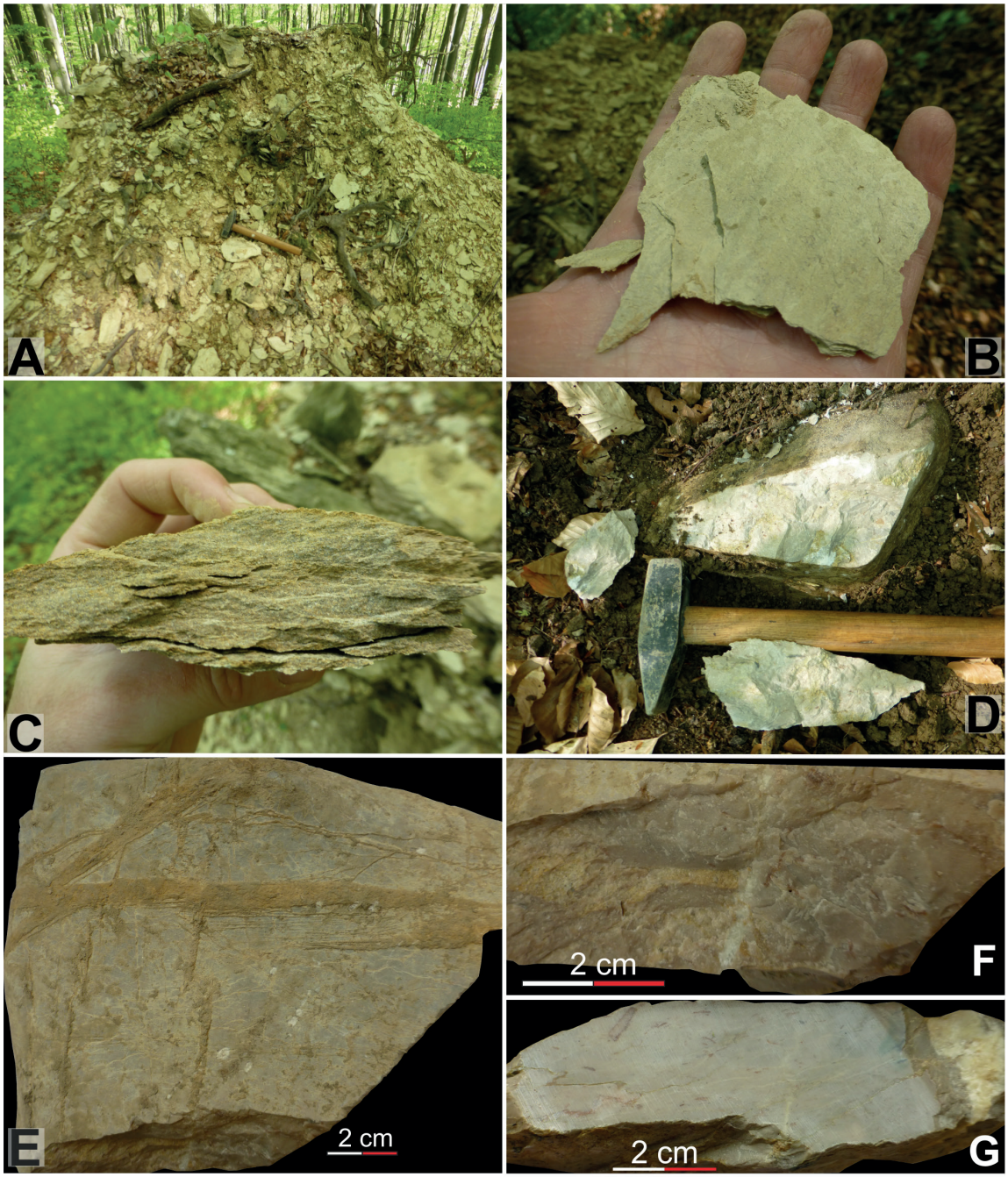


Fig. 4. A – Rock debris of the Rázová Fm. in the roots of uprooted tree at the PI4 site ("under the spring"); B – Detail of the calcareous shales of the Rázová Fm., site PI4; C – Quartz-carbonate sandstones of the Rázová Fm. with visible deformation, probably due to emerging cleavage, site PI4; D – Loose blocks of pale grey Upper Cretaceous limestones, site PI4; E–G – Detail on the sample PI4 – grey to pink pelagic limestone; E – Weathered sample; F – Fresh surface; G – Polished section.

identification, observed community most likely represents Cenomanian age. Both authigenic and clastic quartz are rarely present. The presence of Fe-minerals was also observed. Despite the limestone samples PI5A and B macroscopically strongly resemble Campanian limestones described above, their stratigraphic range is different and suggests possible correlation with Svinica Marlstone.

Discussion

Various both native/intrabasinal (originating from Selec Succession) and exotic blocks (originating from hypothetical Humienec Succession) in the Upper Cretaceous sediments of the Horné Belice Group are considered olistoliths of pre-existing and/or contemporary

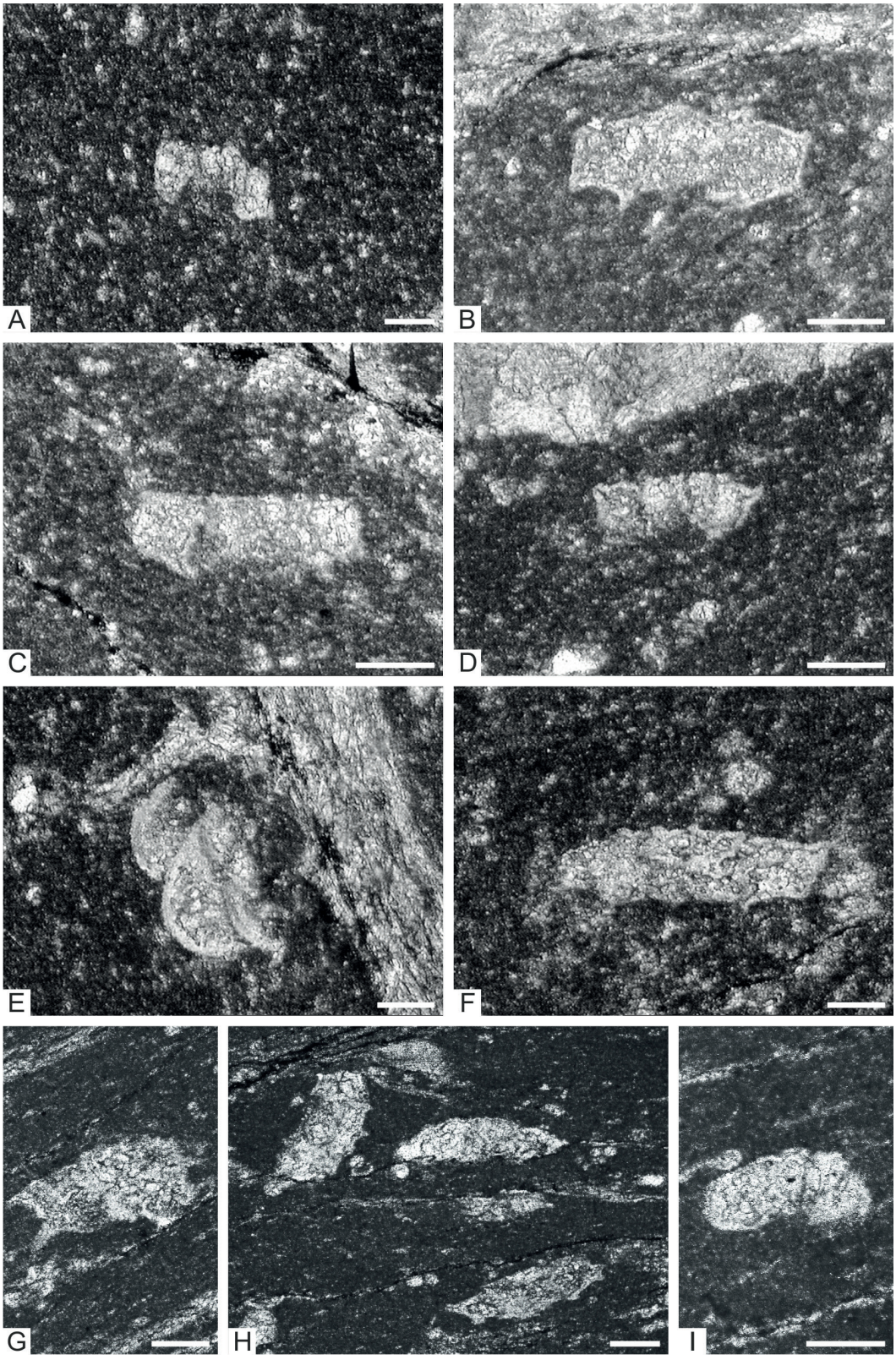


Fig. 5. Photomicrographs showing planktonic foraminifera from studied olistoliths. A–F sample HR1; G–I sample PI4. A – *Globotruncanita stuartiformis* (Dalbiez); B – *Globotruncana* cf. *linneiana* (d'Orbigny); C – *Globotruncana ventricosa* White; D – *Globotruncanita subspinosa* (Pessagno); E – *Globotruncana* sp.; F – *Falsomarginotruncana* cf. *desioi* (Gandolfi); G –*Globotruncanita calcarata* (Cushman); H – Group of recrystallized foraminifera of Calcarata Zone; I – *Globotruncanella havanensis* (Voorwijk). Scale 100 μm.

Tab. 1
An overview of important outcrops and studied sites.

Sample	Latitude (N, Y)°	Longit. (E, X)°	Lithology and locality description	Lithostratigraphy
Pl3	48.815145	18.070117	grey-green laminated limestone, forest road cut (Svinica Marlstone olistolith)	Rázová Fm
Pl4 & HR1	48.817752	18.069885	olistolith of grey fine-grained Campanian limestone, "under the spring"	Rázová Fm
Pl5	48.819024	18.070630	olistolith of grey fine-grained limestone (?Svinica Marlstone)	Rázová Fm

formations that were eroded, or tectonically dismembered (e.g. boudinaged) in the hinterland and later transported by gravity mass movements into the sedimentary basin (Fig. 6) during folding and thrusting. Therefore, the age of olistoliths cannot be younger than the age of the strata in which they are found. The youngest age of olistoliths most probably represents the onset of thrusting and destruction of the former Late Cretaceous basin overlying Tatricum in the Považský Inovec Mts. as well as in the adjacent western portion of the Strážovské vrchy Mts. (boreholes SBM-1 Soblahov and P-1 Peťovka; Kullmanová & Maheľ, 1969; Maheľ & Kullmanová, 1975; Kullmanová, 1978; Gašpariková, 1980; Maheľ, 1985).

Studied olistoliths are located in the Rázová Formation, formerly considered Coniacian – Santonian in age (Plašienka et al., 1994; Ivanička et al., 2007, 2011). Indications that the Rázová and Hranty formations coexisted together during the Campanian has sporadically appeared also earlier (Kullmanová, 1978; Pelech et al., 2016a). The confirmation of the Campanian age of the limestone olistoliths suggests that stratigraphic range of the Rázová Formation is wider. It follows that the lateral transition between the Rázová and Hranty formations existed during the Campanian and their contact is (at least partly) diachronous. Paleocurrent directions from both formations, however, differ (Plašienka et al., 1994). While the mass transport deposits (sandy turbidites and conglomerates) of the Rázová Fm. were transported generally from South to North, the sandy turbidites of the Hranty Fm. were transported from NW to SE, S and SW. The sedimentary sequence of the Horné Belice Group than can represent mixing of two sources, or two distinct submarine fans. The coarse-grained debris flow sediments of the Hubina Fm. in the Bojná Block were transported generally from the South (Pelech et al., 2017a). The paleocurrent data are, however, very sparse.

The studied olistoliths are included into the hypothetic (composite) sequence of the Humienec Succession (Fig. 3) in accordance with the previous interpretations of Rakús (in Ivanička et al., 2011; Hók et al., 2006). Unlike previous research, we consider correct to include the Svinica Marlstones to the Humienec Succession as well.

The new knowledge is in accordance with known ages of other Upper Cretaceous rocks occurrences in the Považský Inovec Mts. The sedimentation in the Hlohovec Block (southern portion of the Považský Inovec Mts.) terminated in Campanian. The age of Hubina Formation, the youngest documented Tatric sediments in the Bojná Block (central portion of the Považský Inovec Mts.), is middle Turonian – Santonian (Pelech et al., 2017a). The age of similar sediments in the borehole SBM-1 Soblahov Coniacian – Campanian (Kullmanová, 1978; Gašpariková, 1980) possibly up to Eocene (Maheľ & Kullmanová, 1975). It can be deduced, that the end of sedimentation of the Horné Belice Group is younging in general direction from south to north. This is in accordance with the process of gradual movement of the Middle Group of Nappes (sensu Hók et al., 2014, 2019).

There exist also other interpretations of the structure of Horné Belice Group and they are described in paper Pelech et al. (2016b). The Upper Cretaceous sediments are often included into the so-called Belice Unit (Plašienka et al., 1994, 2017). According to aforementioned papers it represents a continuous sedimentary succession ranging from the uppermost Middle Jurassic to Maastrichtian. The Belice Unit is often considered to be a remnant of Vahic oceanic crust, exhumed to the surface by out-of-sequence thrusting. The validity of this interpretation has been discussed by Pelech et al. (2017b). Other rarer interpretations include works of Leško et al. (1988) and Putiš et al. (2008). It should be noted, that we cannot completely exclude, that the blocks of Campanian limestones are not olistoliths and represent another thrust sheet, which is not seen in the field due to poor outcrop conditions. However, such an interpretation is, due to knowledge of structure of the wider area, mentioned here only as an unlikely alternative.

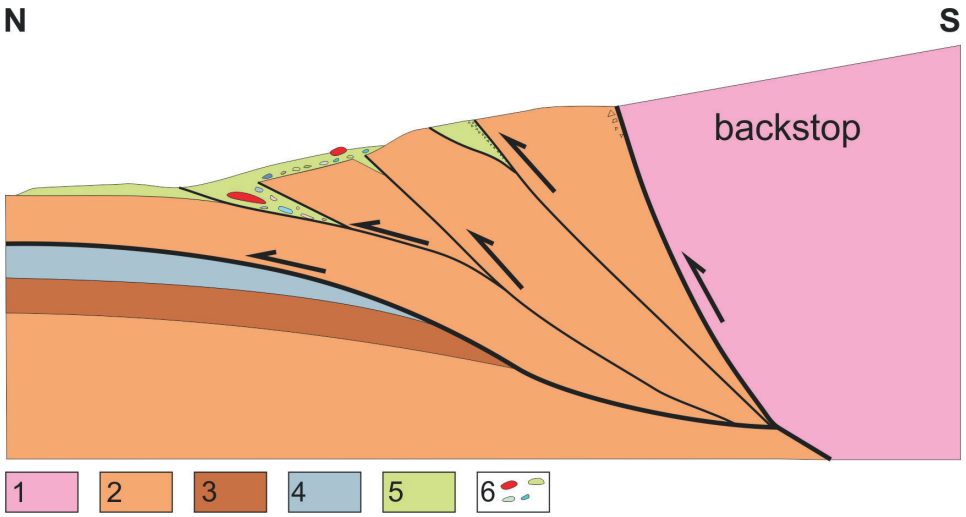


Fig. 6. Scheme showing structural position of the Upper Cretaceous Horné Belice Group tectonic mélange between the thrust sheets of the mica-schist basement of the Selec Block. 1 – Crystalline basement of Bojná Block (acting as a backstop); 2 – Mica-schists basement rocks of the Selec Block; 3 – Upper Paleozoic Kálnica Group; 4 – Selec Succession: Mesozoic sedimentary cover of the Selec Block; 5 – Upper Cretaceous Horné Belice Group; 6 – Olistoliths.

Conclusions

The Horné Belice Group of the Selec Block of the Považský Inovec Mts. is represented by mass transport deposits that accumulated on the outer active margin of the Tatric unit during the main nappe-stacking event of the Internal Western Carpathians since the Turonian. The evolution of the basin was marked by formation of olistoliths that were deposited in the Rázová and Hranty formations. The sedimentary sequence of the Upper Cretaceous Horné Belice Group thus represents a typical tectonic mélange.

Two analysed samples (PI4 and HR1) from grey pelagic limestone olistoliths (Fig. 3) situated in Rázová Fm. at the northeastern slopes of the Humienec elevation point (Fig. 2, Tab. 1) yielded foraminifera fauna of Globotruncana ventricosa and Globotruncanita calcarata zones indicating middle to late Campanian age (Fig. 5). The Upper Cretaceous limestones are included in to the hypothetical (composite) Humienec Succession. New findings suggest that the deposition of the Rázová Formation continued at least until the period of the latest Campanian. The relationship of the Rázová Formation with the Hranty Formation is diachronous.

At the same time, it can be assumed that the tectonic activity that caused deformation and folding of the Horné Belice Group together with the crystalline basement rocks postdates the late Campanian. New findings are in good agreement with process of gradual termination of deposition in the Horné Belice Group which started in the Campanian in the Hlohovec Block (southern portion of the Považský Inovec Mts.) and lasted until the Maastrichtian in the north (Selec Block) or possibly to Eocene, according to the borehole SBM-1 Soblahov.

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Olistolity vápencov vrchnej kriedy v rázovskom súvrství hornobelickej skupiny Považského Inovca (Západné Karpaty)

Považský Inovec je v rámci jadrových pohorí výnimočný kvôli výskytu sedimentov vrchnej kriedy, ktoré sa nachádzajú v odlišných pozíciách v nadloží tektonickej jednotky tatrika, resp. zavrásnené medzi jeho tektonickými šupinami (Kullmanová a Gašpariková, 1982; Plašienka et al., 1994; Havrila in Pristaš et al., 2000; Rakús et al., 2006; Pelech et al., 2016a, 2016b, 2017a, 2017b). Plošne najrozšírenejšie sú v severnej časti pohoria (selecký blok *sensu* Maheľ, 1986), kde boli formálne zahrnuté do belickej sukcesie (*sensu* Plašienka et al., 1994) a neskôr do hornobelickej skupiny (*sensu* Rakús in Ivanička et al., 2011). Sedimenty hornobelickej skupiny sa vnútorne členia na rázovské (koňak – spodný kampán) a hrantské súvrstvie (kampán – ?mástricht). V oboch súvrstviach sa vyskytujú bloky/olistolity hornín podložného kryštalinika, bázických vulkanických hornín (paleozoikum), ako aj sedimentov mezozoika v stratigrafickom rozsahu od spodného triasu do spodnej kriedy (Ivanička et al., 2011). Pre tento kompozitný horninový súbor, ktorý sa považuje za pôvodný sedimentárny obal tatrického fundamentu, zaviedli Plašienka et al. (1994) pomenovanie humienecká sukcesia. Osobitým litostratigrafickým členom humieneckej sukcesie, opísaným z rázovského súvrstvia severného okraja Považského Inovca (Rakús in Ivanička et al., 2007; Rakús in Ivanička et al., 2011), sú úlomky až bloky (max. 0,5 m^3) svetlosivých nevrstevnatých jemnozrnných vápencov vyskytujúce sa na severnom svahu kóty Humienec (609,0). Tieto vápence boli stratigraficky zaradené do stredného kampánu až spodnej časti vrchného kampánu, ale bez náležitej lokalizácie a biostratigrafickej dokumentácie (Rakús et al., 2006). V príspevku uvádzame ich lokalizáciu, litologický opis a biostratigrafické vyhodnotenie (obr. 1 – 3, tab. 1).

Pri stanovení veku vápencov odobraných z olistolitov je určujúci výskyt rekryštalizovaných planktonických foraminifer zistených vo výbrusovom materiáli.

Z opakovaného terénneho zberu materiálu z olistolitov v roku 2020 pochádza vzorka PI4. Jednotlivé komponenty vápenca sú vplyvom tlakového postihnutia usmernené. Z hľadiska mikroštruktúry ide o foraminiferový biomikrit (foraminiferový *wackestone*). Lokálne sa vyskytujú výraznejšie rekryštalizované pasáže základnej hmoty tvorené pseudosparitom so zvyškami mikritu/mikrosparitu, čím sediment nadobúda šmuhovitý charakter.

Mikrofosílie sú výrazne rekryštalizované. Dominujú planktonické foraminifery, ktorých schránky sú bežne amputované, ponorené v základnej hmote, prípadne sa vyskytujú iba ich fragmenty. Sú vyplnené spravidla kryštalickým kalcitom. Foraminifery tvoria sporadicky malé akumulácie (zhluky) (obr. 5H). Identifikované bolo spoločenstvo *Globotruncana ventricosa* White, *Globotruncana* sp., *Globotruncanita* cf. *subspinosa* (Pessagno), najbežnejšie sa vyskytujúca forma *Globotruncanita calcarata* (Cushman) (obr. 5G), *Globotruncanella havanensis* (Voorwijk) (obr. 5I), *Muricohedbergella* cf. *monmouthensis* (Olsson) a *Heterohelix* sp. Spoločenstvo planktonických dierkavcov reprezentuje zónu Globotruncanita calcarata, ktorá indikuje vrchný kampán. Organické zvyšky reprezentuje aj ojedinelý malý úlomok najpravdepodobnejšie lastúrnika. Bežne sa vyskytuje drobný rekryštalizovaný biodetrit, resp. detrit.

Výnimočne je prítomný autigénny kremeň a sľuda. Na plochách foliácie je koncentrovaná hnedá substancia.

Vo vzorke HR1 zo starších zberov M. Rakúsa, ktorá bola podrobená revízii, je rovnako viditeľné tlakové postihnutie vápenca a usmernenie alochémov. Mikroštruktúrne sa zaraďuje k foraminiferovým biomikritom (foraminiferový *wackestone*).

Výrazne rekryštalizované planktonické foraminifery reprezentujú *Globotruncana* cf. *linneiana* (d´ Orbigny) (obr. 5B), *Globotruncana* cf. *arca* (Cushman), *Globotruncana ventricosa* White (obr. 5C), *Globotruncana* sp. (obr. 5E), *Globotruncanita stuartiformis* (Dalbiez) (obr. 5A), *Globotruncanita subspinosa* (Pessagno) (obr. 5D), *Falsomarginotruncana* cf. *desioi* (Gandolfi) (obr. 5F), *Muricohedbergella* sp. a *Heterohelix* sp. Spoločenstvo foraminifer indikuje stredný kampán až spodnú časť vrchného kampánu. Ide najpravdepodobnejšie o zónu Globotruncana ventricosa.

Mikrofosílie zastupujú okrem foraminifer časti, ako aj nepravidelne „roztrúsené“ prizmy schránok lastúrnika *Inoceramus* sp. Prítomný je bližšie neurčený rekryštalizovaný biodetrit, resp. detrit.

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