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CONTRIBUTION TO STRATIGRAPHY OF THE REIFLING LIMESTONES OF THE MALÉ KARPATY MTS. (WEST CARPATHIANS)

(Figs. 2, Tab. 2, Pls. 8)

Abstract: In geological mapping and investigation of the north-western part of the Malé Karpaty Mts. it was possible to delimit stratigraphically the vertical range of cherty limestones of Reifling type. The determination of the age and position of the Reifling limestones is one of the supporting points in tectonic interpretation. On the basis of conodonts the studied profiles point to the stratigraphic range of the Reifling limestones of the Biele hory Mts. of the Malé Karpaty Mts. as Upper Anisian (Bystrický, 1973; Kollárová-Andrusovová — Bystrický, 1974) to Lower Carnian (Cordevolian).

Резюме: Во время геологического картирования и разведки северо-западной части Малых Карпат удалось стратиграфически определить вертикальный диапазон роговиковых известняков райфлингского типа. Установление возраста и позиции райфлингских известняков является одной из опорных точек при тектонической интерпретации. Исследованные профили указывают на основе конodontов на то, что стратиграфический диапазон райфлингских известняков Белых гор Малых Карпат верхний анис (Быстрицкий, 1973; Колларова-Андрусова — Быстрицкий, 1974) до нижнего карна (кордевол).

Introduction

The northern part of the Malé Karpaty Mts., also called Biele Hory Mts. (Mazur — Lukniš, 1978) differs from the southern areas in the geological structure, geomorphological development and relief character. The appearance of the relief is here conditioned mainly by resistance of carbonate rocks. Typical of the area built up of the Choč and higher nappes are the elongated ridges of Vápenná, Veterlín and Záruby.

The Reifling limestones, known from the Malé Karpaty Mts., have been little stratigraphically proved till now and their stratigraphic range was not known (mainly the upper part of the sequence).

The essential problem is the tectonic interpretation, the evidence of the existence of one sequence of strata — of the "Veterník Group" (sensu Maheľ, 1961, 1967, 1979) or two, although incomplete bed sequences (sensu Bystrický — Maheľ, 1970; Biely — Bystrický — Mello, 1980).

As the Reifling limestones represent sequence poor in fossils, we paid attention to the conodont microfauna for clearing up of this problem.

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We carried out investigation in the area between the communities Sološnica and Plavecké Podhradie in profiles IV – Plavecké Podhradie (Rajtárka valley) and V – Plavecké Podhradie (below Červenica), see the situation map in Fig. 1. From these profiles we took samples (see Fig. 2) for microfauna) conodonts were determined by K. Puškárová, foraminifers by O. Jendřejáková, oral communication (and for lithological valuation (P. Masaryk).

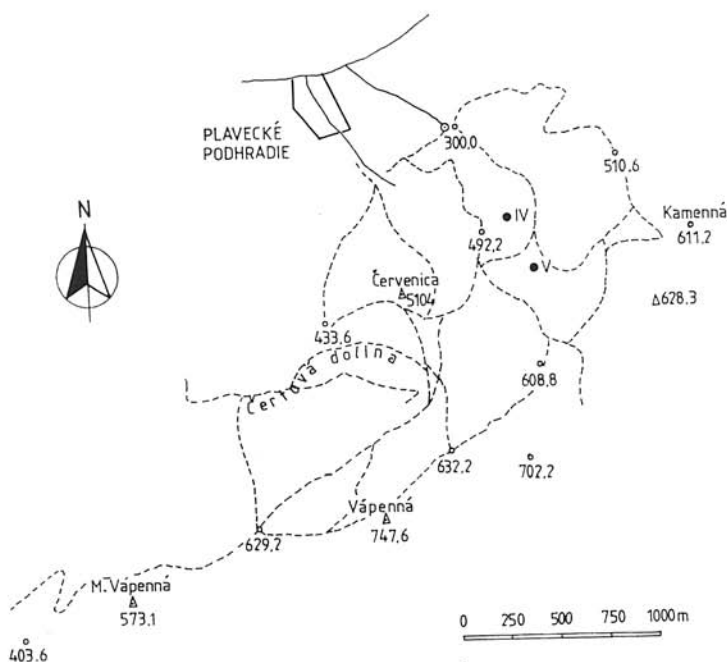


Fig. 1. Situation map

Explanations: ● designation of profiles. Profile IV – Plavecké Podhradie (Rajtárka valley), profile V – Plavecké Podhradie (below Červenica).

Brief survey of geology of the northwestern part of the Biele hory Mts. of the Malé Karpaty Mts.

Systematical investigation of Mesozoic of this part of the Malé Karpaty Mts. was begun after World War 2 only. Important are the works (Maheľ, 1961, 1967, 1968, 1979), Peržel 1964, 1965, 1966) and Bystrický (1970, 1973, 1980). Maheľ (l. c.) originally distinguished in the Choč unit the "Veterník Group" in Maheľ, 1961, p. 52., 1967, p. 96), which is the normal overlier of the "Melaphyre Group" (s. l.). In the "Veterník Group" he distinguished three developments, the Vápenná, Havranica and Jablonica.

The opinions of the tectonic interpretation at the present state of knowledge are not quite uniform as the second opinion testifies (Bystrický – Maheľ, 1970).

Litho- and biostratigraphy of cherty limestones of Reifling type

In the area studied by us Peržel delimited (1966, p. 158) "darkgrey and grey platy limestones with chert nodules" from the "Raštún limestone". He considers him as Lower Illyrian. Bystřický (1967) carried out parallelization of these limestones with the Reifling limestones. The only one indication

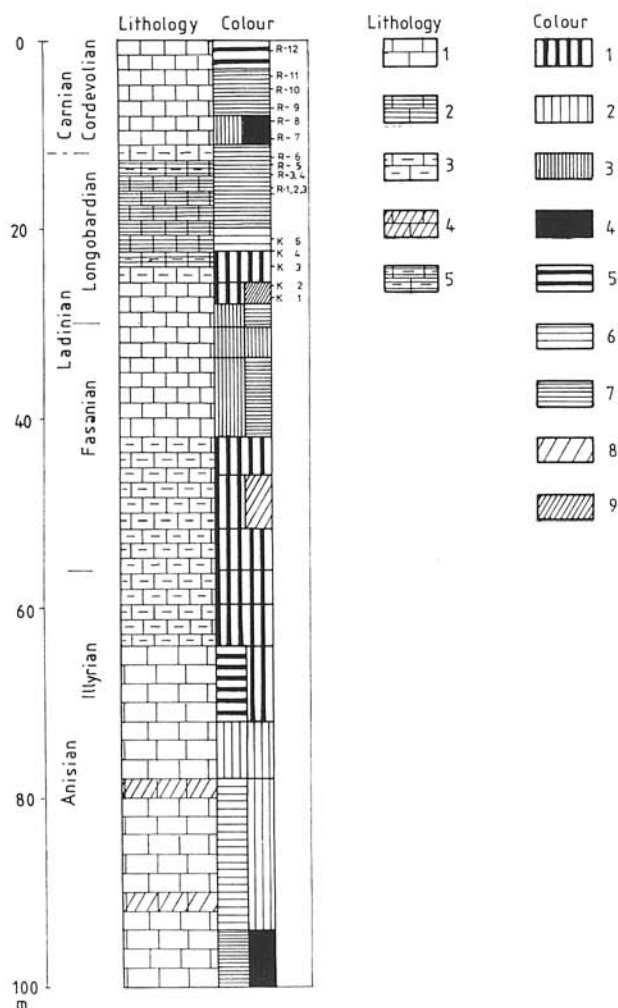


Fig. 2. Lithologic profile of cherty limestones of Reifling type from the Choč nappe of the Malé Karpaty Mts.

Explanations: a) lithology: 1 — limestone; 2 — marly limestone; 3 — cherty limestone; 4 — dolomite limestone; 5 — marly cherty limestone. b) colour: 1 — light-grey; 2 — grey; 3 — dark-grey; 4 — black; 5 — light-brown; 6 — brown; 7 — dark-brown; 8 — yellow; 9 — reddish-yellow.

of the possibility of Ladinian age represents the lamellibranch *Posidonia wengensis* WISSM. (in Mahel, 1967, p. 96). Later on Bystrický (1973) and Kollárová-Andrusovová in Kollárová-Andrusovová — Bystrický (1974, p. 131) mention a fauna from the locality Hurtovec near Plavecký Mikuláš: *Piarorhynchella trinodosi* (BITTN.) (in Siblík, 1971, p. 175), *Judicarites prezzanus* (MOJS.), *Semiornites* sp., *Longobardites* sp., which indicate the *Paraceratites trinodosus* zone — Lower Illyrian.

Profile IV — Plavecké Podhradie (Rajtárka valley)

Location of profile IV see in Fig. 1. In the lithological profile (Fig. 2) we see the geological position in the sequence.

The sequence is formed by platy to thin-platy dark cherty limestones, belonging to the Choč units. s. s. (in the sense of Bystrický in Bystrický — Mahel, 1970). The position corresponds to the conditions of deposition in the wider area—320°/40°. Tectonic disturbing is restricted to faults of local importance. Dark-brown cherts of brown colour. The size of the cherts varies from 1–20 cm. Biomicrite (Pl. 7., Fig. 1) biomicroparite limestones predominate, often are biopellmicrite (Pl. 7., Fig. 2) and rarely biointramicrite limestone types. The groundmass of limestones is prevailingly micrite or microparitic. Relatively abundant is the admixture of authigenic quartz and pyrite. From organisms dominate thin-walled lamellibranchs—“filaments”, predominate ostracodes, foraminifers, crinoides, spicules of sponges, radiolarians and microproblematica are present (Earlandie and *Bacanella floriformis* PANTIĆ). On the whole the limestone is poor in organisms, the average content of organisms is 8–10 ‰. Representation of pellets is 5 ‰ on an average. Intraclasts are rare. About a typical microfacies as such one cannot be spoken, because no one species of fossils or other structural character is dominant. On the basis of foraminifers the sequence cannot be precisely ranged stratigraphically.

In profile IV — Plavecké Podhradie (Rajtárka valley) we took samples K-1 to K-5 (see Tab. 1). The conodont fauna points to a Longobardian age. The presence of the species *Metapolygnathus hungaricus* (KOZUR — VÉGH) in samples K-2 and K-3 confirms their Lower Longobardian age (sensu Kozur — Végh in Kozur — Mock, 1972; Kovács — Kozur, 1980). At this locality we therefore could prove the Longobardian age, i. e. *Metapolygnathus hungaricus* assemblage Zone (sensu Kozur, 1980). The accompanying fauna of this zone in this profile is: *Gondolella excelsa* (MOSHER), *Gondolella cornuta* BUDUROV — STEFANOV, *Neocavitella tatrica* (ZAWIDZKA) and *Gladigondolella tethydis* (HUCKRIEDE). The mentioned association of conodonts is typical of the Upper Ladinian—Longobardian.

Besides these platform conodonts also ramiform conodonts are abundant: *Enantiognathus petraeviridis* (HUCKRIEDE), *Hindeodella* (M.) *pectiniformis* (HUCKRIEDE), *Prioniodina* (C.) *venusta* (HUCKRIEDE), *Chirodella dinodoides* (TATGE), *Diplododella meissneri* (TATGE), *Enantiognathus zieglerei* (DIEBEL), *Hibbardella magnidentata* (TATGE), *Hindeodella* (M.) *suevica* (TATGE), *Neochindeodella triassica* (MÜLLER), *Ozarkodina tortilis* TATGE and further fish teeth and scales, rarely are foraminifers. Scarcely were found ostracodes and sclerites of holothurians, (*Theelia planorbicula* (MOSTLER)).

Table 1

Table of qualitative representation of conodont fauna in profile IV – Plavecké Podhradie (Rajtárka valley)

Designation of samples of profile IV – Plavecké Podhradie (Rajtárka valley)	K1	K2	K3	K4	K5
<i>Gondella cornuta</i> (BUDUROV – STEFANOV)		+			
<i>Gondolella excelsa</i> (MOSHER)		+			
<i>Gladigondolella tethydis</i> (HUCKRIEDE)		+	+	+	+
<i>Metapolygnathus hungaricus</i> (KOZUR – VÉGH)			+		+
<i>Neocavitella tatrica</i> (ZAWIDZKA)		+	+		+
<i>Enantiognathus petraeviridis</i> (HUCKRIEDE)	+		+		
<i>Hindeodella</i> (M.) <i>pectiniformis</i> (HUCKRIEDE)			+		
<i>Prioniodina</i> (C.) <i>venusta</i> (HUCKRIEDE)					
<i>Chirodella dinodoides</i> (TATGE)			+		+
<i>Diplododella meissneri</i> (TATGE)					+
<i>Enantiognathus zieglerei</i> (DIEBEL)		+		+	+
<i>Hibbardella magnidentata</i> (TATGE)	+	+			
<i>Hindeodella</i> (M.) <i>suevica</i> (TATGE)					
<i>Neohindeodella triassica</i> (MÜLLER)					+
<i>Ozarkodina tortilis</i> TATGE				+	

Profile V – Plavecké Podhradie (below Červenica)

Location of profile V see in Fig. 1. At the lithological profile (Fig. 2) we see the geological position in the sequence.

The limestones are platy in places thin-platy, average thickness is 25 cm. Predominating are dark-brown to greyishbrown slightly marly organodetrital limestones. The cherts are relatively rare and found irregularly. The size of cherts varies between 5 to 20 cm, the colour is light-brown. The sequence is characterized by a position identical as in profile IV. Tectonic disturbing is restricted to faults of local importance only. Biopellmicrite (Pl. 7, Fig. 2), pellmicrite, pellsparite (Pl. 7, Fig. 2), and biointramicrite limestones predominate. The ground mass of limestones is prevailingly micritic, partly recrystallized. From organisms fragments of "filaments", ostracodes, predominate more rare are foraminifers, crinoid oscicles, radiolarians, microproblematica (mainly Earlandia and Globochaets). The sequence is very poor in organisms. Abundant are shrinkage pores mostly of round shape, but often are also elongated and irregular forms. In some limestones were found authigenic quartz and pyrite, abundant are limonite and fine illite admixture.

The average content of bioclasts is 5%, of pellets 3%. Intraclasts are very rare, their content seldom exceeds 1%.

The foraminifer fauna is qualitatively and quantitatively poor. The tests of foraminifers are dwarfed, prevailingly of fragmentary preservation. Characteristic is the "*Turritella*" *mesotriassica* KOEHN – ZANINETTI, accompanied by earlandians: *Earlandia gracilis* (PANTIĆ), *Earlandia amplimuralis* (PANTIĆ) and small fragments of nodosariid types of foraminifers. From other species, which are scarce, it is necessary to mention: *Ophthalmidium? chialingchiangensis* (HO), *Ophthalmidium* cf. *exiguum* KOEHN – ZANINETTI, Aga-

Table 2
Table of qualitative representation of conodont fauna in profile V – Plavecké Podhradie (below Červenica)

Designation of samples of profile V – Plavecké Podhradie (below Červenica)	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12
<i>Gondolella cornuta</i> (BUDUROV – STEFANOV)	+		+									
<i>Gondolella excelsa</i> (MOSHER)		+	+								+	
<i>Gondolella foliata</i> (BUDUROV)			+									
<i>Gondolella polygnathiformis</i> BUDUROV – STEFANOV												
<i>Gondolella tadpole</i> HAYASHI												
<i>Gladigondolella tethydis</i> (HUCKRIEDE)				+			+		+	+	+	+
<i>Metapolygnathus hungaricus</i> (KOZUR – VĚGH)					+	+		+				
<i>Metapolygnathus japonicus</i> (HAYASHI)					+	+		+				
<i>Metapolygnathus mungoensis</i> (DIEBEL)					+	+		+				
<i>Neocavitella tatrica</i> (ZAWIDZKA)				+								
<i>Enantiognathus petraeviridis</i> (HUCK- RIEDE)			+		+	+	+	+	+	+	+	+
<i>Hindeodella (Metaproniodus) pectini- formis</i> (HUCKRIEDE)	+		+		+	+						
<i>Prioniodina (Cypridodella) venusta</i> (HUCKRIEDE)			+		+				+	+	+	+
<i>Prioniodina excavata</i> MOSHER			+					+	+			
<i>Enantiognathus ziegléri</i> (DIEBEL)								+				
<i>Hibbardella magnidentata</i> (TATGE)										+	+	
<i>Neohindeodella triassica</i> (MÜLLER)												
<i>Prioniodina (Cypridodella) muelleri</i> (TATGE)		+		+		+	+	+				+

thamina sp., *Agathamina austroalpina* KRISTAN — TOLLMANN and TOLLMANN, *Trochamina* sp. and *Paraophthalmidium* sp.

The mentioned association of foraminifers does not permit a more precise stratigraphical assignment, because they are species with a wide stratigraphical range (Upper Anisian — Lower Carnian).

In profile V we took samples R-1 to R-12 (see Tab. 2, Fig. 2).

The Longobardian age is indicated by the species: *Metapolygnathus hungaricus* (KOZUR — VÉGH), *Gondolella excelsa* (MOSHER) and *Metapolygnathus mungoensis* (DIEBEL). According to Kovacs — Kozur (1980) *Metapolygnathus mungoensis* (DIEBEL) appears in the Upper Longobardian (in ammonite zone *Meginoceras meginiae*) and reaches the Cordevolian. In the highest taken sample B-12 are represented the species: *Metapolygnathus mungoensis* (DIEBEL), *Gondolella tadpole* HAYASHI, *Gondolella polygnathiformis* BUDUROV — STEFANOV and *Prioniodina excavata* MOSHER, which point to the Cordevolian age.

According to the species *Gondolella tadpole* HAYASHI, *Gondolella polygnathiformis* BUDUROV — STEFANOV, which were found in the highest parts of the profile (sample R-12) the highest part of this profile belongs to the Cordevolian.

Abundant are also ramiform conodonts species: *Enantiognathus petraeviridis* (HUCKRIEDE), *Hindeodella* (M.) *pectiniformis* (HUCKRIEDE), *Prioniodina* (C.) *venusta* (HUCKRIEDE), *Prioniodina excavata* MOSHER, *Enantiognathus zieglerei* (DIEBEL), *Hibbardella magnidentata* (TATGE), *Neohindeodella triassica* (MÜLLER), *Prioniodina* (C.) *muelleri* (TATGE), further fish teeth and scales, sponges spicules, seldom were found holothurian sclerites.

Summary

In the sequence of Reifling type cherty limestones the following stratigraphic range was characterized in the area studied by us (profile IV — Plavecké Podhradie) Rajtárka valley (and profile V — Plavecké Podhradie) below Červenica:

1. Profile IV. *Metapolygnathus hungaricus* assemblage Zone (Lower Longobardian). Is proved by the species *Metapolygnathus hungaricus* (KOZUR — VÉGH) in association with the assemblage of species: *Gondolella excelsa* (MOSHER), *Gondolella cornuta* BUDUROV — STEFANOV, *Neocavitella tatrica* (ZAWIDZKA) and *Gladigondolella tethydis* (HUCKRIEDE). The age of the sequence is Longobardian.

2. Profile V. The conodont fauna in the lower part of the profile V (samples R-1 to R-8): *Metapolygnathus hungaricus* (KOZUR — VÉGH), *Gondolella excelsa* (MOSHER) and *Metapolygnathus mungoensis* (DIEBEL) testify to a Longobardian age of this profile part. The highest part of this profile (sample R-12) belongs on the basis of the species: *Gondolella tadpole* HAYASHI, *Gondolella polygnathiformis* BUDUROV — STEFANOV to the Cordevolian.

3. On the basis of foraminifers (from thin section material) no more precise stratigraphic ranging is possible because of their wide stratigraphic vertical range (Upper Anisian-Lower Carnian).

4. The find of the conodont fauna indicating the Lower Carnian overlying the Reifling limestones deserves to be mentioned. There are limestones of the

near-reef facies alternating laterally and vertically with grey brecciated dolomites. In the highest part of profile IV light-coloured, massive limestones of the coral-sponge facies (= "Veterník limestones") occur (sensu Bystrický — Maheľ, 1970). The stratigraphic range of the "Veterník limestones" we cannot consider so far.

After determination of Longobardian and Cordevolian in the Reifling limestones it does not seem that "the Veterník limestone", in the base of which there are dark limestones of the Anisian age (Biely — Bystrický — Mello, 1980), is in the normal superposition. It seems that the Veterník development is tectonic overlying strata.

Translated by J. Pevný

Plate 1

- Figs. 1 a, b. *Gondolella excelsa* (MOSHER), loc. profile IV — Plavecké Podhradie, No. K-2, magnif. 1 a — 250 ×, 1 b — 220 ×
 Figs. 2 a, b. *Gondolella excelsa* (MOSHER). Loc. profile IV — Plavecké Podhradie, No. K-2. Magnif. 2 a — 250 ×, 2 b — 220 ×
 Figs. 3 a, b. *Metapolygnathus hungaricus* (KOZUR — VÉGH). Loc. profile IV — Plavecké Podhradie, No. K-2. Magnif. 100 ×
 Figs. 4 a, b. *Metapolygnathus hungaricus* (KOZUR — VÉGH). Loc. profile IV — Plavecké Podhradie, No. K-3. Magnif. 180 ×

Plate 2

- Figs. 1 a, b. *Gondolella excelsa* (MOSHER). Loc. profile IV — Plavecké Podhradie, No. K-5. Magnif. 100 ×
 Fig. 2. *Gondolella excelsa* (MOSHER) — Loc. profile IV — Plavecké Podhradie, No. K-4. Magnif. 200 ×
 Fig. 3. *Gondolella foliata* (BUDUROV). Loc. profile V — Plavecké Podhradie, No. R-3. Magnif. 110 ×
 Figs. 4 a, b. *Gondolella foliata* (BUDUROV). Loc. profile V — Plavecké Podhradie, No. R-3. Magnif. 4 a. 90 ×, 4 b — 100 ×
 Figs. 5 a, b. *Neocavittella tatrica* (ZAWIDZKA). Loc. profile V — Plavecké Podhradie, No. R-3. Magnif. 80 ×

Plate 3

- Figs. 1 a, b. *Metapolygnathus mungoensis* (DIEBEL). Loc. profile V — Plavecké Podhradie, No. R-8. Magnif. 90 ×
 Figs. 2 a, b. *Metapolygnathus mungoensis* (DIEBEL). Loc. profile V — Plavecké Podhradie, No. R-9. Magnif. 60 ×
 Fig. 3. *Metapolygnathus mungoensis* (DIEBEL). Loc. profile V — Plavecké Podhradie, No. R-11. Magnif. 220 ×
 Fig. 4. *Gondolella foliata* (BUDUROV). Loc. profile V — Plavecké Podhradie, No. R-11. Magnif. 180 ×
 Figs. 5 a, b. *Metapolygnathus mungoensis* (DIEBEL). Loc. profile V — Plavecké Podhradie, No. R-8. Magnif. 150 ×

Plate 4

- Figs. 1 a, b. *Metapolygnathus mungoensis* (DIEBEL). Loc. profile V — Plavecké Podhradie, No. R-12. Magnif. 220 ×
 Figs. 2 a, b. *Gondolella foliata* (BUDUROV). Loc. profile V — Plavecké Podhradie, No. R-12. Magnif. 140 ×
 Figs. 3 a, b. *Metapolygnathus mungoensis* (DIEBEL). Loc. profile V — Plavecké Podhradie, No. R-12. Magnif. 160 ×
 Fig. 4. *Gladigondolella tethydis* (HUCKRIEDE). Loc. profile V — Plavecké Podhradie, No. R-12. Magnif. 100 ×

Plate 5

- Figs. 1 a, b. *Gondolella foliata* (BUDUROV). Loc. profile V — Plavecké Podhradie, No. R-12. Magnif. 120 ×
 Figs. 2 a, b. *Gondolella tadpole* (HAYASHI). Loc. profile V — Plavecké Podhradie, No. R-12. Magnif. 220 ×
 Figs. 3 a, b. *Metapolygnathus japonicus* (HAYASHI). Loc. profile V — Plavecké Podhradie, No. R-12. Magnif. 200 ×
 Figs. 4 a, b. *Prioniodina excavata* MOSHER. Loc. profile V — Plavecké Podhradie, No. R-12. Magnif. 150 ×

Plate 6

- Fig. 1. Outcrop in platy to thin-banked dark-brown limestones of Reifling type. Loc. Plavecké Podhradie — Kráľova dolina-valley, NE of elev. p. 510, Malé Karpaty Mts.
 Fig. 2. A detailed view at the outcrop of platy-thin-platy limestones with irregular cherty layers (upper bed). Loc. Rajtárka valley-profile IV — Plavecké Podhradie, Malé Karpaty Mts.

Plate 7

- Fig. 1. Weakly recrystallized biomicrite limestone. In the groundmass fragments of thin-walled lamellibranchs "filaments", are prevailing, sporadically were found ostracodes, globochets and foraminifers, besides the picture. Characteristic filament microfacies for the basal part of the Reifling limestones. Loc. Veľká Vápenná-ridge, 250 m NE of elev. p. 748, Malé Karpaty Mts. Magnif. 6 ×, photo by F. Martančík
 Fig. 2. Biopellmicrite to microsparite limestone. In the groundmass are abundant pellets, "filaments", rarely are radiolarians, globochets and foraminifers. Loc. Rajtárka — valley- profile V — Plavecké Podhradie, Malé Karpaty Mts. Magnif. 26 ×, photo by H. Brodnianska

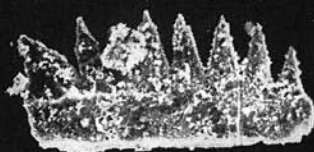
Plate 8

- Fig. 1. Pellmicrosparite limestone with silicified groundmass. The quartz is prevailingly idiomorphic authigenic with numerous enclosures of calcite. Loc. Rajtárka-valley-profile IV — Plavecké Podhradie, Malé Karpaty Mts. Magnif. 64 ×, photo by F. Martančík
 Fig. 2. Pellsparite limestone with sporadical clasts of algal micrite. Micrite microsparite groundmass only in relicts. Loc. Rajtárka-valley, profile V — Plavecké Podhradie, Malé Karpaty Mts. Magnif. 26 ×, photo by H. Brodnianska

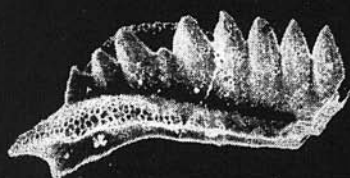
Plate 1



1a



1b



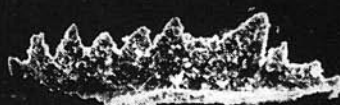
2a



2b



3a



3b



4a



4b

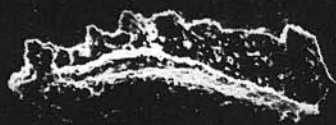
Plate 2



1a



2



1b



3



4a



4b



5a



5b

Plate 3

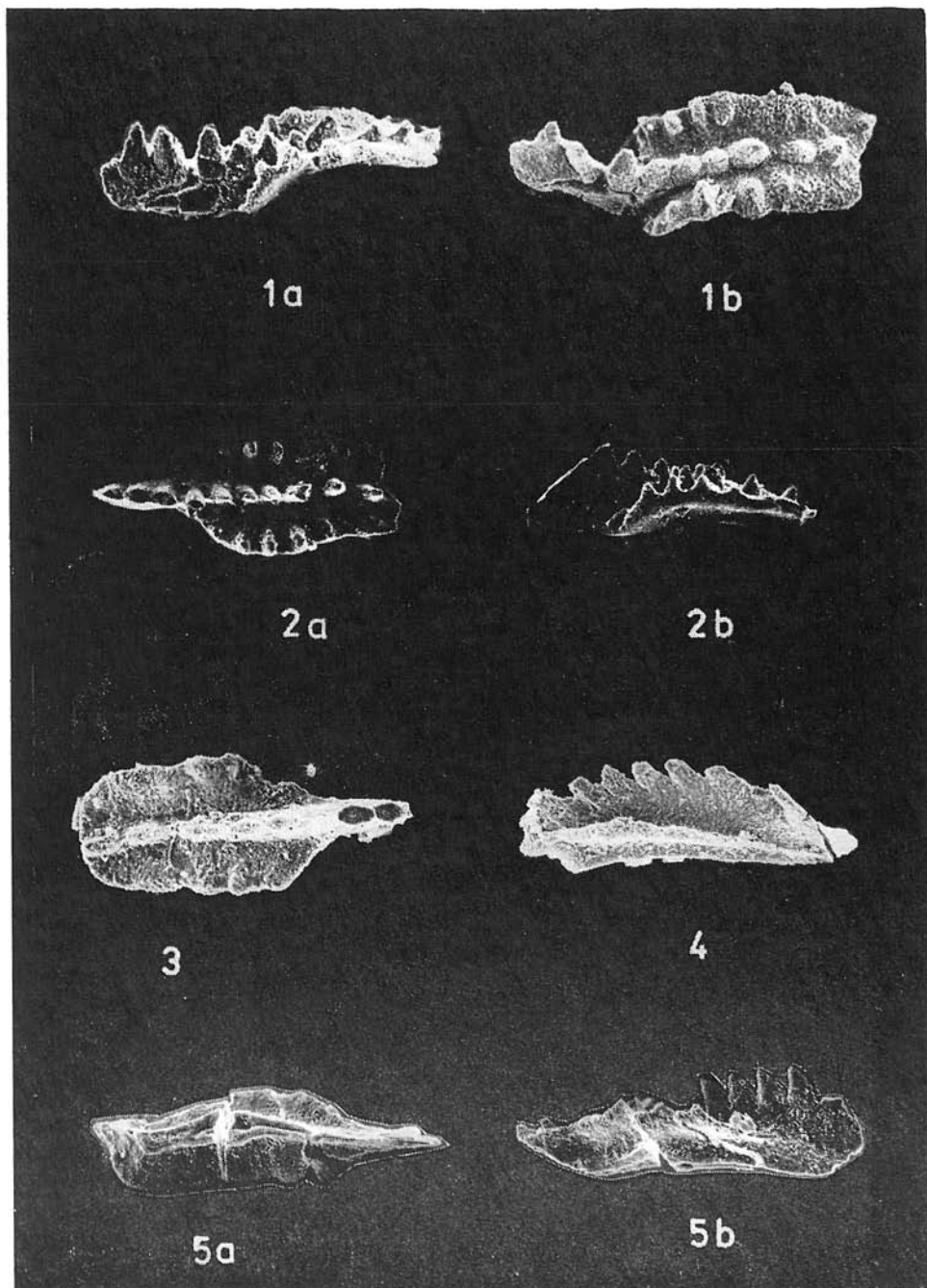


Plate 4



1a



1b



2a



2b



3a

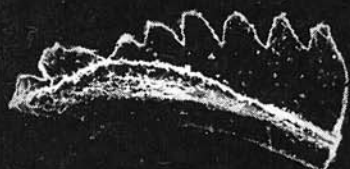


3b



4

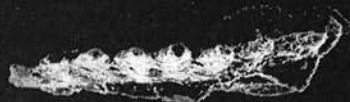
Plate 5



1a



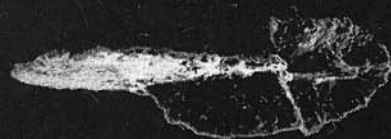
1b



2a



2b



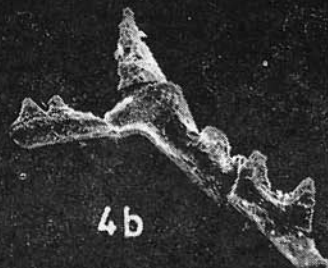
3a



3b



4a



4b

Plate 6

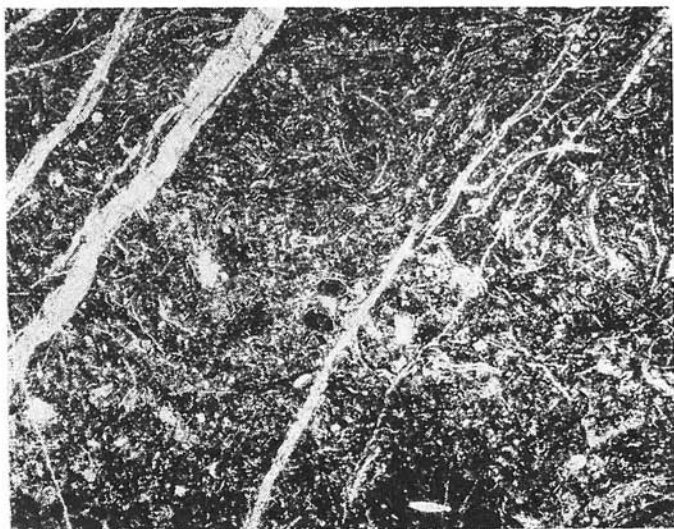


1

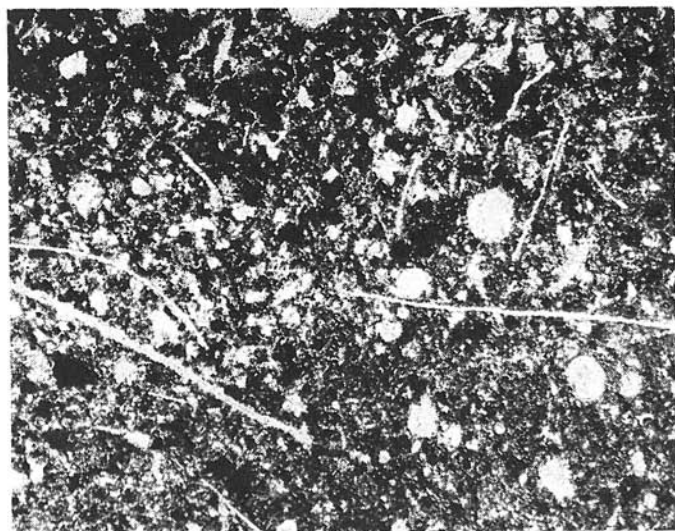


2

Plate 7

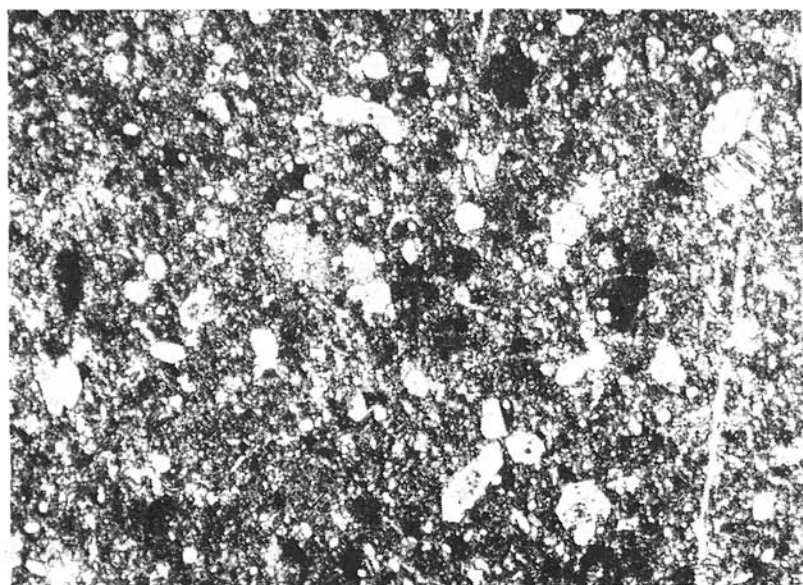


1

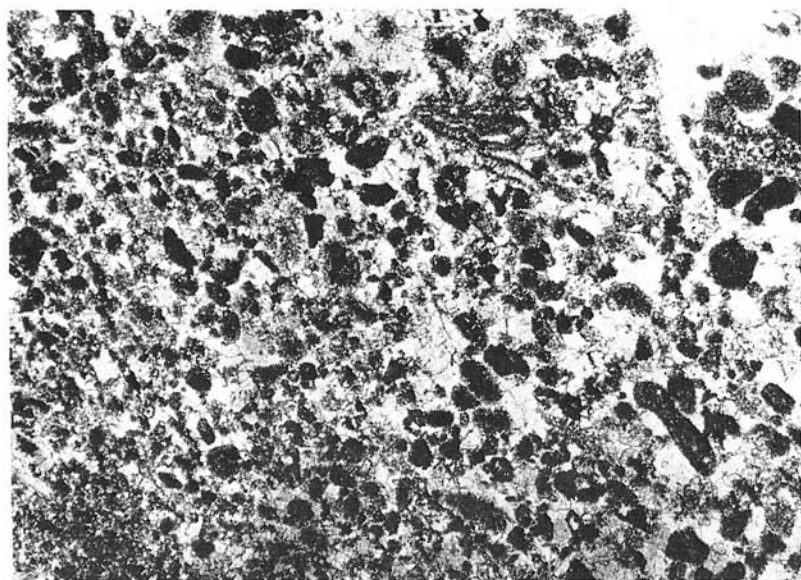


2

Plate 8



1



2

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Manuscript received April 12, 1983