

## Oligocene larger foraminifers in Paleogene sediments westward of Banská Bystrica (Middle Slovakia)

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**Abstract:** The Lower Oligocene larger foraminifers *Nummulites vascus* JOLY et LEYMERIE and *Nummulites* cf. *fichteli* MICHELOTTI are described from the Western Carpathian Inner Carpathian Paleogene of Sub-Tatric Group for the first time. They were found in several localities in the surrounding of Banská Bystrica in sandstones of Huty Formation (upper sandstone horizon) in the northern part of Zvolen Basin (Middle Slovakia). According to Cahuzac & Poignant (1997) the described species belong to SBZ 21 and are characteristic for transitional development between Sub-Tatric Group and Budín Paleogene.

**Key words:** larger foraminifers, Western Carpathians, Zvolen Basin, Lower Oligocene

### Introduction

The relicts of Paleogene rocks being preserved in the belt from Badín to Kordíky westward of Banská Bystrica (Middle Slovakia) formerly undoubtedly covered the larger and more continual area than in the present time.

Paleogene rocks in this area are known from the time of Štúr (1866, 1868), but literature data about them are very scarce. The age determination of these sediments was mentioned only by Vaňová (1972). She stated that the organogenic sandy limestones near Králiky contain Upper Eocene assemblage with *Nummulites variolarius* (LAMARCK), *N. incrassatus incrassatus* DE LA HARPE and the calcareous sandstones between Tajov and Králiky contain species *Nummulites variolarius* (LAMARCK), *N. striatus pannonicus* (ROZL.), *N. incrassatus incrassatus* DE LA HARPE and transitional forms from *N. fabianii* (PREVER) to *N. fichteli fichteli* MICHELOTTI. These transitional forms indicate the relatively young age of sediments. The recent investigations not only confirmed this fact, but owing the presence of *Nummulites vascus* JOLY et LEYMERIE the Oligocene age of rocks of Inner Carpathian Paleogene was for the first time proved by the larger foraminifers.

### Section in the Malachovský potok stream

According to recently valid knowledge the Paleogene sediments westward of Banská Bystrica belong to transitional development between Sub-Tatric Group sensu Gross et al. (1984) and Budín Paleogene sensu Tari et al. (1992), Gyalog et al. (1996) and Vass (2002).

Minute occurrences of Paleogene rocks are spread from Badín through Malachov, Radvaň, Tajov to Kordíky and belong to various formations. The most complete section can be studied in the Malachovský potok stream (BB-63) westward of village Malachov and 700 m to NW of altitude point Krpcová 935 (Fig. 1). Formation (section

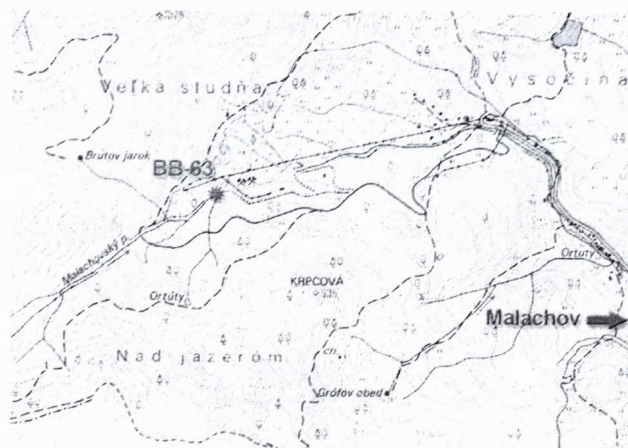
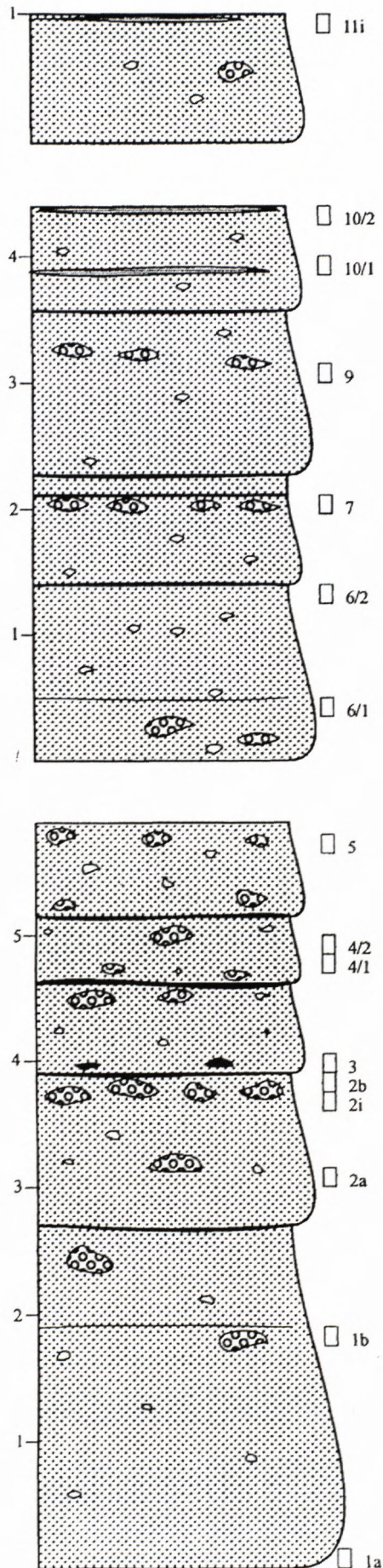


Fig. 1. Location of section Malachov BB-63 westward of Banská Bystrica in topographic sheet 36-143 Banská Bystrica in the scale 1 : 25 000.

in Fig. 2) is allocated to the upper sandstone horizon of Huty Formation and reaches the thickness to 20 m (Filo et al. in Polák et al. 2003).

Sandstones are bedded with rough planes, blue, grey (after weathering yellow), middle to coarse-grained, calcareous. Usually they are irregularly bedded, some layers have distinctive graded bedding with fine-grained upper part. They contain intraclasts of organodetritic (prevalingly Paleogene) limestones, pebbles of dolomites, less often quartzstones, limestones and shales of dimensions to 100 mm, max. 160 mm of spindle and isometric shapes. The quartz fragments are smaller and less re-worked. Pebble material is mostly chaotically distributed, sometime the occurrence of bigger pebbles near the bed surface is observable. The large pebbles of dolomite and further rocks toward the hanging wall became gradually rare and the quartz pebbles of 1-8 mm dimension is dominating.





Petrographically the sandstones correspond with calcareous sublithic and lithic arenites consisting from calcite cement (18-33 %), mono- (15-32 %) and polycrystalline (4-7 %) quartz, metamorphites (8-9 %), organic remnants (4-7 %), quartzstones (4-6 %), plagioclase (3-4 %), orthoclase (1-3 %), fragments of carbonates, sandstones, claystones, quartz porphyries, biotite, microcline and granitoids (Siráňová 2001).

Sandstones locally pass into the fine-grained conglomerates, their bigger pebbles locally form bands or lensoidal clusters of paraconglomeratic character.

#### Larger foraminifers in the Malachov section

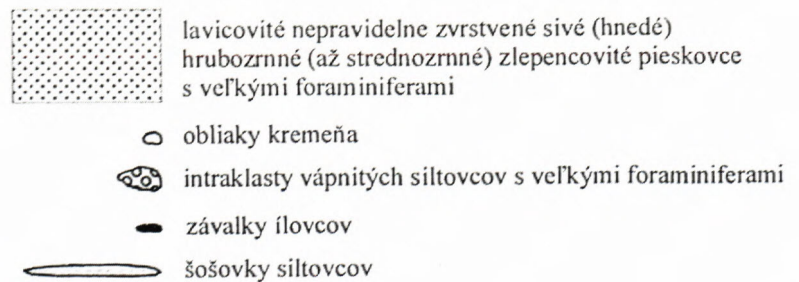
The larger foraminifers in the Malachov section occur either in fragments of Upper Eocene limestones and sandstones, or as isolated tests of Upper Eocene and Oligocene species in the sandstone matrix.

Fragments of Upper Eocene limestones and sandstones are spread in the whole section, but most frequently in horizons 2 to 7 (see section in Fig. 2). The cross-section through the fragment of Upper Eocene organogenic discocycline limestone with cross-sections of *Discocyclina sella* (D'ARCHIAC) is figured in Pl. I, Fig. 1. The fragments of Upper Eocene limestones and sandstones contain unmixed assemblages of larger foraminifers consisting from species *Nummulites striatus* (BRUG.), *N. variolarius* (LAMARCK), *N. chavannesii* DE LA HARPE, *N. incrassatus* DE LA HARPE, *Assilina* (*Operculina*) *alpina* (DOUVILLÉ), *Ass. (O.) gomezi* (COLOM et BAUZÁ), *Discocyclina sella* (D'ARCHIAC), *D. augustae* VAN DER WEIJDEN, *D. pratti* (MICHELIN), *Asterocyclina* sp. Another organic remnants are rare. These assemblages of Priabonian age belong to SBZ 19 sensu Serra-Kiel et al. (1998).

The fragments of Upper Eocene rocks are sometimes small and occur as clasts in sandstones. The fragment of sandstone with tests *Discocyclina sella* (D'ARCHIAC) are shown in Pl. I, Fig. 2. The axial section through the test *Nummulites fabianii* (PREVER), being still stuck around by former sandy rock, is shown in Pl. I, Fig. 4.

The majority of tests of larger foraminifers is redeposited without remnants of former rock and give the impression that they belong into the original assemblage in sandstones. Such assemblage is displayed e.g. in Fig. 5 of

Fig. 2. Section Malachov (BB-63). Left-bank cut of the Malachovský potok stream 700 m to NW of elevation point Krpcová (935), catastral area Banská Bystrica – Malachov.





Pl. I with cross-sections of *Nummulites striatus* (BRUG.) from the horizon 11 in the Malachov section. The majority of assemblage also in the sandstones is formed by Upper Eocene species (Pl. I, Figs. 3 and 6; Pl. II, Fig. 3).

The preservation of tests is usually excellent (e. i. *Nummulites striatus* (BRUG.) in Pl. II, Fig. 4 or *N. incrassatus* DE LA HARPE in Pl. II, Fig. 5), but also damaged tests, being grinded and fragmented (mainly the tests of discocyclines) are present.

The Upper Eocene larger foraminifers whose isolated tests are present in sandstones along the whole section of the Malachovský potok stream, belong to zones SBZ 19 and SBZ 20 sensu Serra-Kiel et al. (1998). The following species were identified: *Nummulites incrassatus* DE LA HARPE, *N. garnieri* BOUSSAC, *N. fabianii* (PREVER), *N. striatus* (BRUG.), *N. chavannesii* DE LA HARPE, *N. pulchellus* DE LA HARPE, *Assilina* (*Operculina*) *alpina* (DOUV.), *Ass. (O.) gomezi* (COLOM et BAUZÁ), *Heterostegina reticulata* (RÜTIMEYER), *H. (Grzybowskia) multifida* (BIEDA), *Spiroclypeus carpaticus* UHLIG, *Orbitoclypeus varians* (KAUFM.), *Discocyclina pulchra* CHECCHIA-RISPOLI, *D. sella* (D'ARCHIAC), *D. pratti* (MICHELIN), *D. augustae* VAN DER WEIJDEN, *Asterocyclina* sp. In thin sections very rarely also tests of Middle Eocene species can be recognized, e.g. *Nummulites* cf. *brongniarti* D'ARCHIAC et HAIME in horizon 6 and *N. millecaput* BOUBÉE in horizon 3. Rarely also small fragments of coral line algae, bryozoans, lamellibranchiata and crinoid segments are present. The smaller foraminifers are sporadically represented by miliolid, rotalid and agglutinated forms. The cross-sections through globigerinas are very scarce.

For the age classification of the Malachov section there is determining the presence of Oligocene larger foraminifers (Buček, 2001, Buček in Filo et al. 2003), namely *Nummulites vascus* JOLY et LEYMERIE and *N. cf. fichteli* MICHELOTTI, being found in the whole section (horizons 1 to 11, Fig. 2).

### Description of Oligocene larger foraminifers in the Malachov section

*Nummulites vascus* JOLY et LEYMERIE  
(Pl. I, Figs. 3, 6; Pl. II, Figs. 3, 6, 7)

The tests of *Nummulites vascus* JOLY et LEYMERIE are frequently present in the Malachov section and we succeeded in obtaining of isolated individuals for the study in oriented sections (Pl. II, Figs. 6, 7).

The tests are of symmetric lenticular shape, on their surface decorated with radial septal filaments, without central pillar. A-forms are 1.8-3.1 mm large and 0.9-1.2 mm thick, rarely present tests of B-forms have diameter 3.8-4.2 mm and thickness 1.2-1.7 mm. While the A-forms have 3-5 whorls, B-forms have maximally 7 whorls.

The protoconchs of A-forms have largeness 0.15-0.20 mm, the diameter of the first two chambers is 0.25-0.29 mm, the arrangement is isolepidine. The step of whorls grows slowly and regularly. For the radius 1.2 mm there are 4 whorls, for 1.4-1.6 mm 5 whorls. The marginal cord = 1/3 of the chambers height. Partitions are slightly in-

clined and moderately bended. For 1/4 of the 1. whorl = 2-3, 2. = 3-4, 3. = 4-5, 4. = 6-7 partitions. Chambers are higher than long, from the fourth whorl there is registrable the tendency to obtain the isometric form.

Stated values correspond with those, being stated for *N. vascus* JOLY et LEYMERIE by Blondeau (1972), Schaub (1981) and Jámboř-Kness (1988). With exception to Jámboř-Kness (l. c.), who allows the presence of *N. vascus* JOLY et LEYM. in Upper Eocene, further authors suppose this species to be typical for Oligocene.

The tests *N. vascus* JOLY et LEYM. occur mainly in horizons 1, 2, 3, 6, 8, 10 and 11 of the section Malachov BB-63.

*Nummulites* cf. *fichteli* MICHELOTTI  
(Pl. II, Figs. 1-2)

The tests of this species are relatively rare. We did not succeed in obtaining of isolated individuals for oriented sections and so this species is known only from axial sections. The tests are flat-lenticular to disc-like, sometimes bended, on the surface decorated with irregular fine reticulation. There were found only the tests of A-generation, having the diameter 4.0-6.5 mm and thickness 1.1-1.5 mm and formed maximally by 6 whorls.

The species is present only in Oligocene (Blondeau 1972; Schaub 1981). The tests were found in horizons 3, 10 and 11 of the section Malachov BB-63.

Both *N. vascus* JOLY et LEYM. as well as *N. cf. fichteli* MICHELOTTI are of Lower Oligocene age and belong to SBZ 21 sensu Cahuzac & Poignant (1997).

### Conclusions

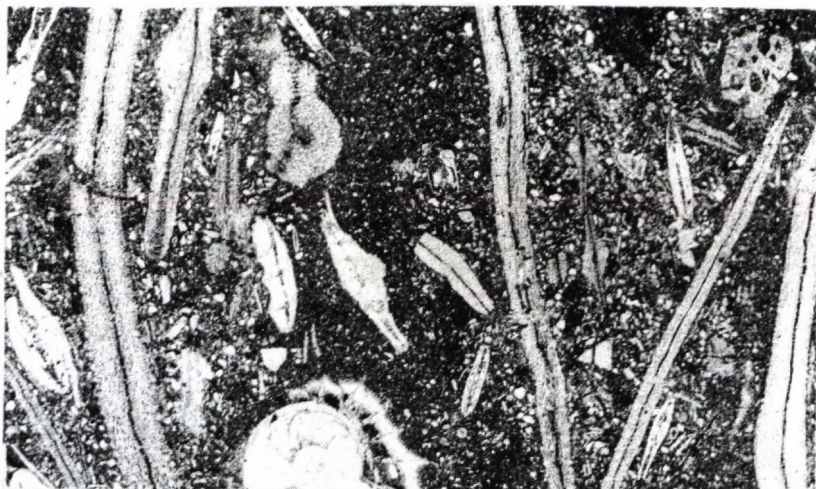
The section Malachov BB-63 contains the mixed assemblage of larger foraminifers formed by Upper Eocene to Oligocene species. The Upper Eocene component should be supposed to be redeposited, which is confirmed with clasts of Upper Eocene species.

The presence of numerous intraclasts and pebbles of large dimensions in the section confirms, that the origin of upper sandstone horizon of Huty Formation was caused by uplift and destruction of the basin margins due to tectonic events or the significant decrease of the sea level at the beginning of Oligocene. The second possibility seems to be more realistic, because the destruction affected only the Upper Eocene part of succession, the fragments from the Middle Eocene Borové Formation were not in the Malachov section found (with exception of very rare tests *Nummulites* cf. *brongniarti* D'ARCHIAC et HAIME and *N. millecaput* BOUBÉE, which could be redeposited already to Upper Eocene rocks).

Besides the Malachov section the tests *Nummulites vascus* JOLY et LEYMERIE and *N. cf. fichteli* MICHELOTTI were found also at Badín and Tajov.

From the Western Carpathian area the similar assemblage is known only from the outer flysch belt. From the lower Krosno Beds near Baligrod (Poland) Bieda (1963) described the mixed assemblage formed by redeposited tests of Upper Eocene larger foraminifers and tests of *Nummulites vascus* JOLY et LEYM. and *N. sp. aff.*

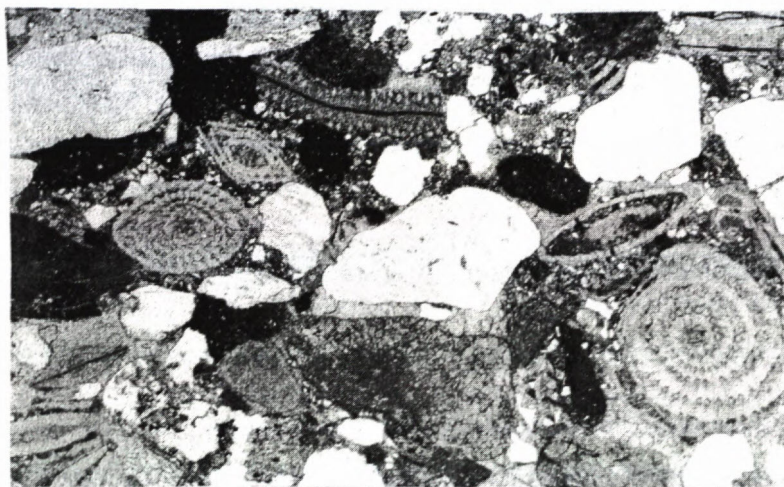




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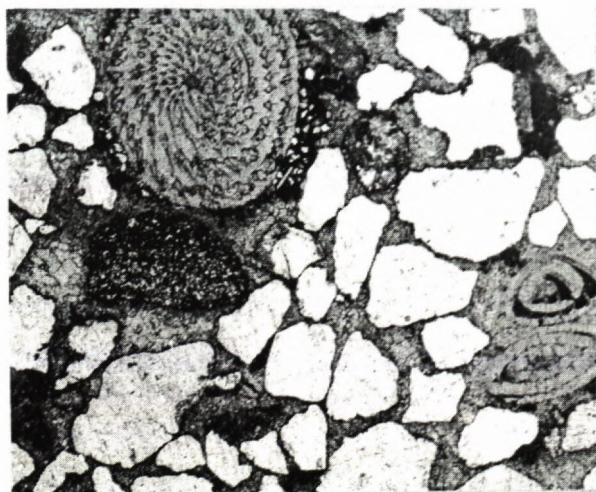
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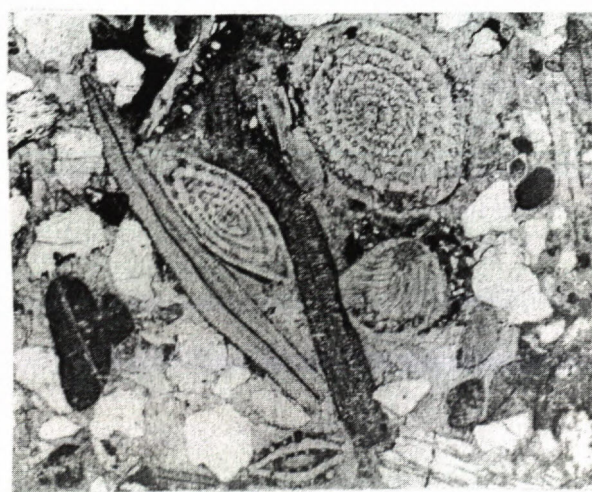
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## Plate I

Fig. 1 – Organogenic limestone with cross-sections of tests *Discocyclus sella* (D'ARCHIAC), *Assilina* (*Operculina*) *alpina* (DOUV.) and *Ass. (O.) gomezi* (COLOM et BAUZÁ). Fragment in debris, Malachov BB-63, thin section Bu-934, magn. 10x; Fig. 2 – Fragment of sandstone with *Discocyclus sella* (D'ARCHIAC) in Oligocene sandstone. Right side shows the redeposited test *Nummulites chavannesii* DE LA HARPE. Fig. 3 – Oligocene sandstone with sections of *Nummulites vascus* JOLY et LEYM. (oblique section in the right side), *N. variolarius* (LAMARCK), *Discocyclus pratti* (MICHELIN). Section Malachov BB-63-11, thin section Bu-944, magn. 10x;



*intermedius* D'ARCH. (= *N. fichteli* MICHELOTTI). This assemblage was designated by Bieda to be probable of Oligocene age. This phenomenon is noticeably similar to the situation in the section of Malachovský potok stream.

*Nummulites* cf. *vascus* JOLY et LEYM. describes Bieda (1931) from locality Turinok in Orava, but the presence of this species in Orava Paleogene was not confirmed with later works (Gross et al. 1993).

In Budín Paleogene the presence of *N. vascus* JOLY et LEYM. is stated by Kecskeméti (1981) from the section Solymar together with redeposited Upper Eocene nummulites and discocyclines. This author places this locality unambiguously into the Oligocene, similarly as the beds with *N. vascus* JOLY et LEYM. in locality Pilisborosjenő in the Pilis mountain ridge. Jámbo-Kness (1988) introduces this species from formations Tokod a Nagysáp situated to uppermost part of Priabonian.

In the Eastern Carpathians *N. vascus* JOLY et LEYM. in assemblage with *N. fichteli* MICHELOTTI (= *N. intermedius*) is announced by Nemkov (1955, 1967) from sediments of Menilite and Krosno units from Seletin. He does not doubt about their Oligocene age.

Logically there occurs a question, whether also Oligocene fossils in the Malachov section are not redeposited and the formation is not even younger. Despite very detail investigation of foraminifera fauna in this locality the younger sediments than those in SBZ zone 21 (= P 18-19, NP 21-23) of Rupelian age (sensu Cahuzac & Poignant, 1997) were not revealed.

The Huty Formation on northeastern margin of the Kremnica Hills was simultaneously elaborated also by microfauna and microflora studies. According to Zlinská (in Kováč et al. 2001) it corresponds to the age diapason Priabonian – Upper Kiscelian. The considerable differences were found by dating of the calcareous nanoplankton. According to Žecová (2000) the formation is of the age Priabonian - Lower Kiscelian (NP 19–21), according to Andrejeva-Grigorovič (in Zlinská 2001) it corresponds to Kiscelian to Lower Egerian (NP 23–25). The spread of the Huty Formation into Priabonian is confirmed also by the larger foraminifers (so-called basal sandstone horizon among Tajov, Kordíky and Králíky villages; Filo et al. 2003), the overreaching into Egerian appears exceedingly unprobable, also regarding the overall thickness of formation (ca 300 m).

The presence of Oligocene larger foraminifers near Banská Bystrica is surprising not only from the stratigraphic viewpoint, but raises the doubt about the commonly accepted thesis, that in Western Carpathian Oligocene the larger foraminifers were not preserved because of climatic

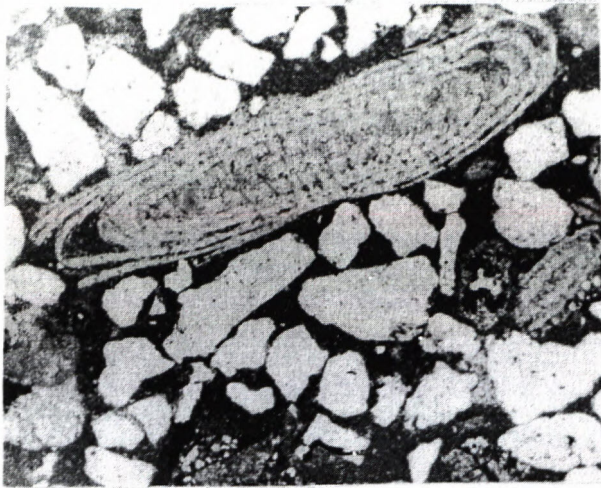
reasons. Though Portnaja (1981) supposes the distinctive cooling at the beginning of Oligocene as a reason of disappearance of discocyclinid foraminifers, she warns, that nummulites could survive also at lowered temperature of the sea water (according to her to 16 °C).

## References

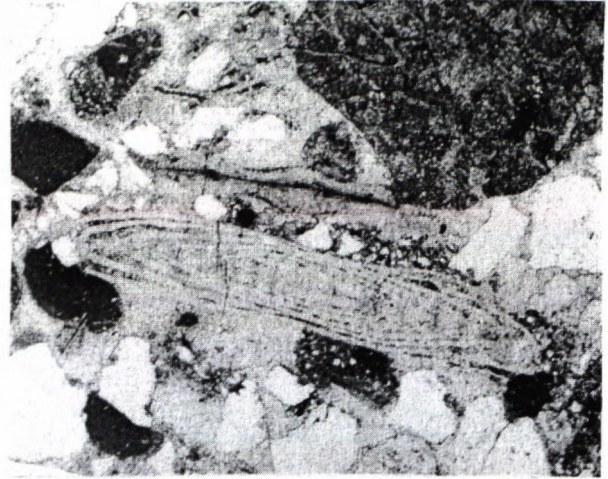
- Bieda, F., 1931: O kilku nummulinach z Karpat czechoslowackich. Věstn. Stát. geol. Úst. ČSR (Praha), 7, 1, 58-74.
- Bieda, F., 1963: Siódmy poziom dużnych otwornic we fliszu Karpat polskich. Roczn. Pol. Tow. geol. (Krakow), 33, 2, 189-218.
- Blondeau, A., 1972: Les Nummulites. Vuibert, Paris, 1-254.
- Buček, S., 2001: Biostratigraphic evaluation of larger foraminifers in the project No. 150: Starohorské vrchy Hills, Čierťaz and northern part of the Zvolen Basin (map sheet 36-143 Banská Bystrica). Manuscript, archives ŠGÚDŠ, Bratislava. (in Slovak)
- Cahuzac, B. & Poignant, A., 1997: Essai de biozonation de l'Oligo-Miocène dans les bassins européens à l'aide des grands Foraminifères néritiques. Bull. Soc. géol. France (Paris), 168, 2, 155-169.
- Filo, I., Buček, S. & Siránová, Z., 2003: Paleogén. In: Polák, M. (ed.), Filo, I., Havrila, M., Bezák, V., Kohút, M., Kováč, P., Vozár, J., Mello, J., Maglay, J., Elečko, M., Vozárová, A., Olšovský, M., Šiman, P., Buček, S., Siránová, Z., Hók, J., Rakús, M., Lexa, J., Šimon, L., Pristaš, J., Kubeš, P., Zakovič, M., Liščák, P., Žáková, E., Boorová, D. & Vaněková, H.: Explanations to geological map of Starohorské vrchy Hills, Čierťaz and northern part of the Zvolen Basin 1 : 50 000. ŠGÚDŠ, Bratislava, 91-97. (in Slovak)
- Gross, P., Köhler, E. & Samuel, O., 1984: Lithostratigraphic classification of Inner Carpathian Paleogene sedimentary cycle. Geol. Práce, Spr. (Bratislava), 81, 103-117. (in Slovak)
- Gross, P., Köhler, E., Mello, J., Haško, J., Halouzka, R., Nagy, A. et al., 1993: Geology of southern and eastern Orava. Geol. Úst. D. Štúra, Bratislava, 7-319. (in Slovak)
- Gyalog, L. (ed.), 1996: A földtani térképnek jelkölcsa és a rétegtani egységek rövid leírása. Magy. All. Földt. Int. Alkalmi kiadványa (Budapest), 187, 1-171.
- Jámbo-Kness, M., 1988: Les grands Foraminifères éocènes de la Hongrie. Geol. Hung., Palaeontol. (Budapest), 52, 3-629.
- Kecskeméti, T., 1981: The Eocene/Oligocene boundary in Hungary in the light of the study of larger foraminifera. Palaeogeogr., Palaeoclimatol., Palaeoecol. (Amsterdam), 36, 3/4, 249-262.
- Kováč, P., Hók, J., Maglay, J., Filo, I., Lexa, J., Filová, I., Elečko, M., Boorová, D., Siránová, Z., Buček, S. & Zlinská, A., 2001: Explanations to geological map 1 : 25 000, map sheet 36-143 Banská Bystrica. Manuscript, archives ŠGÚDŠ, Bratislava. (in Slovak)
- Nemkov, G. I., 1955: Numulitidy i orbitoidy Pokutsko-Marmarošských Karpat i Severnoj Bukoviny. In: Materialy po biostrat. zap. obl. Ukr. SSR, Gostechizdat, Moskva, 133-227.
- Nemkov, G. I., 1967: Numulitidy Sovetskogo Sojuza i ich biostratigrafičeskoje značenie. Nauka, Moskva, 5-318.
- Portnaja, V. L., 1981: Orbitoidy Sovetskogo Sojuza i utočnenije ich sistematiki. Izv. Vyšš. učeb. zav., Geol. i razv. (Moskva), 7, 35-39.
- Schaub, H., 1981: Nummulites et Assilines de la Téthys paléogène. Taxinomie, phylogénèse et biostratigraphie. Schweiz. Paläontol. Abh. (Basel), 104-106, 3-236.
- Serra-Kiel, J., Hottinger, L., Caus, E., Drobne, K., Ferrández, C., Jauhri, A. K., Less, G., Pavlovec, R., Pignatti, J., Samsó, J. M., Schaub, H., Sirel, E., Strougo, A., Tambareau, Y., Tosquella, J. & Zakrevskaya, E., 1998: Larger foraminiferal biostratigraphy of the Tethyan Paleocene and Eocene. Bull. Soc. géol. France (Paris), 169, 2, 281-299.

Fig. 4 – Axial section through redeposited test *Nummulites fabianii* (PREVER), still stuck around with original rock. Oligocene sandstone, section Malachov BB-63-2, thin section Bu-1011, magn. 10x; Fig. 5 – Oligocene sandstone with sections of *Nummulites striatus* (BRUG.) (upper part of the picture) and *Nummulites* sp. Section Malachov BB-63-11, thin section Bu-945, magn. 10x; Fig. 6 – Oligocene sandstone with cross-sections of *Nummulites vascus* JOLY et LEYM. (oblique section in the upper part), *N. fabianii* (PREVER) (axial section in the middle), *Discocyclina sella* (D'ARCHIAC) a. o. Section Malachov BB-63-10, thin section. Bu-927, magn. 10x. Photo by the authors.

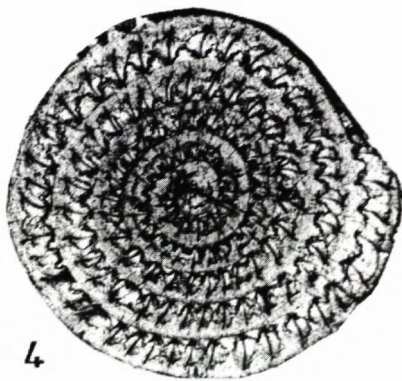




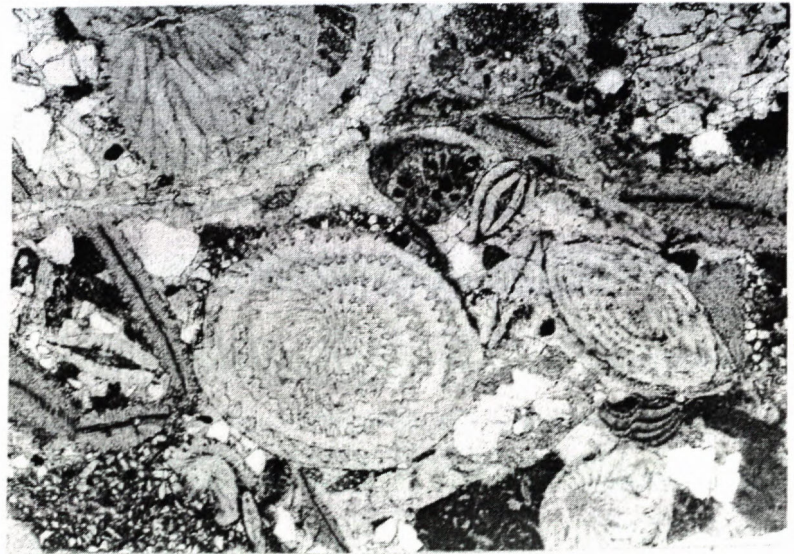
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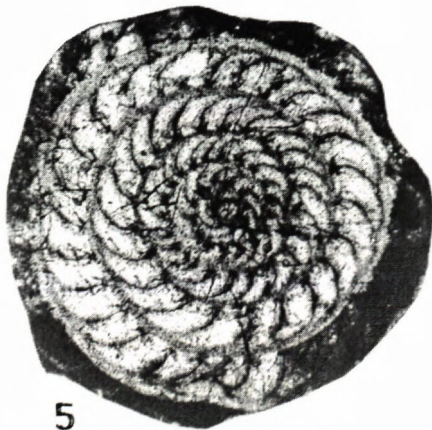
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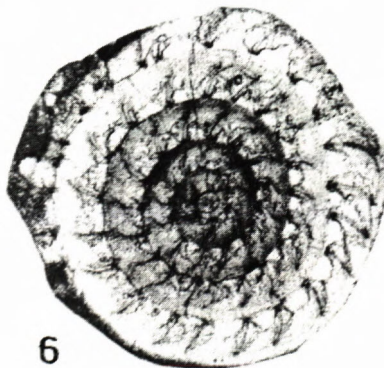
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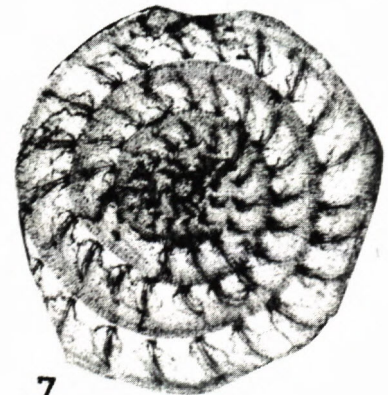
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## Plate II

Fig. 1 – Oligocene sandstone with cross-section of *Nummulites* cf. *fichteli* MICHELOTTI. Section Malachov BB-63-2, thin section Bu-1011, magn. 10x; Fig. 2 – Oligocene sandstone with cross-section of *Nummulites* cf. *fichteli* MICHELOTTI. Section Malachov BB-63-3, thin section Bu-1020, magn. 10x; Fig. 3 – Oligocene sandstone with cross-sections of *Nummulites vascus* JOLY et LEYMERIE (oblique section in the middle and upper parts), *N. fabianii* (PREVER) (axial section in the right), *Discocyclina sella* (D'ARCHIAC) a. o.



- Siráňová, Z., 2001: Petrographic evaluation of thin sections (map sheet Banská Bystrica 36-143 1:25 000). Manuscript, archives ŠGÚDŠ, Bratislava. (in Slovak)
- Štúr, D., 1866: Petrefacten von Liptsche. Jb. K. Kön. geol. Reichsanst. (Wien), 16, 1, 57-58.
- Štúr, D., 1868: Bericht über die geologische Aufnahme im oberen Waag- und Granthale. Jb. K. Kön. geol. Reichsanst. (Wien), 18, 3, 337-426.
- Tari, G., Báldi, T., Báldi-Béke, M., 1992: Paleogene retroarc flexural basin beneath the Neogene Pannonian Basin: A geodynamic model. Tectonophysics (Amsterdam), 226, 433-455.
- Vaňová, M., 1972: Nummulites from the area of Bojnice, the Upper Hron Depression, and the Budín Paleogene around Štúrovo. Zbor. geol. Vied, Záp. Karpaty (Bratislava), 17, 5-104.
- Vass, D., 2002: Lithostratigraphy of Western Carpathians: Neogene and Budín Paleogene. Št. geol. Úst. D. Štúra, Bratislava, 1-202. (in Slovak)
- Zlinská, A., 2001: Microfaunistic evaluation of samples in project No. 150: Starohorské vrchy Hills, Čierťaž and northern part of Zvolen Basin (map sheets 36-141 Staré Hory, 36-142 Lučatín and 36-143 Banská Bystrica). Manuscript, archives ŠGÚDŠ, Bratislava. (in Slovak)
- Žecová, K., 2000: Microbiostratigraphic evaluation of calcareous nanoplankton from localities Kordfky, Tajov, Králiky, Lúbietová. Manuscript, archives ŠGÚDŠ, Bratislava. (in Slovak)

Section Malachov BB-63-10, thin section Bu-929, magn. 10x; Fig. 4 – Equatorial section through A-form of *Nummulites striatus* (BRUG.). Section Malachov BB-63, thin section Bu-IZ/14, magn. 20x; Fig. 5 – Equatorial section through A-form of *Nummulites incrassatus* DE LA HARPE. Section Malachov BB-63, thin section Bu-IZ/1, magn. 20x; Fig. 6 – Equatorial section through A-form of *Nummulites vascus* JOLY et LEYM. Section Malachov BB-63, thin section Bu-IZ/13, magn. 20x; Fig. 7 – Equatorial section through A-form of *Nummulites vascus* JOLY et LEYM. Section Malachov BB-63, thin section Bu-IZ/12, magn. 20x. Photo by the authors.