

Bioevents at the Paleocene/Eocene boundary in flysch sediments of the Bílé Karpaty Unit (West Carpathians, Czech Republic)

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Abstract

Several meters thick section through the Paleocene/Eocene boundary was studied in the flysch sediments of the Bílé Karpaty Unit. Calcareous-nannofossil assemblage of the Zone NP9 is replaced by assemblage of NP10 at the boundary. Low diversity assemblages of agglutinated foraminifers - surface-dwelling detritus feeders - can be compared with "low-oxygen" biofacies of various authors. Diversity and variety of feeding strategies of agglutinated assemblages grow from upper part of NP10 Nanno-Zone in the Bílé Karpaty Unit. Bioevents at the Paleocene/Eocene boundary are supposed to be caused by high productivity of phytoplankton connected with decrease in oxygen content. In the Bílé Karpaty Unit the stratigraphically important taxa of agglutinated foraminifers of Upper Senonian - Paleocene interval (rzhakinids, some hormosinids, *Glomospirella grzybowskii* etc.) disappear in the early NP9 Nanno-Zone and marker taxa of the Eocene (*Reophax nodulosus*, *R. elongatus*) appear in the late NP10 Nanno-Zone. The absence of this species in interval close to Paleocene/Eocene boundary was probably caused by restricted conditions in bottom waters.

On the Paleocene/Eocene boundary (hereinafter denoted by PEB), an extent change of different fossil groups takes a place. Global changes in deep-sea agglutinated foraminifera assemblages are especially marked. Many agglutinated taxa extinct (some hormosinids, rzhakinids, *Glomospirella grzybowskii* (JURKIEWICZ), *Sphaerammina gerochi* HANZLÍKOVÁ etc.) and other taxa appear (*Saccamminoides carpathicus* GERÖCH, *Reophax nodulosus* BRADY, *R. elongatus* GRZYBOWSKI).

In pelagic environment the assemblages of several microfossil groups change taxonomically. As concerns calcareous nannofossils, several genera disappear near the end of the Paleocene, namely *Fasciculithus*, *Rhombosaster*, *Placozygus*, *Hornibrookina* (Perch-Nielsen, 1985), *Tribrahiatus contortus* (STRADNER) BUKRY (nominate taxon of the NP10 Zone of Martini, 1971) together with *Tribrahiatus bramlettei* (BRONNIMANN and STRADNER) PROTO DECIMA et al. and *Discoaster diastypus* BRAMLETTE and SULLIVAN have their first occurrence on the PEB (Perch-Nielsen, 1985). Upon planktonic foraminifers the PEB is determined by the last occurrence of *Morozovella velascoensis* (CUSHMAN), that means at upper boundary of *M. velascoensis* Zone [e.g. Berggren (1971) places the PEB at the first occurrence of *Pseudohastigerina wilcoxoensis* (CUSHMAN and PONTON). This "*Pseudohastigerina datum*" is about age-equivalent of *M. velascoensis* Zone (Tourmarkine and Luterbacher, 1985). According to these criteria, the PEB should be placed to the boundary of P6a and P6b Zones of Blow (1969), P6 and P7 Zones of Blow (1979) and to the boundary of *Morozovella velascoensis* and *M. edgari* Zones of Bolli (1966) and *M. velascoensis* and *M. subbotinae* Zones of Stainforth et al. (1975).

Paleocene/Eocene boundary in the Blatnička section

Several meter thick section through the PEB was studied in 1989 in the Nivnice Formation of the Bílé Karpaty Unit. The section was open by an accidental excavation near southeast end of Blatnička village in small forest close to the road to Boršice. Thin to medium bedded flysch sequence consists of light grey, fine-grained calcareous sandstones (mostly Tc turbidite members), brown grey siltstones (Td) and grey, brown grey rarely green grey marly claystones. Hemipelagites are represented by thin (up to 7 cm) intercalations of grey green spotted carbonate-free clays. Calcareous nannofossils and planktonic foraminifers were obtained from the turbidite marly claystones (Te). Hemipelagite clay intercalations contain only agglutinated foraminifera and less frequent radiolarians and fish teeth. Benthic fauna of the hemipelagites is supposed to be completely autochthonous.

Stratigraphically important taxa (*Rzhakina* and *Hormosina* representatives, *Glomospirella grzybowskii* (JURKIEWICZ), *Saccamminoides carpathicus* GERÖCH, *Reophax elongatus* GRZYBOWSKI, *R. nodulosus* BRADY) are missing in studied section. Their absence could be explained by restricted conditions near the PEB in the Bílé Karpaty Unit. *Rzhakina epigona* (RZEHAK), *R. fissistomata* (GRZYBOWSKI) and *Glomospirella grzybowskii* disappear in the Bílé Karpaty Unit probably in the lower part of NP9 Nanno-Zone. On the other hand the Eocene markers *Reophax nodulosus* and *R. elongatus* appear in higher levels of NP10. The increased occurrence of different *Glomospira* representatives at the PEB (see fig. 2) seems to be only distinct bioevent. *Glomospira* assemblage is characteristic for the Lower Eocene of the Carpathian flysch [e.g. Morgiel and Olszewska, 1981, Malata, 1981], but it is distributed also world-wide.

Samples 64E and 64G (see fig. 1) contain assemblage with *Discoaster multiradiatus* BRAMLETTE and RIEDEL, *Rhombosaster cuspis* BRAMLETTE and SULLIVAN, *Fasciculithus schaubii* HAY and MOHLER, and rarely *Pontosphaera rimosa* (BRAMLETTE and SULLIVAN) ROTH and THIERSTEIN. This assemblage indicates upper part of NP9 Zone of the uppermost Paleocene. Different nannofossil assemblage appear in samples 64I and 64J. Occurrence of *Pontosphaera plana* (BRAMLETTE and SULLIVAN) HAO, *Campylosphaera eodola* BUKRY and PERCIVAL, *Zygrhablithus bijugatus* (DEFLANDRE and FERT) DEFLANDRE and *Discoaster binodosus* MARTINI marked basal part of NP10 Zone of the Early Eocene.

Only poor assemblages of planktonic foraminifers were unfortunately obtained from turbidite marly claystones (Te). The stratigraphically important taxa for determination of the PEB as *Morozovella velascoensis* (CUSHMAN) and *Pseudohastigerina wilcoxoensis* (CUSHMAN and PONTON) are generally missing in Magura flysch of Carpathians. Nevertheless the occurrence of *Subbotina velascoensis* (CUSHMAN) and *Morozovella subbotinae* (MOROZOVA) indicates the Paleoc-

ne/Eocene transition. Radiolarians of predominantly spherical shape, often limonitized, are frequent in studied section.

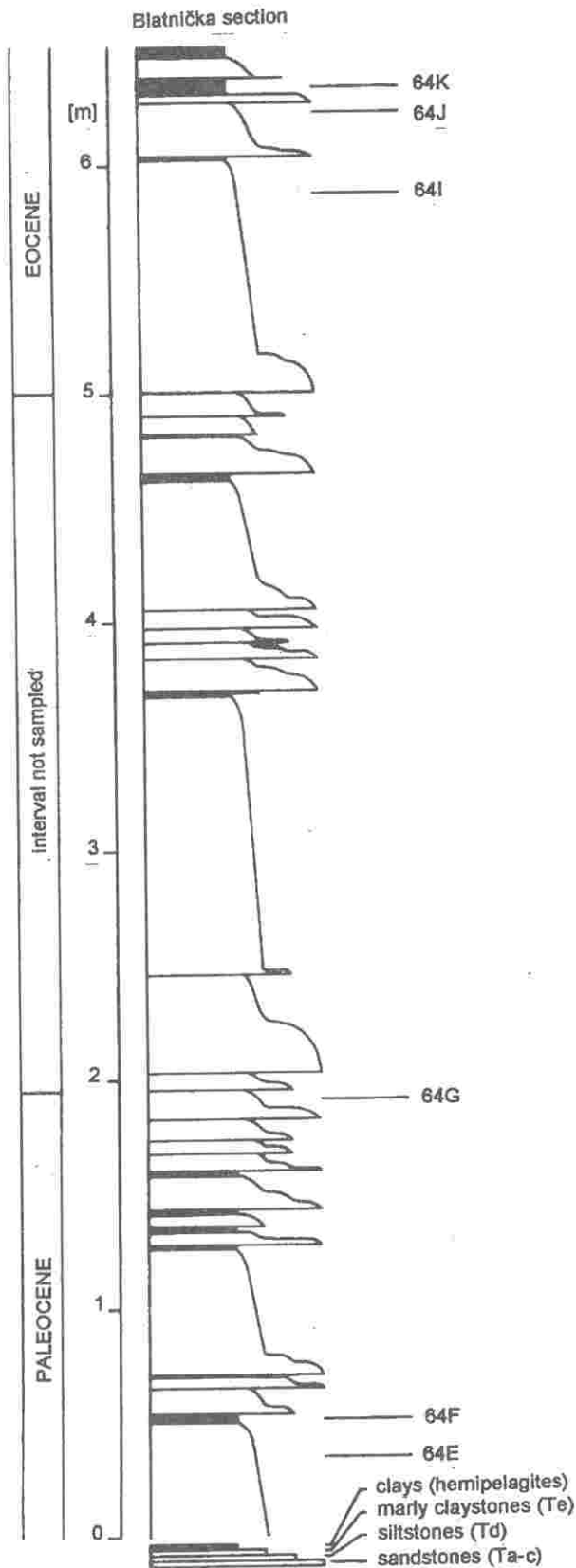


Fig. 1. Lithology of the Nivnice Formation in Blatnička at the Paleocene/Eocene boundary.

Agglutinated assemblages of hemipelagic intercalations (samples 64F and 64K, see fig. 1) possess species diversity about 15. *Glomospira* representatives and small form of *Recurvoides* (?new species) dominate the assemblages. Test size of agglutinated taxa is small. That suggest, together with somewhat low diversity, the decreased oxygen content. These assemblages can be compared with the biofacies B of Kuhnt, Kaminski and Moullade (1989) and also with flysch type biofacies of lower slope of the mentioned authors. Dominant representatives of the *Glomospira* and *Recurvoides* belong to the morphogroup B of surface dwelling herbivores and detritivores, *sensu* Jones and Charnock (1985). That suggest the idea of increased detritus input connected with the increased productivity of phytoplankton (but not strong overproduction). In other areas the organic-rich sediments and biosilicites appear at the PEB. Such lithological phenomena are not developed at the PEB in studied section. Plankton productivity in Magura flysch was probably lesser. In the more external Rača and Bystrica units of Magura flysch even well-oxygenated bottom-water conditions are evidenced by variegated sedimentation.

Nevertheless decrease in benthic diversity to about 15 at the PEB from more than 30 in Late Paleocene NP8 Nanno-Zone (the Nivnice Formation, Louka locality) supports the idea of the decreased oxygen content that was caused by the increased phytoplankton productivity. On the contrary calcareous-nannofossil diversity increased from about 20 species in NP8 Zone (Louka locality) to about 30 species at the PEB (studied section). Extremely low diversity (2 to 5) possesses the agglutinated assemblage from the type locality of Nivnice Formation (small old quarry in Nivnice village). Sediments of this locality belong to the NP9 Nanno-Zone of the latest Paleocene. The agglutinated assemblage is dominated by small *Bathysiphon broegei* TAPPAN, frequent is small form of *Recurvoides* (mentioned above), and rarely occur "*Rhizammina*" and *Subreophax scalaria* (GRZYBOWSKI). This assemblage should represent an ecological equivalent of biofacies B of Kuhnt, Kaminski and Moullade (1989), respectively "low-oxygen" assemblage of Kuhnt and Kaminski (1989).

Benthic species diversity is locally higher in later levels of NP10 Nanno-Zone at Louka locality and increased up to 28 in NP11 Nanno-Zone of the Kuželov Formation (Javorník, clay pit). Low-diversity assemblage of predominantly opportunistic surface-dwelling detritus feeders and herbivores connected probably with increased plankton detritus input at the PEB is gradually replaced by more complex assemblages of diverse feeding strategy, *sensu* Jones and Charnock (1985). In later levels of Nanno-Zone (Louka locality), the infaunal detritus feeders (*Reophax*), surface-dwelling deposit feeders (*Ammidiscus*) and erected tubular suspension feeders (*Nothia*, "*Rhizammina*") are already present. That illustrates slow development of agglutinated assemblages during the Early Eocene.

Detail data on faunal density, organic carbon content and more detail quantitative distributional data on fossil content would be helpful for better understanding of the Paleocene/Eocene boundary event. Reinvestigation of Blatnička section, especially detail sampling could bring valuable contribution to this topic.

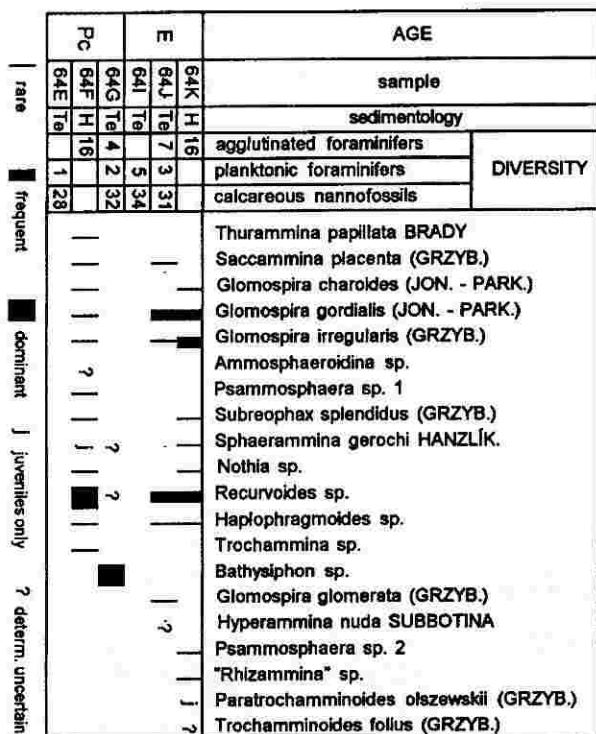


Fig. 2. Distribution of agglutinated foraminifera and diversity of different microfossil groups in Blatnička Section. Abbreviation used for sedimentology: H - hemipelagite, Te - turbidite claystone (Te interval).

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Refugia in ecology: a question of their existence and their basic attributes

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Introduction

An explanation about possible source-areas or biological sources represents one of the most promising views to the recovery game that superimposes over the global crisis.

Major categories are suggested here: refugia and relicts. Both subjects display two faces - they are as the biotope as the joined biological system. We cannot dissect the structures exclusively even favoring a holistic approach.

As clearly visible from the name, the refugium is a place that is convenient for coming "refugees" that is such a pla-

ce that can adsorb a partial biota stressed in neighborhood. The refugium, as a biotope, is settled by migrants they are coming from marginal of previously flourishing ecosystems. Various types can be distinguished among these settlements or colonizations: from random or passive dispersals, through changed-reproductive but still "passive" ways, up to an "active or aimed" invasion. The beginning crises have to be reflected by "a flow in" on the fluctuating margins of the refugium.

Contrary to this scenario, a relict of formerly flourishing ecosystem is never characterized by any important "flow in"; that means no large-spectrum immigration can be detected.