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K/T BOUNDARY IN THE TURBIDITE SEQUENCE OF THE EMINE FORMATION NEAR KOZICHINO VILLAGE, BOURGAS DISTRICT (EASTERN BALKAN): FORAMINIFERAL ASSEMBLAGES

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ABSTRACT. Totally 80 species (20 planktic and 60 benthic) were established in the foraminiferal assemblages from the K/T boundary interval near Kozichino Village. Planktic foraminifers are divided into three groups: Cretaceous, survivors and Paleocene ones. Cretaceous forms occur with rare or single specimens and this fact makes difficult the biostratigraphical characterization of the interval which is referred to the Abathompalus mayaroensis Zone. The K/T boundary was localized without any difficulty, because of the very clear taxonomical change. The Paleocene part of the section is referred to Pα and P1a Zone. The P0 Zone was not defined because *Parvulorugoglobigerina eugubina* (Luterbacher & Premoli Silva) and *Eoglobigerina fringa* (Subbotina) appear in the lowermost Paleocene sample.

The investigated boundary interval is characterized by comparatively uniform benthic foraminiferal assemblages dominated by agglutinated taxa. Common species in all samples are *Bathysiphon discreta* (Brady), *Ammodiscus glabratus* Cushman & Jarvis, *Dendrophrya excelsa* Grzybowski, *Saccammina placenta* (Grzybowski), *Spiroplectinella dentata* (Alth). Hyaline forms are rare with exception of the uppermost Cretaceous and the lowermost Paleocene samples where they are dominating component. Their main representative is *Quadrimorphina allomorphinoides* (Reuss). As a whole there are no any changes across the K/T transition in the benthic assemblage taxonomical composition and structure.

Key words: foraminifera, K/T boundary, Emine Formation, Eastern Balkan

ГРАНИЦАТА КРЕДА/ТЕРЦИЕР В ТУРБИДИТИТЕ НА ЕМИНСКАТА СВИТА ПРИ С. КОЗИЧИНО, БУРГАСКА ОБЛАСТ (ИЗТОЧНА СТАРА ПЛАНИНА): ФОРАМИНИФЕРНИ АСОЦИАЦИИ

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РЕЗЮМЕ. 80 вида (20 планктонни и 60 бентосни) бяха установени в изследваните фораминиферни асоциации от граничния интервал Креда/Терциер при с. Козичино. Планктонните фораминифери са поделени на три групи: кредни, преживяващи и палеоценски. Кредните форми се срещат предимно като редки и единични екземпляри и този факт затруднява биостратиграфското характеризиране на този интервал, който може да бъде отнесен към зона Abathompalus mayaroensis. Границата K/T се локализира без никакви затруднения, поради много ясната промяна в таксономичния състав на асоциациите. Палеоценската част от разреза се отнася към зоните Pα и P1a. Зона P0 не е дефинирана, тъй като видовете *Parvulorugoglobigerina eugubina* (Luterbacher & Premoli Silva) и *Eoglobigerina fringa* (Subbotina) се появяват още в най-долната палеоценска проба.

В изследвания граничен интервал се наблюдават сравнително еднообразни бентосни фораминиферни асоциации, които с редки изключения са доминирани от аглутинирани форми. Характерни видове за всички проби са *Bathysiphon discreta* (Brady), *Ammodiscus glabratus* Cushman & Jarvis, *Dendrophrya excelsa* Grzybowski, *Saccammina placenta* (Grzybowski), *Spiroplectinella dentata* (Alth). Хиалинните бентосни форми са по-слабо представени, като само в пробите непосредствено около граничния слой те доминират количествено над аглутинираните. В тези проби основният елемент на асоциациите е *Quadrimorphina allomorphinoides* (Reuss). Като цяло не се констатира промяна в таксономичния състав и структурата на бентосните асоциации при преминаването на граничния слой.

Ключови думи: фораминифери, граница Креда/Терциер, Еминска свита, Източна Стара планина

Introduction

The Eastern Balkan is of great interest for the K/T boundary researchers, because the boundary clay layer in Bulgaria was first described from this part of the country – near Byala Town, Varna District (Stoykova, Ivanov, 1992). Another nine outcrops were found later (Fig. 1): N of Emona Village (Sinnyovsky, Stoykova, 1995), Kozichino Village and Aytos Pass (Sinnyovsky, Vangelov, 1997), Marash River south of Kotel (Стойкова et al., 2000), "Chudnite Skali", Kozya River, Razkrachenitsa River (Вангелов, Синьовски, 2000; Sinnyovsky, 2001), N of Cape Kochan (Sinnyovsky, 2004), and near Goritza Village (Stoykova et al., 2004).

As the majority of the publications have described the mass extinction event at the K/T boundary from nerritic or hemipelagic deposits (for example Gubbio, El Kef, Caravaca, Agost, etc.) the present article aims to reveal the foraminiferal turnover across the Cretaceous/Paleocene boundary in a turbidite sequence.

The section near Kozichino Village is the first place where the boundary layer in Bulgaria was established in turbidite deposits (the second one is N of Cape Kochan, while in the section N of Emona Village the layer was not found). It was first described by Sinnyovsky (2003) who localized biostratigraphically the boundary by means of calcareous nannofossils. The section is one of the five protected outcrops of the K/T boundary in Bulgaria.

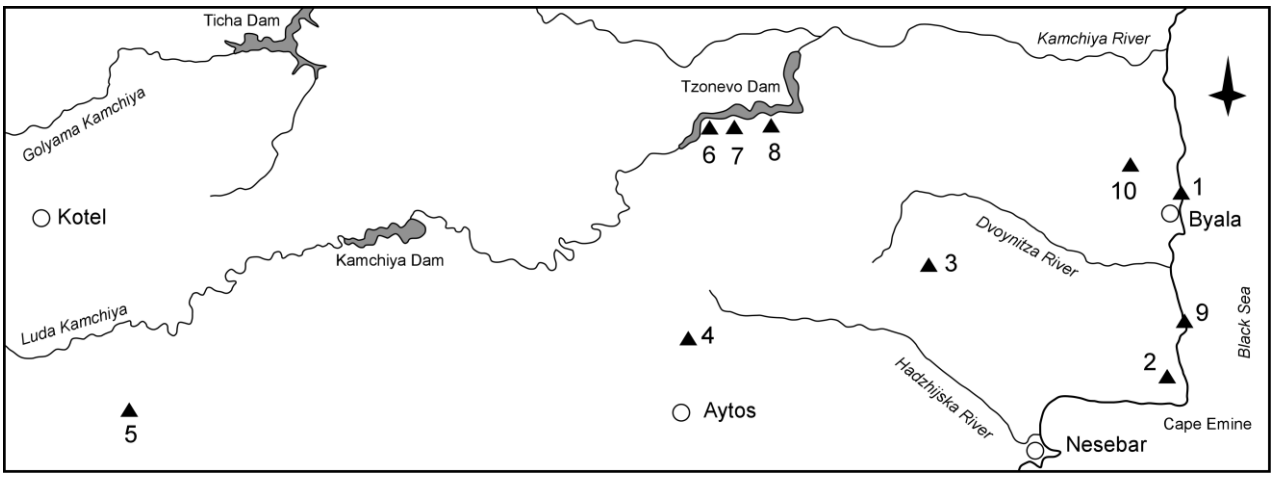

Fig. 1. Location of the K/T boundary outcrops in the Eastern Balkan: 1 – Geotope "Belite Skali"; 2 – N of Emona Village; 3 – Geotope "Kozichino"; 4 – Aytos Pass; 5 – Marash River; 6 – "Chudnite Skali"; 7 – Razkrachenitsa River; 8 – Geotope "Kozya Reka"; 9 – N of Cape Kochan; 10- Goritza Village; scale 1:540000

The boundary interval is well exposed (Fig. 2) and it belongs to the uppermost part of the Emine Flysh Formation (Гочев, 1932; Бончев et al., 1957; Джуранов, Пимпирев, 1989). The section is located along the valley in the south outskirts of Kozichino Village (Figs. 2, 3).

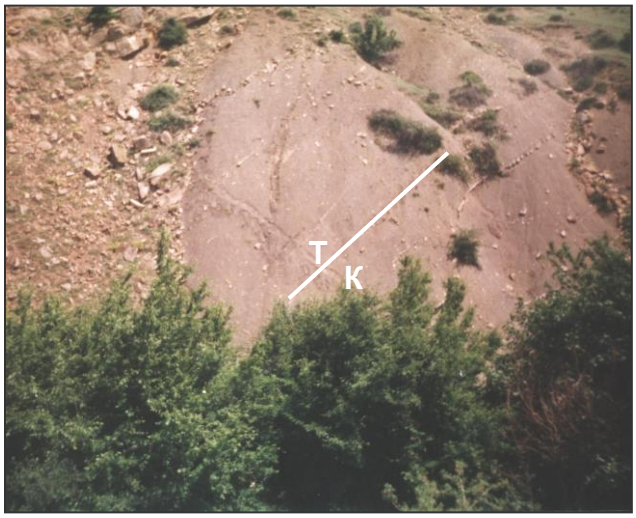

Fig. 2. Location of the K/T boundary in the turbidite sequence of the Emine Flysh Formation near Kozichino Village (Photo by D. Sinnyovsky)

The interval from 7 m below to 10 m above the K/T boundary layer was sampled (Fig. 4). All planktic and benthic specimens from 63 μm, 100 μm, 200 μm and 310 μm residue were investigated.

Results

Totally 80 species (20 planktic and 60 benthic) were established in the foraminiferal assemblages from the boundary interval.

Planktic foraminifera

Three groups of planktic species could be described: Cretaceous, survivors, and Paleocene ones (Fig. 4).

Cretaceous forms. Over 10 typical Cretaceous forms were established in the samples bellow the boundary layer, but as rare or single specimens. The most characteristic amongst them is *Planoglobulina acervulinoides* (Egger), while species like *Heterohelix planata* (Cushman), *Abathomphalus mayaroensis* (Bolli), *Globotruncanita stuartiformis* (Dalbiez), *Globotruncana arca* (Cushman), *Pseudotextularia elegans* (Rzehak), *Rugoglobigerina rugosa* (Plummer), *Planoglobulina brazoensis* Martin were found in single samples.

Survivors. Two groups of survivors could be described from this section. The first one includes *Heterohelix globulosa* (Ehrenberg) and *Laeviheterohelix glabrans* (Cushman), which are typical Maastrichtian species. They were found in all Paleocene samples near Kozichino. The second group comprises species known from the micropaleontological literature as typical examples for planktic forms continuing their stratigraphical distribution across the K/T boundary in many sections all over the world. The group is represented by *Guembelitria cretacea* Cushman, *Muricohedbergella holmdelensis* (Olsson), and *M. monmouthensis* (Olsson). Characteristic feature of these three taxa is that they were not found in the samples bellow the boundary layer. *G. cretacea* disappear at +3,5 m, *M. holmdelensis* – at +1,0 m, and *M. monmouthensis* – at +2,0 m.

Paleocene forms. The taxonomical composition of the planktic foraminiferal assemblages above the boundary layer is marked by comparatively abundant occurrence of *Parvulorugoglobigerina eugubina* (Luterbacher & Premoli Silva), and *Eoglobigerina fringa* (Subbotina) which appear in the lowermost Paleocene sample. Characteristic elements are also *Subbotina triloculinoides* (Plummer) which first appearance was marked at a level of +0,80 m, *Globoconusa daubjergensis* (Broennimann), first occurring at +2,5 m and disappearing at + 4,0 m, and *Parasubbotina pseudobulloides* (Plummer) first occurring at +4,0 m.

All Paleocene planktic forms were derived from the 100 μm and 63 μm residue.

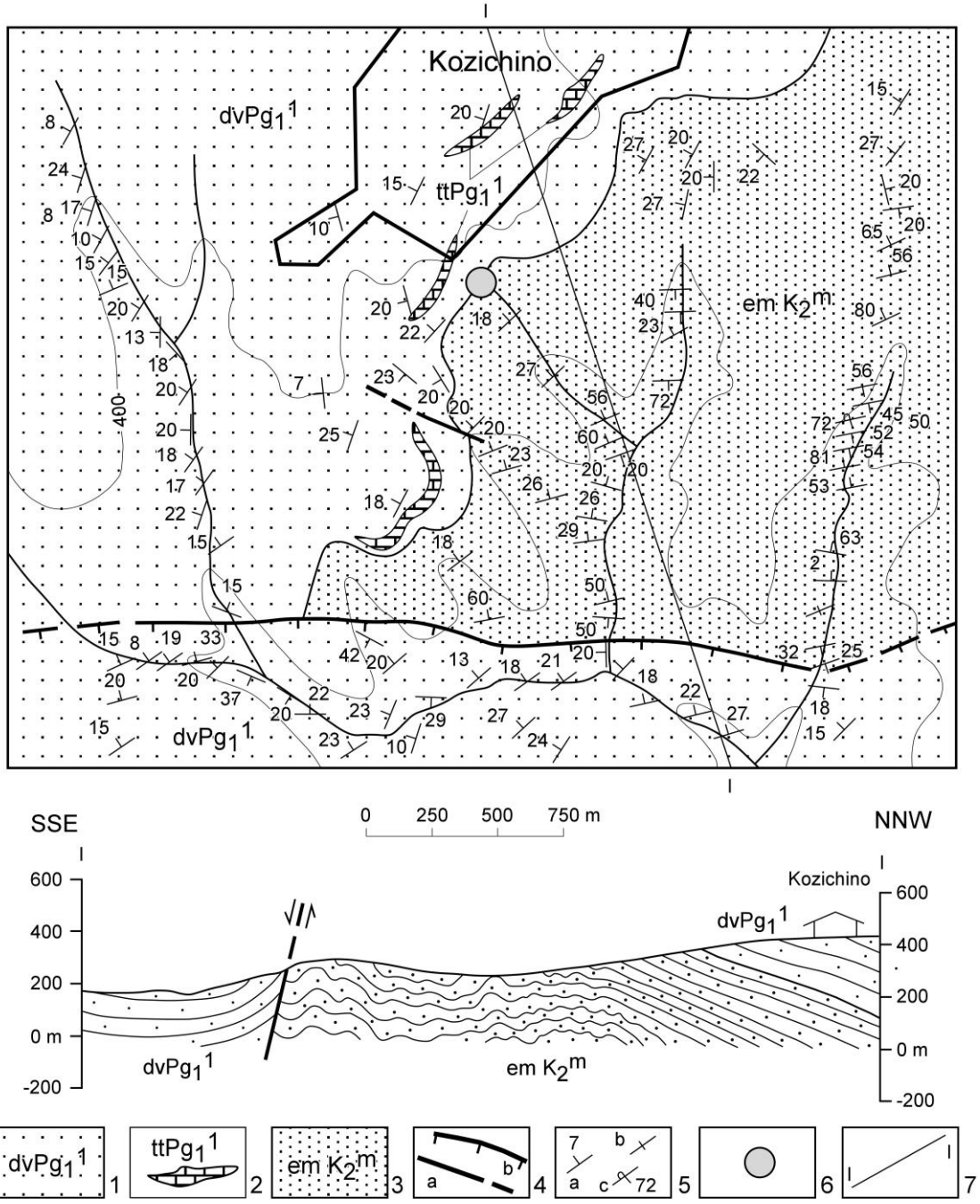

Fig. 3. Geological map of the area of Geotope "Kozichino" in scale 1:25000 (after Джуранов et al., 1997): 1 – Emine Formation (Maastrichtian – Lower Paleocene): alternation of sandstones, siltstones, mudstones, marls and limestones; 2 – Dvoynitsa Formation (Paleocene): thick bedded to massive sandstones interbedded by siltstones, mudstones and marls; 3 – Tepetarla Formation (Paleocene): alternation of limestones, sandstones and siltstones with marls and clays; 4 – faults: a - normal, b – reverse fault; 5 – dip and strike of bedding: a - normal, b - vertical, c - overturned; 6 – location of the geotope; 7 – line of the geological section

Benthic foraminifera

The investigated boundary interval is characterized by comparatively uniform foraminiferal assemblages dominated by agglutinated taxa. Common species amongst them in all samples are *Bathysiphon discreta* (Brady), *Ammodiscus glabratus* Cushman & Jarvis, *Dendrophrya excelsa* Grzybowski, *Saccammina placenta* (Grzybowski), *Spiroplectinella dentata* (Alth) which are almost uniformly distributed. Subsidiary elements to the assemblage structure are species like *Bathysiphon* sp., *Rhizammina indivisa* Brady, *Ammodiscus cretaceous* (Reuss), *Trochamminoides dubius* (Grzybowski), *Paratrochamminoides irregularis* White, *Hyperammina dilatata* Grzybowski, *Repmanina charoides* (Jones & Parker), *Marssonella* spp., which occur as rare or single specimens.

As a whole the hyaline benthics are rare with exception of the uppermost Cretaceous and the lowermost Paleocene samples where they dominate quantitatively in the assemblages. The most common amongst them is *Quadrimorphina allomorphinoides* (Reuss). Uniformly distributed in all samples are *Gyroidinoides girardanus* (Reuss) and *Oridorsalis megastomus* (Grzibowski), while forms like *Nodosaria limbata* d'Orbigny, *Lenticulina* spp., *Guttulina irregularis* (d'Orbigny), and *Chilostomelloides* sp. occur as single specimens at different levels of the section.

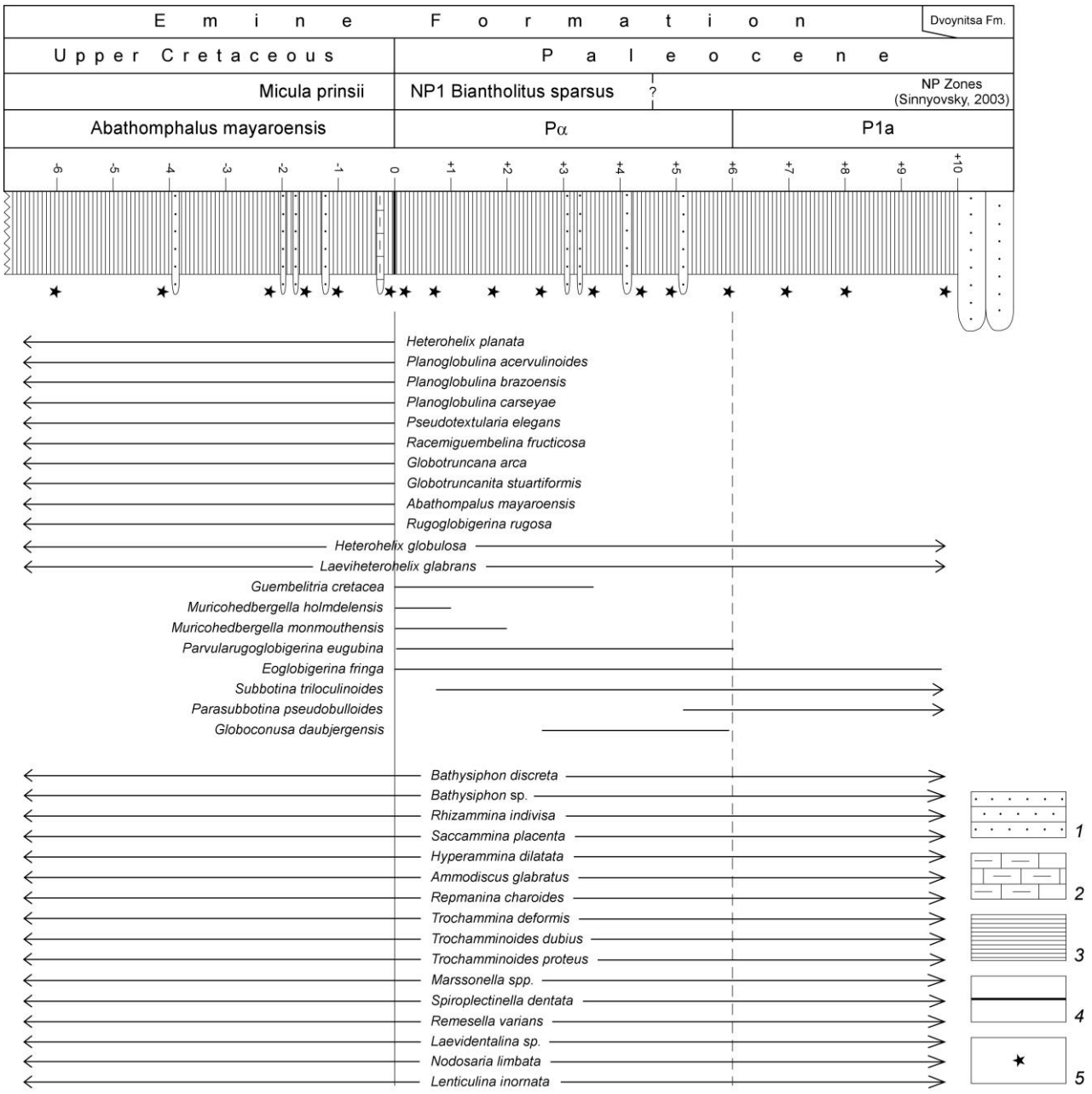

Fig. 4. Column section across the K/T boundary in the turbidite sequence of the Emine Flysh Formation near Kozichino Village with the stratigraphical range of the planktic foraminifera and selected benthic taxa: 1 – sandstones; 2 – marls; 3 – mudstones; 4 – K/T boundary layer; 5 – sample

As a whole there are no changes in the taxonomical composition and assemblage structure across the K/T boundary.

Discussion

The K/T boundary interval near Kozichino Village is comparatively rich of planktic foraminifers which is not typical for the turbidite sequences. It is interesting that the Cretaceous assemblages are less abundant that the Paleocene ones. As it was above mentioned Cretaceous forms occur with rare or single specimens and this fact makes difficult biostratigraphical characterization of the interval. The presence of the index species allowed me to refer the lower 7 m of the section to the Abathompalus mayaroensis Zone.

Taxonomical composition of the planktic assemblages allowed me to localize the K/T boundary without any difficulty, because the change is very clear (not typical for turbidite deposits). The first occurrence of *Parvulorugoglobigerina eugubina* (Luterbacher & Premoli Silva) and *Eoglobigerina fringa* (Subbotina) in the lowermost Paleocene sample did not enabled me to define the P0 Zone, which confirms the presence of a short hiatus noted by Sinnyovsky (2003).

The clear presence of *Parvulorugoglobigerina eugubina* (Luterbacher & Premoli Silva) in the fist six meters above the K/T boundary is a reason for defining of the upper boundary of the Pα Zone. The uppermost 4 m of the studied section could

be referred to P1a Zone because of the occurrence of the zonal marker *Parasubbotina pseudobulloides* (Plummer).

The absence of any taxonomical changes in the benthic assemblages is a typical feature for the flysh deposits of the Tethys region and their taxonomical composition allows referring them to the so called Flysh-type benthic assemblages.

Conclusions

The well exposed turbidite sequence of the Emine Flysh Formation near Kozichino Village, Bourgas District was investigated from planktic and benthic foraminiferal point of view. The Cretaceous part of the studied section contains poor planktic assemblages and that is why it is difficult to characterize biostratigraphicaly this interval. The K/T boundary was marked easily because of the clear planktic foraminiferal change. 5 species could be considered as survivors. All of them were derived from the 63 μm and 100 μm residue.

Paleocene planktic assemblages are more abundant than the Cretaceous ones which is not typical for the K/T transitions. The taxonomical composition allowed me to define two zones - Pα and P1a. The lowermost Paleocene P0 Zone was not defined, which confirms the presence of a short hiatus as a possible reason.

Benthic foraminifera show the typical features for the Upper Cretaceous-Paleogene flysh-type assemblages of the Tethys region – uniform taxonomical composition and structure without changes across the K/T boundary and strongly dominated by agglutinated taxa.

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APPENDIX

List of planktic and benthic foraminiferal species found in the present study

Cretaceous planktic foraminifera

Abathomphalus mayaroensis (Bolli, 1951)
Globotruncana arca (Cushman, 1926)
Globotruncanita stuartiformis (Dalbiez, 1955)
Guembelitria cretacea Cushman, 1933
Heterohelix globulosa (Ehrenberg, 1840)
H. planata (Cushman, 1938)
Laeviheterohelix glabrans (Cushman, 1938)
Muricohedbergella holmdelensis (Olsson, 1964)
M. monmouthensis (Olsson, 1960)
Planoglobulina acervulinoides (Egger, 1899)
P. brazoensis Martin, 1972
P. carseyae (Plummer, 1931)
Pseudotextularia elegans (Rzehak, 1891)
Racemiguembelina fructicosa (Egger, 1902)
Rugoglobigerina rugosa (Plummer, 1926)

Paleogene planktic foraminifera

Eoglobigerina fringa (Subbotina, 1950)
Globoconusa daubjergensis (Broennimann, 1953)
Parasubbotina pseudobulloides (Plummer, 1926)

Parvulorugoglobigerina eugubina (Luterbacher & Premoli Silva, 1964)
Subbotina triloculinoides (Plummer, 1926)

Cretaceous/Paleogene small benthic foraminifera
Ammodiscus cretaceus (Reuss, 1845)
A. glabratus Cushman and Jarvis, 1928
Ammosphaeroidina pseudopauciloculata (Mjatliuk, 1966)
Aragonia velascoensis (Cushman, 1925)
Arenobulimina dorbignyi (Reuss, 1845)
Bathysiphon discreta (Brady, 1881)
Bathysiphon sp.
Chilostomelloides sp.
Clavulinoides sp.
Cribrostomoides sp.
Cyclammina sp.
Dendrophrya excelsa Grzybowski, 1898
Dorothia cubensis Cushman and Bermudez, 1936
Ellipsoglandulina chilostoma (Rzehak, 1895)
Gavelinella beccariiformis (White, 1928)
Glomospira irregularis (Grzybowski, 1898)
Guttulina irregularis (d'Orbigny, 1846)
Gyroidinoides girardanus (Reuss, 1851)
Haplophragmoides walteri (Grzybowski, 1898)
Hormosina ovulum ovulum (Grzybowski, 1896)
Hyperammina dilatata Grzybowski, 1896
Laevidentalina sp.
Lenticulina inornata (d'Orbigny, 1846)
L. velascoensis White, 1928
Lituotuba sp.
Marginulina sp.
Marssonella indentata (Cushman and Jarvis, 1928)
M. oxycona (Reuss, 1860)
Nodosaria aspera Reuss, 1845
? *N. hispida* (Soldani, 1791)
N. limbata d'Orbigny, 1840
Nuttalides trümpyi (Nuttal, 1930)
Oridorsalis megastomus (Grzibowski, 1896)
O. umbonatus (Reuss, 1851)
Osangularia florealis (White, 1928)
Paratrochamminoides irregularis White, 1928
Psammosphaera sp.
Pseudonodosaria cylindracea (Reuss, 1845)
Pseudoclavulina globulifera ten Dam and Sigal, 1950
Pullenia jarvisi Cushman, 1936
Pygmaeoseistron hispidum (Reuss, 1858)
P. oxystomum Reuss, 1858
Pyramidulina velascoensis (Cushman, 1926)
Pyrulinoides cylindroides (Roemer, 1838)
Quadrimorphina allomorphinoides (Reuss, 1860)
Recurvoides sp.
Remesella varians (Glaessner, 1937)
Repmanina charoides (Jones and Parker, 1860)
Reussoolina apiculata (Reuss, 1851)
Rhizammina indivisa Brady, 1884
Saccammina placenta (Grzybowski, 1898)
Spiroplectinella dentata (Alth, 1850)
Subreophax scalaria (Grzybowski, 1896)
Textularia sp.
Trochammina deformis Grzybowski, 1898
T. quadriloba (Grzybowski, 1896)
Trochamminoides coronatus (Brady, 1879)
Trochamminoides dubius (Grzybowski, 1901)
Trochamminoides proteus (Karrer, 1866)
Vaginulinopsis earlandi (Plummer, 1926)

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