ГОДИШНИК НА МИННО-ГЕОЛОЖКИЯ УНИВЕРСИТЕТ "СВ. ИВАН РИЛСКИ", Том 53, Св. I, Геология и геофизика, 2010
ANNUAL OF THE UNIVERSITY OF MINING AND GEOLOGY "ST. IVAN RILSKI", Vol. 53, Part I, Geology and Geophysics, 2010

CAMPANIAN-MAASTRICHTIAN PLANKTIC FORAMINIFERAL ASSEMBLAGES FROM THE STRATOTYPE SECTION OF THE LYUTIDOL FORMATION SOUTH OF THE LYUTI DOL VILLAGE, MEZDRA REGION (WESTERN BULGARIA)

Boris Valchev

University of Mining and Geology "St. Ivan Rilski", 1700 Sofia; b_valchev@mgu.bg

ABSTRACT. The allochthonous Lyutidol Formation is considered as a transitional facies between the North European and the Mediterranean Upper Cretaceous in Bulgaria. It crops out between the Lyuti Dol and Scravena Villages in a tectonically complicated region, which is part of the Balkan Frontal Strip. The Campanian-Maastrichtian age of the unit was first established in the early 1990s on the base of calcareous nannoplankton and planktic foraminifera. A detailed nannofossil zonation was proposed in the beginning of the 21 century. The present investigation of the type section of the Lyutidol Formation, situated south of Lyuti Dol Village, Mezdra Region (Western Bulgaria), revealed relatively rich and moderately diverse planktic foraminiferal assemblages of Campanian and Maastrichtian age dominated by globotruncanids. The wide stratigraphical range of the most of the species makes difficult establishing of biostratigraphical markers (FAD and LAD) as a base of a detailed biostratigraphical zonation.
Key words. Campanian, Maastrichtian, planktic foraminifera, Lyutidol Formation, Western Bulgaria

КАМПАН-МАСТРИХТСКИ ПЛАНКТОННИ ФОРАМИНИФЕРНИ АСОЦИАЦИИ ОТ СТРАТОТИПОВИЯ РАЗРЕЗ НА ЛЮТИДОЛСКАТА СВИТА ЮЖНО ОТ С. ЛЮТИ ДОЛ, МЕЗДРЕНСКО (ЗАПАДНА БЪЛГАРИЯ)

Борис Вълчев
Минно-геоложки университет "Св. Иван Рилски", София 1700; b_valchev@mgu.bg

РЕЗЮМЕ. Алохтонната Лютидолска свита е смятана за преходен фациес между Северноевропейския и Медитеранския тип Горна Креда на територията на България. Тя се разкрива между селата Люти дол и Скравена в тектонски усложнен район, който е част от Старопланинската челна ивица. Кампан-мастрихтската възраст на единицата е установена за първи път в началото на 90-те години на 20 век на базата на варовит нанопланктон и планктонни фораминифери. Детайлно нанофосилно зониране е предложено в началото на 21 век. При настоящото изследване на типовия разрез на Лютидолската свита южно от село Люти дол, Мездренско (Западна България), бяха установени сравнително богати и умерено разнообразни планктонни фораминиферни асоциации с кампанска и мастрихтска възраст доминирани от глоботрунканиди. Широкото стратиграфско разпространение на по-голямата част от видовете затруднява сериозно отделянето на биостратиграфски репери (нива на поява и изчезване), които биха послужили за детайлно биостратиграфско разчленяване.
Ключови думи. Кампан, Мастрихт, планктонни фораминифери, Лютидолска свита, Западна България

Introduction

The Lyuti Dol village surroundings are built of a remarkable combination of terrigenous and carbonate rocks (sandstones, marls, muds, clays, limestones, gravelites, conglomerates, breccia, and chalk) filling a small structure known as Lyutidol syncline (Batandjiev, 1971). These sediments were first described by Toula (1881). He noted the well bedded fine-grained sandstones and marked that they contain fragments of inoceramid shells. Until the beginning of the 1990s these sediments have been considered as "Aptian" (Bonchev, 1932), "Lutetian" (Stoyanov, Nenov, 1975), "Eocene" (Cheshitev, 1971; Batandjiev, 1971) or have been refered to the Staropatitsa Formation (Tzankov, 1989; Aladjova-Hrischeva et al., 1991; Tzankov et al., 1990; Tzankov et al., 1995). Sinnyovsky et al. (1990) reported rich nannofossil and foraminiferal association of Late Cretaceous age from a locality in the south part of Lyuti Dol Village. The authors included these deposits in marl-sandstone unit. Sinnyovsky, Hristova-Sinnyovska (1993) integrated the terrigenous-carbonate rocks into Lyutidol Formation with Campanian-Maastrichtian age. Later these rocks have been characterised biostratigraphically by means of calcareous nannofossils (Sinnyovsky, 2001; 2007). As a result 5 biostratigraphical zones have been defined.

The Lyutidol Formation is composed mainly of fine-grained sandstones with interbeds of conglomerates, breccia, limestones, marls, clays and chalk (Sinnyovsky, Hristova-Sinnyovska, 1993). Despite the inoceramid, nannofossil and foraminiferal remains mentioned above, rare examples of echinoids (Ilieva, 2000) and internal moulds of ammonites have been found in these rocks (Antonov et al., 2004). Normal relationships with the other Upper Cretaceous lithostratigraphical units in the studied area have not been observed (Fig. 1). The Lyutidol Formation is thrusted over "Mezdra Formation", limestone, and bioclastic-limestone units (Lyutidol thrust) and it is overthrusted by the Cherepish, Lyutibrod, and Mramoren Formations, as well as the limestones of "Mezdra Formation" (Gradishte thrust). In this way the unit is an allochthonous sheet, which is part of the Balkan Frontal Strip (Sinnyovsky, 2009).

As a whole the Lyutidol Formation is poorly exposed between the Lyuti Dol and Skravena villages. The stratotype section of the unit was desribed by Sinnyovsky, Hristova-Sinnyovska (1993). It is situated in the south outskirts of Lyuti Dol Village on the right slope of Klisurska River (Fig. 1) and it was included in route IV in the "*Guide of Field Geological Training*" (Sinnyovsky et al., 2004). Interbeds of red and motley limestones with tephra, resembling Mirkovo Formation's limestones from Srednogorie tectonic zone, have been recorded from the area north of Skravena Village (Sinnyovsky, Hristova-Sinnyovska, 1996). That is why the Lyutidol Formation is considered as a transitional facies between the North European and the Mediterranean Upper Cretaceous in Bulgaria (Sinnyovsky, Hristova-Sinnyovska, 1996; Sinnyovsky, 2001; 2009).

The aim of this article is to reveal the structure and stratigraphical distribution of planktic foraminiferal microfauna from the stratotype section of the unit. Only carbonate intervals were sampled (Fig. 2).

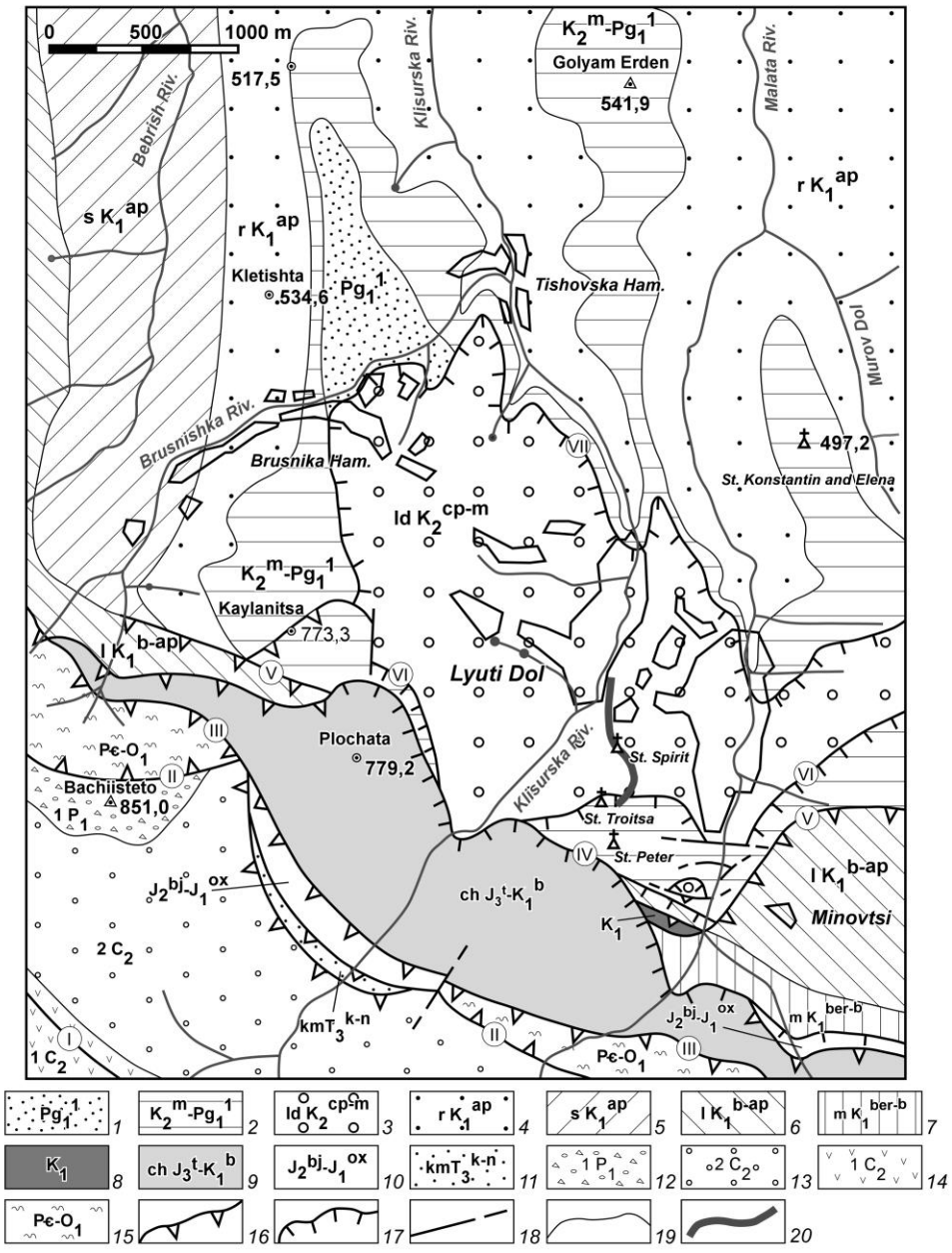

Fig. 1. Geological map of the Lyuti Dol area (modified after Sinnyovsky et al., 2004): 1 – sandstone unit (Middle Paleocene); 2 – Darmantsi, Kunino, and "Mezdra" Fms., limestone and bioclastic-limestone units (Maastrichtian-Lower Paleocene); 3 – Lyutidol Fm. (Campanian-Maastrichtian); 4 – Roman Fm. (Middle-Upper Aptian); 5 – Sumer Fm. (Lower-Middle Aptian); 6 – Lyutibrod Fm. (Barremian-Lower Aptian); 7 – Mramoren Fm. (Berriasian-Barremian); 8 – unidentified Lower Cretaceous; 9 – Cherepish Fm. (Tithonian-Barremian); 10 – Polaten and Yavorets Fms. (Bajocian-Oxfordian); 11 – Komshtitsa Fm. (Carnian-Norian); 12 – Buk and Vran Fms. (Lower Permian); 13 - Zlotitsa, Ignatitsa, and Ochindol Fms. (Upper Stephanian); 14 – volcanogenic unit (Upper Stephanian); 15 – diabase-phyllitoid compex (Vendian-Ordovician); 16 – thrust; 17 – low-angle thrust; 18 – normal fault; 19 – lithostratigraphic boundary; 20 – location of the stratotype section of the Lyutidol Formation; I – Dragojbalkan fault; II – Zverino thrust; III – Plakalnitsa thrust; IV – Kaylanitsa thrust; V – Tipchenitsa thrust; VI – Gradishte thrust; VII – Lyutidol thrust

Taxonomical analysis

Totally 17 species were recorded during the investigation of the planktic foraminiferal content of the studied section. Most of them are uniformly distributed in all samples. The base of the section (sample LD 5-1) is characterized by low taxonomical diversity. The assemblage is dominated by *Globotruncana lapparenti* Brotzen. Additional taxa are *Globotruncana arca* (Cushman) and *Globotruncana rosetta* (Carsey). Rare contributors like *Contusotruncana fornicata* (Plummer) and *Rugoglobigerina rugosa* (Plummer) were observed.

The second (sample LD 6) and the third studied level (samples LD 7 and LD 8) demonstrate similar taxonomical diversity, but there are some differences in the taxonomical composition. *Globotruncana lapparenti* Brotzen is again the main contributor to the assemblage. *Globotruncana arca* (Cushman) and *Globotruncana rosetta* (Carsey) are represented by rare and single specimens or are absent. New elements like *Globotruncana rugosa* (Marie), *Globotruncanita stuarti* (de Lapparent), *Globotruncanita stuartifofmis* (Dalbiez), *Heterohelix globulosa* (Ehrenberg), and *Rugoglobigerina hexacamerata* (Broennimann) were established. All of them are represented by single specimens.

The fourth studied level (sample LD 10) is the most taxonomically diverse in the section, but with moderate specimen abundance. *Globotruncana arca* (Cushman), *Globotruncana rugosa* (Marie), *Globotruncana falsostuarti* Sigal, *Heterohelix globulosa* (Ehrenberg), and *Rugoglobigerina hexacamerata* (Broennimann) dominate the assemblage. *Contusotruncana fornicata* (Plummer), *Globotruncana rosetta* (Carsey), *Globotruncanita stuarti* (de Lapparent), *Globotruncanita stuartifofmis* (Dalbiez), and *Rugoglobigerina rugosa* (Plummer) are additional elements.

The fifth carbonate level (samples LD 21 and LD 15-2) is characterized by the occurrence of two species – *Pseudotextularia intermedia* de Klasz and *Racemiguembelina fructicosa* (Egger). The first one is amongst the two dominators of the assemblage (the other one is *Globotruncanita stuartifofmis* (Dalbiez). Additional species are *Globotruncana falsostuarti* Sigal, *Globotruncana lapparenti* Brotzen, and *Globotruncana rosetta* (Carsey). *Contusotruncana fornicata* (Plummer) and *Heterohelix globulosa* (Ehrenberg) are represented by single specimens.

The sixth studied carbonate level is the uppermost part of the stratotype section of the Lyutidol Formation (samples LD11, LD12, and LD13). It is the most taxonomically diverse and shows the highest specimen abundance in the whole section. The assemblage is dominated by *Globotruncanita stuartifofmis* (Dalbiez), as well as species like *Globotruncana lapparenti* Brotzen and *Racemiguembellina powelli* Smith & Pessagno. The last one was recorded from this level only. Additional taxa are *Contusotruncana fornicata* (Plummer), *Globotruncana falsostuarti* Sigal, *Heterohelix globulosa* (Ehrenberg), and *Heterohelix navarroensis* Loeblich as the last one occurrs only in this part of the section. *Planoglobulina carseyae* (Plummer) and *Rugoglobigerina hexacamerata* Broennimann supplement the assemblage as single specimens. *P. carseyae* occurs in these samples only.

Discussion

As it was mentioned in the "Introduction", the Upper Cretaceous age of the sediments of the Lyutidol Formation was proved by means of calcareous nannoplankton and foraminifers in the early 1990s. Later a detailed nannofossil investigation was made (Sinnyovsky, 2001; 2007), while new foraminiferal studies were not introduced. The present investigation revealed some characteristic features of the foraminiferal assemblages from this locality.

Taxonomical diversity

Despite the relatively large number of the established species (17 in number) the assemblage structure is dominated by 2-3 species, while the other contributors occur as rare or single specimens. The lower and the middle part of the section (the first three carbonate levels) are marked by relatively low taxonomical diversity (5-6 species recorded). The peak (11 species) was observed at the fourth carbonate level. The fifth level is marked by comparatively low diversity (6-7 species). Moderately diverse are the assemblages from the uppermost part of the section – 9 species was recorded in the samples from this level.

Abundance of specimens

Specimen's abundance demonstrates fluctuations at the lower, the middle and the upper part of the section. At the lowermost carbonate level the dominating species shows high abundance of specimens. The second and the third levels are marked by lower specimen's abundance – here the dominating species re represented as common ones. The lowest abundance was recorded from the fourth carbonate level – despite the comparatively large number of species, there are no abundant ones. The fifth level is marked by higher abundance – dominating species are characterized as common. The uppermost part of the section gives the most abundant assemblages. Here the dominating species were characterized as abundant and common.

Biostratigraphical markers

The stratotype section of the Lyutidol Formation was divided into five nannofossil zones, which are a good biostratigraphical framework for comparison with other fossil groups. Unfortunately the present planktic foraminiferal investigation does not provide any satisfying results. Six of the species, recorded from more than one sample, are distributed in the whole section and thus they cover wide stratigraphical range - Lower Campanian-Upper Maastrichtian. Only two couples of taxa are restricted in definite levels. *Pseudotextularia intermedia* de Klasz and *Racemiguembelina fructicosa* (Egger) occur at the fifth carbonate level only. Both are typical Maastrichtian species, which corresponds to the age determined on the base of nannofossils. *Planoglobulina carseyae* (Plummer) and *Racemiguembellina powelli* Smith & Pessagno were recorded from the uppermost part of the section. Both are characteristic for the Upper Campanian-Upper Maastrichtian. Our data corresponds to the nannofossil zonation, because this part of the section was determined as Upper Campanian. As could be seen, the wide stratigraphical distribution of the majority of species makes difficult finding biostratigraphical markers (FAD and LAD) for a planktic foraminiferal zonation.

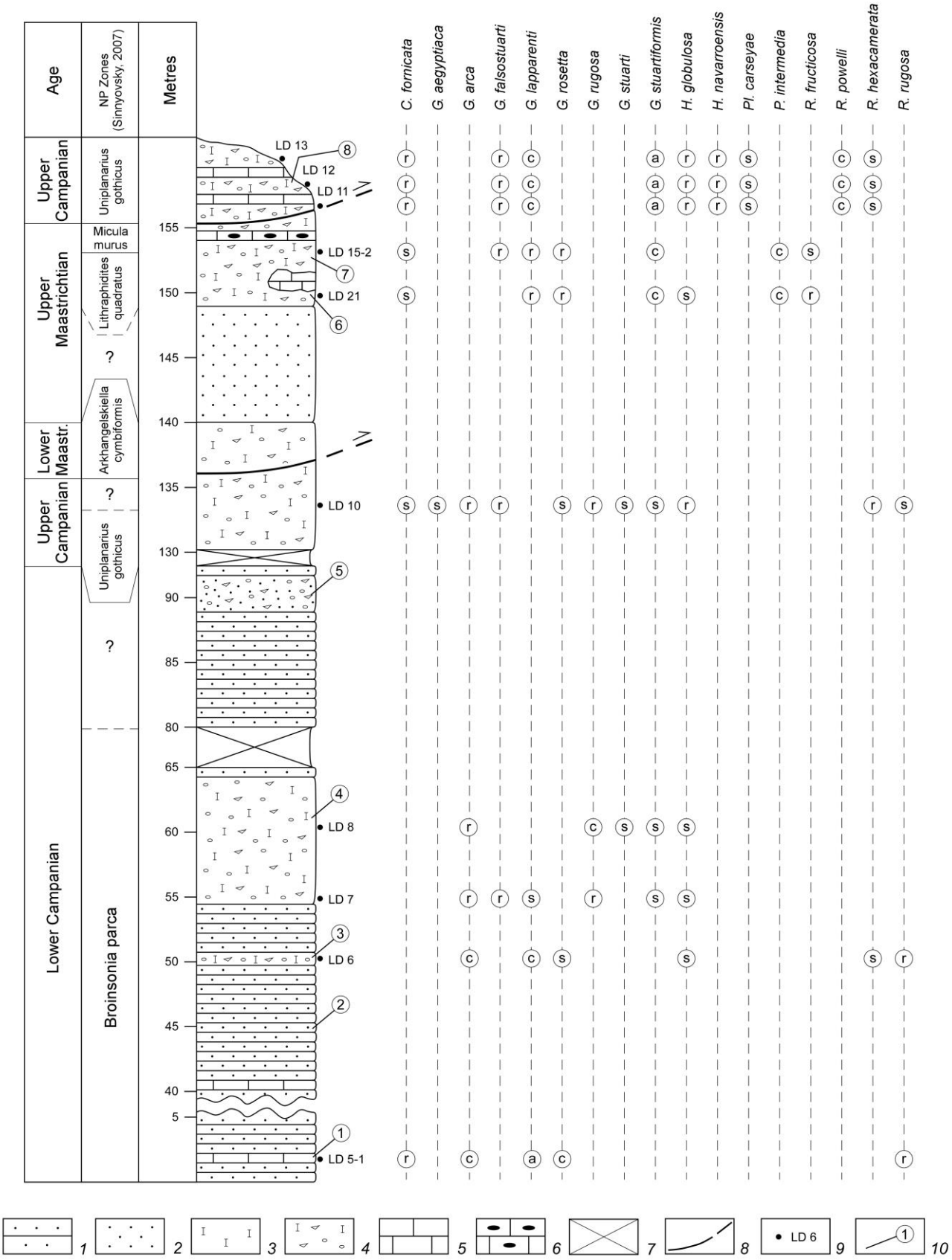

Fig. 2. Stratotype section of the Lyutidol Formation (modified after Sinnyovsky, 2007) with the stratigraphical distribution of planktic foraminiferal species: 1 – thin-bedded sandstone; 2 – massive weakly cemented sandstone; 3 – chalk; 4 – carbonate conglomerate and breccia with soft chalky matrix; 5 – limestone; 6 – limestone with cherty concretions; 7 – lack of outcrops; 8 – thrust; 9 – sample; 10 – number of photo in Plate I, abundance of specimens (s – single, r – rare, c – common, a – abundant)

Conclusions

The study of the planktic foraminiferal assemblages from the stratotype section of the Lyutidol Formation revealed the following characteristic features:

- Assemblages show moderate taxonomical diversity with domination of one, rarely two or three taxa. Totally 17 species were established.
- Species abundance varies along the section and it does not depend on the taxonomical diversity.
- Most of the recorded species are with wide stratigraphical range and it makes difficult establishing of biostratigraphical markers (FAD and LAD). Obviously we can,t use our data for a detailed biostratigraphical subdivision of this section.

Abundance of planktic specimens could be used in a further investigation in a paleoecological and paleogeographical aspect to prove the position of the Lyutidol Formation as a transitional facies between the North European and the Mediterranean type Upper Cretaceous in Bulgaria.

References

Aladjova-Hrischeva, K., L. Nedyalkova, Tz. Tzankov. 1991. Stratigraphy and deformation of the Paleogene deposits in the western and central parts of the Fore-Balkan and Stara Planina Mountain. – *Geologica Balc., 21*, 6, 49-90 (in Russian).

Antonov, M., D. Sinnyovsky, V. Jelev. 2004. Overview of regional geology. – In: Sinnyovsky, D. (Ed.). *Geological Routes in the Northern Part of the Iskar Gorge. Guide of Field Geological Training*, Sofia, "Vanio Nedkov" Publ. House, 4-12.

Batandjiev, I. 1971. Ljutidol syncline. – In: Bonchev, E. (Ed.), *Tectonics of the Fore-Balkan*. Sofia, Bulgarian Academy of Sciences, 435-436 (in Bulgarian).

Bonchev, E. 1932. Geology of the Orhanie Fore-Balkan west of Bebrish and Mali Iskar Rivers. – *Rev. Bulg. Geol. Soc., 4*, 2, 85-156 (in Bulgarian).

Cheshitev, G. 1971. Mezdra syncline depression. – In: Yovchev, Y. (Ed.). *Tectonic Structure of Bulgaria*. Sofia, Technics, 320-321 (in Bulgarian).

Ilieva, T. 2000. *Late Cretaceous and Danian Echinids of Superorder Spatangacea from Northern Bulgaria – Taxonomy and Stratigraphical Importance.* Summary of PhD Thesis, 34 p. (in Bulgarian)

Sinnyovsky, D. 2001. Detail nannofossil biostratigraphy of the allochthonous Ljutidol Formation and underlying autochthonous sediments in the type locality near Ljutidol Village. – *Ann. Univ. Min. Geol., 43-44, Part 1, Geol.,* 11-20.

Sinnyovsky, D. 2007. *Biostratigraphy of the Upper Cretaceous in Bulgaria based on calcareous nannoplankton*. DSc. Thesis, Sofia, 267 p. (in Bulgarian)

Sinnyovsky, D. 2009. Lithostratigraphy. North European type Upper Cretaceous. – In: Zagorchev, I., H. Dabovski, T. Nikolov (Eds.) *Geology of Bulgaria. Volume II, Part 5. Mesozoic Geology.* Sofia, Acad. Publ. House "Prof. Marin Drinov", 311-337 (in Bulgarian).

Sinnyovsky, D., M. Antonov, S. Juranov. 2004. Route IV. Klisurska River. – In: Sinnyovsky, D. (Ed.). *Geological Routes in the Northern Part of the Iskar Gorge. Guide of Field Geological Training*, Sofia, "Vanio Nedkov" Publ. House, 53-65.

Sinnyovsky, D., D. Hristova-Sinnyovska. 1993. New concept about the geologic structure of a part of the West Fore-Balkan south of Mezdra Town. – *Rev. Bulg. Geol. Soc., 54*, 3, 25-40 (in Bulgarian).

Sinnyovsky, D., D. Hristova-Sinnyovska. 1996. The Lyutidol Formation – Transitional Facies between the North Europian and the Mediterranean Type Upper Cretaceous. – *Ann. UMG, 41, Part I, Geol.,* 117-118 (in Bulgarian).

Sinnyovsky, D., E. Dimitrova, S. Juranov. 1990. Upper Cretaceous microfossils from the core of the Ljutidol Syncline.- *Ann. High Inst. Min. and Geol., 36, Part 1, Geol.*, 199-203 (in Bulgarian).

Stoyanov, I., T. Nenov. 1975. Notes on the Stara Planina frontal strip between Iskar and Bebresh Rivers. – *Geotect., Tectonophys., Geodynam., 3*, 70-78 (in Bulgarian).

Toula, F. 1881. Grundlinien der Geologie des Westlichen Balkan. Von Orhanie, über Ljutidol and Ljutibrod, nach Cerepis am Isker. – *Denkschr. Acad. Wiss. Wien, Math.-naturwiss. Cl., 44*, 1-56.

Tzankov, Tz. 1989. On the western end of Luda Kamchia synclinorium. – *Compt. Rend. Acad. Bulg. Sci., 42*, 11, 71-73 (in Russian).

Tzankov, Tz., L. Nedyalkova, V. Angelov, K. Aladjova-Hrischeva, S. Yanev, I. Haidutov, I. Sapunov, P. Tchoumachenko. 1990. *Geological Map of Bulgaria in Scale 1:100000, Map Sheet Vratsa*. Sofia, CGMR.

Tzankov, Tz., K. Aladjova-Hrischeva, S. Yanev, I. Haidutov, I. Sapunov, P. Tchoumachenko, L. Nedyalkova, V. Angelov. 1995. *Explanatory Note of the Geological Map of Bulgaria in Scale 1:100000, Map Sheet Vratsa*. Sofia, Avers, 102 p. (in Bulgarian)

Recommended for publication by Department of Geology and Paleontology, Faculty of Geology and Prospecting

PLATE I

1 – soft limestone at the base of the stratotype section of the Lyutidol Formation (sample LD 5-1); from this location Sinnyovsky et al. (1990) determined for the first time Cretaceous age on the base of calcareous nannofossils and foraminifers; 2 – thin-bedded fine-grained sandstones 45 m above the base of the stratotype section; 3 – chalky cement of the carbonate breccia 50 m above the base of the section (sample LD 6); 4 – carbonate conglomerate and breccia 60 m above the base in the gully beneath the spring "St. Spirit"; 5 – carbonate conglomerates with clasts of micritic limestone and fine-grained sandstone 90 m above the base of the section; 6 – limestone clasts amongst the carbonate conglomerate east of "St. Troitsa" 150 m above the base of the section; 7 – soft carbonate conglomerates with chalky matrix east of "St. Troitsa" 153 m above the base (sample LD 15-2); 8 – the uppermost level of the stratotype section – carbonate conglomerates and breccia with chalky matrix and thin limestone beds (samples LD 11, LD 12, LD 13)

PLATE I