

PALEOGENE PLANKTIC FORAMINIFERA OF THE REPUBLIC OF MACEDONIA

Violeta Stojanova, Boris Valchev*, Sava Juranov**

Abstract

The present study deals with the taxonomy of the Paleogene planktic foraminifera of the Republic of Macedonia. 5 species, belonging to 2 genera, 1 family (GLOBIGERINIDAE Carpenter, Parker, and Jones, 1862), and 1 superfamily are described for the first time from this part of the Balkan Peninsula. The studied micropaleontological material was obtained from 8 outcrop sections belonging to 5 sedimentary basins.

Key words: planktic foraminifera, taxonomy, Paleogene, Republic of Macedonia

Introduction. The present article aims to introduce the taxonomy of the Paleogene planktic foraminifera on the territory of the Republic of Macedonia. Paleogene sediments in this part of the Balkan Peninsula are distributed into 3 major (larger) basins and 4 isolated masses: Tikvesh, Ovche Pole, Skopje-Kumanovo basins, as main ones, and Delchevo, Deve Bair, Valandovo-Gevgelija, and Strumica basins, as isolated blocks (Fig.1)

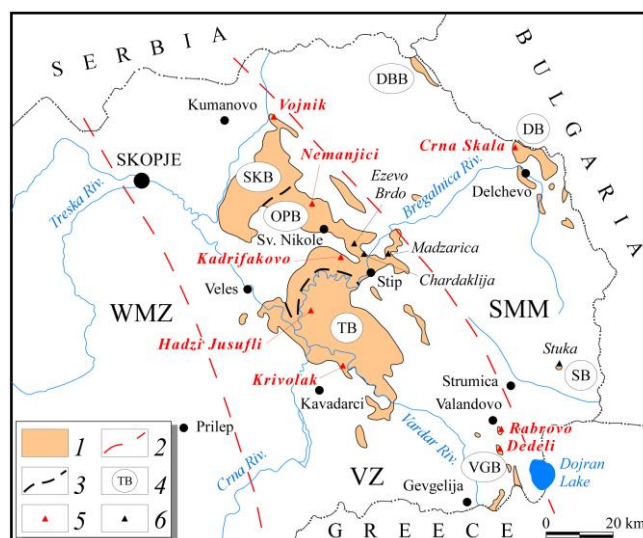


Fig. 1. Sketch with the location of the Paleogene basins in Republic of Macedonia and the studied sections

1 - Distribution of Paleogene sediments; 2 – Tectonic boundary; WMZ – Western Macedonian Zone, VZ – Vardar Zone, SMM – Serbian-Macedonian Massif; 3 – Basin boundary; 4 – Basins: SKB – Skopje-Kumanovo, OPB – Ovche Pole, TB – Tikvesh, VGB – Valandovo-Gevgelija, DB – Delchevo, SB – Strumica, DBB – Deve Bair; 5 -section with established planktic foraminifers; 6 –section without established planktic foraminifers

They are located in the Vardar Zone and the Serbo-Macedonian Massif [1]. First data about the presence of planktonic foraminifera (list of taxa including *Globigerina bulloides* d'Orb., *Globigerina eocena* Gümbel, *Globigerina eocenica* Terq., *Globigerinoides conglobatus* Brandy, etc.) were given by MAKSIMOVIČ et al. [2] during the complex investigation of Ovche Pole and Tikvesh basins, but until now detailed taxonomical works on this microfossil group have not been carried out. Part of the above mentioned species occur into younger stratigraphic levels only, that is why a taxonomical revision of them is necessary.

The data for the geological age (determined as Upper Eocene to Lower Oligocene) of the studied sediments in all basins have been obtained from many fossil remainings of macrofossil and microfossil groups including benthic and planktic foraminifera [2, 3, 4].

Geological setting. The Paleogene of the Republic of Macedonia has been subdivided into five lithostratigraphical units [2, 3]: basal unit, lower flysh unit, unit of yellow sandstones, upper flysh unit and carbonate-sandy unit (Fig. 2).

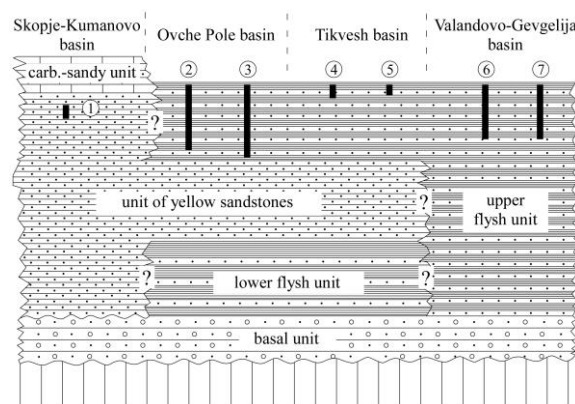


Fig. 2. Schematic section of the spatial relationships of the Paleogene lithostratigraphical units in the Vardar Zone with the positions of the sections containing planktic foraminifera

1 – Vojnik; 2 – Nemanjici; 3 – Kadrifakovo; 4 – Hadzi Jusufli; 5 – Krivolak; 6 – Rabrovo; 7 – Dedeli

The *basal unit* (50-700 m) has been established in all basins. It is composed of red or violet conglomerates and sandstones with interbeds of shales and calcarenites. It is overlaid with gradual transition (in Tikvesh, Ovche Pole and Deve Bair basins) by rhythmic alternation of red or gray conglomerates, sandstones, siltstones, shales, and limestones comprising the *lower flysh unit* (300-1100 m), or it is transgressively covered by the unit of yellow sandstones (in Skopje-Kumanovo basin), and the upper flysh unit (in Delchevo and Strumitsa basins). In Valandovo-Gevgelija basin the boundary between the basal unit and the upper flysh unit is a gradual transition. The *unit of yellow sandstones* (100-1000 m) is known from Tikvesh, Ovche Pole and Skopje-Kumanovo basins. It consists mainly of yellow sandstones in association with conglomerates and shales. The unit is covered with normal transition by the upper flysh unit (in Tikvesh and Ovche Pole basins), or it is concordantly overlaid by the carbonate-sandy unit (in Skopje-Kumanovo basin). The *upper flysh unit* (100-2500 m) has been recorded from Tikvesh, Ovche Pole, Delchevo, Valandovo-Gevgelija, and Strumica basins. It is composed of rhythmic alternation of shales, sandstones, siltstones and limestones. It is covered transgressively by Neogene volcanic or sedimentary rocks. The *carbonate-sandy unit* (200 m) comprises predominantly yellow limestones associated with sandstones and shales. It is known from Skopje-Kumanovo basin only.

Planktic foraminiferal data. Totally 151 samples from 12 outcrop sections have been investigated. 143 of them come from the upper flysh unit, while the samples from the Skopje-

Kumanovo basin (8 in number) were picked from the unit of yellow sandstones. The studied planktic foraminifera were obtained from 42 samples picked from 8 sections (Fig. 1). The species are rarely distributed in the upper levels of the two above mentioned units. They are represented by single or rare specimens and in the majority of sections they occur at isolated levels. In all sections, with the exception of Nemanjici (Fig. 3), only one or two species were found.

Nemanjici section is located 6,5 km NE from the town of Sveti Nikole. 90-100 m of the upper flysh unit, represented by calcareous clay alternating with thin sandstone beds (Fig.3), crop out here. Planktic foraminiferal association, containing all five taxa described below, was established in most of the samples. All species were recorded in the whole section. Generally *Globigerina officinalis* Subb., *Globoturborotalia ouachitaensis* (Howe and Wallace), *Globoturborotalia angulioffcinialis* (Blow) and *Globoturborotalia gnaucki* (Blow et Banner) occur together from the Upper Eocene (Zone P 16) to the end of the Oligocene (Zone P 22). The first one comes from lower levels of the Eocene. *Globoturborotalia angulisuturalis* (Bolli) appears in the Oligocene and continues its range later on. This species, together with the other four ones, was found in the lowermost sample of Namanjici section, which determines Oligocene age for this part of the section of the upper flysh unit. It is not excluded the lower levels of the unit (Fig. 2), not exposed here and without planktic foraminiferal data, to be older (most probably Upper Eocene).

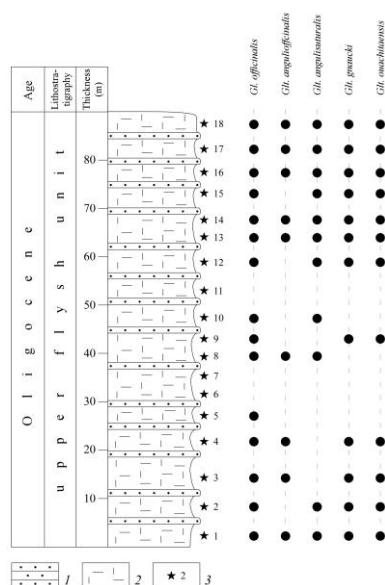


Fig. 3. Stratigraphical distribution of planktic foraminiferal taxa in Nemanjici section from Ovche Pole basin

1 – thin bedded sandstones; 2 – clayey-carbonate sediments; 3 - sample

Taxonomy. The following pages give taxonomical description of 5 species, belonging to 2 genera of the family GLOBIGERINIDAE Carpenter, Parker, and Jones, 1862. Taxonomical determination at generic level is based on the classification of LOEBLICH & TAPPAN [5] and PEARSON et al. [6]. All the species are first described in the Republic of Macedonia.

Suborder GLOBIGERININA Delage and Hérouard, 1896

Superfamily GLOBIGERINACEA Carpenter, Parker, and Jones, 1862

Family GLOBIGERINIDAE Carpenter, Parker, and Jones, 1862

Subfamily GLOBIGERININAE Carpenter, Parker, and Jones, 1862

Genus *Globigerina* d'Orbigny, 1826

Globigerina officinalis Subbotina, 1953

Plate I, Figures 4, 5

1953. *Globigerina officinalis* sp.n.; [7], p. 78, pl. 11, figs. 1a-7c. (in Russian)

1957. *Globigerina parva* sp. n.; [8], p. 108, pl. 22, figs. 14a-c.

1962. *Globigerina officinalis* Subbotina; [9], p. 88, pl. 9a-c; fig. 16.

1975. *Globigerina officinalis* Subbotina; [10], p. 211, fig. 71.

2005. *Globigerina officinalis* Subbotina; [11], pl. 5.

2006. *Globigerina officinalis* Subbotina; [6], p. 114, pl. 6.1, figs. 1-16.

Nomenclature. The holotype (VNIGRI Coll. No. 4038) is from the Upper Eocene (Bolivina Zone) of Northern Caucasus [7]. Here, the species is identified after the holotype figures and the SEM images of paratype No. 4040 of the same collection [6].

Material. More than 20 specimens, most of them well preserved.

Description. The test is small, low trochospiral, with perforated wall, the chambers are globular. The spiral side of the ultimate whorl is composed of 4 chambers, while the umbilical side comprises 3,5 chambers. Their size grows gradually. The sutures are distinct and depressed on both sides. The aperture is umbilical, a low arch.

Remarks. Our specimens are closer to the paratypes No. 4040 and 4041, than to the holotype [7]. They are with 3,5 chambers only in the ultimate whorl on the umbilical side and with a very low arch aperture. *G. parva* Bolli is considered as a younger synonym of *G. officinalis* Subbotina.

Stratigraphic range. Middle Eocene to Oligocene (P12 to P20 Zone).

Occurrence. Ovche Pole basin (Kadrifakovo section - samples 5, 6, 9; Nemanjici section – samples 1-5, 8-10, 12-18), Skopje-Kumanovo basin (Vojnik section – samples 6-8).

Genus *Globoturborotalia* Hofker, 1976

Globoturborotalia anguliofficialis (Blow, 1969)

Plate I, Figures 2-3

1985. *Globigerina ciperoensis anguliofficialis* Blow; [12], fig. 13 (10-11).

2005. *Globoturborotalia anguliofficialis* (Blow); [11], p. 113, pl. 17.

2006. *Globoturborotalia anguliofficialis* (Blow); [6], p. 116, pl. 6.2, figs. 1-7.

Nomenclature. The species was first described from the Lower Oligocene (Cipero Formation) of Trinidad. Here, it is identified after the refigured holotype [12].

Material. More than 50 well preserved specimens.

Description. The test is compact, trochospiral with a distinct ultimate whorl composed of 4,5 (in some cases 4) chambers on both spiral and umbilical sides. They are close to each other, globular, and grow gradually in size. The wall surface is cancellate, with normal pores. The peripheral outline is subquadratic. The sutures are straight and depressed, but not deep. The umbilicus is small and shallow. The aperture is umbilical, a low arch, covered with a narrow lip.

Remarks. Most of the studied specimens are similar to *G. gnaucki* (Blow et Banner) by the number of the chambers in the ultimate whorl (4 to 4,5).

Stratigraphic range. Late Eocene to Late Oligocene (P15 to P22 Zone).

Occurrence. Tikvesh Basin (Krivolak section – samples 5-7; Hadzi Jusufli section – samples 3, 6, 7), Ovche Pole Basin (Nemanjici section – samples 1, 3, 4, 8, 13, 14, 16-18), Skopje-Kumanovo basin (Vojnik section – sample 8), Delchevo basin (Crna Skala section – samples 13, 16, 20, 22-24, 26), Valandovo-Gevgelija basin (Dedeli section – samples 9, 11, 14, 15; Rabrovo section – samples 7, 14, 15).

Globoturborotalia angulisuturalis (Bolli, 1957)

Plate I, Figure 1

1957. *Globigerina ciperoensis angulisuturalis* subsp. n.; [8], p. 109, pl. 22, figs. 11a-c.

1962. *Globigerina angulisuturalis* Bolli; [⁹], 84, pl. 9-a-c.
 1975. *Globigerina angulisuturalis* Bolli; [¹⁰], 250, fig. 104.
 1981. *Globigerina angulisuturalis* Bolli; [¹³], 21, pl. 7, fig. 2a-c.
 1985. *Globigerina angulisuturalis* Bolli; [¹²], fig. 13 (4-7).
 2005. *Globoturborotalia angulisuturalis* (Bolli); [¹¹], p. 113, pl. 17.

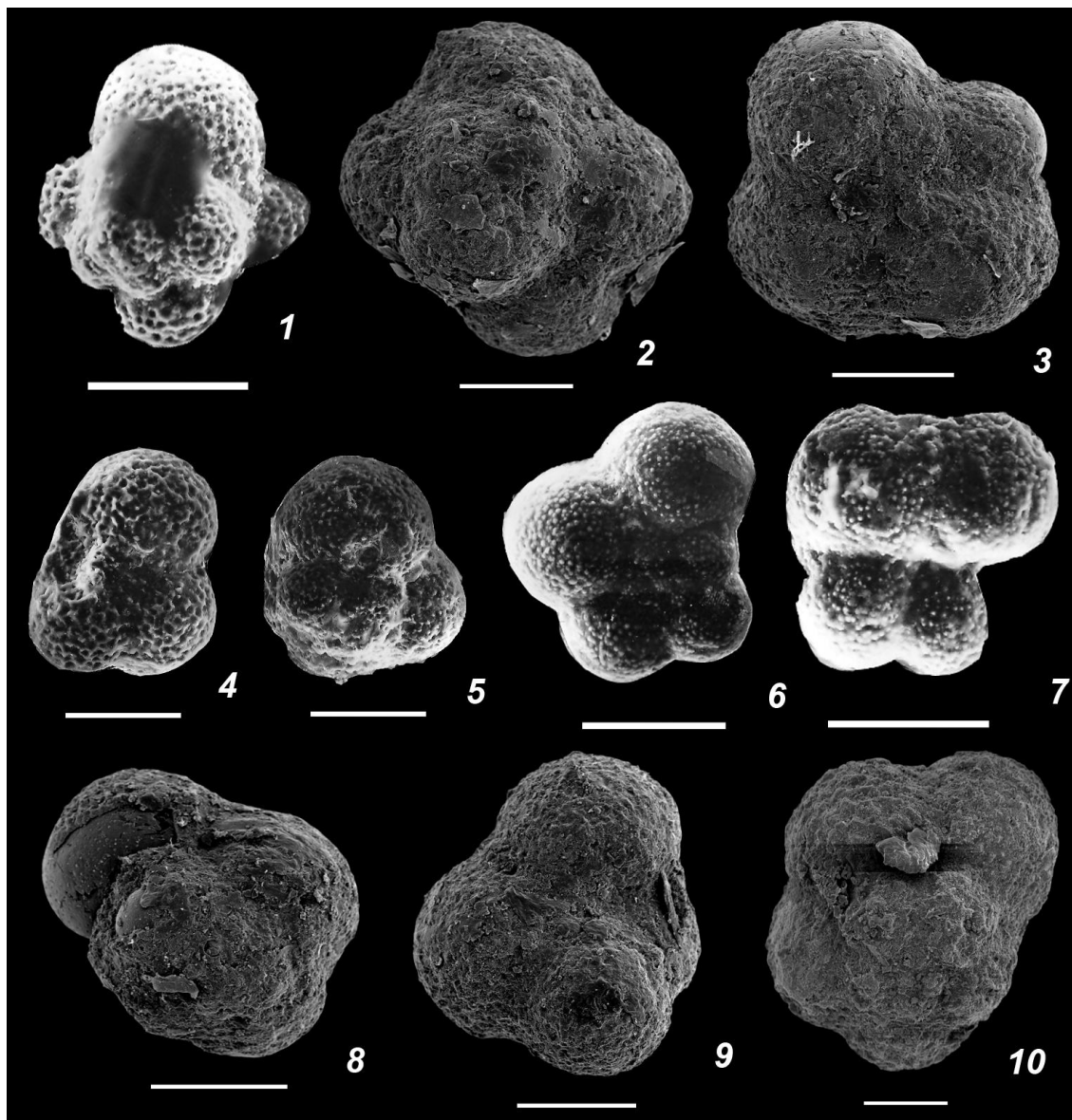


PLATE I

1. *Globoturborotalia angulisuturalis* (Bolli, 1957); Ovche Pole basin, Nemanjici section, upper flysh unit, sample 13; spiral view; SEMx300; 2, 3. *Globoturborotalia angulioffinalis* (Blow, 1969); Tikvesh basin, Hadzi Jusufi section, upper flysh unit, sample 7; 2 – spiral view, SEMx200; 3 – umbilical view, SEMx 220; 4, 5. *Globigerina officinalis* Subbotina, 1953; Ovche Pole basin, Nemanjici section, upper flysh unit; 4 - umbilical view, sample 14; SEMx325; 5 - spiral view, sample 13; SEMx240; 6, 7. *Globoturborotalia gnaucki* (Blow et Banner, 1962); Ovche Pole basin, Nemanjici section, upper flysh unit, sample 13; 6 - spiral view, SEMx325; 7- umbilical view, SEMx340; 8-10. *Globoturborotalia ouachitaensis* (Howe and Wallace, 1932); 8 - Valandovo-Gevgelija basin, Rabrovo section, upper flysh unit, sample 14; apertural view; SEMx200; 9, 10 - Tikvesh basin, Krivolak section, upper flysh unit, sample 7; 9 - spiral view, SEMx250; 10 - umbilical view, SEMx220; Scale bar – 100 µm

Nomenclature. The holotype (US Nat. Mus. Coll. No. P5608) is from the Oligocene of Trinidad (Cipero Formation). Here, the species is identified after the original figure of the holotype [8], as well as the SEM images of specimens from the same formation [10].

Material. More than 10 specimens, most of them well preserved.

Description. The test is high trochospire, subglobular. The ultimate whorl is composed of 4 chambers, well separated from each other. They are globular on the spiral side and slightly flattened on the umbilical one. The wall surface is cancellate, without cortex. The periphery is round and lobulate. The sutures are wide, short, straight and strongly depressed. The umbilicus is wide and shallow. The aperture is umbilical, a low arch, often with a rim.

Remarks. The taxon was proposed as a subspecies of *G. ciperoensis* (Bolli). Later on [9], it was proposed a separate species status, which was accepted by the majority of the authors. Its inclusion within genus *Globoturborotalia* Hofker is based on its spinose wall and cancellate test surface. The species is easily distinguished by its deep and wide septal seams. The majority of our specimens have 4 chambers in the ultimate whorl and a higher spiral than that of the holotype.

Stratigraphic range. Oligocene to Earliest Miocene (P21 (?) to N4 Zone).

Occurrence. Ovche Pole basin (Nemanjici section – samples 1, 2, 8, 10, 12-18).

***Globoturborotalia gnaucki* (Blow et Banner, 1962)**

Plate I, Figures 6, 7

1962. *Globigerina ouachitaensis gnaucki* subsp. n.; [9], p. 91, pl. 9-l-n.

1985. *Globigerina ouachitaensis gnaucki* Blow and Banner; [12], fig. 13 (16).

2005. *Globoturborotalia ouachitaensis gnaucki* (Blow and Banner); [11], pl. 19.

2006. *Globoturborotalia gnaucki* (Blow and Banner); [6], p. 118, pl. 6.4, figs. 1-15.

Nomenclature. The holotype (Nat. Hist. Mus. London Coll. No. P 44509) is from the Lower Eocene (Lindi area) of Tanzania. It was reillustrated by BOLLI & SAUNDERS [12] (fig. 13: 16a-c). Here the species is identified after the SEM images of the holotype [6].

Material. More than 10 well preserved specimens.

Description. The test is low trochospiral. Initial spire of chambers is flat. The ultimate whorl comprises 4,5 chambers on the spiral side, and 4 chambers on the umbilical side. They are globular and their size increases gradually. The wall surface is cancellate, normal perforate. The peripheral margin is rounded, distinctly lobulate. The sutures are concave, straight and not very deep. The umbilicus is wide and shallow. The aperture is a low arch with thin lip, umbilical to umbilical-extraumbilical.

Remarks. Our specimens are with a lower arch aperture than in the holotype and they are to a greater degree similar to the paratype of *Globigerina ouachitaensis* Howe and Wallace (USNM No. 18946), which, after a revision by PEARSON et al. [6] was referred to *G. gnaucki* (Blow et Banner).

Stratigraphic range. Late Eocene to Early Oligocene (end of P15 Zone- to P19 Zone).

Occurrence. Ovche Pole basin (Nemanjici section – samples 1-4, 9, 12-18).

***Globoturborotalia ouachitaensis* (Howe and Wallace, 1932)**

Plate I, Figures 8-10

1962. *Globigerina ouachitaensis ouachitaensis* Howe and Wallace; [9], p. 90, pl. 9-d, h-k, fig. 9(6).

1985. *Globigerina ouachitaensis ouachitaensis* (Howe and Wallace); [12], fig. 13 (15).

2005. *Globoturborotalia ouachitaensis* (Howe and Wallace); [11], p.115, pl. 19.

2006. *Globoturborotalia ouachitaensis* (Howe and Wallace); [6], p. 122, pl. 6.5, figs. 1-16.

Nomenclature. The species was first found in the Upper Eocene (Jackson Formation, Louisiana) of the USA. Here the species is identified after the refigured holotype [12] and by SEM images from Yazoo Fm, Mississippi [6].

Material. More than 20 well preserved specimens.

Description. The test is low trochospiral. Initial spire of chambers on the spiral side is convex. The ultimate whorl is composed of 4,5 chambers on the spiral side, and of 4 chambers on the umbilical side. They are globular and increase gradually in size. The periphery is rounded, distinctly lobulate. The wall surface is cancellate, normal perforate. The sutures are short, straight and concave. The umbilicus is relatively wide, shallow and open. The aperture is a high arch without lip, umbilical to umbilical-extraumbilical. Sometimes it is outlined with a rim.

Remarks. The number of chambers composing the spiral and umbilical side distinguishes our specimens from the holotype and the characteristics typical for the species.

Stratigraphic range. Middle Eocene to Late Oligocene (P10 to P22 Zone).

Occurrence. Ovche Pole Basin (Nemanjici section – samples 1-4, 8, 11-18), Valandovo-Gevgelija basin (Rabrovo section – samples 7, 8, 14).

REFERENCES

- [¹] DUMURDZHANOV, N., T. SERAFIMOVSKI, B. C. BURCHFIEL. *Geosphere*, 1, 1, 2005, 1-22.
- [²] MAKSIMOVICH, B., B. SIKOSEK, O. MARKOVICH, M. VESELINOVICH. *Trudovi na Geološki Zavod na NRM*, 4, Skopje, 1954, 1-177.
- [³] STOJANOVA, V. Evolution and stratigraphy of the Paleogene in the Republic of Macedonia. Resume of Ph.D. Thesis, Štip, 2008, 38 pp.
- [⁴] STOJANOVA, V., G. PETROV, V. STEFANOVA. *Proc. Nat. Sci. Conf. "Geosciences 2011"*, Bulg. Geol. Soc., Sofia, 2011, 93-94.
- [⁵] LOEBLICH, A. JR., H. TAPPAN. 1988. Foraminiferal genera and their classification. New York, Van Nostrand Reinhold C., 970 pp.
- [⁶] PEARSON, P., R. OLSSON, B. HUBER, C. HEMLEBEN, W. BERGGREN (eds). *Atlas of Eocene Planktonic Foraminifera*. Cushman Foundation, Sp. Publ., 41, 2006, 513 pp.
- [⁷] SUBBOTINA, N. Fossil Foraminifers of the USSR: Globigerinidae, Hantkeninidae and Globorotalidae. *Tr. VNIGRI, New ser.*, 76, 1953, 296 pp. (in Russian)
- [⁸] BOLLI, H. *U. S. Nat. Mus. Bull.*, 215, 1957, 155-172.
- [⁹] BLOW, W., F. BANNER. In: F. E. Eames et al. (eds), *The Mid-Tertiary (Upper Eocene to Aquitanian) Globigerinaceae*. Camb. Univ. Press, 1962, 61-151.
- [¹⁰] STAINFORTH, R., J. LAMB, H. LUTERBACHER, J. BEARD, R. JEFFORDS. *Univ. Kansas, Paleontol. Contrib.*, 62, 1975, 1-425.
- [¹¹] IACCARINO S. M., I. PREMOLI SILVA, M. BIOLZI, L. M. FORESI, F. LIRER, M.R. PETRIZZO. *Practical manual of Oligocene to Middle Miocene planktonic foraminifera*. Intern. School of Planktic Foraminifera, Perugia, 2005.
- [¹²] BOLLI, H., J. SAUNDERS. In: Bolli, H., J. B. Saunders, K. Perch-Nielsen (eds), *"Plankton Stratigraphy"*, Camb. Univ. Press, 1985, 155-261.
- [¹³] STAINFORTH, R., J. LAMB. *Univ. Kansas, Paleontol. Contrib.*, 104, 1981, 1-34.

Department of Geology and
Geophysics
Faculty of Natural and Technical
Sciences
"Goce Delčev" University
89, Goce Delčev Str.
MK-2000 Štip
Republic of Macedonia

*Department of Geology and
Paleontology
Faculty of Geology and
Prospecting
"St. Ivan Rilski" University of
Mining and Geology
1, Prof. Boyan Kamenov Str.
1700 Sofia
Bulgaria

**Department of Geology,
Paleontology and Fossil Fuels
Faculty of Geology and Geography
"St. Kliment Ohridski" University
of Sofia
15, Tsar Osvoboditel Blvd.
1504 Sofia
Bulgaria