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MIDWAY-TYPE BENTHIC FORAMINIFERA FROM THE PALEOCENE OF THE COASTAL PART OF EAST STARA PLANINA (EASTERN BULGARIA). FAMILY HETEROLEPIDAE GONZALES-DONOSO, 1969 TO FAMILY ROTALIIDAE EHRENBERG, 1839

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ABSTRACT. The present article is the third one (last) from the series concerning the taxonomy of the so-called Midway-type benthic foraminifera. Taxonomical descriptions of 8 species are introduced in the article. The species belong to 5 genera (*Anomalinoides* – 4 species, *Heterolepa* – 2 species, *Gyroidinoides* – 1 species, *Karreria* – 1 species, *Rotalia* – 1 species), 4 families, 6 superfamilies and 1 suborder. 4 species are first described in Bulgaria, 1 species is first described from the Paleocene, and 4 species is first described from the Paleocene of Bulgaria. The Loeblich & Tappan's (1988) classification is applied in the article. *Key words*: taxonomy, Midway-type benthic foraminifera, Paleocene, East Stara Planina

БЕНТОСНИ ФОРАМИНИФЕРИ ТИП "MIDWAY" ОТ ПАЛЕОЦЕНСКАТА СЕРИЯ В ПРИМОРСКАТА ЧАСТ НА ИЗТОЧНА СТАРА ПЛАНИНА (ИЗТОЧНА БЪЛГАРИЯ). СЕМЕЙСТВО HETEROLEPIDAE GONZALES-DONOSO, 1969 ДО СЕМЕЙСТВО ROTALIIDAE EHRENBERG, 1839

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РЕЗЮМЕ. Настоящата статия е трета (последна) от поредицата, посветена на таксономията на бентосните фораминифери тип "Midway". Представени са таксономични описания на 8 вида принадлежащи на 5 рода (*Anomalinoides* – 4 species, *Heterolepa* – 2 species, *Gyroidinoides* – 1 species, *Karreria* – 1 species, *Rotalia* – 1 species), 4 семейства, 6 надсемейства и 1 подразред. 4 вида се описват за първи път в България, 1 вид е установен за първи път в Палеоценски скали, а 4 са установени за първи път в скалите на Палеоценската серия в България. Използвана е систематиката на Loeblich & Tappan (1988). *Ключови думи*: таксономия, бентосни фораминифери тип "Midway", Палеоценска серия, Източна Стара планина

Introduction

The present article is the third one (last) from the series concerning the taxonomy of the so-called Midway-type benthic foraminifera. Taxonomical descriptions of 8 species are introduced in the article. The species belong to 5 genera, 4 families (HETEROLEPIDAE Gonzales-Donoso, 1969 to ROTALIIDAE Ehrenberg, 1839), 6 superfamilies and 1 suborder. 4 species are first described in Bulgaria, 1 species is first described from the Paleocene, and 4 species is first described from the Paleocene of Bulgaria.

The map with the location of the studied borehole and outcrop sections was published by Valchev (2003). The biostratigraphical framework was discussed in the same article.

The Loeblich & Tappan's (1988) classification is applied in the article.

Taxonomical descriptions

Suborder ROTALIINA Delage and Herouard, 1896
Superfamily CHILLOSTOMELLACEA Brady, 1881
Family HETEROLEPIDAE Gonzales-Donoso, 1969
Genus **Anomalinoides** Brotzen, 1942

Type species. *Anomalina plummerae* Brotzen, 1942 = *Anomalina pinguis* P. H. Jennings, 1936 (original designation).
Distribution. Albian - Holocene; cosmopolitan.

Anomalinoides acutus (Plummer, 1926)
Plate I, Figures 1, 2

1947. *Anomalina acuta* Plummer; Subbotina, p. 133, pl. 4, figs. 23-25.
1947. *Cibicides acutus* sp. nov.; Samojlova, p. 97, figs. 40-42.
1954. *Anomalina* (*Pseudovalvulineria*) *acuta* var. *acuta* Plummer; Vassilenko, p. 113, pl. 16, figs. 3, 4.
1959. *Anomalina acuta* Plummer; Stancheva, p. 341, pl. 4, fig. 2.
1961. *Anomalina acuta* var. *acuta* Plummer; Dikova, p. 210, pl. 12, figs. 12, 13, pl. 13, fig. 4.
1969. *Anomalina acuta acuta* Plummer; Krajeva, Zernetskij, p. 85, pl. 34, fig. 1.
1974. *Anomalina acuta* Plummer; Szczechura, Pozaryska, p. 103, pl. 26, figs, 1-3, 6, 7.
1976. *Anomalinoides acuta* (Plummer); Aubert, Berggren, p. 429, pl. 9, fig. 1.
1993. *Anomalinoides acutus* (Plummer); Darakchieva, Juranov, p. 70, pl. 3, figs. 1, 2.
Nomenclature. I have no data about the holotype.
Material. Byala Formation (about 400 specimens).

Remarks. In Bulgaria the species was described from the Eocene of Pleven District (Stancheva, 1959), and the Upper Cretaceous of NE Bulgaria (Dikova, 1961). It was also established in the Eocene of Bourgas District (Darakchieva, Juranov, 1993).

Distribution. It is known from the Upper Cretaceous and the Paleocene of Texas, the Paleocene of Trinidad, Arkansas, the Netherlands, Sweden, Tunisia, Caucasus, Middle Asia, the Lower Eocene of England, the Eocene of Ukraine, Byelorussia, Caucasus, Ural, North Turkmen, Germany, Belgium. It was also found during the deep-sea drilling in Norwegian Sea (Lower Eocene) and the Atlantic (Eocene).

Occurrence. C-11 (191.60-192.40 m - P1c Zone), C-12 (167.00 m - Lower Paleocene, 204.00 m - P1c Zone, 219.00 m - P1b Zone, 268.50 m - P1c Zone), C-21 (22.00-38.50 m - P1b Zone), C-23 (139.50 m - P1b Zone), C-24 (23.00 m - P3 Zone, 40.00 m - P2 Zone, 107.70 m - P1c Zone), C-25 (22.50-40.40 m - P1b Zone, 355.00 m - P2 Zone), C-28 (15.00-16.00 m - P2 Zone, 56.90 m - P1c Zone), C-29 (361.10-365.90 m - P3 Zone, 383.20-420.60 m - P4 Zone, 433.50-476.30 m - P5 Zone), C-30 (83.90-86.30 m - P4 Zone, 99.50-107.90 m - P5 Zone), section Byala 2b (NP3 Zone).

Anomalinoides danicus (Brotzen, 1942)
Plate I, Figures 3, 4

1948. *Anomalinoides danica* (Brotzen); Brotzen, p. 87, pl. 14, fig. 1, text-fig. 22.
1954. *Anomalina* (*Anomalina*) *danica* (Brotzen); Vassilenko, p. 67, pl. 4, fig. 3.
1961. *Anomalina danica* Brotzen; Dikova, p. 316, pl. 2, fig. 3.
1962. *Gavelinella rubiginosa* (Cushman); Hillebrandt, S. 102, Taf. 8, fig. 1.
1965. *Anomalina danica* Brotzen; Pozaryska, p. 128, pl. 24, figs. 1-3.
1976. *Gavelinella danica* (Brotzen); Aubert, Berggren, p. 433, pl.11, fig. 5.
1983. *Gavelinella danica* (Brotzen); Tjalsma, Lohman, p. 13, pl. 5, fig.7.

Nomenclature. I have no data about the holotype.

Material. Byala Formation (217 specimens), Emine Formation (2 specimens).

Remarks. In Bulgaria the species was described from the Paleogene of Varna District (Dikova, 1961).

Distribution. It is known from the Upper Cretaceous of Germany, the Maastrichtian of Tunisia, Ukraine, the Netherlands, the Paleocene of North Europe, Poland, Ukraine, North Caucasus, Crimea, Tunisia, deep-sea holes in the Atlantic (Paleocene – Lower Eocene), and Norwegian Sea (Lower Eocene).

Occurrence. Byala Formation. C-11 (191.60-192.40 m - P1c Zone), C-12 (167.00 m - Lower Paleocene, 204.00 m - P1c Zone), C-23 (128.00 m - P3 Zone, 271.20 m - P1b Zone), C-24 (23.00 m - P3 Zone, 40.00 m - P2 Zone, 107.70 m - P1c Zone), C-25 (22.50-40.40 m - P1b Zone, 355.00 m - P2 Zone), C-28 (15.00-16.00 m - P2 Zone), C-29 (361.10-365.00 m - P3 Zone, 383.20-420.60 m - P4 Zone, 433.50-476.30 m - P5 Zone), C-30 (83.90-91.90 m - P4 Zone, 99.50-107.90 m - P5 Zone). Emine Formation. Section Kochan (P1c Zone), and a sample from the geological mapping (Paleocene).

Anomalinoides praeacutus (Vassilenko, 1950)
Plate I, Figures 5, 6

1950. *Anomalina praeacuta* n. sp.; Vassilenko, p. 208, pl. 5, figs. 2, 3.
1954. *Anomalina* (*Pseudovalvulineria*) *praeacuta* Vassilenko; Vassilenko, p. 11, pl. 16, figs. 1, 2.
1951. *Anomalina acuta* Plummer; Cushman, p. 62, pl. 18, figs. 5, 6.
1962. *Anomalinoides praeacuta* (Vassilenko); Hillebrandt, S. 112, Taf. 9, Fig. 8.
1976. *Anomalinoides praeacuta* (Vassilenko); Aubert, Berggren, p. 430, pl. 9, fig. 2.

Nomenclature. Holotype (VNIGRI Coll. № 2247) is from the Paleocene of Romnen region (Dnepr-Donets basin, Ukraine). It was figured by Vassilenko (1950, pl. 5, fig. 2).

Material. Byala Formation (190 specimens), Emine Formation (1 specimen).

Description. Test is trochospiral, symmetrically biconvex. 2-2.5 whorls are visible on the spiral side. Umbilical side reveals 10-11 triangular chambers with gradually increasing sizes. Sutures are radial, slightly elevated, curved backwards. Umbilicus is small, slightly depressed. Periphery is broadly rounded. Aperture is medial.

Remarks. This species differs from *A. acutus* (Plummer) by clearly distinctive whorls on the spiral side and the rounded periphery.

Distribution. It is known from the Maastrichtian and Lower Paleocene of the Russian Plateau, Caucasus, Western Siberia, Polish Carpathians, the Paleocene of Ukraine, Carpathians, Sweden, Arkansas, Alabama, Austrian Alps, Tunisia, East Kamchatka, the Eocene of Arkansas and Alabama, deep-sea holes in the Atlantic (Paleocene – Lower Eocene).

Occurrence. Byala Formation. C-12 (167.00-169.70 m - Lower Paleocene, 203.00-204.00 m - P1c Zone, 264.50 m - Lower Paleocene), C-21 (7.50 m - P1c Zone, 22.00 m - P1b Zone), C-23 (74.00-123.00 m - P3 Zone, 139.50-215.00 m - P1b Zone), C-24 (40.00 m - P2 Zone, 107.70 m - P1c Zone), C-25 (22.50-45.00 m - P1b Zone, 355.00 m - P2 Zone), C-28 (15.00-16.00 m - P2 Zone), C-29 (361.10-365.00 m - P3 Zone, 383.20-420.60 m - P4 Zone, 433.50-476.30 m - P5 Zone), C-30 (83.90-86.30 m - P4 Zone, 99.50-107.90 m - P5 Zone). Emine Formation. Section Kochan (P1c Zone).

Anomalinoides welleri (Plummer, 1927)
Plate I, Figure 7

1951. *Anomalina welleri* (Plummer); Cushman, p. 63, l. 18, fig.12.
1954. *Anomalina* (*Anomalina*) *welleri* (Plummer); Vassilenko, p. 62, pl. 3, figs. 6, 7.
1975. *Anomalinoides welleri* (Plummer); Berggren, Aubert, p. 151, pl. 5, fig. 3, pl. 13, fig. 7, pl. 18, fig. 6, pl.19,fig.1.
1976. *Anomalinoides welleri* (Plummer); Aubert, Berggren, p. 430, pl. 9, fig. 5.

Nomenclature. I have no data about the holotype.

Material. Byala Formation (22 specimens).

Description. Test is trochospiral, biconvex, moderately flattened. Spiral side is evolute and it reveals 2-2.5 whorls, as the chambers are distinct in the last one only. 10-12 triangular chambers with gradually increasing sizes are visible on the umbilical side. Sutures are radial, slightly depressed, curved backwards. Umbilicus is narrow, deep, usually filled with secondary deposits. Periphery is broadly rounded. Wall is finely perforated. Aperture is slit-like, extended from periphery to umbilicus.

Distribution. The species is known from the Maastrichtian and Paleocene of the Tethys region. It was also established in the deep-sea holes in the North Atlantic (Paleocene).

Occurrence. C-11 (191.60-247.50 m - P1c Zone), C-21 (38.50 m - P1b Zone), C-28 (15.00 m - P2 Zone), C-30 (83.90 m - P4 Zone), sections Byala 1 (NP4-5 Zones), Byala 2b (NP1 Zone), Byala 2c (NP1 Zone).

Genus **Heterolepa** Franzenau, 1894

Type species. *Heterolepa simplex* Franzenau, 1894 = *Rotalina dutemolei* d'Orbigny, 1846 (subsequent designation by Loeblich and Tappan, 1962).

Distribution. Maastrichtian - Holocene; cosmopolitan.

Heterolepa grimsdalei (Nuttal, 1930)
Plate I, Figures 9, 10

1930. *Cibicides grimsdalei* Nuttal, n. sp.; Nuttal, p. 291, pl. 25, figs. 7, 8, 11.
1973. *Cibicidoides grimsdalei* (Nuttal); Douglas, p. 650, pl. 15, figs. 1-6.
1975. *Heteropepa grimsdalei* (Nuttal); Braga et al., p. 98, T. 2, fig. 18.

Nomenclature. I have no data about the holotype. The species was first described from the Eocene of Mexico.

Material. Byala Formation (397 specimens), Emine Formation (3 specimens).

Description. Test is trochospiral, with almost flat spiral side and dome-like umbilical one. 2 whorls with oblique, depressed and curved backwards sutures are visible on the spiral side. Umbilical side reveals 9-10 triangular chambers. Here sutures are flush or slightly depressed, curved backwards. Umbilicus is flush. Periphery is narrowly rounded. Aperture is interiomarginal. Spiral side is covered with large pores and pistules.

Distribution. The species is known from the Eocene of Mexico, Apennines, the deep-sea drilling in the Atlantic (Eocene-Lower Oligocene), and the Pacific (Eocene – Lower Miocene).

Occurrence. Byala Formation. C-11 (192.40 m - P1c Zone), C-12 (194.00214.90 m - P1c Zone, 219.20 m - P1b Zone, 264.50 m - Lower Paleocene, 268.50-289.20 m - P1c Zone, 296.10 m - P1b Zone), C-21 (22.00-38.50 m - P1b Zone), C-23 (139.50-271.20 m - P1b Zone), C-24 (23.00 m - P3 Zone, 40.00 m - P2 Zone, 107.70 m - P1c Zone), C-25 (22.50-45.00 m - P1b Zone, 355.00, 454.60 m - P2 Zone), C-28 (15.00-16.00 m - P2 Zone, 512.00-513.00 m - P3 Zone), C-29 (364.40-365.00 m - P3 Zone, 399.20 m - P4 Zone, 440.30-476.30 m - P5 Zone), C-30 (86.30 m - P4 Zone). Emine Formation. Section Banya-Southwest (Lower Paleocene).

Heterolepa perlucida (Nuttal, 1932)
Plate I, Figures 11, 12

1947. *Cibicides perlucidus* Nuttal; Subbotina, p. 137, pl. 7, figs. 22-25.
1950. *Cibicides* (*Gemelides*) *perlucidus* Nuttal; Vassilenko, p. 191, pl. 24, figs. 2, 4, 5.
1959. *Cibicides perlucidus* Nuttal; Stancheva, p. 342, pl. 5, fig. 2.
1961. *Cibicides perlucidus* Nuttal; Dikova, p. 322, pl. 5, fig. 1.
1973. *Cibicidoides perlucidus* (Nuttal); Douglas, p. 650, pl. 15, figs. 7-9.
1993. *Heterolepa perlucida* (Nuttal); Darakchieva, Juranov, p. 70, pl. 2 , figs. 10, 11.

Nomenclature. I have no data about the holotype.

Material. Byala Formation (over than 400 specimens).

Remarks. In Bulgaria the species was described from the Eocene of Pleven District (Stancheva, 1959), and the Paleogene of the NE part of the country (Dikova, 1961), as in both cases it was referred to genus Cibicides de Montfort. It was also established in the Eocene of Bourgas District (Darakchieva, Juranov, 1992). It differs from *H. grimsdalei* (Nuttal) by its smaller pore's diameter on the spiral side.

Distribution. This species is known from the Paleocene of Caucasus, Crimea, the Upper Paleocene and Eocene of Turkmenia, the Eocene of North Caucasus, Crimea, the Upper Eocene of Poland, the Oligocene of Mexico, France.

Occurrence. C-11 (191.60-192.40 m - P1c Zone), C-12 (167.00-169.70 m - Lower Paleocene, 204.00 m - P1c Zone, 264.50 - Lower Paleocene), C-21 (22.00-38.50 m - P1b Zone), C-23 (74.00 m - P3 Zone, 139.50-271.20 m - P1b Zone), C-24 (23.00 m - P3 Zone, 40.00 m - P2 Zone), C-25 (22.50-45.00 m - P1b Zone, 355.00, 454.60 m - P2 Zone), C-28 (15.00-16.00 m - P2 Zone, 512.00-513.00 m - P3 Zone), C-29 (361.10-365.00 m - P3 Zone, 383.20-420.60 m - P4 Zone, 433.50-476.30 m - P5 Zone), C-30 (83.90-91.90 m - P4 Zone, 99.50-107.90 m - P5 Zone).

Family GAVELINELLIDAE Hofker, 1956
Subfamily GYROIDINIDAE Saidova, 1981
Genus **Gyroidinoides** Brotzen, 1942

Type species. *Rotalia nitida* Reuss, 1844 (original designation).

Distribution. Cenomanian - Holocene; cosmopolitan.

Gyroidinoides octocameratus (Cushman and Hanna, 1927)
Plate I, Figure 8

1937. *Gyroidina soldanii* d'Orbigny var. *octocamerata* Cushman et G. D. Hanna; Glaessner, S. 379, Taf. 3, Fig. 27.
1948. *Gyroidinoides soldanii* (d'Orbigny) var. *octocamerata* (Cushman & Hanna); Brotzen, p. 76, pl. 2, fig. 3.
1953. *Gyroidina octocamerata* (Cushman and Hanna); Mjatljuk, p. 60, pl. 4, figs. 7, 8.
1962. *Gyroidinoides soldanii octocameratus* (Cushman and Hanna); Hillebrandt, S. 108, Taf. 9, Fig. 6.
1993. *Gyroidinoides octocameratus* (Cushman and Hanna); Darakchieva, Juranov, p. 72, pl. 3, figs. 10, 11.

Nomenclature. I compare to the refigured by Mjatljuk (1953, pl. 4, fig. 7) holotype. The species was first described from the Eocene of California.

Material. Byala Formation (44 specimens).

Remarks. In Bulgaria the species was described from the Upper Eocene of Bourgas District (Darakchieva, Juranov, 1992).

Distribution. It is known from the Maastrichtian and Paleocene of Poland, the Paleocene of Sweden, Slovakia, the Alps, Caucasus, Australia, East Kamchatka,, the Upper Paleocene of France, the Eocene of California, Caucasus, North Italy, Belgium, the deep-sea holes in the Atlantic (Campanian - Maastrichtian), bay of Biscay (Upper Eocene – Lower Oligocene).

Occurrence. C-12 (204.00 m - P1c Zone), C-21 (38.50 m - P1b Zone), C-25 (22.50-26.40 m - P1b Zone), C-29 (364.40 m - P3 Zone, 44.30-476.30 m - P5 Zone), C-30 (83.90 m - P4 Zone, 99.50 m - P5 Zone), sections Byala 1 (NP5 Zone), Byala 2b (NP1-3 Zones), Byala 2c (NP1-2 Zones), Byala River and Koundilaki Cheshme Valleys (Paleocene).

Family KARRERIIDAE Saidova, 1981
Genus **Karreria** Rzehak, 1891

Type species. *Karreria fallax* Rzehak, 1891 (original designation).

Distribution. Albian - Holocene; cosmopolitan.

Karreria fallax Rzehak, 1891
Plate I, Figures 13, 14

1895. *Karreria fallax* m.; Rzehak, S. 226, Tab. 7, Fig. 7, 8.
1928. *Karreria fallax* Rzehak; White, p. 229, pl. 41, fig. 2.
1948. *Karreria fallax* Rzehak; Brotzen, p. 113, pl. 18, fig. 3, text-figs. 34-37.
1954. *Karreria fallax* Rzehak; Vassilenko, p. 201, pl. 36, figs. 3, 4.
1974. *Karreria fallax* Rzehak; Szczechura, Pozaryska, p. 114, pl. 18, figs. 1-5.
1976. *Karreria fallax* Rzehak; Aubert, Berggren, pl. 12, fig. 5.
1988. *Karreria fallax* Rzehak; Loeblich, Tappan, pl. 724, figs. 1-4.

Nomenclature. I have no data about the holotype. The species was first described from the Lower Paleogene of the Carpathians.

Material. Byala Formation (70 specimens).

Description. Test is free, heteromorphous. Initial portion is trochospiral, the late one is uniserial. Spiral side is flush or slightly concave, the umbilical one is convex. 5-6 inflated chambers with gradually increasing sizes are visible in the last whorl. Sutures are distinct, deep, and radial almost straight. Periphery varies from broadly rounded to slightly tapered. Surface is smooth. Aperture is terminal, oval.

Distribution. The stratigraphical range of the species is Upper Cretaceous – Eocene; cosmopolitan.

Occurrence. C-11 (191.60 m - P1b Zone), C-12 (204.00 m - P1b Zone, 289.20 m - P1c Zone, 296.10 m - P1b Zone), C-21 (29.50-38.50 m - P1b Zone), C-28 (16.00 m - P2 Zone), C-29 (420.60 m - P4 Zone, 440.30-476.30 m - P5 Zone), C-30 (83.90 m - P4 Zone, 107.90 m - P5 Zone), sections Byala 1 (NP3 Zone), Byala 2b (NP1-3 Zones), Byala 2c (NP1-2 Zones), Byala River and Koundilaki Cheshme Valleys (Paleocene)

Superfamily ROTALIACEA Ehrenberg, 1839
Family ROTALIIDAE Ehrenberg, 1839
Subfamily ROTALIINAE Ehrenberg, 1839
Genus **Rotalia** Lamarck, 1804

Type species. *Rotalites trochidiformis* Lamarck, 1804 (subsequent designation by Childrean, 1823);

Distribution. Coniacian – Eocene; cosmopolitan.

Rotalia hermi Hillebrandt, 1962
Plate I, Figures 15-17

1962. *Rotalia hermi* n. sp.; Hillebrandt, S. 116, Taf. 10, Fig. 13, 14; Taf. 15, Fig. 16, 17; Texttab. 10.

Nomenclature. Holotype (Slg. München Prot. 1363a (P 2140)) is from the Lower Paleocene (Graue Mergel in der Fazies der Nierentaler Schichten) of the Austrian Alps.

Material. Byala Formation (199 specimens).

Description. Test is trochospiral, biconvex. Spiral side is more convex and it shows 2-2.5 whorls. Here sutures are flush or slightly elevated. 11-12 triangular chambers are visible on the umbilical side. Sutures are radial, deep, slightly curved backwards. Umbilicus is comparatively broad (1/4 to 1/5 of test diameter), flush or slightly concave. In the last case it is filled with secondary deposits. Periphery bears narrow and thick keel. Surface is covered with pores. Aperture is basal, extraumbilical, simple.

Distribution. The species is known from the Paleocene of the Austrian Alps.

Occurrence. C-11 (191.60-192.40 m - P1c Zone), C-12 (219.20 m - P1b Zone), C-21 (29.50-37.00 m - P1b Zone), C-24 (40.00 m - P2 Zone, 56.90 m - P1c Zone, 74.25 m - P1b Zone), C-25 (40.40 m - P1b Zone, 355.00, 454.00 m - P2 Zone), C-28 (15.00 m - P2 Zone), C-29 (383.20-420.60 m - P4 Zone, 440.30-476.30 m - P5 Zone), C-30 (83.90-86.30 m - P4 Zone, 99.50 m - P5 Zone).

References

Aubert, J., W. A. Berggren. 1976. Paleocene benthic foraminiferal biostratigraphy and paleoecology of Tunusia. – *Bull. Centre Res. Pau - SNPA, 10*, 2, 379-469.

Berggren, W. A., J. Aubert. 1975. Paleocene benthonic foraminiferal biostratigraphy, paleogeography and paleoecology of Atlantic-Tethyan regions: Midway type fauna. – *Paleogeogr. Paleoclim. and Paleoecol., 18*, 73-192.

Braga, G., R. de Biase, A. Grunig, F. Proto Decima. 1975. Foraminiferi bentonici del Paleocene ed Eocene della sezione di Possagno. – *Schweiz. Palaeont. Abh*., *97*, 85-199.

Brotzen, F. 1948. The Swedish Paleocene and its foraminiferal fauna. – *Sverig. Geol. Unders., Ser. C 493, 4*, 2, 3-140.

Cushman, J. A. 1951. Paleocene Foraminifera of the Gulf Coastal Region of the United States and Adjacent Areas. – *Geol. Survey Prof. Paper, 232*, 1-75.

Darakchieva, S., S. Juranov. 1993. Small Foraminifers from the Middle and Upper Eocene in the Burgas District. Calcareous benthic foraminifers. Part II. – *Geologica Balc., 23*, 1, 59-77.

Dikova, P. 1961. Upper Cretaceous and Tertiary Anomalinidae from Northeastern Bulgaria. – *Treat. Geol. Bulg., Ser. Paleont., 3*, 311-342 (in Bulgarian).

Douglas, R. G. 1973. Benthonic foraminiferal biostratigraphy in the Central North Pacific, Leg 17. – *Init. Repts. DSDP*, *17*, 607-671, *111*, 1-207.

Glaessner, M. 1937. Studien über Foraminiferen aus der Kreide und dem Tertiär des Kaukasus. 1. Die Foraminiferen der Altesten Tertiärschichten des Northwest Kaukasus. – *Probl. Paleontol.*, *2-3*, 349-410.

Hillebrandt, A. von. 1962. Das Paleozän und seine Foraminiferenfauna im Becken von Reichenhall und Salzburg. – *Bayer. Acad. Wiss*., math-natw. Cl., Abh.*, (N. F.), 108*, 1-192.

Krayeva, E.Y., B. F. Zernetskij. 1969. Paleogene foraminifers from Ukraine. – *Paleont. Misc., 3*, 197 p. (in Russian)

Loeblich, A. Jr., H. Tappan. 1988. *Foraminiferal Genera and Their Classification*. Van Nostrand Reinhold, New York, 970p.

Mjatljuk, E. V. 1953. Spirilinids, Rotaliids, Epistomonids, and Asterigerinids. – *Treat. VNIGRI, New Ser., 71*, 274 p. (in Russian)

Nuttal, W. L. F. 1930. Eocene foraminifera from Mexico. – *J. Paleont*., *4*, 271-293.

Pozaryska, K. 1965. Foraminifera and biostratigraphy of the Danian and Montian in Poland. – *Paleont. Polonica*, *14*, 156 p.

Rzehak, A. 1895. Über einige merkwurdige Foraminiferen aus dem österreichischen Tertiär. – *Ann. k. k. Naturhist. Hofmus*., *10*, 2, 213-230.

Samojlova, R. B. 1947. Some New and Characteristic Foraminiferal Species from the Upper Paleogene of Crimea. – *Bull. Mosc. Soc. Test. Nat., 22*, 4, 77-99 (in Russian).

Szczechura, J., K. Pozaryska. 1974. Foraminiferida from the Paleocene of Polish Carpatians (Babica clays). – *Paleontol. Polonica*, *32*, 142 p., 38 pls.

Stancheva, M. 1959. Eocene foraminifers from Pleven District. – *Treat. Geol. Bulg., Ser. Paleont., 1*, 321-359 (in Bulgarian).

Subbotina, N. N. 1947. Danian and Paleogene Foraminifers from North Caucasus. – In: *Microfauna from the Oil Deposits of Caucasus, Emba and Middle Asia*. VNIGRI, 39-160 (in Russian).

Tjalsma, R. C., G. P. Lohman. 1983. Paleocene-Eocene bathyal and abyssal benthic foraminifera from the Atlantic Ocean. – *Micropaleont., Spec. Publ*., 4, 90 p.

Valchev, B. 2003. Biostratigraphy of the Paleocene of the Coastal Part of East Stara Planina based on Small Benthic Foraminifera. – *Geologica Balc*., *33*, 1-2, 47-59.

Valchev, B. 2007. Midway-type benthic foraminifera from the Paleocene of the coastal part of East Stara Planina (Eastern Bulgaria). Family TEXTULARIIDAE Ehrenberg, 1838 to Family STILOSTOMELLIDAE Finlay, 1947. – *Ann. Univ. Mining and Geology, 50*, *Part I, Geology and Geophysics*, 129-137.

Valchev, B. 2008. Midway-type benthic foraminifera from the Paleocene of the coastal part of East Stara Planina (Esatern Bulgaria). Family BAGGINIDAE Cushman, 1927 to Family ORIDORSALIDAE Loeblich and Tappan, 1964. – *Ann. Univ. Mining and Geology, 51, Part I, Geology and Geophysics,* 119-126.

Vassilenko, V. P. 1950. Paleocene foraminifers from the central part of Dnepr-Donets Lowering. – In: *Microfauna USSR, 4*, 177-224. (in Russian).

Vassilenko, V. P. 1954. Anomalinids. – *Treat. VNIGRI, New Ser., 80*, 282 p. (in Russian).

White, M. P. 1928. Some Index Foraminifera of the Tampico Embayment Area of Mexico. Part I. – *J. Paleont*., 2, 177-215.

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PLATE I

1, 2. ***Anomalinoides acutus*** (Plummer, 1926). Byala Formation, Borehole C-30, Upper Paleocene, 83.90 m, P4 Zone, Sample C-30-6; *1* – umbilical view, *2* – spiral view; SEMx101.

3, 4. ***Anomalinoides danicus*** (Brotzen, 1948). Byala Formation, Byala River Valley, Paleocene, Sample БР-7; *3* – spiral view, *4* – umbilical view; SEMx50.5.

5, 6. ***Anomalinoides praeacutus*** (Vassilenko, 1950). Byala Formation, Section Byala 2b, Lower Paleocene, NP3 Zone, Sample Б-2b-13; *5* – spiral view, *6* – umbilical view; SEMx63.

7. ***Anomalinoides welleri*** (Plummer, 1927). Byala Formation, Section Byala 1, Lower Paleocene, NP5 Zone, Sample Б1-10; umbilical view; SEMx60.

8. ***Gyroidinoides octocameratus*** (Cushman&Hanna, 1927). Byala Formation, Byala River Valley, Paleocene, Sample БР-6; umbilical view; SEMx60.

9, 10. ***Heterolepa grimsdalei*** Nuttal, 1930. Byala Formation, Section Byala 1, Lower Paleocene, NP5 Zone, Sample Б1-9; *9* – spiral view, *10* – umbilical view; SEMx50.5.

11, 12. ***Heterolepa perlucida*** (Nuttal, 1932). Byala Formation, Section Byala 2b, Lower Paleocene, NP3 Zone, Sample Б2b-15; *11* – spiral view, *12* – umbilical view; SEMx85.

13, 14. ***Karreria fallax*** Rzehak, 1891. Byala Formation, Section Byala 2b, Lower Paleocene, NP3 Zone, Sample Б2b-15; 13 – spiral view, 14 – umbilical view; SEMx40.8.

15-17. ***Rotalia hermi*** Hillebrandt, 1962. Byala Formation, Byala River Valley, Paleocene, Sample БР-6; *15* – spiral view, *17* – umbilical view; SEMx75; *16* – apertural view; SEMx110.

PLATE I