

MIDWAY-TYPE BENTHIC FORAMINIFERA FROM THE PALEOCENE OF THE COASTAL PART OF EAST STARA PLANINA (EASTERN BULGARIA). FAMILY BAGGINIDAE CUSHMAN, 1927 TO FAMILY ORIDORSALIDAE LOEBLICH AND TAPPAN, 1964

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ABSTRACT. The present article is the second one from a series of three parts concerning the taxonomy of the so called Midway-type benthic foraminifera from the Paleocene of the Coastal Part of East Stara Planina. Taxonomical descriptions of 14 species are introduced in the article. They belong to 9 genera (*Valvulineria* – 1 species, *Cibicides* – 2 species, *Pullenia* – 1 species, *Allomorphina* – 2 species, *Chilostomelloides* – 1 species, *Quadriformina* – 2 species, *Alabamina* – 1 species, *Osangularia* – 1 species, *Oridorsalis* – 3 species), 4 subfamilies, 8 families, 4 superfamilies and 1 suborder. 12 species are first described in 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 BAGGINIDAE CUSHMAN, 1927 ДО СЕМЕЙСТВО ORIDORSALIDAE LOEBLICH AND TAPPAN, 1964

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РЕЗЮМЕ. Настоящата статия е втора от поредицата, посветена на таксономията на бентосните фораминифери тип "Midway" от Палеоценската серия в приморската част на Източна Стара планина. Представени са таксономични описания на 14 вида. Те принадлежат на 9 рода (*Valvulineria* – 1 вид, *Cibicides* – 2 вида, *Pullenia* – 1 вид, *Allomorphina* – 2 вида, *Chilostomelloides* – 1 вид, *Quadriformina* – 2 вида, *Alabamina* – 1 вид, *Osangularia* – 1 вид, *Oridorsalis* – 3 вида), 4 подсемейства, 8 семейства, 4 надсемейства и 1 подразред. 12 вида се описват за първи път 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 second one from a series of three parts concerning the taxonomy of the so called Midway-type benthic foraminifera from the Paleocene of the Coastal Part of East Stara Planina (Eastern Bulgaria). Taxonomical descriptions of 14 species are introduced in the article. They belong to 9 genera 4 subfamilies, 8 families (BAGGINIDAE Cushman, 1927 to ORIDORSALIDAE Loeblich and Tappan, 1964), 4 superfamilies and 1 suborder. 12 species are first described in 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 DISCORBACEA Ehrenberg, 1838
Family BAGGINIDAE Cushman, 1927

Subfamily BAGGININAE Cushman, 1927

Genus ***Valvulineria*** Cushman, 1926

Type species. *Valvulineria californica* Cushman, 1926 (original designation).

Distribution. Paleocene – Holocene; cosmopolitan.

Valvulineria alpina Hillebrandt, 1962

Plate I, Figures 1, 2

1962. *Valvulineria alpina* n. sp.; Hillebrandt, S. 104, Taf. 8, Fig. 7, 8.

1974. *Valvulineria alpina* Hillebrandt; Szczechura, Pozaryska, p. 62, pl. 11, figs. 3-5.

Nomenclature. Holotype (Slg. Munchen Prot. 1336a) is from the Lower Paleocene of Austrian Alps. It was figured by Hillebrandt (1962, Taf. 8, Fig. 8).

Material. Byala Formation (24 specimens).

Description. Test is with oval outline, trochospiral, moderately biconvex. Spiral side is evolute; 2-2.5 whorls are visible. Umbilical side is involute, comprising 5-6 triangular chambers gradually increasing in size. Sutures are depressed, straight, and tangential on the spiral side; slightly curved backwards and radial on the umbilical side. Periphery is

rounded. Umbilicus is narrow, filled with secondary deposits. Surface is smooth. Aperture is arch-shaped, interior marginal, umbilical-extraumbilical.

Distribution. The species is known from the Paleocene of the Austrian Alps, and Polish Carpathians.

Occurrence. C-12 (287.90 m – P1c Zone), C-25 (P1b Zone), sections Byala 1 (NP3-5 Zones), Byala 2b (NP3 Zone), Byala 2c (NP1-2 Zones), Byala River and Koundilaki Cheshme Valleys (Paleocene).

Superfamily PLANORBULINACEA Schwager, 1877

Family CIBICIDIDAE Cushman, 1927

Subfamily CIBICIDINAE Cushman, 1927

Genus **Cibicides** de Montfort, 1808

Type species. *Cibicides refulgens* de Montfort, 1808 (original designation).

Distribution. Paleocene – Holocene; cosmopolitan.

Cibicides megaloperforatus Said and Kenawy, 1956
Plate I, Figures 3, 4

1962. *Cibicides megaloperforatus* Said & Kenawy; Hillebrandt, S. 114, Taf. 10, Fig. 5, 6.

Nomenclature. I have no data about the holotype.

Material. Byala Formation (14 specimens).

Description. Test is small-sized, trochospiral, with slightly convex umbilical side and slightly concave spiral one. 2 whorls are visible on the spiral side; umbilical side comprises 5-6 chambers. Sutures on both sides are radial, depressed, curved backwards. Umbilicus is narrow, depressed. Periphery is rounded. Surface is covered with large pores. Aperture is basal, extraumbilical.

Distribution. The species is known from the Paleocene of the Alps and Egypt.

Occurrence. C-12 (167.00-169.70 m – Lower Paleocene, 268.50 m – P1c Zone), C-21 (22.00, 38.50 m - P1b Zone), C-24 (56.90 m - P1c Zone).

Cibicides simplex Brotzen, 1948
Plate I, Figures 5, 6

1948. *Cibicides simplex* n. sp.; Brotzen, p. 83, pl. 13, figs. 4, 5.

1960. *Cibicides simplex* Brotzen; Olson, p. 53, pl. 12, figs. 7-9.

1962. *Cibicides simplex* Brotzen; Hillebrandt, S. 115, Taf. 10, Fig. 11.

1965. *Cibicides simplex* Brotzen; Pozaryska, p. 135, pl. 26, fig. 2.

1969. *Anomalina simplex* (Brotzen); Krayeva, Zernetskij, p. 88, pl. 32, fig. 3.

Nomenclature. The holotype (S. G. U. No. 2671) is from the Paleocene of Sweden (Klagscham greensand). It was figured by Brotzen (1948, pl. 13, fig. 4).

Material. Byala Formation (23 specimens), Emine Formation (3 specimens).

Description. Test is trochospiral, with flush spiral and moderately inflated umbilical side. 2 whorls are visible on the spiral side. The umbilical side comprises 5-6 inflated triangular chambers. Sutures are radial, depressed, curved backwards. Umbilicus is narrow, depressed. The wall is finely perforated. Aperture is arch-shaped, extraumbilical.

Remarks. The species differs from the previous one by the slightly inflated triangular chambers.

Distribution. It is known from the Cretaceous of Poland, the Paleocene of Sweden, Poland, New Jersey, the Alps, Paris basin, Crimea, Tunisia.

Occurrence. Byala Formation. C-11 (191.60 m - P1b Zone), C-12 (169.70 m – Lower Paleocene), C-29 (476.30 m - P4 Zone), sections Byala 1 (NP3-4 Zones), Byala 2c (NP1-2 Zones); Emine Formation. Samples from the geological mapping (Paleocene).

Superfamily NONIONACEA Schultze, 1854

Family NONIONIDAE Schultze, 1854

Subfamily PULLENIINAE Schwager, 1877

Genus **Pullenia** Parker and Jones, 1862

Type species. *Nonionina bulloides* d'Orbigny, 1846 (original designation by monotypy).

Distribution. Late Cretaceous – Holocene; cosmopolitan.

Pullenia quinqueloba (Reuss, 1851)
Plate I, Figure 7

1851. *N. (Nonionina) quinqueloba* m.; Reuss, S. 71, Taf. 5, Fig. 31.

1959. *Pullenia quinqueloba* (Reuss); Stancheva, p. 334, pl. 4, Fig. 5.

1969. *Pullenia quinqueloba* (Reuss); Krayeva, Zernetskij, p. 101, pl. 42, fig. 3.

1973. *Pullenia quinqueloba* (Reuss); Douglas, p. 638, pl. 9, figs. 4, 5.

1992. *Pullenia quinqueloba* (Reuss); Darakchieva, Juranov, p. 65, pl. 2, figs. 1, 4.

Nomenclature. Holotype is the specimen figured by Reuss (1851, Taf. 5, Fig. 31). The species was first described from the Oligocene (septarien clays) of Germany (Hermsdorf surroundings).

Material. Byala Formation (23 specimens), Emine Formation (1 specimen).

Remarks. In Bulgaria the species was described from the Eocene of Pleven District (Stancheva, 1959). It was also established in the Eocene of Bourgas District (Darakchieva, Juranov, 1992). It differs from *P. jarvisi* Cushman by the presence of 5 chambers in the last whorl.

Distribution. It is known from the Senonian of Saratov and Volgograd Districts, Turkmenia, the Paleocene of Denmark, North Caucasus, Turkmenia, Tunisia, the Netherlands, the Upper Paleocene of England, the Eocene of Ukraine, Donets basin, Carpathians, Belgium, the Netherlands, England, Turkmenia, the Oligocene of Germany, Belgium, the Netherlands, Trinidad, Turkmenia, the Upper Miocene of Dominican Republic, the Miocene of Vienna basin, Bavaria, the Miocene and Pliocene of the Netherlands. It was also established during the deep-sea drilling in the Atlantic (Eocene – Oligocene, Upper Miocene, Pleistocene), Bay of Biscay (Upper Eocene - Oligocene), Norwegian Sea (Lower Eocene). Nowadays it lives in calm waters and great depths.

Occurrence. Byala Formation. C-11 (191.60 m - P1c Zone), C-12 (214.90 m - P1c Zone), C-24 (40.00 m – P2 Zone, 107.90 m - P1c Zone), C-25 (26.40-40.40 m - P1b Zone), C-28 (16.00 m - P2 Zone), C-29 (399.20 m – P4 Zone, 433.50-476.30 m - P4 Zone), C-30 (83.90-86.30 m - P4 Zone, 99.50 m – P5 Zone), sections Byala 1 (NP4-5 Zones), Byala 2b (NP3 Zone), Byala 2c (NP1 Zone). Emine Formation. A sample from the geological mapping (Paleocene).

Superfamily CHILLOSTOMELLACEA Brady, 1881

Family CHILOSTOMELLIDAE Brady, 1881

Subfamily CHILOSTOMELLINAE Brady, 1881

Genus **Allomorphina** Reuss, 1849

Type species. Allomorphina trigona Reuss, 1850 (subsequent designation by monotypy).

Distribution. Campanian – Holocene; cosmopolitan.

Allomorphina conica Cushman and Todd, 1949

Plate I, Figure 8

1949. *Allomorphina conica* Cushman and Todd, n. sp.; Cushman and Todd, p. 62, pl. 11, fig. 8.

1962. *Allomorphina conica* Cushman and Todd; Hillebrandt, S. 90, Taf. 6, Fig. 21.

Nomenclature. The holotype (Cushman Coll. No. 15458) is from the Paleocene of Trinidad (Lizard Springs formation).

Material. Byala Formation (11 specimens).

Description. Test is trochospiral. 3 whorls are visible on the spiral side; the first two build a cone. Their chambers are very small-sized, compared to these from the last whorl. Here they are 3, gradually increasing in size. Sutures are tangential, curved backwards, depressed. On the umbilical side they are radial, almost straight, depressed. Umbilicus is broad. Surface is smooth. Aperture is elongated, basal, umbilical.

Distribution. The species is known from the Upper Cretaceous and Paleocene of Central America, California, the Paleocene of the Austrian Alps.

Occurrence. C-12 (287.90 m - P1c Zone, 303.40 m - P1b Zone), C-25 (40.40 m - P1b Zone), sections Byala 2b (NP3 Zone), Byala 2c (NP2 Zone), Byala River and Koundilaki Cheshme Valleys (Paleocene).

Allomorphina paleocenica Cushman, 1948

Plate I, Figures 12, 13

1948. *Allomorphina paleocenica* Cushman, n. sp.; Cushman, p. 45, pl. 8, fig. 10.

1962. *Allomorphina paleocenica* Cushman; Hillebrandt, S. 91, Taf. 6, Fig. 23.

Nomenclature. The holotype (Cushman Coll. No. 56 885) is from the Paleocene of Texas.

Material. Byala Formation (4 specimens), Emine Formation (3 specimens).

Description. Test is trochospiral, elliptical to triangular in outline. Last whorl comprises 3 moderately inflated chambers sharply increasing in size. Sutures are depressed, almost straight, tangential on the spiral side and radial on the umbilical one. Periphery is rounded. Surface is smooth. Aperture is elongated, umbilical, covered partly with lip.

Distribution. The species is known from the Paleocene of Texas, Austrian Alps, Central America, the Eocene of California.

Occurrence. Byala Formation. C-29 (399.20 m - P4 Zone), C-30 (83.90 m - P4 Zone); Emine Formation. Section Kochan (P1c Zone).

Genus **Chilostomelloides** Cushman, 1926

Type species. Lagena (Obliquina) oviformis Sherborn and Chapman, 1886 (original designation).

Distribution. Paleocene – Miocene; cosmopolitan.

Chilostomelloides sp.

Plate I, Figure 9

Material. Byala Formation (1 specimen), Emine Formation (56 specimens).

Description. Test is oval to elliptical in outline, planispiral, involute. Only 2 chambers are visible. They differ strongly from each other by their sizes. Sutures are straight, oblique, slightly depressed. Surface is smooth. Aperture is oval, with thick lip.

Occurrence. Byala Formation. C-30 (83.90 m - P4 Zone); Emine Formation. Sections Kochan (P1c Zone), Banya-North (P1c Zone), Emona (NP1 Zone).

Family QUADRIMORPHINIDAE Saidova, 1981

Genus **Quadrिमorphina** Finlay, 1939

Type species. Valvulina allomorphinoides Reuss, 1860 (original designation).

Distribution. Coniacian – Holocene; cosmopolitan.

Quadrिमorphina allomorphinoides (Reuss, 1860)

Plate I, Figures 10, 11

1860. V. (*Valvulina*) *allomorphinoides* m.; Reuss, S. 79, Taf. 11, Fig. 6.

1926. *Discorbis allomorphinoides* (Reuss); Cushman, p. 606, pl. 20, figs. 18, 19; pl. 21, fig. 5.

1952. *Valvulineria allomorphinoides* Reuss; Tzaneva, p. 497, pl. 1, fig. 2.

1962. *Allomorphina allomorphinoides* (Reuss); Hillebrandt, S. 89, Taf. 6, Fig. 24.

1969. *Gyromorphina allomorphinoides* Reuss; Krayeva, Zernetskij, p. 167, pl. 76, fig. 8.

1975. *Quadrिमorphina allomorphinoides* (Reuss); Berggren, Aubert, pl. 3, fig. 1.

1988. *Quadrिमorphina allomorphinoides* (Reuss); Loeblich, Tappan, pl. 705, figs. 6-9.

1999. *Quadrिमorphina allomorphinoides* (Reuss); Darakchieva, p. 77.

Nomenclature. Holotype is the specimen figured by Reuss (1860, Taf. 11, Fig. 6). The species was first described from the Upper Cretaceous of Westphalia (Germany).

Material. Byala Formation (260 specimens), Emine Formation (2 specimens).

Remarks. In Bulgaria the species was described from the Paleogene of Varna District as *V. allomorphinoides* (Tzaneva, 1952). It was also established in the Middle and Upper Paleocene, and the Lower Eocene of South Bulgaria (Darakchieva, 1999).

Distribution. It is known from the Upper Cretaceous of Western Europe, North America, Dnepr-Donets basin, the Paleocene of Ukraine, Emba District, Georgia, North America, Austrian Alps, Australia, Tunisia. It was also established during the deep-sea drilling in the Atlantic (Santonian-Maastrichtian) and Norwegian Sea (Lower Eocene).

Occurrence. Byala Formation. C-11 (191.60 m - P1c Zone), C-12 (169.70 m - Lower Paleocene, 205.00-214.90 m - P1c Zone, 219.20-243.00 m - P1b Zone, 268.50-289.20 m - P1c Zone, 303.40 m - P1b Zone), C-21 (22.00-38.50 m - P1b Zone), C-23, (74.00 m - P3 Zone, 271.20 m - P1b Zone), C-25 (26.40-45.00 m - P1b Zone), 15.00-16.00 m - P2 Zone, 513.00 m - P3 Zone), C-29 (365.00 m - P3 Zone, 399.20-420.60 m - P4 Zone, 433.50-440.30, 476.30 m - P5 Zone), C-30 (83.90-86.30 m - P4 Zone, 99.50-107.90 m - P5 Zone), sections Byala 1 (NP3-5 Zones), Byala 2b (NP1-2 Zones), Byala 2c (NP1-2 Zones), Byala River and Koundilaki Cheshme Valleys (Paleocene); Emine Formation. Samples from the geological mapping (Paleocene).

Quadrिमorphina cretacea (Reuss, 1851)

Plate I, Figures 14, 15

1949. *Allomorphina cretacea* (Reuss); Cushman, Todd, p. 61, pl. 11, figs. 3, 4.

1962. *Allomorphina cretacea* (Reuss); Hillebrandt, S. 90, Taf. 6, Fig. 25.

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

Material. Byala Formation (2 specimens).

Description. Test is trochospiral, oval in outline. Last whorl consists of 3 moderately inflated chambers gradually increasing in size. Periphery is rounded. Aperture is arch-shaped, umbilical, covered with triangular lip.

Remarks. The species differs from *Q. allomorphinoides* (Reuss) by the lower number of chambers in the last whorl.

Distribution. It is known from the Upper Cretaceous of central Europe and North America, the Paleocene of Central Europe.

Occurrence. C-30 (99.50 m - P5 Zone).

Family ALABAMINIDAE Hofker, 1951

Genus ***Alabamina*** Toulmin, 1941

Type species. *Alabamina wilcoxensis* Toulmin, 1941 (original designation).

Distribution. Santonian – Holocene; cosmopolitan.

Alabamina midwayensis Brotzen, 1948

Plate II, Figures 3, 4

1948. *Alabamina midwayensis* nov. nom.; Brotzen, p. 99 pl. 16, figs. 1, 2, text-figs. 25, 26.

1965. *Alabamina midwayensis* Brotzen; Pozaryska, p. 114, pl. 21, fig. 3.

1976. *Alabamina midwayensis* Brotzen; Aubert, Berggren, p. 428, pl. 8, fig. 3.

Nomenclature. The holotype (S. G. U. No. 2598) is from the Paleocene of Sweden. It was figured by Brotzen (1948, pl. 16, fig. 1).

Material. Byala Formation (138 specimens), Emine Formation (2 specimens).

Description. Test is trochospiral, asymmetrically biconvex. 2.5-3 whorls are observable on the spiral side. Here sutures are tangential and curved backwards. 5-6 triangular chambers sharply increasing in size. Sutures are radial, slightly curved backwards, depressed. Periphery is tapered and lobated. Umbilicus is comparatively narrow, slightly depressed. Aperture is basal, extending from umbilicus to periphery.

Distribution. The species is known from the Maastrichtian and Paleocene of Poland, Tunisia, the Paleocene of Sweden, Denmark, Egypt, East Kamchatka. It was also established during the deep-sea drilling in the North Atlantic (Lower Paleocene).

Occurrence. Byala Formation. C-11 (191.30-192.40, 247.50 m - P1c Zone), C-12 (167.00-169.70 m - Lower Paleocene, 204.00 m - P1c Zone, 264.50 m - Lower Paleocene, 268.50-289.20 m - P1c Zone, 304.40 m - P1b Zone), C-21 (22.00-38.50 m - P1b Zone), C-23 (74.00 m - P3 Zone, 271.20 m - P1b Zone), 40.00 m - P2 Zone, 107.70 m - P1c Zone), C-25 (26.40-40.40 m - P1b Zone), C-28 (15.00-16.00 m - P2 Zone), C-30 (83.90 m - P4 Zone, 99.50 m - P5 Zone). Emine Formation. Section Emona (NP1 Zone).

Family OSANGULARIIDAE Loeblich and Tappan, 1964

Genus ***Osangularia*** Brotzen, 1940

Type species. *Osangularia lens* Brotzen, 1940 (original designation).

Distribution. Cretaceous – Holocene; cosmopolitan.

Osangularia plummerae Brotzen, 1940

Plate II, Figures 1, 2

1962. *Osangularia plummerae* Brotzen; Hillebrandt, S. 110, Taf. 9, Fig. 15.

1976. *Osangularia plummerae* Brotzen; Aubert, Berggren, p. 429, pl. 8, fig. 5.

Nomenclature. I have no data about the holotype.

Material. Byala Formation (25 specimens).

Description. Test is trochospiral, biconvex, with more inflated umbilical side. 7-8 triangular chambers with gradually increasing sizes are visible on the last whorl. Sutures are slightly depressed, slightly curved backwards in the periphery. Periphery bears thin and narrow keel. Aperture is basal, extended to the periphery.

Distribution. The species is known from the Paleocene of North America, the Alps, Australia, Tunisia, Egypt, East Kamchatka and the deep-sea holes in the Norwegian Sea (Lower Eocene).

Occurrence. C-12 (167.00-169.70 m – Lower Paleocene), C-29 (476.30 m - P5 Zone), C-30 (83.90 m - P4 Zone), sections Byala 1 (NP1 Zone), Byala 2b (NP2 Zone), Byala 2c (NP2 Zone).

Family ORIDORSALIDAE Loeblich and Tappan, 1964

Genus ***Oridorsalis*** Andersen, 1961

Type species. *Oridorsalis westi* Andersen, 1961 (original designation).

Distribution. Oligocene – Holocene; North America, Europe, Caribbeans, Japan.

Remarks. The numerous finds of representatives of the genus in the Upper Cretaceous and Lower Paleogene emend the stratigraphical range given by Loeblich, Tappan (1988).

Oridorsalis lotus (Schwager, 1883)

Plate II, Figures 5, 6

1883. *Pulvinulina lotus* Schwag.; Schwager, S. 132, Taf. 28, Fig. 9.

1937. *Eponides lotus* (Schwager); Glaessner, S. 379, Taf. 3, Fig. 26.

1951. *Eponides lotus* (Schwager) Cushman and Ponton; Cushman, p. 52, pl. 14, fig. 21.

1962. *Eponides lotus* (Schwager); Hillebrandt, S. 105, Taf. 8, Fig. 15, 16.

1993. *Oridorsalis lotus* (Schwager); Hauser, Grünig, pl. 8, figs. 1-3.

Nomenclature. Holotype is the specimen figured by Schwager (1883, Taf. 28, Fig. 9). The species was first described from the Eocene of Libya (El-Guss-Abu-Said).

Material. Byala Formation (288 specimens), Emine Formation (4 specimens).

Description. Test is trochospiral, biconvex. Spiral side is more inflated, evolute, comprising 2.5-3 whorls, as the chambers are clear in the last one only. Here sutures are oblique, slightly depressed, straight. 6-7 broad triangular chambers are observable on the umbilical side. Here sutures are radial, curved backwards, slightly depressed. Umbilicus is narrow, flush. Periphery is tapered. Surface is smooth. Aperture is arch-shaped, basal, extraumbilical.

Remarks. The species differs from *O. umbonatus* (Reuss) by the larger number of chambers and the curved sutures in the last whorl.

Distribution. It is known from the Upper Cretaceous of Egypt, the Paleocene of Austrian Alps, Caucasus, Trinidad, Central America, Alabama, Egypt, Tunisia, the Eocene of Libya. It was also established during the deep-sea drilling in the South Atlantic (Lower Eocene).

Occurrence. Byala Formation. C-11 (191.60-191.80 m - P1c Zone), C-12 (167.00 m - Lower Paleocene, 204.00 m - P1c Zone, 264.50 m - Lower Paleocene, 268.50-289.20 m - P1c Zone, 296.10 m - P1b Zone), C-21 (7.50 m - P1c Zone, 38.50 m - P1b Zone), C-24 (40.00 m - P2 Zone), C-25 (22.50 m - P1b Zone, 355.00 m - P2 Zone), C-28 (15.00-16.00 m - P2 Zone), C-29 (365.90 m - P3 Zone, 383.20-420.60 m - P4 Zone, 476.30 m - P5 Zone), C-30 (83.90 m - P4 Zone), sections Byala 1 (NP3-5 Zones), Byala 2b (NP1-3 Zones), Byala 2c (NP1-2 Zones), Byala River and Koundilaki Cheshme Valleys (Paleocene); Emine Formation. Samples from the geological mapping (Paleocene).

Oridorsalis megastomus (Grzybowski, 1896)
Plate II, Figures 9-11

1928. *Gyroidina beisseli*, n. sp.; White, p. 201, pl. 39, fig. 7.
1937. *Eponides megastoma* (Grzybowski); Glaessner, S. 377, Taf. 3, Fig. 25.
1962. *Eponides megastoma* (Grzybowski); Hillebrandt, S. 105, Taf. 8, Fig. 13, 14.
1974. *Eponides megastomus* (Rzehak, 1838) emend. (Grzybowski, 1896); Szczechura, Pozaryska, p. 83, pl. 16, figs. 5-7.
1976. *Eponides megastoma* (Grzybowski); Aubert, Berggren, p. 426, pl. 7, fig. 3.
1981. *Gyroidina megastoma* (Grzybowski); Liszka, Liszkowa, p. 196, pl. 6, fig. 4.
1983. "*Pulvinulina megastoma* Rzk"; Geroch, Verdenius, pl. 11, fig. 9.
1993. *Oridorsalis megastomus* (Grzybowski); Hauser, Grünig, pl. 7, figs. 5-11.

Nomenclature. I have no data about the holotype. Geroch, Verdenius (1983) refigured the original Grzybowski's image. I compare to it. The species was first described from the Campanian of the Polish Carpathians (red clays from Vadovce area).

Material. Byala Formation (over 500 specimens), Emine Formation (101 specimens).

Description. Test is conical in shape, trochospiral, with convex umbilical and almost flush spiral side. The last one consists of 2.5-3 whorls. Umbilical side comprises 5-6 triangular chambers gradually increasing in size. Sutures are depressed, curved backwards, tangential. Umbilicus is narrow, flush to slightly depressed. Periphery is angled, surface is smooth. Aperture is low arch-shaped, interiomarginal, extending from umbilicus to periphery.

Distribution. The species is known from the Upper Cretaceous, Paleocene and Eocene of the Tethys region.

Occurrence. Byala Formation. C-11 (191.60-247.50 m - P1c Zone), C-12 (167.00 m - Lower Paleocene, 194.00-214.90 m - P1c Zone, 219.00 m - P1b Zone, 268.50-289.20 m - P1c Zone, 296.10 m - P1b Zone), C-21 (22.00-38.50 m - P1b Zone), C-23 (74.00 m - P3 Zone, 215.00-271.20 m - P1b Zone), C-24 (40.00 m - P2 Zone, 56.90 m - P1c Zone, 74.25 m - P1b 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 (361.10-364.90 m - P3 Zone, 368.20-420.60 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), sections Byala 1 (NP3-5 Zones), Byala 2b (NP1-3 Zones), Byala 2c (NP1-2 Zones), Byala River and Koundilaki Cheshme Valleys (Paleocene); Emine Formation. Sections Kochan (P1c Zone), Emona (NP1 Zone) and Banya South-West (Lower Paleocene); samples from the geological mapping (Paleocene).

Oridorsalis whitei (Hillebrandt, 1962)
Plate II, Figures 7, 8

1962. *Eponides whitei*, n. sp.; Hillebrandt, S. 106, Taf. 8, Fig. 11.

Nomenclature. The holotype (Slg. Munchen Prot. 1341) is from the Lower Paleocene of the Austrian Alps.

Material. Byala Formation (58 specimens).

Description. Test is trochospiral, biconvex. Spiral side is more convex, evolute, comprising 2.5-3 whorls. Here sutures are oblique, flush to slightly depressed. 9-10 triangular chambers are visible on umbilical side. They are divided by radial, straight, flush to slightly depressed. Umbilicus is round, flush, comprising up to 1/3 of test diameter, glassy. Periphery is tapered. Surface is smooth. Aperture is arch-shaped, basal, extraumbilical.

Remarks. The species differs from *O. lotus* (Schwager) by the larger number of chambers in the last whorl as well as the broader umbilicus.

Distribution. It is known from the Paleocene of the Alps.

Occurrence. C-12 (243.00 m - P1b Zone, 264.50 m - Lower Paleocene, 268.50-289.20 m - P1c Zone), C-21 (22.00-38.50 m - P1b Zone), C-25 (26.40-40.40 m - P1b Zone), C-28 (16.00 m - P2 Zone), C-29 (364.40 m - P3 Zone, 420.60 m - P4 Zone, 476.30 m - P5 Zone), sections Byala 1 (NP3-5 Zones), Byala 2b (NP1,2 Zones), Byala 2c (NP1-2 Zones), Byala River Valley (Paleocene).

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PLATE I

- 1, 2. **Valvulineria alpina** Hillebrandt, 1962. Byala Formation, Byala River Valley, Paleocene; 1 – umbilical view, Sample BP-6; SEMx63; 2 – spiral view, Sample K4-1; SEMx63.
- 3, 4. **Cibicides megaloperforatus** Said&Kenawy, 1956. Byala Formation, Borehole C-12, 169.70 m, Lower Paleocene, Sample C-12-61; 3 – umbilical view, 4 – spiral view; SEMx93.
- 5, 6. **Cibicides simplex** Brotzen, 1948. Byala Formation, Section Byala 1, Lower Paleocene, NP5 Zone, Sample B1-11; 5 – spiral view, 6 – umbilical view; SEMx93.
7. **Pullenia quinqueloba** (Reuss, 1851). Byala Formation, Borehole C-30, 86.30 m, Upper Paleocene, P4 Zone, Sample C-30-8; SEMx65.5.
8. **Allomorphina conica** Cushman & Todd, 1949. Byala Formation, Koundilaki Cheshme Valley, Paleocene, Sample K4-1, umbilical view; SEMx65.5.
9. **Chilostomelloides** sp. Byala Formation, Borehole C-30, 83.90 m, Upper Paleocene, P4 Zone, Sample C-30-6; apertural view; SEMx65.5.
- 10, 11. **Quadrимorphina allomorphinoides** (Reuss, 1860). Byala Formation, Koundilaki Cheshme Valley, Paleocene, Sample K4-1; 10 – spiral view, 11 – umbilical view; SEMx110.
- 12, 13. **Allomorphina paleocenica** Cushman, 1948. Byala Formation, Borehole C-29, 399.20 m, Upper Paleocene, P4 Zone, Sample C-29-8; 12 – spiral view, 13 – umbilical view; SEMx81.5.
- 14, 15. **Quadrимorphina cretacea** (Reuss, 1851). Byala Formation, Borehole C-30, 99.50 m, Upper Paleocene, P5 Zone, Sample C-30-14; 14 – spiral view, 15 – umbilical view; SEMx81.5.

PLATE II

- 1, 2. **Osangularia plummerae** Brotzen, 1940. Byala Formation, Borehole C-30, 83.90 m, Upper Paleocene, P4 Zone, Sample C-30-6; 1 – umbilical view, 2 – spiral view; SEMx85.
- 3, 4. **Alabama midwayensis** Brotzen, 1948. Byala Formation, Section Byala 2b, Lower Paleocene, NP3 Zone, Sample B-2b-14; 3 – umbilical view, 4 – spiral view; SEMx50.5.
- 5, 6. **Oridorsalis lotus** (Schwager, 1883). Byala Formation, Section Byala 2b, Lower Paleocene, NP3 Zone, Sample B2b-13; 5 – umbilical view, 6 – spiral view; SEMx97.
- 7, 8. **Oridorsalis whitei** (Hillebrandt, 1962). Byala Formation, Section Byala 2b, Lower Paleocene, NP3 Zone, Sample B2b-13; 7 – umbilical view, 8 – spiral view; SEMx53.
- 9-11. **Oridorsalis megastomus** (Grzybowski, 1896). Byala Formation; 9, 11 – Borehole C-30, 107.90 m, Upper Paleocene, P5 Zone, Sample C-30-19; 9 – umbilical view, 11 – spiral view; SEMx75; 10 – Byala River Valley, Paleocene, apertural view, Sample BP-6; SEMx110.

PLATE I

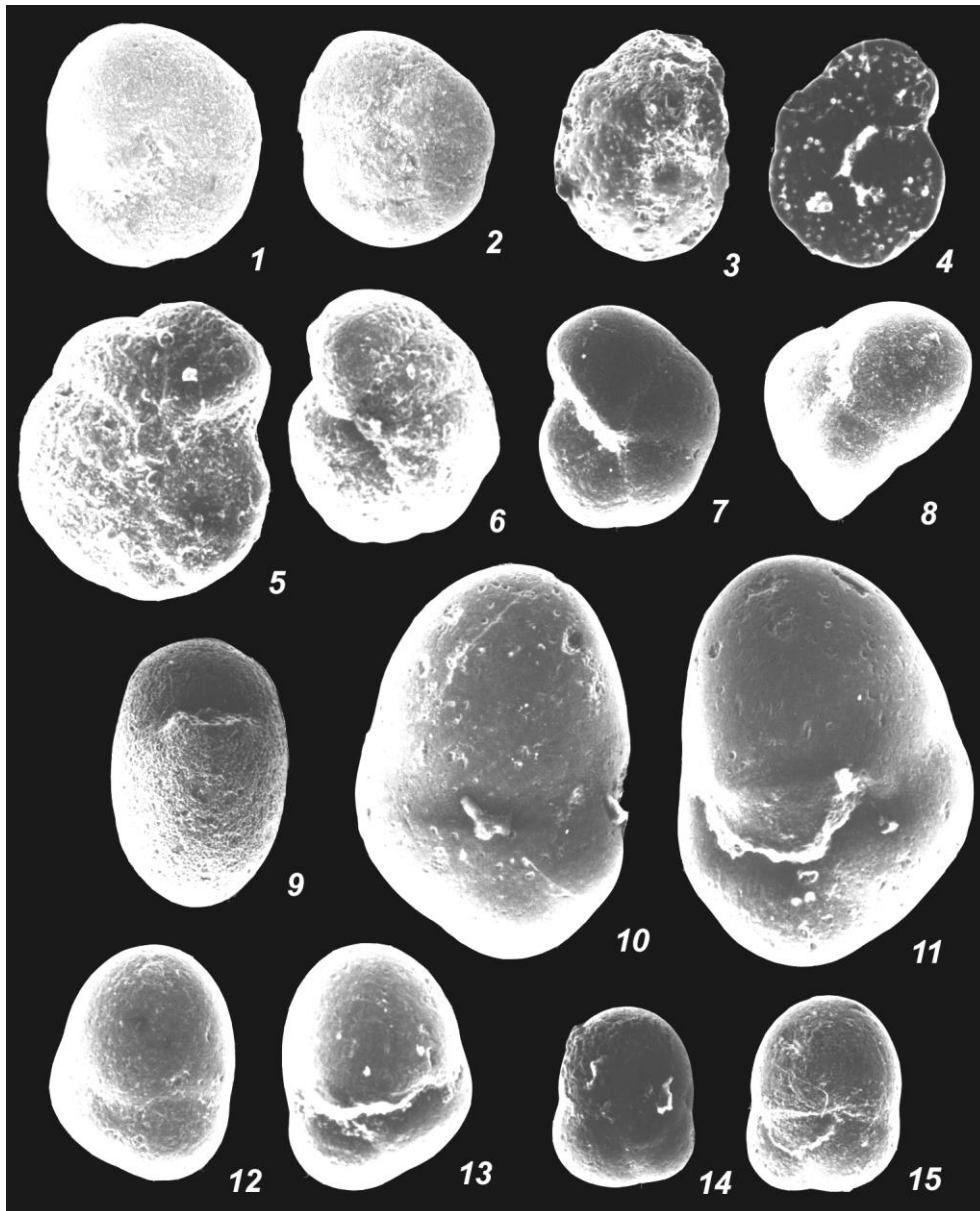


PLATE II

