

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

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ABSTRACT. Taxonomical descriptions of 15 species Midway-type benthic foraminifera are introduced in the article. The species belong to 11 genera (*Textularia* – 2 species, *Dentalina* – 1 species, *Pyramidulina* – 1 species, *Bolivina* – 1 species, *Bulimina* – 2 species, *Globobulimina* – 1 species, *Praeglobobulimina* – 1 species, *Fursenkoina* – 1 species, *Nodogenerina* – 1 species, *Orthomorphina* – 1 species, *Siphonodosaria* – 3 species), 6 families, 6 superfamilies and 3 suborders. 13 species are first described in Bulgaria, 4 species are first found in Paleocene, and 1 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 TEXTULARIIDAE EHRENBERG, 1838 ДО СЕМЕЙСТВО STILOSTOMELLIDAE FINLAY, 1947

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РЕЗЮМЕ. Настоящата статия представя таксономични описания на 15 вида бентосни фораминифери тип "Midway". Те принадлежат на 11 рода (*Textularia* – 2 вида, *Dentalina* – 1 вид, *Pyramidulina* – 1 вид, *Bolivina* – 1 вид, *Bulimina* – 2 вида, *Globobulimina* – 1 вид, *Praeglobobulimina* – 1 вид, *Fursenkoina* – 1 вид, *Nodogenerina* – 1 вид, *Orthomorphina* – 1 вид, *Siphonodosaria* – 3 вида), 6 семейства, 6 надсемейства and 3 подразеда. 13 вида се описват за първи път в България, 4 са намерени за първи път в палеоценски седименти, а 1 е установен 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 Paleocene of the Coastal part of East Stara Planina (East Bulgaria) contains characteristic elements of three types of benthic foraminiferal assemblages – flysh-type or A-type, Midway-type and Velasco-type (Valchev, 2004a). The present article is the first one from a series of three parts concerning the taxonomy of the Midway-type assemblages from this part of the country.

A sketch with the location of the studied sections and outcrops was published by Valchev (2003). The biostratigraphical framework of the Paleocene in the coastal part of East Stara Planina was discussed in the same article. The microphotographs were made in the Central Laboratory of Mineralogy and Crystallography of the Bulgarian Academy of Sciences by scanning electron microscope "Philips SEM-515" ($U_{op} = 25$ kV).

General remarks

"Midway-type" faunal assemblages (MF) are a middle to outer shelf assemblages (50-200 m water depth) developed in a shale-marl environment and characterized by various representatives of the families Textulariidae, Nodosariidae,

Vaginulinidae, Polymorphinidae, Alabaminidae, Heterolepidae. The assemblages were named the "Midway-type" because they have been described and illustrated repeatedly in the rocks of the Midway Group (Gulf Coastal Plain) and equivalent rocks in the Atlantic Coastal Plain of the USA and circum-Caribbean and Antillean region (Cushman, 1951; Olson, 1960; Berggren, 1972, 1974). They have been established in some other localities of the Tethyan region (e. g. Ukraine – Vassilenko, 1950; Kaptarenko-Chernousova et al., 1963; Krayeva, Zernetskij, 1969; Poland – Pozaryska, 1965; Pozaryska, Szczuchura, 1968; Caucasus – Subbotina, 1947, 1950; Sweden – Brotzen, 1948; the Netherlands – ten Dam, 1944; Australia – McGowran, 1965).

Taxonomical descriptions

The present article aims to introduce taxonomical descriptions of 15 species small benthic foraminifera from the Paleocene of the Coastal Part of East Stara Planina, East Bulgaria. The species belong to 11 genera, 6 families, 6 superfamilies and 3 suborders. 13 species are first described in Bulgaria, 4 species are first found in the Paleocene, and 1 species is first described from the Paleocene of Bulgaria.

Several taxonomical descriptions (See Appendix) of Midway-type benthics were given in previous Valchev's publications (Valchev, 2000, 2001, 2002, 2004b, c, 2005a, b).

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

Suborder TEXTULARIINA Delage and Herouard, 1896
Superfamily TEXTULARIACEA Ehrenberg, 1838
Family TEXTULARIIDAE Ehrenberg, 1838
Subfamily TEXTULARIINAE Ehrenberg, 1838
Genus *Textularia* DeFrance, 1824

Type species. *Textularia saggitula* DeFrance, in de Blainville, 1824 (original designation by monotypy).

Distribution. Paleocene - Holocene; cosmopolitan.

? *Textularia plummerae* Lalicker, 1935
Plate I, Figures 1, 2

1937. *Textularia plummerae* Lalicker; Glaessner, S. 364.

1951. *Textularia plummerae* Lalicker; Cushman, p. 4, pl. 2, figs. 2, 3.

1960. *Textularia* cf. *plummerae* Lalicker; Geroch, p. 56, Tabl. 6, fig. 6.

1975. *Textularia plummerae* Lalicker; Braga et al., p. 91, T. 1, fig. 6.

Nomenclature. I have no data about the holotype.

Material. Byala Formation (199 specimens), Emine Formation (25 specimens).

Description. Test is elongated, coarsely agglutinated, biserial, with tapered initial part; gradually broadening towards the apertural end. Chambers are distinct, slightly inflated. Sutures are depressed, slightly curved backwards. Periphery is rounded. Aperture is basal.

Remarks. The species is morphologically similar to *S. navaroana* Cushman, but differs from it by the lack of spiral initial portion. When the initial part is broken both species are indistinct.

Distribution. The species is known from the Paleocene of Arkansas, Texas, Caucasus, the Alps, the Upper Paleocene of France, the Eocene of Caucasus and the Alps. It was found in the deep sea holes in the Labrador (Paleocene) and North Sea (Lower Eocene).

Occurrence. Byala Formation: C-11 (247.50 m – P1c Zone), C-12 (219.20 m – P1b Zone, 264.50 m – Lower Paleocene, 268.50-289.20 m – P1c Zone, 303.40 m – P1b Zone), C-21 (22.00-38.50 m – P1b Zone), C-23 (271.20 m – P1b Zone), C-24 (40.00 m – P2 Zone, 74.25 m – P1b Zone), C-25 (22.50-40.40 m – P1b Zone), C-28 (513.00 m – P3 Zone), C-29 (364.40-365.90 m – P3 Zone, 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), sections Byala 1 (NP3-5 Zone), Byala 2b (NP1-3 Zone), Byala 2c (NP1-2 Zone), Byala River and Koundilaki Cheshme valleys (Paleocene); Emine Formation: sections Emona (NP1 Zone) and Banya-Southwest (Paleocene).

Textularia sp.
Plate I, Figure 3

Material. Byala Formation (1 specimen).

Description. Test is coarsely agglutinated, biserial, laterally flattened, sharply broadening towards the apertural end. It is composed of 4 couples of chambers, as the chambers from the last one are strongly inflated.

Occurrence. C-25 (40.40 m – P1b Zone).

Suborder LAGENINA Delage and Herouard, 1896
Superfamily NODOSARIACEA Ehreberg, 1838
Family NODOSARIIDAE Ehreberg, 1838
Subfamily NODOSARIINAE Ehreberg, 1838
Genus *Dentalina* Riso, 1826

Type species. *Nodosaria* (les Dentalines) *cuvieri* d'Orbigny, 1826 (original designation by monotypy).

Distribution. Late Cretaceous - Holocene; cosmopolitan.

Dentalina longicostata (Cushman and Jarvis, 1934)
Plate I, Figure 8

1934. *Chrysalogonium longicostatum* Cushman and Jarvis, n. sp.; Cushman, Jarvis, p. 74, pl. 10, fig. 12.

1949. *Chrysalogonium longicostatum* Cushman and Jarvis; Bermudez, p. 151, pl. 10, fig. 3.

1957. *Chrysalogonium longicostatum* Cushman and Jarvis; Agyp, pl. 14, fig. 8.

Nomenclature. The holotype (Cushman Coll. No. 21 441) is from the Lower Miocene of Trinidad (Cipero section).

Material. Byala Formation (21 specimens).

Description. Test is uniserial, elongated, slightly curved, and tapered at both ends, with parallel sides. Chambers are distinct, gradually increasing in size. Sutures are straight depressed, horizontal. Surface is covered by fine longitudinal ribs. Aperture is terminal, compound.

Remarks. The representatives of this species have been usually referred to genus *Chrysalogonium*. According to Loeblich, Tappan's (1988) classification it is characterized by straight, elongated and smooth test, while the specimens described and figured in the micropaleontological literature are with slightly curved test covered by fine longitudinal ribs – characteristic features of genus *Dentalina*. That is why in the present article these specimens are referred to it.

Distribution. The species is known from the Oligocene of Italy, Cuba, Trinidad, the Miocene of Italy, and Trinidad. It has been also established in the deep sea holes in the Northwest Atlantic (Eocene – Lower Miocene).

Occurrence. C-11 (191.60 m – P1c Zone), C-25 (40.40 m – P1b Zone), C-29 (440.30 m – P5 Zone), sections Byala 1 (NP3 Zone), Byala 2b (NP3 Zone), Byala River Valley (Paleocene).

Genus *Pyramidulina* Fornasini, 1894

Type species. *Pyramidulina eptagona* Fornasini, 1894 = *Nautilus raphanus* Linne, 1758 (original designation by monotypy).

Distribution. Cretaceous - Holocene; cosmopolitan.

Pyramidulina tenuicostata (Cushman & Bermudez, 1936)
Plate I, Figure 4

1936. *Chrysalogonium tenuicostatum* Cushman & Bermudez, n. sp.; Cushman, Bermudez, p. 27, pl. 5, figs. 3-5.

1949. *Chrysalogonium tenuicostatum* Cushman & Bermudez; Bermudez, p. 151, pl. 10, fig. 2.

1957. *Chrysalogonium tenuicostatum* Cushman & Bermudez; Agyp, pl. 14, fig. 10.

Nomenclature. The holotype (Cushman Coll. No. 23 094) is from the Middle Eocene of Cuba.

Material. Byala Formation (33 specimens).

Description. Test is elongated, straight, tapered in the initial part. Sides are parallel. Chambers gradually increasing in size. Sutures are straight, horizontal, slightly depressed. Surface is covered by coarse longitudinal ribs. Aperture is terminal, compound.

Remarks. The representatives of this species have been usually referred to genus *Chrysalogonium*, but the presence of coarse longitudinal ribs made me refer them to genus *Pyramidulina*. The species differs from *D. longicostata* (Cushman and Jarvis) by its straight test and coarsely ornamented surface.

Distribution. It is known from the Eocene of Alabama, Cuba, the Upper Eocene, Oligocene and Miocene of Italy, the Oligocene of Cuba, and Trinidad. It was also established in the deep sea holes in the Atlantic (Lower – Middle Eocene), Bay of Biscay (Upper Eocene – Lower Oligocene).

Occurrence. C-23 (271.20 m – P1b Zone), C-24 (56.90 m – P1c Zone), C-25 (P1b Zone), C-30 (107.90 m – P5 Zone), sections Byala 1 (NP3-5 Zone), Byala 2c (NP1-2 Zone), Byala River and Koundilaki Cheshme Valleys (Paleocene).

Suborder ROTALIINA Delage and Herouard, 1896

Superfamily BOLIVINACEA Glaessner, 1937

Family BOLIVINIDAE Glaessner, 1937

Genus ***Bolivina*** d'Orbigny, 1839

Type species. *Bolivina plicata* d'Orbigny, 1839 (subsequent designation by Cushman, 1911);

Distribution. Late Cretaceous – Holocene; cosmopolitan.

Bolivina midwayensis Cushman, 1936

Plate I, Figure 5

1937. *Bolivina midwayensis* Cushman; Cushman, p. 45, pl. 6, figs. 11–13.

1962. *Loxostomum midwayensis* (Cushman); Hillebrandt, S. 88, Taf. 6, Fig. 18, 19.

1976. *Bolivina midwayensis* Cushman; Aubert, Berggren, p. 420, pl. 4, fig. 10.

1983. *Coriphostoma* cf. *midwayensis* (Cushman); Tjalsma, Lohman, p. 12, pl. 2, figs. 7, 8.

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

Material. Byala Formation (47 specimens).

Description. Test is elongated, slightly tapered in the apertural end, biserial. Chambers are low, broad. Sutures are oblique, slightly depressed. Periphery is narrowly rounded. Surface is smooth. Aperture is low, loop-shaped, basal.

Distribution. The species is known from the Paleocene of the Tethys region. It was also established during the deep sea drilling in the Atlantic (Paleocene).

Occurrence. Sections Byala 2b (NP3 Zone), Byala 2c (NP1 Zone).

Superfamily BULIMINACEA Jones, 1875

Family BULIMINIDAE Jones, 1875

Genus ***Bulimina*** d'Orbigny, 1826

Type species. *Bulimina marginata* d'Orbigny, 1826 (subsequent designation by Cushman, 1911);

Distribution. Paleocene – Holocene; cosmopolitan.

Bulimina midwayensis Cushman and Parker, 1936

Plate I, Figure 9

1936. *Bulimina arkadelphia* Cushman and Parker var. *midwayensis* Cushman and Parker, n. var.; Cushman and Parker, p. 42, pl. 7, figs. 9, 10.

1962. *Bulimina midwayensis* Cushman and Parker; Hillebrandt, S. 76, Taf. 5, Fig. 19.

1976. *Bulimina midwayensis* Cushman and Parker; Aubert, Berggren, p. 422, pl. 5, fig. 7.

1983. *Bulimina midwayensis* Cushman and Parker; Tjalsma, Lohman, p. 6, pl. 3, fig. 1.

Nomenclature. The holotype (Cushman Coll. No. 23136) is from the Eocene of Texas. (Midway Formation).

Material. Byala Formation (28 specimens).

Description. Test is triserial, tapered at the initial part, bearing a basal spine. The last 3 chambers are inflated, smooth, comprising 1/3 to 1/2 of test length. The previous ones are covered by fine ribs. Sutures are depressed, curved. Aperture is loop-shaped, with lip.

Distribution. The species is known from the Paleocene of North America, Sweden, Denmark, Austria, Slovakia, Egypt, Tunisia, and the Eocene of Texas. It was also established during the deep-sea drilling in the Atlantic (Paleocene).

Occurrence. C-24 (40.00 m – P2 Zone), C-28 (16.00 m – P2 Zone), C-29 (399.00–420.60 m – P4 Zone), C-30 (86.30 m – P4 Zone, 99.50 m – P5 Zone), sections Byala 1 (NP4 Zone), Byala 2b (NP3 Zone), Byala 2c (NP2 Zone), Byala River Valley (Paleocene).

Bulimina paleocenica Brotzen, 1948

Plate I, Figure 10

1948. *Bulimina* (*Reussella*) *paleocenica* n. sp.; Brotzen, p. 60, pl. 6, figs. 5, 6.

1958. *Bulimina paleocenica* Brotzen; Haynes, p. 74, pl. 16, fig. 17.

1965. *Bulimina paleocenica* Brotzen; Pozaryska, p. 98, pl. 15, fig. 4.

1969. *Reussella paleocenica* (Brotzen); Krayeva, Zemetzkij, p. 149, pl. 71, fig. 2.

1976. *Bulimina paleocenica* Brotzen; Aubert, Berggren, p. 422, pl. 5, fig. 8.

Nomenclature. The holotype (S. G. U. No. 138) is from the Paleocene of Sweden. It was figured by Brotzen (1948, pl. 6, fig. 6).

Material. Byala Formation (27 specimens).

Description. Test is elongated, tapered at the initial portion, triangular in cross section, triserial. Edges are rounded, sides are slightly depressed. Sutures are oblique, slightly depressed. Aperture is basal, loop-shaped.

Distribution. The species is known from the Paleocene of Sweden, Denmark, Poland, the Netherlands, Tunisia, Ukraine, Georgia, Russian Plate, the Upper Paleocene of England.

Occurrence. C-21 (29.50–37.00 m – P1b Zone), C-23 (271.20 m – P1b Zone), C-24 (40.00 m – P2 Zone), C-28 (15.00 m – P2 Zone), C-30 (83.90–86.30 m – P4 Zone, 99.50 m – P5 Zone), sections Byala 1 (NP4 Zone), Byala 2b (NP2 Zone), Byala River Valley (Paleocene).

Genus ***Globobulimina*** Cushman, 1927

Type species. *Globobulimina pacifica* Cushman, 1927 (original designation).

Distribution. Paleocene – Holocene; cosmopolitan.

Globobulimina suteri (Cushman and Renz, 1946)
Plate I, Figure 11

1947. *Bulimina* (*Desinobulimina*) *suteri* Cushman and Renz; Cushman, p. 14, pl. 4, fig. 16.

1962. *Bulimina* (*Desinobulimina*) *suteri* Cushman and Renz; Hillebrandt, S. 81, Taf. 5, Fig. 32-34.

Nomenclature. I have no data about the holotype.

Material. Byala Formation (42 specimens), Emine Formation (1 specimen).

Description. Test is oval in outline and round in cross section, triserial. Chambers are inflated, sharply increasing in size. The last row comprises up to 2/3 of the test length. Sutures are indistinctive in the initial part, later they become slightly depressed, curved. Surface is smooth. Aperture is low loop-shaped.

Distribution. The species is known from the Maastrichtian, of Trinidad, the Paleocene of Austria, Trinidad, Venezuela, the Eocene of Trinidad.

Occurrence. Byala Formation: C-12 (169.70 m – Lower Paleocene, 264.50 m – Lower Paleocene), C-24 (40.00 m – P2 Zone), C-25 (22.50-40.40 m – P1b Zone, 454.60 m – P2 Zone), C-29 (361.10 m – P3 Zone, 433.50-464.70 m – P5 Zone), C-30 (83.90 m – P4 Zone), sections Byala 1 (NP3-4 Zone), Byala 2b (NP3 Zone), Byala 2c (NP2 Zone), Byala River and Koundilaki Cheshme Valleys (Paleocene); Emine Formation: a sample from the geological mapping (Lower Paleocene).

Genus ***Praeglobobulimina*** Hofker, 1951

Type species. *Bulimina pyrula* d'Orbigny var. *spinescens* Brady, 1884 (original designation);

Distribution. Late Paleocene - Holocene; cosmopolitan.

Remarks. The numerous finds of *P. pyrula* (d'Orbigny) in Senonian and Lower Paleocene emend the genus' range as given by Loeblich, Tappan (1988).

Praeglobobulimina pyrula (d'Orbigny, 1846)
Plate I, Figure 6

1846. *Bulimina pyrula* d'Orbigny; d'Orbigny, p. 184, tab. 11, fig. 9, 10.

1846. *Bulimina ovata* d'Orbigny; d'Orbigny, p. 185, tab. 11, fig. 13, 14.

1846. *Bulimina pupoides* d'Orbigny; d'Orbigny, p. 185, tab. 11, fig. 11, 12.

1948. *Bulimina* aff. *ovata* d'Orbigny; Brotzen, p. 59, pl. 10, figs. 9, 10.

1957. *Bulimina ovata* d'Orbigny; Tzaneva, p. 14, pl. 2, fig. 2.

1959. *Bulimina ovata* d'Orbigny; Stancheva, p. 259, pl. 7, fig. 8.

1985. *Bulimina pyrula* d'Orbigny; Papp, Schmidt, p. 69, pl. 62, figs. 2-10.

1992. *Bulimina pyrula* d'Orbigny; Darakchieva, Juranov, p. 24, pl. 4, fig. 8.

1999. *Praeglobobulimina pyrula* (d'Orbigny); Darakchieva, p. 59.

Nomenclature. The lectotype (GBA Coll. No. 1981/03/314) was pointed out by Papp, Schmidt (1985, pl. 62, fig. 9). The species was first described from the Miocene of the Vienna Basin.

Material. Byala Formation (24 specimens).

Remarks. The species was described as *B. ovata* d'Orbigny (Tzaneva, 1957) from the Eocene in NE Bulgaria and the Miocene of NW Bulgaria (Stancheva, 1959). It was also established in the Eocene of Bourgas District (Darakchieva, Juranov, 1992). I accept the Papp, Schmidt's (1985) revision

according to which *B. ovata* d'Orbigny and *B. pupoides* d'Orbigny are synonyms of *B. pyrula* d'Orbigny.

Distribution. The species is known from the Senonian of Caucasus, the Paleocene of Sweden, Poland, the Netherlands, Turkmenia, the Eocene of Hungary, France, the USA, Belgium, Ukraine, Caucasus, Byelorussia, the Netherlands, the Oligocene of Mexico, the Netherlands, Hungary, the Upper Oligocene and Miocene of Dominican Republic, the Miocene of the Vienna Basin, Hungary, Germany, Florida, the Pliocene of Italy, recent sea sediments in Italy and Philippines.

Occurrence. C-11 (191.60 m – P1c Zone), C-21 (7.50 m – P1c Zone), C-23 (271.20 m – P1b Zone), C-29 (395.20–399.20 m – P4 Zone, 440.30-475.30 m – P5 Zone), C-30 (83.90-86.30 m – P4 Zone, 99.50-107.90 m – P5 Zone), sections Byala 1 (NP4 Zone), Byala 2b (NP1-3 Zone).

Superfamily FURSENKOINACEA Loeblich and Tappan, 1961
Семейство FURSENKOINIDAE Loeblich and Tappan, 1961
Род ***Fursenkoina*** Loeblich and Tappan, 1961

Type species. *Virgulina squamuosa* d'Orbigny, 1826 (original designation).

Distribution. Late Cretaceous – Holocene; cosmopolitan.

Fursenkoina sp.
Plate I, Figure 7

Material. Byala Formation (8 specimens).

Description. Test is narrow, elongated, laterally flattened, biserial. Initial portion is twisted, with indistinctive sutures. Sutures in the late portion are slightly depressed, oblique. Surface is smooth. Aperture is low, elongated, slit-like.

Occurrence. C-30 (107.90 m – P5 Zone), section Byala 1 (NP5 Zone), Byala 2b (NP1-3 Zone).

Superfamily STILOSTOMELLACEA Finlay, 1947
Family STILOSTOMELLIDAE Finlay, 1947
Genus ***Nodogenerina*** Cushman, 1927

Type species. *Nodogenerina bradyi* Cushman, 1927 (original designation).

Distribution. Campanian – Holocene; cosmopolitan.

Nodogenerina emaciata (Reuss, 1851)
Plate I, Figure 12

1851. *D. (Dentalina) emaciata* m.; Reuss, S. 63, Taf. 3, Fig. 9.

1956. *Dentalina emaciata* Reuss; Hagn, S. 136, Taf. 12, Fig. 5.

1979. *Stilostomella emaciata* (Reuss); Sztrakos, pl. 19, fig. 14.

Nomenclature. Holotype is the specimen figured by Reuss (1851, Taf. 3, Fig. 9). The species was first described from the Oligocene of Germany.

Material. Byala Formation (7 specimens).

Description. Test is slim, elongated, uniserial, curved. Chambers are elongated, gradually increasing in size. Initial chamber bears a basal spine. Sutures are straight, horizontal, flush in the initial portion, slightly depressed in the late one. Surface is smooth. All available specimens are with broken aperture.

Distribution. The species is known from the Paleogene of Germany, the Oligocene of Hungary.

Occurrence. C-24 (74.25 m – P1b Zone), sections Byala 2b (NP3-5 Zone), Byala 2c (NP1-2 Zone).

Genus **Orthomorphina** Stainforth, 1952

Type species. *Nodogenerina havanensis* Cushman and Bermudez, 1937 (original designation).

Distribution. Eocene – Holocene; cosmopolitan.

Remarks. The present find of representatives of the genus in the Paleocene emend the stratigraphical range given by Loeblich, Tappan (1988).

Orthomorphina rohri (Cushman and Stralnforth, 1945)

Plate I, Figure 13

1945. *Nodogenerina rohri* Cushman and Stralnforth, n. sp.; Cushman and Stralnforth, p. 39, pl. 5, fig. 26;

1956. *Orthomorphina rohri* (Cushman and Stralnforth); Hagn, S. 144, Taf. 13, Fig. 20;

1979. *Orthomorphina rohri* (Cushman and Stralnforth); Sztrakos, pl. 14, fig. 9;

1983. *Orthomorphina rohri* (Cushman and Stralnforth); Basov, Krashennikov, p. 762, pl. 12, fig. 5.

Nomenclature. The holotype (Cushman Coll. No. 43618) is from the Oligocene of Trinidad (Cipero formation, zone III, sample Rz. 425).

Material. Byala Formation (2 specimens).

Description. Test is straight, uniserial, composed of subspherical chambers with gradually increasing sizes. Sutures are straight, horizontal, depressed. Surface is smooth. Aperture is broken.

Distribution. The species is known from the Eocene of Trinidad, North Alps, the Upper Eocene of Barbados, the Lower Oligocene of Barbados, the Oligocene of Trinidad. It was also found during the deep sea drilling in the Southeast Atlantic (Middle Eocene – Oligocene) and Norwegian Sea (Lower Eocene).

Occurrence. C-12 (303.40 m – P1b Zone), section Byala 2b (NP3 Zone).

Genus **Siphonodosaria** A. Silvestri, 1924

Type species. *Nodosaria abyssorum* Brady, 1881 (subsequent designation by monotypy - Cushman, 1927);

Distribution. Eocene - Holocene; cosmopolitan.

Remarks. The numerous finds of representatives of the genus in the Senonian and Paleocene emends the stratigraphical range given by (Loeblich, Tappan, 1988).

Siphonodosaria adolphina (d'Orbigny, 1846)

Plate I, Figure 14

1846. *Dentalina adolphina* d'Orbigny; d'Orbigny, p. 51, tab. 2, fig. 18-20;

1951. *Dentalina adolphina* d'Orbigny; Spasov, p. 100, pl. 1, fig. 11;

1926. *Nodosaria* cf. *adolphina* (d'Orbigny); Cushman, p. 597, pl. 18, fig. 2;

1969. *Nodosaria adolphina* (d'Orbigny); Krayeva, Zernetskij, p. 41, pl. 14, fig. 6;

1985. *Stilostomella adolphina* (d'Orbigny); Papp, Schmidt, p. 31, pl. 14, figs. 8-11;

1992. *Siphonodosaria adolphina* (d'Orbigny); Darakchieva, Juranov, p. 30, pl. 5, fig. 4.

Nomenclature. The lectotype (GBA Coll. No. 1981/03/58) was pointed out by Papp, Schmidt (1985, pl. 14, fig. 9). The

species was first described from the Badenian of the Vienna Basin.

Material. Byala Formation (1 specimen).

Remarks. In Bulgaria the species was described from the Miocene of Kula District (Spasov, 1951). It was also established in the Eocene of Bourgas District (Darakchieva, Juranov, 1992).

Distribution. It is known from the Upper Senonian of Germany, the Paleocene of Texas (Midway Formation), Mexico, Poland, the Eocene of Ukraine, Caucasus, Crimea, Turkmenia, California, Venezuela, the Middle Eocene of Dalmatian, the Oligocene of the Netherlands, Hungary, the Miocene of the Vienna Basin, Bavaria.

Occurrence. C-30 (83.90 m – P4 Zone).

Siphonodosaria paleocenica (Cushman and Todd, 1946)

Plate I, Figure 15

1946. *Ellipsonodosaria paleocenica* Cushman and Todd, n. sp.; Cushman and Todd, p. 61, pl. 10, fig. 26;

1951. *Ellipsonodosaria paleocenica* (Cushman and Todd); Cushman, p. 46, pl. 13, figs. 3-5.

Nomenclature. The holotype (Cushman Coll. No. 46415) is from the Paleocene of Little Rock (Arkansas, USA).

Material. Byala Formation (6 specimens).

Description. Test is slim, elongated, straight, uniserial, slightly tapered in the initial portion, than slightly broadening. It is composed of 11-14 spherical chambers with gradually increasing sizes. Sutures are straight, horizontal, deep. Surface is smooth. Aperture is terminal, round, located on a short neck with lip.

Distribution. The species is known from the Paleocene of Arkansas, Alabama, Texas, Mississippi, and Tennessee.

Occurrence. Section Byala 2b (NP3 Zone), Byala River Valley (Paleocene).

Siphonodosaria sp.

Plate I, Figure 16

Material. Byala Formation (49 fragments).

Description. The investigated fragments are composed of 4-6 spherical equidimensional chambers separated by deep sutures. In the last 2-3 chambers they turn into short necks. Surface is smooth. Aperture is terminal, round, on a short neck.

Occurrence. C-12 (194.10 m – P1c Zone), C-21 (22.00 m – P1b Zone), C-23 (215.00 m – Lower Paleocene), C-24 (40.00 m - P2 Zone, 107.70 m – P1c Zone), C-29 (440.30 m – P5 Zone), C-30 (86.30 m – P4 Zone, 107.90 m – P5 Zone), sections Byala 1 (NP5 Zone), Byala 2b (NP3 Zone), Byala River Valley (Paleocene).

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Appendix

List of the Midway-type taxa from the Paleocene of the Coastal Part of East Stara Planina published in previous articles

<i>Dentalina acuta</i> d'Orbigny	<i>Lenticulina clypeiformis</i> (d'Orbigny)	<i>Pygmaeoseistrum hispidum</i> (Reuss)
<i>D. alternata</i> (Jones)	<i>L. degolyeri</i> (Plummer)	<i>P. laevis</i> (Montagu)
<i>Dentalinoides approximata</i> (Reuss)	<i>L. disca</i> (Brotzen)	<i>P. oxystomum</i> Reuss
<i>D. colei</i> (Cushman&Dusenbery)	<i>L. inornata</i> (d'Orbigny)	<i>Reussolina apiculata</i> (Reuss)
<i>D. fallax</i> (Franke)	<i>L. macrodisca</i> (Reuss)	<i>R. emaciata</i> (Reuss)
<i>Grigelis pyrula longicostata</i> Cushman	<i>L. ovalis</i> (Reuss)	<i>R. globosa</i> (Montagu)
<i>Laevidentalina communis</i> (d'Orbigny)	<i>L. pseudomamilligera</i> (Plummer)	<i>Favulina hexagona</i> (Williamson)
<i>L. eocenica</i> (Cushman)	<i>L. turbinata</i> (Plummer)	<i>Palliolatella crebra</i> (Mathes)
<i>L. glaessneri</i> (ten Dam)	<i>L. vortex</i> (Fichtel&Moll)	<i>P. orbignyana</i> Seguenza
<i>L. laticolis</i> (Grzybowski)	<i>L. wilcoxensis</i> (Cushman&Ponton)	<i>Globulina gibba</i> d'Orbigny
<i>L. megalopolitana</i> (Reuss)	<i>Marginulinopsis jacksonensis</i>	<i>Guttulina communis</i> d'Orbigny
<i>L. mucronata</i> Neugeboren	(Cushman&Applin)	<i>G. ipatovcevi</i> Vassilenko
<i>Nodosaria aspera</i> Reuss	<i>Saracenaria arcuata</i> (d'Orbigny)	<i>G. irregularis</i> (d'Orbigny)
<i>N. concinna</i> Reuss	<i>S. hantkeni</i> Cushman	<i>G. lidiae</i> Vassilenko
<i>N. ewaldi</i> Reuss	<i>Neofilabellina rugosa</i> (d'Orbigny)	<i>Pyrulinoides cylindroides</i> (Roemer)
<i>N. guttifera</i> (d'Orbigny)	<i>Astaculus cymboides</i> (d'Orbigny)	<i>Ramulina globulifera</i> Brady
<i>N. (?) hispida</i> (Soldani)	<i>A. gibbus</i> (d'Orbigny)	<i>Glandulina laevigata</i> d'Orbigny
<i>N. longiscata</i> d'Orbigny	<i>A. gladius</i> (Philippi)	<i>Ellipsoglandulina chilostoma</i> (Rzehak)
<i>N. praegnans</i> (Reuss)	<i>Hemirobulina pediformis</i> (Bornemann)	<i>E. manifesta</i> Franke
<i>N. radricula</i> (Linne)	<i>Marginulina apiculata</i> Reuss	<i>Ellipsoidina ellipsoides ellipsoides</i>
<i>N. soluta</i> Reuss	<i>M. hamulus</i> Chapman	Seguenza
<i>Pseudonodosaria caudigera</i> (Schwager)	<i>M. hirsuta</i> d'Orbigny	<i>E. ellipsoides oblonga</i> Seguenza
<i>P. cylindracea</i> (Reuss)	<i>M. obliqua</i> (d'Orbigny)	<i>Ellipsopolymorphina velascoensis</i>
<i>P. manifesta</i> (Reuss)	<i>M. oblonga</i> Kaptarenko	(Cushman)
<i>P. parallela</i> (Marson)	<i>M. similis</i> d'Orbigny	<i>Nodosarella hedbergi</i> Cushman and Renz
<i>Pyramidulina latejugata</i> (Guembel)	<i>Marginulina</i> sp.	<i>N.cf. paleocenica</i> Cushman and Todd
<i>P. raphanistrum</i> (Linne)	<i>Vaginulinopsis earlandi</i> (Plummer)	<i>N. tuberosa</i> (Gümbel)
<i>P. raphanus</i> (Linne)	<i>V. longiformis</i> (Plummer)	<i>Nodosarella</i> sp.
<i>P. tutkowskii</i> (Kaptarenko)	<i>V. midwayana</i> (Fox&Ross)	<i>Pleurostomella eocaena</i> Gümbel
<i>Fronicularia jarvisi</i> Cushman	<i>V. pedum</i> (d'Orbigny)	<i>P. kugleri</i> Cushman and Renz
<i>Fronicularia</i> sp. 1	<i>Hyalinonetion clavatum</i> (d'Orbigny)	<i>P. paleocenica</i> Cushman
<i>Fronicularia</i> sp. 2	<i>Lagena costata</i> (Williamson)	<i>P. subnodosa</i> (Guppy)
	<i>L. sulcata</i> (Walker&Jakob)	
	<i>L. sulcata apiculata</i> Cushman	

Plate I

- 1, 2. ? *Textularia plummerae* Lalicker, 1935. Byala Formation, Section Byala 2c, Lower Paleocene, NP2 Zone, Sample 52c-8; SEMx42.6
3. *Textularia* sp. Byala Formation, C-25, Lower Paleocene, 40.40 m, P1b Zone, Sample C-25-6; SEMx37.4
4. *Pyramidulina tenuicostata* (Cushman & Bermudez, 1936). Byala Formation, Koundilaki Cheshme Valley, Paleocene, Sample K4-1; SEMx65.5
5. *Bolivina midwayensis* Cushman, 1936. Byala Formation, Section Byala 2b, Lower Paleocene, NP1 Zone, Sample 52b-7; SEMx50.5
6. *Präeglobulimina pyrula* (d'Orbigny, 1846). Byala Formation, C-29, Upper Paleocene, 440.30 m, P5 Zone, Sample C-29-11; SEMx63
7. *Fursenkoina* sp. Byala Formation, Section Byala 2b, Lower Paleocene, NP3 Zone, Sample 52b-14; SEMx75
8. *Dentalina longicostata* (Cushman & Jarvis, 1934). Byala Formation, Byala River Valley, Paleocene, Sample 5P-6; SEMx48=6
9. *Bulimina midwayensis* Cushman & Parker, 1936. Byala Formation, C-29, Upper Paleocene, 399.20 m, P4 Zone, Sample C-29-8; SEMx63
10. *Bulimina paleocenica* Brotzen, 1948. Byala Formation, Section Byala 1, Lower Paleocene, NP3 Zone, Sample 51-12; SEMx71.5
11. *Globobulimina suteri* (Cushman & Renz, 1946). Byala Formation, Section Byala 2b, Lower Paleocene, Sample 52b-17; SEMx60
12. *Nodogenerina emaciata* (Reuss, 1851). Byala Formation, Section Byala 2b, Lower Paleocene, NP1 Zone, Sample 52b-8; SEMx48.6
13. *Orthomorphina rohri* (Cushman & Stainforth, 1945). Byala Formation, Section Byala 2b, Lower Paleocene, NP2 Zone, Sample 52b-13; SEMx81.5
14. *Siphonodosaria adolphina* (d'Orbigny, 1846). Byala Formation, C-30, Upper Paleocene, 83.90 m, P4 Zone, Sample C-30-6; SEMx48.6
15. *Siphonodosaria paleocenica* (Cushman & Todd, 1946). Byala Formation, Section Byala 2b, Lower Paleocene, NP3 Zone, Sample 52b-17; SEMx63
16. *Siphonodosaria* sp. Byala Formation, Byala River Valley, Paleocene, Sample 5P-7; SEMx63

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PLATE I

