ЗАГАЛЬНА, МОРСЬКА ГЕОЛОГІЯ ТА ПАЛЕОНТОЛОГІЯ

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THE FIRST RECORD OF THE GENUS *DELTOIDONAUTILUS* SPATH, 1927 (NAUTILIDA: CEPHALOPODA) IN THE PALAEOGENE OF THE CRIMEAN PENINSULA, UKRAINE

The article describes a first record of a species of the genus *Deltoidonautilus* Spath, 1927 (*D.* cf. *sowerbyi* (Wetherell in Sowerby, 1843)) in the Palaeogene (Ypresian or lower Lutetian) deposits of the Crimean Peninsula, southern Ukraine. The data obtained expand the geographical distribution of this genus and complement the palaeontological characteristics of the Palaeogene succession of southern Ukraine.

Key words: nautiloids, Ypresian, Lutetian, southern Ukraine.

INTRODUCTION

Palaeogene marine deposits are widespread in the Crimean Peninsula, southern Ukraine (Zernetsky et al., 2014, 2015 and references therein). Here, they are represented mainly by clays, siltstones, sandstones, and limestones of shallow marine origin (Zernetsky et al., 2014, 2015). These rocks are rich in remains of a variety of shallow marine fauna, with molluscs, mainly bivalves and gastropods, occupying a prominent place (see Zernetsky et al. (2014, 2015) for a review).

Palaeogene cephalopods of Crimea are known from several Danian, Thanetian, and Bartonian stratigraphic levels and are represented by the species of the genera *Eutrephoceras* Hyatt, 1894*, Pseudocenoceras* Spath, 1927*, Hercoglossa* Conrad, 1866*, Aturia* Bronn, 1838*, Teichertia* Glenister, Miller & Furnish, 1956, and *Cimomia* Conrad, 1866 (see Dernov & Udovychenko (2016) for a review). The genus *Deltoidonautilus* Spath, 1927, which occurs in the Palaeogene strata of eastern and central Ukraine (Dernov and Udovychenko, 2018; Berezovsky, 2021), was not known here until recently.

This paper describes the first find of a species of the genus *Deltoidonautilus* in the Palaeogene of the Crimean Peninsula. Palaeogene nautilids are not of significant stratigraphic importance, but they are an excellent tool for palaeogeographic studies

(e.g., Dzik & Gaździcki, 2001). In the recent past, the section near the town of Bakhchisarai was considered to be the Palaeogene reference section of the Crimean-Caucasian region (Zernetsky et al., 2014, 2015). However, it was later found out that the Palaeogene stratigraphic units of Crimea are difficult to correlate with the same age rock successions of neighbouring regions, such as Caucasus and Central Asia. Currently, several Palaeogene sections in Crimea serve as stratotypes for various regional stratigraphic units of the South Ukrainian palaeosedimentary province (Zernetky et al., 2014, 2015). Therefore, the obtained data extend the palaeontological characteristics of the Palaeogene strata of southern Ukraine.

MATERIAL AND METHODS

The studied material is represented by a single almost complete moderately well preserved limestone inner mould of the conch. The specimen (No. GM KNU-299M3) is kept in the Geological Museum of the Taras Shevchenko National University of Kyiv. The collector of this material is unknown.

The specimen GM KNU-299M3 comes from the Eocene (probably the Ypresian or lower Lutetian) limestone bed exposed near the village of Ukrainka, about 4 km south of the city of Simferopol (Autonomous Republic of Crimea, Ukraine: Fig. 1A, B). Five moderately preserved crab carapace inner moulds belonging to

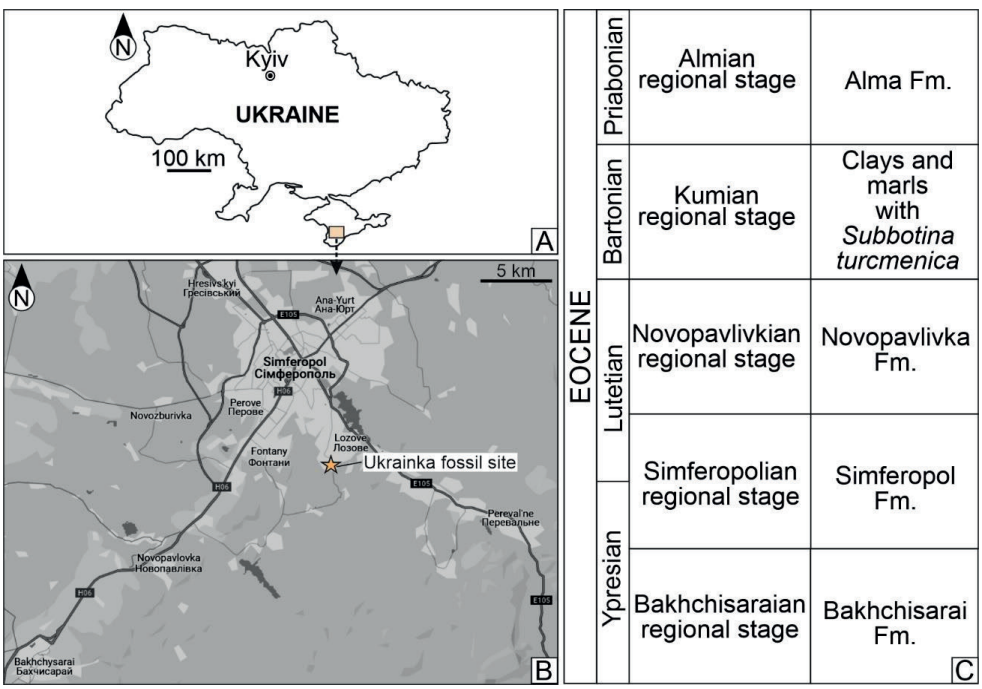

Fig. 1. *Geographical location of the fossil site with Deltoidonautius (A, B) and Eocene stratigraphy of the Simferopol facies zone (C). Stratigraphic scheme in Fig. 1C modified after Zernetsky et al. (2014).*

Harpactoxanthopsis quadrilobatus (Desmarest, 1822) are co-occurred in the studied collection with the steinkern of *Deltoidonautilus.*

The key for the description of Palaeogene nautiloid species proposed by Korn (2010) and Klug et al. (2015) for the description of Palaeozoic ammonoids and coiled nautiloids is used here. The abbreviations used in the species description are: dm = conch diameter, wh = whorl height, ww = whorl width, ap = apertural height, uw = umbilical width; whorl expansion rate (WER) = $(dm_1/dm_2)^2$ or $[dm_1/(dm_1–ah)]^2$, imprint zone rate (IZR) = $wh_1–ah/wh_1$ or $(wh_1–(dm_1–dm_2))/wh_1$ (Korn, 2010).

For a scheme of dimensions of coiled nautiloid conchs, see article of Korn & Bockwinkel (2022: Fig. 3). The taxonomy of nautiloids proposed by Kummel (1964) is used in this work.

GEOLOGICAL SETTING

The studied specimen probably comes from the Ypresian or lower Lutetian limestone bed, which belong to the Bakhchisarai or Simferopol formations (see Fig. 1C). The Bakhchisarai Formation (lower Ypresian) consists of greenish-grey glauconitic sands and greenish- and dark-grey calcareous clays with limestone interlayers, and less frequently sandstones and marls. The formation has a thickness of up to 65 m (Zernetsky et al., 2015).

The Simferopol Formation (upper Ypresian–lower Lutetian) consists of light grey and yellowish grey massive bioclastic and nummulitic limestones with occasional thin interlayers of calcareous clays and marls. Sandstones are present in some areas. The formation has a thickness of 50–70 m (Zernetsky et al., 2015).

SYSTEMATIC PALAEONTOLOGY

Order Nautilida Agassiz, 1847

Superfamily Nautiloidea de Blainville, 1825

Family Hercoglossidae Spath, 1927

Genus *Deltoidonautilus* Spath, 1927

Type species*: Nautilus sowerbyi* Wetherell in Sowerby, 1843; original designation.

Diagnosis. Nautiliconic, involute, compressed, with small inconspicuous umbilicus; whorl section sagittate, with narrowly rounded to angular ventral zone; lateral areas converging toward venter; deeply impressed dorsal zone. Growth lines forming deep hyponomic sinus; suture with broad narrowly rounded to acute ventral saddle, large lateral lobe, small lateral saddle and lobe on umbilical wall, dorsal lobe which may be very narrow; siphuncle near dorsum (after Kummel (1964: p. K456)).

Deltoidonautilus cf. *sowerbyi* (Wetherell in Sowerby, 1843)

Table 1, Fig. 2

Material. One steinkern (specimen GM KNU-299M3).

Description. The specimen GM KNU-299M3 is represented by an inner mould of an extremely discoidal conch (ww/dm = 0.32; see Fig. 2B, C), 190 mm in

diameter, with a weakly compressed whorl cross section (ww/wh = 0.65), a very high coiling rate of the conch (WER = 2.30), and moderately embracing whorls (IZR = 0.29). The venter is very narrow, moderately pointed; flanks are convex, broad, and imperceptibly pass into the venter, i.e. the ventrolateral shoulder is absent. The umbilical margin is broadly rounded; the umbilicus is very narrow (uw/dm ~ 0.10). Fine ornamentation (growth lines) is not preserved. The suture line has a broad, shallow lateral lobe and a narrow, low ventral saddle (Fig. 2D).

Table 1

Conch dimensions (in mm) and ratios of *Deltoidonautilus* cf. *sowerbyi* (Wetherell in Sowerby, 1843)

Specimen	dm	ww	wh	uw	ah	ww/dm	ww/wh	uw/dm	WER	IZR
GM KNU-299M3	190.0	60.0	92.0	~18.0	65.0	0.32	0.65	~0.10	2.30	0.29

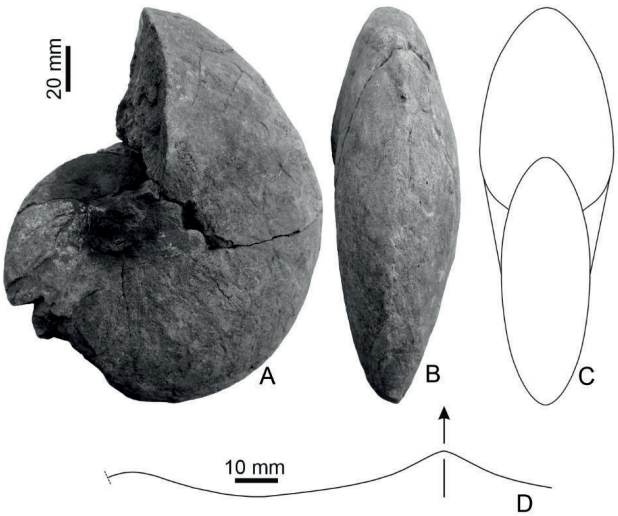

Fig. 2. Deltoidonautilus *cf.* sowerbyi *(Wetherell in Sowerby, 1843) from the Ypresian or lower Lutetian deposits of Crimea (specimen GM KNU-299M3): A – lateral view, B – ventral view, C – septal projection, D – suture line.*

Remarks. The trace fossils attributed to the ichnogenus *Arachnostega* Bertling, 1992 occur on the surface of the ventrolateral area of the steinkern (Fig. 3).

This ichnogenus is usually interpreted as a domichnia or feeding structure in a consolidated soft- to firmground substrate, produced by detritus- or deposit-feeding polychaetes (Bertling, 1992; Fatka et al., 2011; Zatoń, 2020; Dernov, 2023).

Deltoidonautilus cf. *sowerbyi* described above is very similar to the type species of the genus *Deltoidonautilus*, *D. sowerbyi*, in a number of morphological characters, such as a moderately pointed venter and a very narrow umbilicus. However, inability

to observe of growth lines in *Deltoidonautilus* cf. *sowerbyi*, which are clearly visible in the figures of *Deltoidonautilus sowerbyi* given by Sowerby (1843: pl. 627, figs 1–3), does not allow us to confidently identify the above described specimen GM KNU-299M3 as *Deltoidonautilus sowerbyi*.

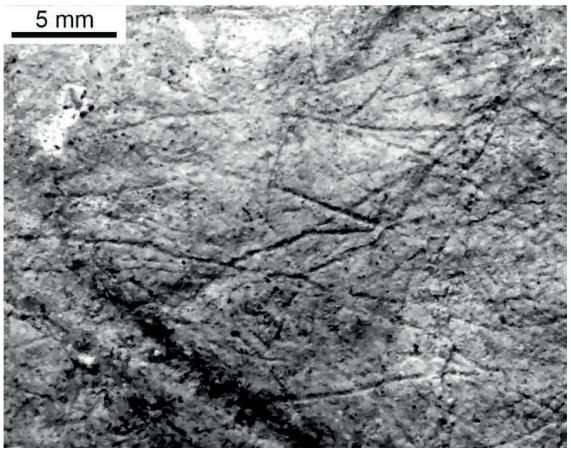

Fig. 3. *Trace fossils* Arachnostega *on the surface of the steinkern of* Deltoidonautilus *cf.* sowerbyi *(Wetherell in Sowerby, 1843).*

Deltoidonautilus cf. *sowerbyi* differs from *Deltoidonautilus bakeri* Teichert, 1947 from the Eocene of Australia and *Deltoidonautilus okinoshimensis* Tanabe & Chiba, 1983 from the late Eocene of Japan by a shallower lateral lobe of the suture line and a more rounded outlines of the venter. The conch of the Japanese species is much narrower (ww/dm = 0.16 to 0.22 in *D. okinoshimensis* and ww/dm = 0.32 in *Deltoidonautilus* cf. *sowerbyi*).

Deltoidonautilus cf. *sowerbyi* differs from *Deltoidonautilus biyogorensis* Haas & Miller, 1952, from the Eocene of Somalia, by its narrower conch (ww/dm = 0.44 in *D. biyogorensis* and ww/dm = 0.32 in *Deltoidonautilus* cf. *sowerbyi*). Additionally, *Deltoidonautilus biyogorensis* has thin but clearly visible growth lines, which are not absent in *Deltoidonautilus* cf. *sowerbyi*. *Deltoidonautilus singularis* Haas & Miller, 1952, from the Eocene of Somalia, has a very deep lateral lobe, which differs from the described *Deltoidonautilus* cf. *sowerbyi*, which has a rather shallow lateral lobe. This morphological feature also distinguishes *Deltoidonautilus* cf. *sowerbyi* from *Deltoidonautilus hassani* Hewaidy, El Qot & Moneer, 2018 from the Palaeocene of Egypt. *Deltoidonautilus spathi* Haas & Miller, 1952, from the Eocene of Somalia, has a more pointed venter compared to that of *Deltoidonautilus* cf. *sowerbyi*.

Deltoidonautilus cf. *sowerbyi* is quite similar to *Deltoidonautilus vredenburgi* Halder, 2012, from the early Eocene of India, in terms of the conch form and the configuration of the suture line. However, due to the lack of material showing some significant morphological details, a detailed comparison of these nautilids is not

possible. It should be noted that in some specimens of *Deltoidonautilus vredenburgi,* such as those shown in Fig. 6 in Halder (2012), the venter is keeled, while in *Deltoidonautilus* cf. *sowerbyi* it is moderately pointed or almost arcuate.

Also, *Deltoidonautilus* cf. *sowerbyi* has some morphological similarities with *Deltoidonautilus haughti* (Olsson, 1928) from the Eocene of Peru, as figured by Miller & Downs (1950), and *Deltoidonautilus molli* Tintant et al. (2001) from the Palaeocene of the Republic of Niger. However, due to the limited available material, a confident comparison of these nautilids was not possible. It is difficult to compare *Deltoidonautilus* cf. *sowerbyi* with *Deltoidonautilus belokrysi* Berezovsky, 2021, since the holotype of the latter species is likely to have been quite strongly compressed laterally during diagenesis. Additionally, the configuration of the suture line of *Deltoidonautilus belokrysi* is not known.

Locality. The fossil site near the village of Ukrainka, about 4 km southeast of the city of Simferopol (Autonomous Republic of Crimea, Ukraine); Ypresian or lower Lutetian, Eocene.

DISCUSSION AND CONCLUDING REMARKS

Representatives of the genus *Deltoidonautilus* have been previously reported from the Palaeogene deposits of Ukraine: *Deltoidonautilus lamarckii* (Deshayes, 1835) recorded from the Kyiv Formation (upper Lutetian–Bartonian) of the North Ukrainian palaeosedimentary province (i.e., northern, central, and eastern Ukraine) (Dernov & Udovychenko, 2016). Dernov & Udovychenko (2018) recorded, but not figured, *Deltoidonautilus* sp. from the highest part of the Kyiv Formation of the Donets Basin (Fig. 4).

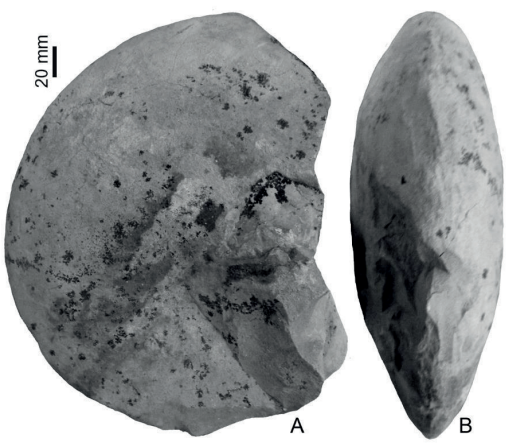

Fig. 4. Deltoidonautilus *sp. from the opoka-like rocks in the upper part of the Kyiv Formation (south part of the city of Luhansk, Donets Basin): A – lateral view, B – ventral view. Uncatalogued specimen in the Geological Museum of the Luhansk Taras Shevchenko National University.*

Berezovsky (2021) described the new species *Deltoidonautilus belokrysi* Berezovsky, 2021 from the middle or upper Eocene rocks exposed near the city of Kryvyi Rih (Dnipropetrovsk Oblast). However, the validity of this species is questionable due to the lack of a detailed comparison with other representatives of the genus *Deltoidonautilus*.

The only characteristic morphological feature of *Deltoidonautilus belokrysi* is the configuration of its suture line. However, the suture line in the holotype, which is the only described and figured specimen, appears highly deformed, as shown in Fig. 2b in Berezovsky (2021). However, there is no doubt that this nautiloid belongs to the genus *Deltoidonautilus*.

In summary, Eocene cephalopods in Ukraine are represented by the genera *Eutrephoceras* Hyatt, 1894, *Aturoidea* Vredenburg, 1925, *Aturia* Bronn, 1838, *Deltoidonautilus* Spath, 1927, *Cimomia* Conrad, 1866, *Belosaepia* Voltz, 1830, *Beloptera* de Blainville, 1825, and *Vasseuria* Munier-Chalmas, 1880 (Dernov & Udovychenko, 2016, 2018; Berezovsky, 2021; Dernov & Demianov, 2023; Dernov, 2024).

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ПЕРША ЗНАХІДКА ПРЕДСТАВНИКА РОДУ *DELTOIDONAUTILUS* SPATH, 1927 (NAUTILIDA: CEPHALOPODA) В ПАЛЕОГЕНОВИХ ВІДКЛАДАХ КРИМСЬКОГО ПІВОСТРОВА (УКРАЇНА)

В статті описано першу знахідку представника роду наутилід *Deltoidonautilus* Spath, 1927 (*D.* cf. *sowerbyi* (Wetherell in Sowerby, 1843)) у палеогенових (іпрських або нижньолютецьких) відкладах Кримського півострова на Півдні України. Іпрські та нижньолютецькі відклади Кримського півострова представлені бахчисарайською та сімферопольською світами, що складаються з пісків, глин та вапняків. Палеогенова малакофауна Криму вивчена досить повно, проте систематичний склад та стратиграфічне поширення цефалопод в палеогенових відкладах цього регіону потребує уточнення. Попри те, що палеогенові головоногі молюски не мають великого стратиграфічного значення, в окремих випадках вони можуть бути цінним інструментом палеоекологічних та палеогеографічних досліджень. На поверхні вивченого ядра черепашки наутиліди виявлено сліди харчування чи існування, віднесені до іхнороду *Arachnostega* Bertling, 1992. Зазвичай, ці іхнофосилії приурочені до софт- та фірмграундів, а їхніми продуцентами ймовірно були поліхети (черви). Раніше, види роду *Deltoidonautilus* фіксувалися в еоцені Українського щита і Донецького басейну. Нова знахідка збільшує таксономічне різноманіття палеогенових цефалопод України. Загалом, з палеогенових відкладів України відомі представники родів *Eutrephoceras* Hyatt, 1894, *Aturoidea* Vredenburg, 1925, *Aturia* Bronn, 1838, *Deltoidonautilus* Spath, 1927, *Cimomia* Conrad, 1866, *Belosaepia* Voltz, 1830, *Beloptera* de Blainville, 1825 та *Vasseuria* Munier-Chalmas, 1880. Однак, слід зауважити, що дані щодо систематичного складу палеогенових головоногих молюсків, опубліковані в порівняно старих роботах потребують ревізії з позицій сучасних знань щодо морфології і таксономії головоногих молюсків.

Ключові слова: наутиліди, іпрський ярус, лютецький ярус, Південь України.