



First species of the genus *Plaxiphora* Gray, 1847 (Mollusca: Polyplacophora) from the Paleocene of Europe

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ABSTRACT

The first species of the genus *Plaxiphora* from the Paleocene of Ukraine is described. The characteristic features of *Plaxiphora luzanovkae* sp. nov. are the strongly increasing size of tegmentum granules toward the edge of the valve, a large number of micraesthetes on these granules, and a random arrangement of the granules. Since the predominant occurrence of the species of the genus is in the Southern Hemisphere, with almost half found in New Zealand and Australia, it is likely that the first species of the genus originated during the final disintegration of Gondwana.

Key words: Cenozoic, fossil chitons, Mopaliidae, new species

Первый вид рода *Plaxiphora* Gray, 1847 (Mollusca: Polyplacophora) из палеоцена Европы

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РЕЗЮМЕ

Описывается первый вид рода *Plaxiphora* из палеоцена Украины. Характерными признаками *Plaxiphora luzanovkae* sp. nov. являются сильно увеличивающиеся к краю щитка размеры зерен тегмента, большое число микраэстетов на этих зернах и беспорядочное расположение зерен. Учитывая преимущественное расположение видов рода в южном полушарии и почти половины из них в районе Новой Зеландии и Австралии, предполагается происхождение первых видов этого рода при окончательном распаде Гондваны.

Ключевые слова: кайнозой, ископаемые хитоны, Mopaliidae, новый вид

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INTRODUCTION

The genus *Plaxiphora* is currently represented in the world fauna by 22 species (Kaas and Van Belle 1994; Sirenko 2012). These species can be divided into two size groups: thirteen species with a maximum body length of 7–19 mm and nine species with a maximum body length of 20–100 mm. The vast majority of species in this genus, with the exception of five Indo-West Pacific species, inhabit exclusively the waters of the Southern Hemisphere. The genus also includes six fossil species from the Pleistocene, Miocene, and Eocene of New Zealand and Australia (Cotton and Godfrey 1940; Van Belle 1981; Beu and Maxwell 1990). Most fossil chitons of the genus *Plaxiphora* belong to the group of large chitons. However, the Paleocene finding of a chiton head valve described in this study belongs to a small species.

MATERIAL AND METHODS

The head valve was collected from the Luzanovka Beds, corresponding to the Danian and Selandian stages (59.2–66.0 Mya) (Makarenko 1976). This outcrop is located near the small village of Luzanovka, south of Cherkassy, Ukraine. To reach the layer containing fossil mollusks, a hole about 1.7 m deep was dug into the riverbank. At the bottom of this hole, a 5–6 cm thick layer was found consisting of intact mollusk shells (Polyplacophora, Scaphopoda, Bivalvia, and Gastropoda) and their fragments, as well as single corals, remains of sea urchin shells, polychaete tubes, and fish teeth. In Sirenko (2021), an erroneous thickness of this bed (0.6 m) was given, instead of 5–6 cm. The contents of the layer containing the remains of fossil animals were washed in the river through a series of sieves with mesh sizes of 10 mm, 5 mm, and 1 mm. The individual valves of the chitons from the upper two sieves were selected under a magnifying glass, and from the lower sieve under an MBS-9 microscope. The head valve of the new species and two valves of *Plaxiphora parva* Nierstrasz, 1905 were examined under a FEI SEM Quanta 250 scanning electron microscope.

The following abbreviation is used: ZIN – Zoological Institute, Russian Academy of Sciences, Saint Petersburg, Russia.

SYSTEMATICS

Class Polyplacophora Gray, 1821

Subclass Neoloricata Bergenhayn, 1955

Order Chitonida Thiele, 1909

Suborder Acanthochitonina Bergenhayn, 1930

Superfamily Mopaliioidea Dall, 1889

Family Mopaliidae Dall, 1889

Subfamily Mopaliinae Dall, 1889

Until a new classification is adopted according to which *Plaxiphora* is not included in the Mopaliioidea superfamily, we use the old system (Sirenko 2006).

Genus *Plaxiphora* Gray, 1847

Type species. *Chiton carmichaelis* Gray, 1828 (= *Chiton auratus* Spalowsky, 1795), by subsequent designation (Gray 1847).

Genus distribution. Australia, New Zealand, Chile, Peru, Japan, Vietnam, Indonesia, India, Sri Lanka, Madagascar, South Africa, Marquesas, Hawaiian, Easter, and Salas y Gómez island. Mainly in the high surf intertidal zone, rarely up to 1.5 m (Kaas and Van Belle 1994; Sirenko 2012).

Plaxiphora luzanovkae sp. nov.

(Fig. 1)

Type material. Ukraine, village of Luzanovka, south of Cherkassy: head valve, holotype, ZIN 2474, coll. B. Sirenko.

Etymology. Named after the village of Luzanovka.

Description. Head valve 1.6 mm wide, 0.6 mm long, semicircular, posterior margin forming an obtuse angle, front slope slightly convex. Tegmentum densely granulose, with round or oval randomly arranged granules; diameters of granules increase by almost a factor of 4 from about 38 µm near apex to 150 µm at valve edge. Each granule with large megalaesthete pore and 7–20 small micraesthete pores.

Articulamentum well developed, dirty white in color, 8 insertion slits, teeth short, thin and not pectinated, slit rays invisible, eaves narrow, finely porous.

Occurrence. Lower Paleocene, Luzanovka Beds, Ukraine.

Comparison. The new species is very similar to the recent species *Plaxiphora parva* Nierstrasz, 1909

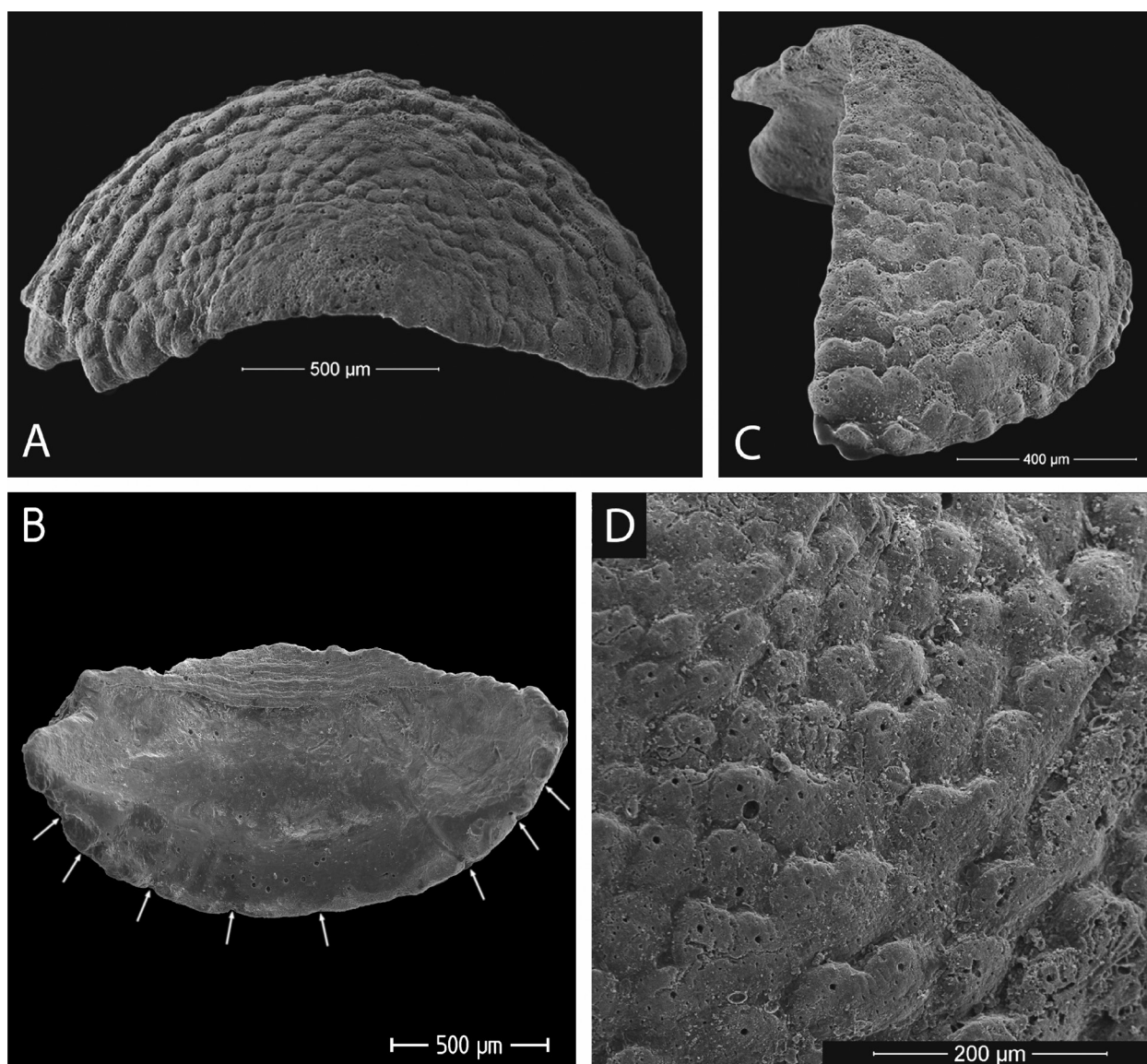


Fig. 1. *Plaxiphora luzanovkae* sp. nov. holotype (ZIN 2474). A – head valve, dorsal view; B – head valve, ventral view; C – head valve, lateral view; D – granules of tegmentum on the head valve.

(Fig. 2) from Madagascar and South Africa, but differs from the latter in having larger granules (up to 150 µm *vs.* up to 75 µm in *P. parva*) and more numerous aesthete pores on these granules (up to 20 *vs.* up to 12 pores in *P. parva*). Moreover, the granules are arranged in a random manner *vs.* quincuncially in *P. parva*.

The head valve of *Plaxiphora luzanovkae* sp. nov. bears some resemblance to the head valve of some species of *Lepidochitona* Gray, 1921 with granules

on the tegmentum, but differs from them in the random arrangement of granules on the tegmentum (*vs.* quincunx arrangement in the *Lepidochitona* species) and the rapid increase in granule size from the apex to the edge of the valve. For example, in *Lepidochitona cinerea* (Sirenko, 2024), the diameter of granules at the apex and at the edge of the flap is approximately 28 µm and 37 µm, respectively, indicating an increase in granule size of only 1.3 times (*vs.* about 4 times in *P. luzanovkae* sp. nov.).

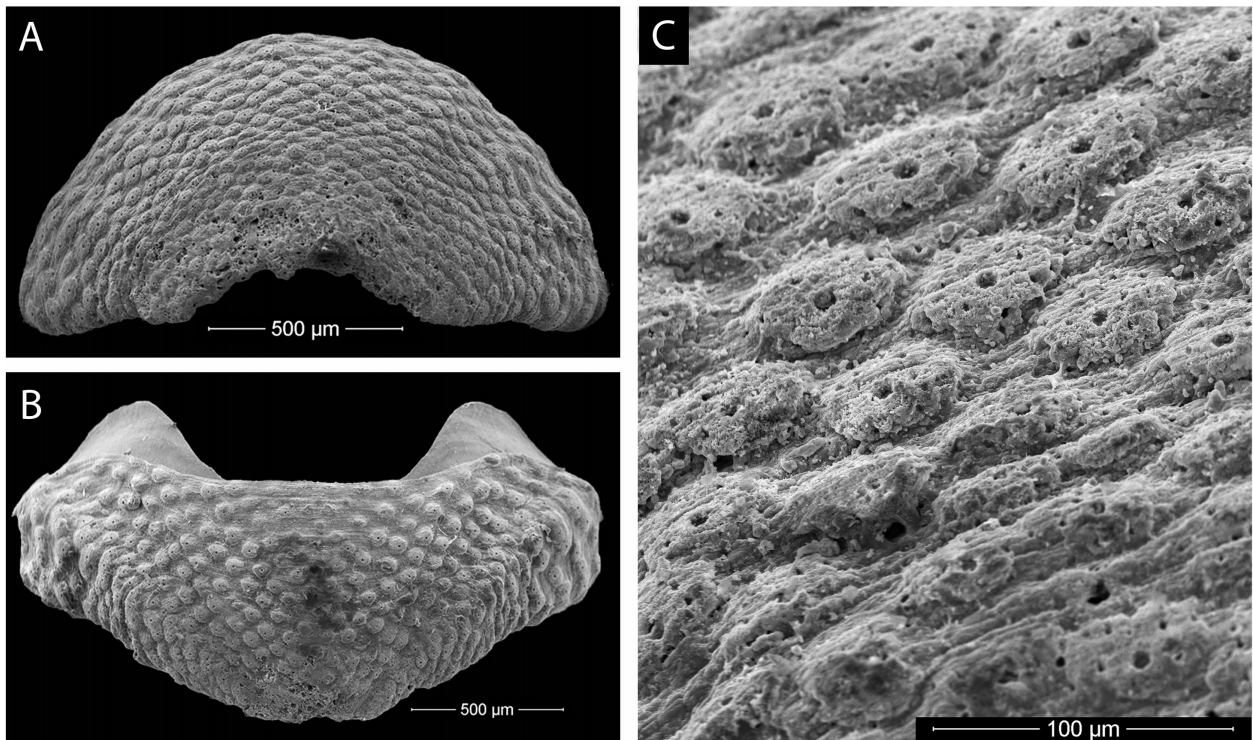


Fig. 2. *Plaxiphora parva* Indian Ocean, South Africa, Mpenjati, body length 5.0 mm, 08.03.2000, coll. B. Sirenko. A – head valve, dorsal view; B – valve V, dorsal view; C – granules of tegmentum on the head valve.

DISCUSSION

As noted in the Introduction, the vast majority of species of *Plaxiphora* inhabit the Southern Hemisphere and almost half of all species live off New Zealand and Australia. Three now-extinct species and three modern species in the fossil record have also been found there. The distribution of both modern and extinct species of the genus suggests a possible origin of the first species of the genus *Plaxiphora* from descendants of the Gondwana fauna, which was facilitated by the break-up of Gondwana. Such a conclusion is consistent with the opinion of Stilwell (2003) that the change in the composition of Paleocene faunas occurred not only as a result of extinction at the end of the Cretaceous, but also as a result of the final break-up of Gondwana, concomitant changes in climate and oceanic circulation, and faunal recovery processes.

In the Paleocene, the location of the continents (Barron et al. 1981; Zonenshain et al. 1984), and the prevailing east-west currents (Phillips and For-

syth 1972) encouraged the fauna to enter the Tethys Ocean, where the new species was collected.

The new species belongs to the group of the genus with small body size as noted in the Introduction. In contrast to the large chitons of the genus that inhabit temperate zones of the oceans, the small species primarily inhabit the coastal areas in the tropics, where predator pressure is much higher than in temperate areas. In the tropics, chitons with small body sizes, up to 10 mm, dominate (Sirenko 2012). The smaller size allows these chitons to find shelter more easily.

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REFERENCES

- Barron E.J., Harrison C.G.A., Sloan J.L. and Hay W.W. 1981.** Paleogeography, 180 million years ago to the present. *Eclogae Geologicae Helvetiae*, **74**(2): 443–470.
- Beu A.G. and Maxwell P.A. 1990.** Cenozoic Mollusca of New Zealand (drawings by R.C. Brazier). *New Zealand Geological Survey Paleontological Bulletin*, **58**: 1–518.
- Cotton B.C. and Godfrey F.K. 1940.** The Molluscs of South Australia. Part II. Scaphopoda, Cephalopoda, Aplacophora and Crepidopoda. In: British Science Guild, South Australian Branch Handbook of the Flora and Fauna of South Australia. Frank Trigg, Adelaide: 317–600.
- Gray J.E. 1847.** A list of the genera of recent Mollusca, their synonymy and types. *Proceedings of the Zoological Society of London*, **15**: 129–206. <https://doi.org/10.1111/j.1469-7998.1847.tb00164.x>
- Kaas P. and Van Belle R.A. 1994.** Monograph of living chitons (Mollusca: Polyplacophora). Volume 5. Ischnochitonidae: Ischnochitoninae (concluded), Callistoplacinae; Mopaliidae. Additions to Volumes 1–4. E.J. Brill, Leiden, 402 p. <https://doi.org/10.1163/9789004431713>
- Makarenko D.E. 1976.** Gastropods of the Lower Paleocene of the Northern Ukraine. Naukova Dumka, Kiev, 180 p. [In Russian].
- Phillips J.D. and Forsyth D. 1972.** Plate tectonics, paleomagnetism and the opening of the Atlantic. *Bulletin of the Geological Society of America*, **83**: 1579–1600. [https://doi.org/10.1130/0016-7606\(1972\)83\[1579:PTPATO\]2.0.CO;2](https://doi.org/10.1130/0016-7606(1972)83[1579:PTPATO]2.0.CO;2)
- Sirenko B.I. 2006.** New outlook on the system of chitons (Mollusca: Polyplacophora). *Venus*, **65**: 81–89.
- Sirenko B.I. 2012.** Chitons (Mollusca, Polyplacophora) of Nha Trang Bay, South Vietnam. In: T.A. Britayev and D.S. Pavlov (Eds). *Benthic fauna of the Bay of Nha Trang, South Vietnam*. Vol. 2. KMK Scientific Press Ltd, Moscow: 56–122.
- Sirenko B.I. 2021.** First Paleocene *Lepidozona* (Mollusca, Polyplacophora: Chitonida) from Ukraine. *Proceedings of the Zoological Institute RAS*, **325**(4): 379–383. <https://doi.org/10.31610/trudyzin/2021.325.4.379>
- Stilwell J.D. 2003.** Patterns of biodiversity and faunal rebound following the K–T boundary extinction event in Austral Palaeocene molluscan faunas. *Paleogeography, Paleoclimatology, Paleoecology*, **195**(3–4): 319–356. [https://doi.org/10.1016/S0031-0182\(03\)00364-X](https://doi.org/10.1016/S0031-0182(03)00364-X)
- Van Belle R.A. 1981.** Catalogue of fossil chitons (Mollusca: Polyplacophora). Dr. W. Backhuys, Publisher, Rotterdam, 83 p.
- Zonenshain L.P., Kuzmin M.I., Kononov M.B. and Gorodnitsky A.M. 1984.** Paleozoic oceans: an attempt of absolute reconstruction. In: Proceedings of the 27th International Geological Congress. Paleooceanology, Collegium 03. Vol. 3. Nauka, Moscow: 35–46. [In Russian].