

Reports of *Haliotis* Linnaeus, 1758 (Mollusca Vetigastropoda) from the Middle Miocene of Ukraine

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ABSTRACT

Two species of Haliotidae are described and illustrated from the Maksymivka quarry near Ternopil (Ukraine), a site characterized by its peculiar Middle Miocene (Badenian) coralgall facies. The first species, *Haliotis volhynica* Eichwald, 1829, has a wide geographical distribution that extends from the Paratethys of Central Europe to the Ukraine, and is quite common in the Maksymivka site. Another different species of *Haliotis* Linnaeus, 1758 was recently found at Maksymivka, only two specimens in several years of research. This species was already reported by Krach (1981) from Poland as *Haliotis tuberculata tauroplanata* Sacco, 1897, a species from the Burdigalian of Piedmont that differs from the Maksymivka species by several characters. We leave this rare species indeterminate at specific level because of the scarcity of material known to date.

KEY WORDS

Gastropoda; Haliotidae; *Haliotis*; Miocene; Ukraine.

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INTRODUCTION

Haliotidae Rafinesque, 1815 is a family of marine gastropods consisting of 56 living species and at least 35 fossil ones (Geiger & Groves, 1999; Geiger, 2000). The genus *Haliotis* Linnaeus, 1758 is the only one for the family and is known from Upper Cretaceous (Maastrichtian) (Sohl, 1992) to Recent. Strausz (1966) and Geiger & Groves (1999) proposed to refer all the 11 fossil European taxa known at that time (*Haliotis anomiaeformis* Sacco, 1896; *H. benoisti* Cossmann, 1895; *H. lamellosa* Lamarck, 1822; *H. lamellosoides* Sacco, 1896; *H. monilifera* Bonelli, 1827; *H. newvillei* Bial de Bell, 1909; *H. ovata* Bonelli, 1827; *H. tauroplanata* Sacco, 1897; *H. torrei* Ruggieri, 1989; *H. tuberculata* Linnaeus, 1758; *H. volhynica*

Eichwald, 1829) to *H. tuberculata volhynica*, because the Recent species (*H. tuberculata tuberculata*) with its Atlantic and Mediterranean populations is known to be extremely plastic in its shell morphology, and most material of European fossil specimens fall within the range of variation within the Recent species.

Aim of the present work is to illustrate some specimens of *Haliotis* recently found at the Maksymivka quarry (Ukraine) from the Middle Miocene (Badenian). A revision of the fossil cited species of *Haliotis* is needed to define the status of the described taxa. The reports of *Haliotis* from the Miocene of Ukraine are scarce, relating to *H. volhynica* or *H. tuberculata volhynica* (Zelinskaya et al., 1968; Krach, 1981) and *H. tuberculata tauroplanata* (Krach, 1981).

MATERIAL AND METHODS

The Maksymivka quarry near Ternopil (Ukraine) (Fig. 1) is well known in literature for its peculiar Middle Miocene (Badenian) coralgal facies and its fauna (Radwański et al., 2006; Studencka & Jasionowski, 2011; Górka et al., 2012). It embraces an area of several square kilometers over a distance of about one kilometer (Radwański et al., 2006: fig. 3). The reef exposed in this quarry is a member of the unique reef structure (almost 300 km long) formed within the Paratethyan realm, and distributed widely in the north-eastern and eastern borders of the Carpathian Foredeep Basin in Western Ukraine, Moldova and north-east Romania (Górka et al., 2012: fig. 1). The coralgal facies at Maksymivka is characterized by a complex structure: particular coralgal buildups of variable size (from centimetres of rodolith forms, to several metres thick), composed of red-algal (lithothamnian) colonies associated locally with sparse hermatypic corals. A survey of all these peculiar features/components is well reported by Radwański et al., 2006.

Other organisms associated with reefs are represented by mollusks (bivalves and gastropods), crabs, foraminifera, annelids, bryozoans and echinoderms. Almost all of the organisms of originally aragonitic shells were dissolved as a result of post sedimentary diagenesis and are now preserved in the form of moulds and/or imprints (see Górka et al., 2012: fig. 7A for a massive coralline-algae boundstone with embedded *Haliotis* shells).

The shells were collected manually inside the reef structure, paying particular attention to prevent breakage, and after were cleaned and measured (Table 1). The measurements are in millimeters (mm) and in degrees for the angle. About the references we considered only those works where species have been not only recorded, but also figured.

ABBREVIATIONS AND ACRONYMS. AS: Alexander Stalennuy collection, Ternopil, Ukraine; BD: Bruno Dell'Angelo collection, Genoa, Italy; BS: Bellardi and Sacco collection, Museo di Geologia e Paleontologia, University of Turin (now stored at the Museo Regionale di Scienze Naturali

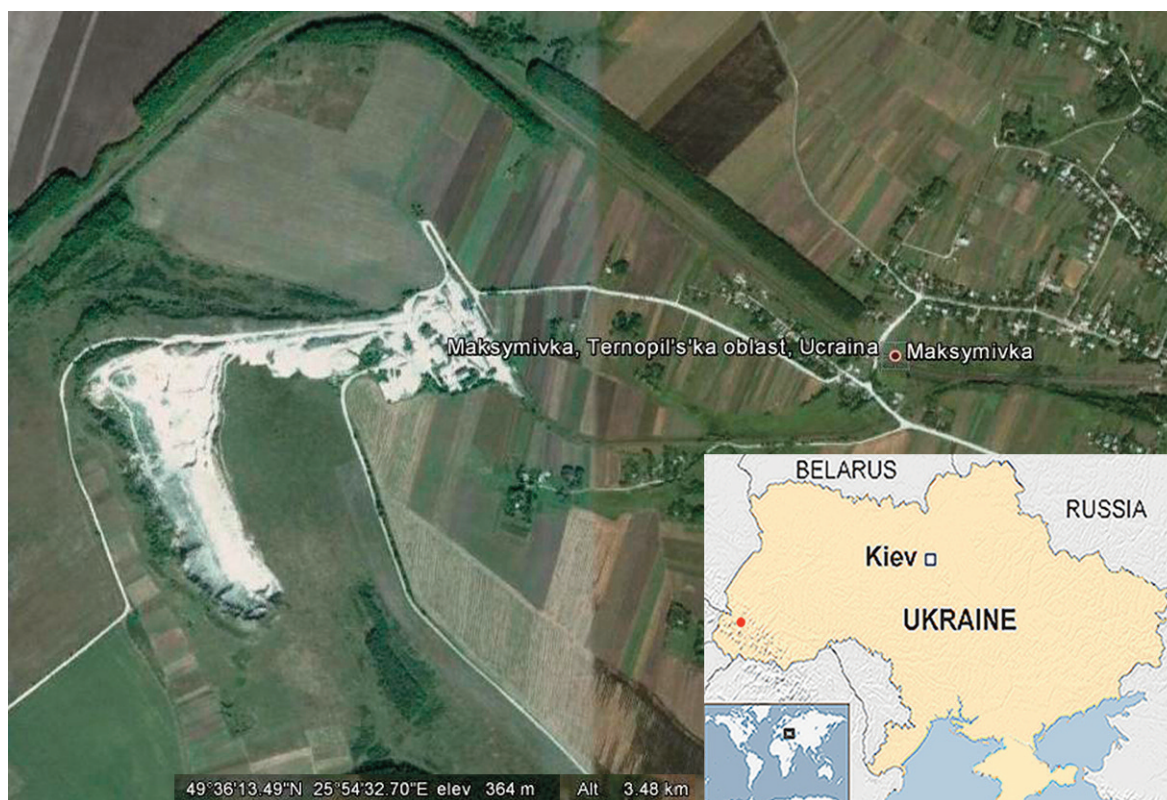


Figure 1. Maksymivka quarry near Ternopil (Ukraine), from Google earth.

of Turin), Italy; MF: Maurizio Forli collection, Prato, Italy; MZB: Museo di Zoologia, University of Bologna, Italy; L: length; W: width; H: maximum height of the shell, measured from the base to the top of the spire; α : angle of inclination of the initial part of the spire; L/W: ratio between L and W.

SYSTEMATICS

Classis GASTROPODA Cuvier, 1795
 Ordo VETIGASTROPODA Salvini-Plawen et Haszprunar, 1987
 Familia HALIOTIDAE Rafinesque, 1815
 Genus *Haliotis* Linnaeus, 1758
 Type species: *Haliotis asinina* Linnaeus, 1758

Haliotis volhynica Eichwald, 1829
 Figs. 2–14

1829. *Haliotis volhynica* Eichwald: 294, pl. 5, fig. 18.
 1856. *Haliotis volhynica* Eichw. - Hörnes: 510, pl. 46, fig. 26

1928. *Haliotis volhynica* Eichw. - Friedberg: 530, pl. 34, figs. 8, 9
 1937. *Haliotis volhynica* Eichwald - Davidaschvili: 540, pl. 1, fig. 5
 1954. *Haliotis tuberculata lamellosoides* Sacco - Csepregy-Meznerics: 10, pl. 1, fig. 24
 1955. *Haliotis (Haliotis) volhynica* Eichw. - Korobkov: pl. 2, fig. 3
 1960. *Haliotis (Haliotis) tuberculata* var. *lamellosoides* Sacco - Kojumdgieva & Strachimirov: 84, pl. 28, fig. 9
 1966. *Haliotis tuberculata volhynica* Eichwald - Strausz: 26, fig. 16c
 1967. *Haliotis volhynica* Eichw. - Bielecka: 132, pl. 8, figs. 3, 4 (fide Bałuk, 1975).
 1968. *Haliotis volhynica* Eichwald - Zelinskaya et al.: 95, pl. 27, fig. 1
 1979. *Haliotis (Sulculus) volhynica* Eichwald - Jakubowski & Musiał: 61, pl. 5, fig. 5
 1981. *Haliotis tuberculata* Eichwald - Krach: 39, pl. 11, figs. 1–3
 2012. *Haliotis tuberculata* Linnaeus - Górká et al.: 163, figs. 7a, 15a, b

| <i>Haliotis volhynica</i> | L | W | H | α | L/W | Repository |
|--|------|------|------|----------|------|---------------|
| 1 | 57.4 | 38.1 | 14.9 | 28 | 1.51 | MF |
| 2 | 56.8 | 36.2 | 14.7 | | 1.57 | MF |
| 3 | 53.2 | 35.3 | 14.8 | | 1.44 | MF |
| 4 | 52.1 | 35.7 | 17 | 26 | 1.46 | MF |
| 5 | 50 | 32 | 16 | | 1.57 | MF |
| 6 | 47.8 | 34.6 | 11.7 | 31 | 1.39 | MF |
| 7 | 42.5 | 29.8 | | | 1.43 | MF |
| 8 | 38.7 | 28.7 | 11.5 | | 1.35 | MF |
| 9 | 34.8 | 25.1 | | | 1.34 | MF |
| 10 | 26.9 | 19.8 | 7.6 | | 1.36 | MF |
| 11 | 26.3 | 18.7 | 6.3 | | 1.41 | MF |
| 12 | | 13 | 4.5 | | | MF |
| 13 | | 12.8 | 3.5 | | | MF |
| 14 | 60.5 | 39.4 | | | 1.54 | MZB 32038 |
| 15 | 70.4 | 44.8 | | | 1.58 | BD |
| <i>Haliotis</i> sp. | L | W | H | α | L/W | |
| 1 | 60 | 34 | | | 1.77 | AS |
| 2 | 46.5 | 26 | 10 | 45 | 1.79 | MF |
| <i>Haliotis tuberculata tauroplanata</i> | L | W | H | α | L/W | |
| 1 | 41 | 24 | 7.5 | 32 | 1.71 | BS.082.01.004 |

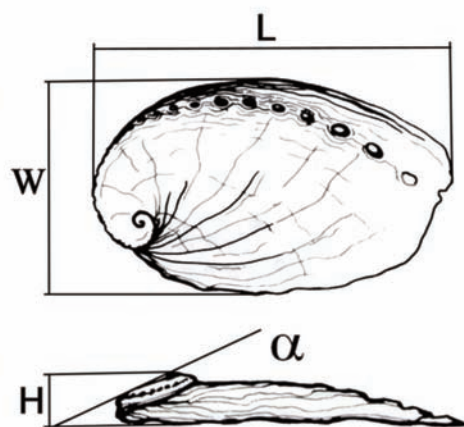


Table 1. Measurements of the examined specimens and their repository. See in Abbreviations and Acronyms.



Figures 2–14. *Haliotis volhynica* Eichwald, 1829 from the Middle Miocene (Badenian) of Maksymivka quarry (Ukraine). Figures 2–4: specimen 4 from Table 1. Figure 5: specimen 10 from Table 1. Figures 6, 7: specimen 11 from Table 1. Figures 8–10: specimen 6 from Table 1. Figures 11–14: specimen 1 from Table 1.



Figures 15–18. *Haliotis* sp. from the Middle Miocene (Badenian) of Maksymivka quarry (Ukraine). Fig. 15: specimen 1 from Table 1. Figures 16–18: specimen 2 from Table 1. Figures 19–22. *Haliotis tuberculata tauroplanata* Sacco, 1897, Early Miocene (Burdigalian) of Torino hills (Piedmont, Italy), BS. 082.01.004.

EXAMINED MATERIAL. Maksymivka: 15 specimens (MF, BD, MZB) (Table 1).

DESCRIPTION. Shell of medium size (L max about 70 mm), widened-oval, spire slightly raised, tilted about thirty degrees relative to the plane formed by the edge of the shell (α). Apex positioned on the left, moved to the center, about a third of the spiral width corresponding to that point. Regularly convex outer surface, with ornamentation spiral constituted by main cords detected, which develop at the beginning almost intermittently and then, becoming evident and irregularly wavy both in the sense of the spire and in height, form knobs scattered or aligned in radial folds more or less signed. The spiral cords are separated by evident furrows, sometimes side by side, giving rise to spiral cords of smaller width of the main, intersecting with growth striae more or less marked, form small imbricated lamellae, arranged irregularly. Openings with marginal conical-tubular protrusions pronounced, regularly spaced from each other by spaces almost equal to that of the size of the base of the next opening, which maintain the proportions, as the size of the shell, of which the last four open. Outer lip, from the edge of the keel formed by the openings up to the basal cords more pronounced, tilted and slightly concave. Columellar callus flattened with weak concavity.

DISTRIBUTION. *Haliotis volhynica* Eichwald, 1829 is a species with a wide geographical distribution that extends from the Paratethys of Central Europe (Austria, Romania, Bulgaria, Poland) to the Ukraine, with chronostratigraphic distribution limited to the Middle Miocene. It is particularly abundant in organogenic limestones of Ukraine related to sediments deposited at depths corresponding to the infralittoral.

REMARKS. The morphological characteristics of *H. volhynica*, at least of the specimens we examined and compared to those from the literature, are fairly constant, in particular the position of the apex and the spiral evolution, which is more rounded and closed with respect to that of *Haliotis* sp., as well as the ornamentation consisting of marked and tuberculate spiral cords (Csepregy-Meznerics, 1954; Zelinskaya et al., 1968; Krach, 1981; Górká et al., 2012). Even by the drawings can be found the same morphological characters that seem peculiar to *H. volhynica*, such as in Strausz (1966)

or in Friedberg (1928) by the shape of the internal moulds of the shell.

Specimens found at Maksymivka are well characterized and show a small degree of variability, and are different from the Recent species *H. tuberculata tuberculata* L., 1758 with its Atlantic and Mediterranean populations, contrary to what previously expressed by many authors about *H. volhynica*, considered as a subspecies *H. tuberculata volhynica* (Strausz, 1966; Geiger & Groves, 1999) or directly as *H. tuberculata* (Gorka et al., 2012). Agreeing to Landau et al. (2003) we consider *H. volhynica* a separable species from the Recent *H. tuberculata*.

Haliotis sp.

Figs. 15–18

1981. *Haliotis tuberculata tauroplanata* [non Sacco, 1897] - Krach: 40, pl. 11, figs. 4–7.

EXAMINED MATERIAL. Maksymivka: 2 specimens (AS, MF) (Table 1).

DESCRIPTION. Shell of small size, elongate-oval, with width about half the length. Spire little high with apex positioned a little more to the left than *H. volhynica*, about a quarter of the spiral width corresponding to that point. Regularly convex surface of the shell, with spiral ornamentation of the first two whorls consisting of 4–5 slender main cords spaced between them, which then become about ten or so, just signed, sometimes forming very small knobs, which disappear as increasing the spiral size, leaving the remaining surface of the shell, smooth or with sparse spiral cords just signed. Openings, of which the last four open, with marginal conical-tubular protrusions less raised. Outer lip, from under the keel of the openings to the edge columellar, with slightly convex profile. It was not possible to examine the internal part because it is filled with cemented limestone.

DISTRIBUTION. Paratethys, Middle Miocene (Badenian): Poland, Weglinek (Krach, 1981); Ukraine, Maksymivka (this work).

REMARKS. Only two specimens of a second species of *Haliotis* were recently found at Maksymivka, and this despite the numerous samples taken in recent years by one of the authors (AS). This second

species may therefore be considered quite rare, unlike *H. volhynica* which instead is found quite commonly, although it is hard to find complete and in fair condition specimens.

Haliotis sp. from Maksymivka differs from *H. volhynica* mainly by a different ratio L/W (1.34–1.58 for *H. volhynica* vs. 1.79 for *Haliotis* sp.) that gives rise to a more open spire and by the different ornamentation, without radial folds and evident spirals cords, if not in the early part of the spire. The similarity with *H. tuberculata tauroplanata* Sacco, 1897 from the Early Miocene (Burdigalian) of Turin hills (Piedmont, Italy) (Figs. 19–22) is evident when considering the general shape of the shell, but it is a bit less when comparing the two different spiral ornamentations. In *Haliotis* sp. the first part of the spire shows some slender spiral cords and small tubercles which disappear as increasing the spiral size, while there are not present in *H. tuberculata tauroplanata* which has also a spiral ornamentation made up of flattened cords which extend over the entire surface of the shell. Moreover *Haliotis* sp. has the anterior margin almost straight, while that of *H. tuberculata tauroplanata* is more convex and gives a more ellipsoid profile to the shell.

We consider the specimen reported by Krach from Weglinek (Poland) as *H. tuberculata tauroplanata* conspecific to the present species.

CONCLUSIONS

The findings of *H. volhynica* from Maksymivka confirm that abalone species, as taxa typical for high-energy, rocky environments, are one of the most characteristic and abundant group of gastropods among Late Badenian free-living reef-dwellers. Particularly important is to be considered the recent discovery of a second species of *Haliotis* from the same site, only two specimens in several years of research that led to the discovery of many specimens of *H. volhynica*. This latter seems the more frequent species of gastropods found at Maksymivka, though most of the specimens are not complete or are so matted in the rock that they can not be extracted.

This second species, already reported in the past by Krach (1981) from Poland as *H. tuberculata tauroplanata*, show differences with the species of

Sacco from the Burdigalian of Piedmont, and must be considered as a different species. We leave it indeterminate at specific level because of the scarcity of material known to date, waiting for more material to give a specific determination and to confirm or not the differences with the species from the Miocene of Italy.

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