

## New Conorbidae and Conidae (Conoidea, Neogastropoda) records from the Middle Miocene of Hungary

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**Abstract** – Newly collected Early Badenian (Middle Miocene) Conorbidae and Conidae assemblages are presented from three localities in the Hungarian part of the Pannonian Basin. Ten species – among others *Pseudonoduloconus wagneri* (Boettger) – are recorded for the first time in the region, others show extended geographical distribution. A new species, *Monteiroconus strauszi* n. sp. is designated. With 67 figures and 1 table.

**Key words** – Badenian, Central Paratethys, Conidae, Conorbidae, Middle Miocene, Pannonian Basin

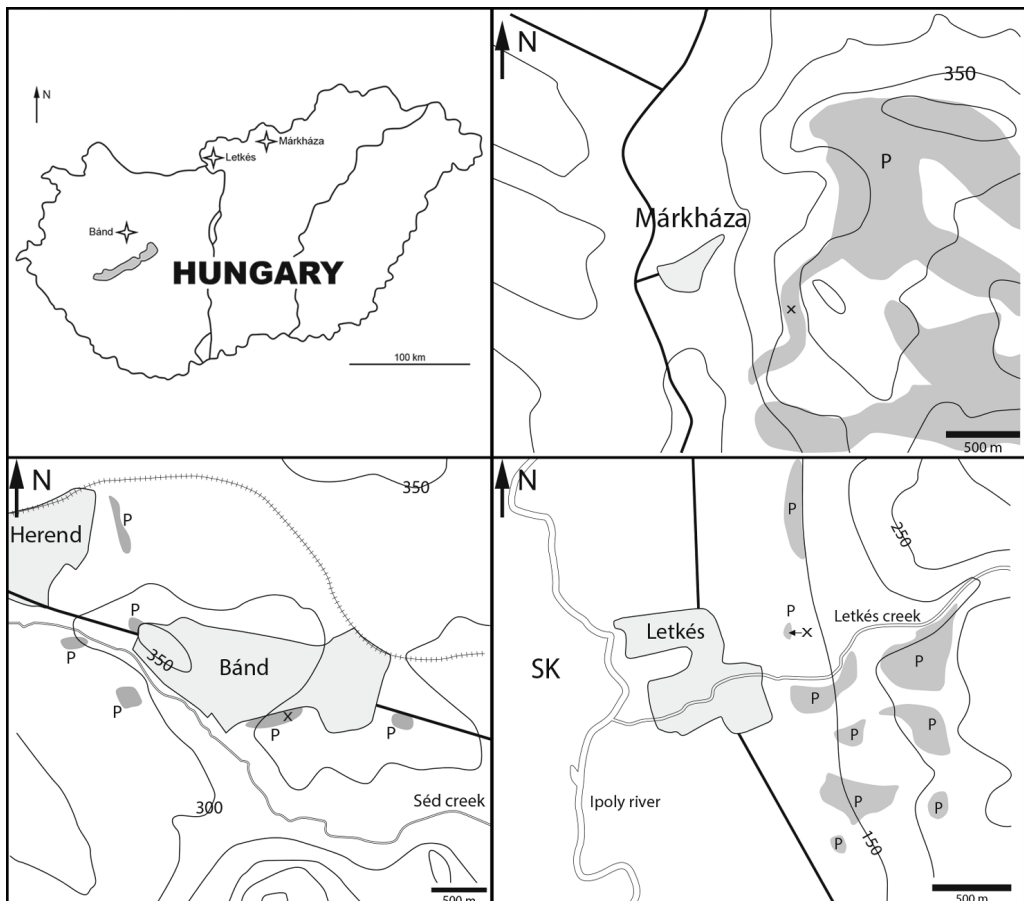
### INTRODUCTION

The aim of this paper is to record and illustrate two diverse Early Badenian (Middle Miocene) Conorbidae and Conidae assemblages in the Hungarian part of the Pannonian Basin: Márkháza (Cserhát Mts, North Hungarian Mountains), and Báánd (Bakony Mts, Herend Sub-basin, Transdanubian Central Range); as well as to complete the list of the Conidae assemblage of Letkés (Börzsöny Mts, North Hungarian Mountains) (Fig. 1). The material has been collected by the authors in the last years, and was completed with specimens from the private collection of Tamás Németh (Hungary). The specimens are housed in the collection of the Hungarian Natural History Museum, Budapest (HNHM), and in private collections. The new records may help to better understand the palaeobiogeographical range of the studied species and the actual diversity of the Early Badenian marine mollusc fauna of the Central Paratethys.

The sedimentary rocks of the studied localities represent the Lower Badenian Pécsszabolcs Member of the Lajta Limestone Formation (KERCSMÁR 2015). Around Márkháza the fossiliferous beds are characterized by clay, clayey sand, tuffaceous sandstone, limestone and andesite conglomerate. The site was mentioned by NOSZKY (1940), later discussed in detail by HEGEDŰS & JANKOVICH

(1972); mollusc assemblages were described by CSEPREGHY-MEZNERICS (1954) and FEHSE & VICIÁN (2008) from different localities of the area. The locality studied herein was first recorded by VICIÁN *et al.* (2017). It consists of several spots of hard greenish clay among andesite blocks in which reworked, 10–50 cm thick fossil-rich layers of sand occur. The characteristic fossils are gastropods and colonial corals, while bivalves are extremely rare. Based on the abundance of gastropod index species *Europrotomus schroeckingeri* (Hörnes), *Tudicla rusticula* (Basterot), *Propustularia neugeboreni* (Hoernes et Auinger), and *Jousseamea diluviana* (Gray), the age of the fossiliferous beds is assigned to the Early Badenian.

Bánd is a well-known Middle Miocene fossiliferous site in the Herend Sub-basin. Rich mollusc assemblages were described by KÓKAY (1966), FEHSE & VICIÁN (2004), DULAI (2005), VICIÁN *et al.* (2017), KOVÁCS (2018, 2020), and KOVÁCS & VICIÁN (2021a). The recently excavated trench is located 250 m south-



**Fig. 1.** The Early Badenian localities mentioned in the text. (P – Pécsszabolcs Member of the Lajta Limestone Formation, X – locality)

east to the village church, and is characterized by clayey sand of 2.5 m thickness; it yielded a large, highly diverse invertebrate macrofauna with diverse colonial coral, brachiopod, and mollusc materials which indicate a patch reef palaeoenvironment.

Letskés is also a famous Early Badenian site; the age, the research history, and the geological background were treated by KOVÁCS & VICIÁN (2014). The locality studied herein is located 400 m eastward to the village, and characterized by resedimented beds of limonitic marly sand with andesite rock fragments, andesitic tuff, and eroded colonial coral blocks. The macrofauna shows a mixture of taxa deriving from shallow to deeper water palaeocommunities.

Badenian Conorbidae and Conidae assemblages of the Central Paratethys were described e.g. by HÖRNES (1851), HOERNES & AUINGER (1879), KOJUMDIEVA (1960), STRAUZ (1966), BAŁUK (1997), CHIRA & VOIA (2001), KOVÁCS & VICIÁN (2014), and KOVÁCS & BALÁZS (2016). The comprehensive revision of the Paratethyan Conorbidae and Conidae was accomplished by HARZHAUSER & LANDAU (2016). In the systematic part of the present paper ten uncommon species are described, all are recorded for the first time in the Middle Miocene of the Pannonian Basin. For detailed distribution of the studied species see HARZHAUSER & LANDAU (2016). A new species, *Monteiroconus strauszi* n. sp. is introduced.

Abbreviations: SL – shell length in mm, MD – maximum diameter in mm, AH – apertural height in mm, SA – spire angle, LA – angle of the last whorl.

## STUDY MATERIAL

Only two Conidae species were recorded by CSEPREGHY-MEZNERICS (1954) from the Márkháza area. The newly collected material contains more than 460 poorly to moderately preserved specimens from which 413 are identified to species level; they represent 29 species (Table 1). The most dominant species is *Kalloconus berghausi*; genera *Kalloconus* and *Conilithes* form approx. 52% in the conoid material. The faunal composition resembles that of the Letskés conoid assemblage (KOVÁCS & VICIÁN 2014), and markedly differs from the fauna of Bánd. New records of four uncommon Central Paratethyan species are here documented: *Kalloconus ponderoaustriacus*, *K. pseudohungaricus*, *Monteiroconus supracompressus*, and *Conus* s.l. *sturi* (see below). The last three are reported for the first time in Hungary. *Monteiroconus strauszi* n. sp. also appears in the assemblage. The gastropod fauna and the abundant colonial corals in the deposits indicate a shallow marine palaeoenvironment.

Four conoid species were recorded by KÓKAY (1966) from Bánd. The newly collected material contains more than 580 moderately to well-preserved specimens from which 570 represent 26 species (Table 1). It is notable that *Lautoconus kovacsi* is the dominant species in the conoid assemblage with 49%.

**Table 1.** Conorbidae and Conidae species of Márkháza and Bánd (Hungary) with numbers of specimens.

Species		Márkháza	Bánd
<i>Artemidiconus granularis</i> (Borson, 1820)		3	12
<i>Conilithes allionii</i> (Michelotti, 1847)		5	0
<i>Conilithes brezinae</i> (Hoernes et Auinger, 1879)		49	5
<i>Kalloconus berghausi</i> (Michelotti, 1847)	Fig. 2	69	2
<i>Kalloconus hendricksi</i> Harzhauser et Landau, 2016	Figs 5–7	34	4
<i>Kalloconus hungaricus</i> (Hoernes et Auinger, 1879)	Figs 8–10	5	27
<i>Kalloconus letkesensis</i> Harzhauser et Landau, 2016	Figs 11–12	38	17
<i>Kalloconus ponderoaustriacus</i> (Sacco, 1893)		1	0
<i>Kalloconus pseudohungaricus</i> Harzhauser et Landau, 2016	Figs 15–16	11	0
<i>Kalloconus tietzei</i> (Hoernes et Auinger, 1879)	Fig. 17	2	4
<i>Kalloconus voeslauensis</i> (Hoernes et Auinger, 1879)	Fig. 18	0	1
<i>Lautoconus eschewegi</i> (Pereira da Costa, 1866)		8	1
<i>Lautoconus kovacsi</i> Harzhauser et Landau, 2016	Figs 19–21	0	277
<i>Lautoconus magnolapugyensis</i> (Sacco, 1893)	Figs 22–25	10	98
<i>Lautoconus miovoeslauensis</i> (Sacco, 1893)	Figs 26–27	0	1
<i>Lautoconus pelagicus</i> (Brocchi, 1814)	Fig. 34	11	3
<i>Lautoconus pestensis</i> Harzhauser et Landau, 2016	Figs 35–36	27	1
<i>Lautoconus quaggaoides</i> Harzhauser et Landau, 2016	Figs 37–38	21	0
<i>Lautoconus ponderosus</i> (Brocchi, 1814)	Figs 39–41	17	9
<i>Lautoconus pseudoponderosus</i> (Glibert, 1952)	Figs 42–43	2	5
<i>Lautoconus</i> cf. <i>rotundus</i> (Hoernes et Auinger, 1879)	Fig. 46	1	13
<i>Lautoconus subraristriatus</i> (Pereira da Costa, 1866)		4	0
<i>Lautoconus</i> cf. <i>steindachneri</i> (Hoernes, 1879)		1	0
<i>Leporiconus paratethyanus</i> Harzhauser et Landau, 2016	Figs 44–45	0	3
<i>Leporiconus suessi</i> (Hoernes et Auinger, 1879)	Figs 47–49	2	27
<i>Monteiroconus supracompessus</i> (Sacco, 1893)	Figs 50–51	2	1
<i>Monteiroconus strauszi</i> n. sp.		1	0
<i>Phasmoconus</i> cf. <i>fuscocingulatus</i> (Hörnes, 1851)		22	0
<i>Phasmoconus schroeckingeri</i> (Hoernes et Auinger, 1879)	Figs 52–53	0	1
<i>Phasmoconus ottiliae</i> (Hoernes et Auinger, 1879)	Figs 54–55	11	3
<i>Pseudonoduloconus austriacus</i> (Hoernes et Auinger, 1879)	Figs 56–57	0	7
<i>Conus</i> s.l. <i>mucronatolaevis</i> Sacco, 1893	Figs 60–63	9	14
<i>Conus</i> s.l. <i>olivaeformis</i> Hoernes et Auinger, 1879		1	0
<i>Conus</i> s.l. <i>sturi</i> Hoernes et Auinger, 1879	Figs 64–65	11	3
<i>Conus</i> s.l. <i>vindobonensis</i> Hoernes et Auinger, 1879	Figs 66–67	35	30

The *Lautoconus kovacsi* specimens agree well with the types (HARZHAUSER & LANDAU 2016, fig. 16E–I) in size, overall morphology, and colour pattern of four broad bands of blotches (visible under UV light), but they are characterized by higher variability in the development of the spire (Figs 19–21). It is the first record of the taxon in Hungary outside Letkés, the type locality. Other abundant taxa are *Kalloconus hungaricus*, *Lautoconus magnolapugyensis*, *Leporiconus suessi*, and *Conus* s.l. *vindobonensis*, all are widespread in the Central Paratethys. The rare occurrence of *Kalloconus berghausi* and *K. hendricksi* is noteworthy as both species are frequent in the northern part of the Pannonian Basin at Márkháza and Letkés. This broad shell group seems to be replaced by a closely allied form in this locality: *Kalloconus hungaricus*. The sporadic appearance of *Conilithes* – that is widespread and abundant in the Pannonian Basin – is also remarkable. On the other hand seven uncommon Central Paratethyan species occur in the material: *Lautoconus magnolapugyensis*, *L. miovoeslauensis*, *Leporiconus paratethyanus*, *Monteiroconus supracompressus*, *Phasmoconus schroeckingeri*, *Pseudonoduloconus austriacus*, and *Conus* s.l. *sturi*; some of them are recorded for the first time in the Hungarian part of the Pannonian Basin (see below).

The Conorbidae and Conidae assemblages of Letkés were described by KOVÁCS & VICIÁN (2014), revised by HARZHAUSER & LANDAU (2016), and completed by VICIÁN *et al.* (2017). New collecting works yielded four species which have previously not been recorded from the locality: *Kalloconus pondero-austriacus*, *Monteiroconus supracompressus*, *Phasmoconus ottiliae*, and *Pseudonoduloconus austriacus*. Three other species are recorded for the first time in the Hungarian part of the Pannonian Basin: *Kalloconus gallicus*, *K. neumayri*, and *Pseudonoduloconus wagneri*. Recently, a new species was mentioned from the site: the *Lautoconus* sp. in KOVÁCS & VICIÁN (2014: 73, fig. 73) was interpreted as a Paratethyan representative of *Conus* (*Lautoconus*) *lauriatragei* Psarras, Merle *et al.* (2022). The rich material allows us to designate another new species in the present paper: *Monteiroconus strauszi* n. sp.

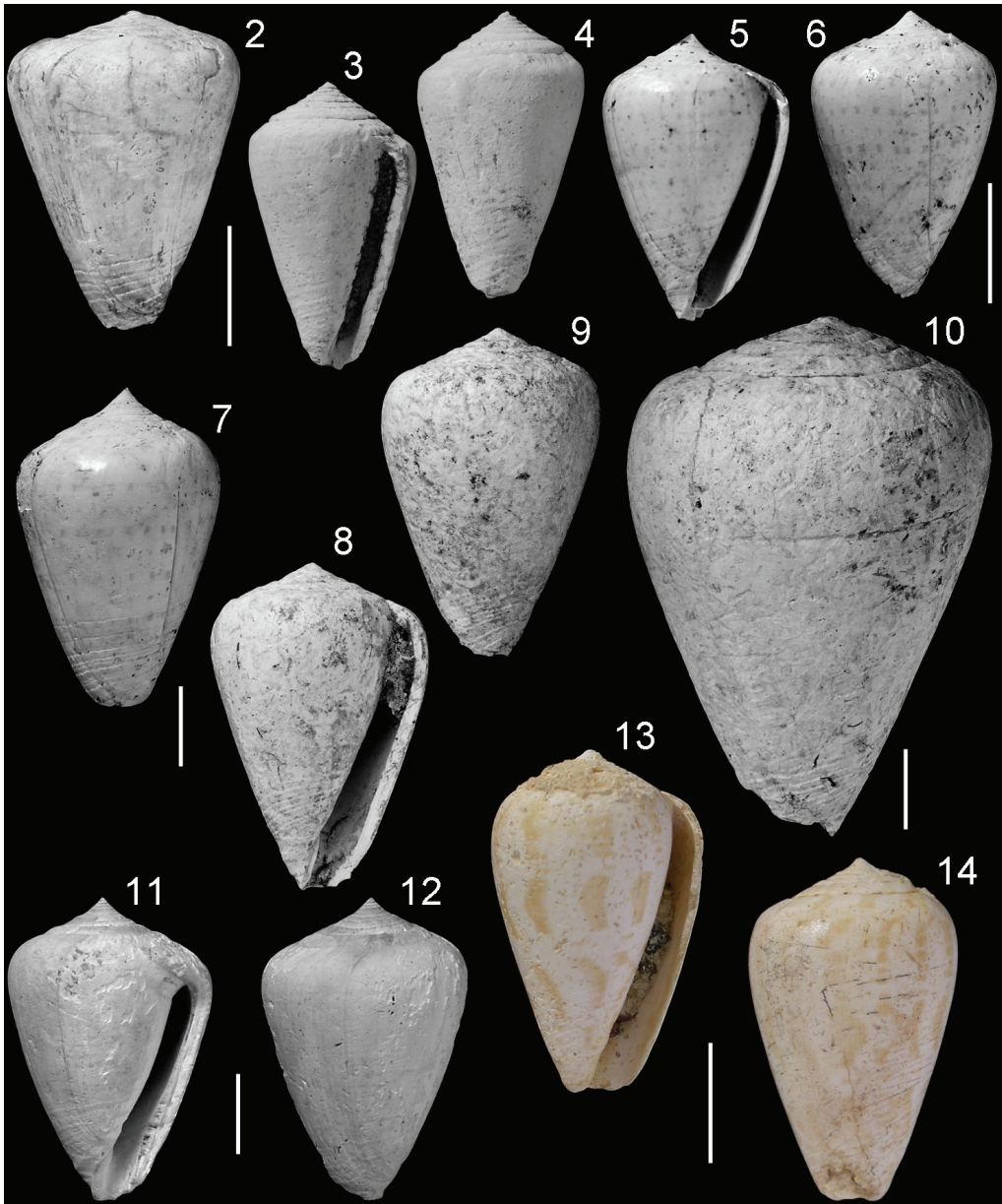
## SYSTEMATIC PALAEOLOGY

Superfamily Conoidea Fleming, 1822

Family Conidae Fleming, 1822

*Remarks* – Although we are aware of the recent discussions around the taxonomy of cone snails (see PULLANDRE *et al.* 2015; LANDAU *et al.* 2020; PSARRAS *et al.* 2022), we follow herein the genus-level classification of HARZHAUSER & LANDAU (2016) for fossil conorbids and conids.

Genus *Kalloconus* da Motta, 1991Type species: *Conus pulcher* Lightfoot, 1786, by original designation*Kalloconus gallicus* (Mayer-Eymar, 1890)  
(Figs 3–4)1890 *Conus gallicus* May.-Eym. – MAYER-EYMAR, p. 295.2016 *Kalloconus gallicus* (Mayer-Eymar) – HARZHAUSER & LANDAU, p. 60, figs 3K, 10A (*cum syn.*).*Material* – Letkés, 1 specimen.*Remarks* – *Kalloconus gallicus* is distinguished from its congeners by moderately low spire with straight outline. The species is a new record in the Pannonian Basin.*Miocene distribution* – Early Miocene: NE Atlantic (France), Proto-Mediterranean Sea (Italy). Middle Miocene: Central Paratethys (Hungary and Romania).*Kalloconus neumayri* (Hoernes et Auinger, 1879)  
(Figs 13–14)1879 *Conus (Lithoconus) Neumayri* – HOERNES & AUINGER, p. 27, pl. 1, figs 17–18.2016 *Kalloconus neumayri* (Hoernes et Auinger) – HARZHAUSER & LANDAU, p. 64, figs 3O, 11C–F.2021 *Conus (Kalloconus) neumayri* Hoernes et Auinger – PSARRAS *et al.*, p. 1322, figs 13–15.*Material* – Letkés, 1 specimen.*Remarks* – The illustrated specimen agrees well in size and morphology with the syntype of *Kalloconus neumayri* (HOERNES & AUINGER 1879, pl. 1, fig. 17, refigured by HARZHAUSER & LANDAU 2016, fig. 11D). The specific colour pattern (spiral rows of large rectangular blotches) is well visible in normal light on the last whorl. Recently, a Tortonian occurrence of the species was recorded from Greece by PSARRAS *et al.* (2021).*Distribution* – Middle Miocene: Central Paratethys (Austria, Hungary, and Romania).*Kalloconus pseudohungaricus* Harzhauser et Landau, 2016  
(Figs 15–16)2016 *Kalloconus pseudohungaricus* nov. sp. – HARZHAUSER & LANDAU, p. 69, figs 3R, 13C–F.*Material* – Márkháza, 11 specimens.*Remarks* – *Kalloconus pseudohungaricus* is closely allied in size and morphology to congeneric species: *K. gallicus* (Mayer-Eymar), *K. moravicus* (Hoernes et Auinger) and *K. tietzei* (Hoernes et Auinger), but it is well distinguishable by the



**Fig. 2.** *Kalloconus berghausi* (Michelotti), Márkháza, SL 27 (1.5×), abapertural view. – **Figs 3–4.** *Kalloconus gallicus* (Mayer-Eymar), Letkés, SL 24 (1.5×), apertural and abapertural views. – **Figs 5–7.** *Kalloconus hendricksi* Harzhauser et Landau, Márkháza. – **Figs 5–6.** SL 24 (1.5×), apertural and abapertural views. – **Fig. 7.** SL 26.5 (1×), abapertural view. – **Figs 8–10.** *Kalloconus hungaricus* (Hoernes et Auinger), Márkháza. – **Figs 8–9.** SL 41 (1×), apertural and abapertural views. – **Fig. 10.** SL 65 (1×), abapertural view. – **Figs 11–12.** *Kalloconus letkesensis* Harzhauser et Landau, Bánd, SL 38 (1×), apertural and abapertural views. – **Figs 13–14.** *Kalloconus neumayri* (Hoernes et Auinger), Letkés, SL 27 (1.6×), apertural and abapertural views. Shell length (SL) in mm. Scale bar: 10 mm

specific colour pattern of spiral rows of small blotches on the last whorl (visible under UV light).

*Distribution* – Middle Miocene: Central Paratethys (Austria, Bosnia, Bulgaria, Croatia, Hungary, and Romania).

Genus *Lautoconus* Monterosato, 1923

Type species: *Conus mediterraneus* Bruguière, 1792, by original designation

*Lautoconus magnolapugyensis* (Sacco, 1893)

(Figs 22–25)

1893 *Conus* (*Chelyconus*) *tauroventricosus*? var. *magnolapugyensis* – SACCO, p. 108 (new name for *Conus ventricosus* in HOERNES & AUINGER 1879, pl. 6, fig. 5).

2016 *Lautoconus magnolapugyensis* (Sacco) – HARZHAUSER & LANDAU, p. 79, figs 17A, 18A–C (*cum syn.*)

*Material* – Márkháza, 10 specimens; Bánd, 98 specimens.

*Remarks* – The specimens are characterized by moderately large shell, striate spire whorls, ventricose last whorl and colour pattern of numerous, densely spaced spirals of small dashes. They are closely allied to the specimen illustrated by HOERNES & AUINGER (1879, pl. 1, fig. 7, pl. 6, fig. 5, refigured by HARZHAUSER & LANDAU 2016, fig. 18A), but they slightly differ from the holotype (HOERNES & AUINGER 1879, pl. 1, fig. 6, refigured by HARZHAUSER & LANDAU 2016, fig. 18B) by a somewhat higher spire. The spire of the studied specimens is similar to that of *Monteiroconus conicomaculatus* (Sacco), but the latter species possesses a different colour pattern.

*Distribution* – Middle Miocene: Central Paratethys (Hungary and Romania).

*Lautoconus miovoeslauensis* (Sacco, 1893)

(Figs 26–27)

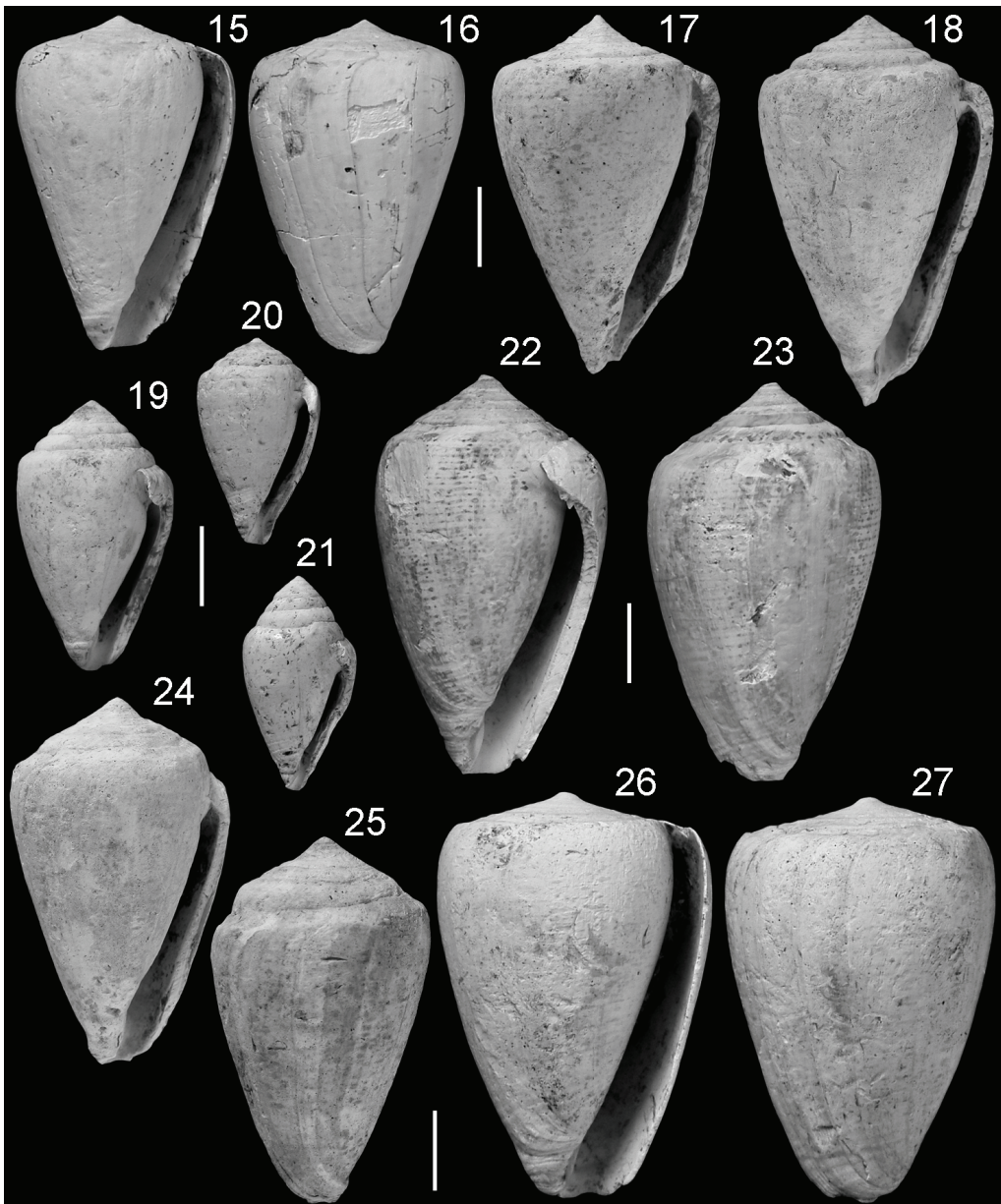
1893 *Conus* (*Chelyconus*) *tauroventricosus* var. *miovoeslauensis* – SACCO, p. 108 (new name for *Conus ventricosus* in HOERNES & AUINGER, 1879, pl. 6, fig. 6).

2016 *Lautoconus miovoeslauensis* (Sacco) – HARZHAUSER & LANDAU, p. 80, figs 17B, 18D–F (*cum syn.*)

*Material* – Bánd, 1 specimen.

*Remarks* – The specimen agrees well in size and morphology with the holotype of *Lautoconus miovoeslauensis* (HOERNES & AUINGER 1879, pl. 6, fig. 6, refigured by HARZHAUSER & LANDAU 2016, fig. 18D). The species differs from *L. magnolapugyensis* in morphology by lower spire and slightly different colour pattern (HARZHAUSER & LANDAU 2016).





**Figs 15–16.** *Kalloconus pseudohungaricus* Harzhauser et Landau, Márkháza, SL 42 (1×), apertural and abapertural views. – **Fig. 17.** *Kalloconus tietzei* (Hoernes et Auinger), Bánd, SL 45 (1×), apertural view. – **Fig. 18.** *Kalloconus voeslauensis* (Hoernes et Auinger), Bánd, SL 49 (1×), apertural view. – **Figs 19–21.** *Lautoconus kovacsi* Harzhauser et Landau, Bánd. – **Fig. 19.** SL 34 (1×), apertural view. – **Fig. 20.** SL 26.5 (1×), apertural view. – **Fig. 21.** SL 27 (1×), apertural view. – **Figs 22–25.** *Lautoconus magnolapugyensis* (Sacco), Bánd. – **Figs 22–23.** SL 50 (1×), apertural and abapertural views. – **Figs 24–25.** SL 46 (1×), apertural and abapertural views. – **Figs 26–27.** *Lautoconus miovoeslauensis* (Sacco), Bánd, SL 51 (1×), apertural and abapertural views. Shell length (SL) in mm. Scale bar: 10 mm

*Distribution* – Middle Miocene: Central Paratethys (Austria, Hungary, Poland, and Romania), Proto-Mediterranean Sea (Türkiye).

Genus *Monteiroconus* da Motta, 1991

Type species: *Conus ambiguus* Reeve, 1844, by original designation

*Monteiroconus strauszi* n. sp.

(Figs 28–33)

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2014 *Lithoconus antiquus* – KOVÁCS & VICIÁN, p. 74, figs 74–76 [non *Monteiroconus antiquus* (Lamarck, 1810)].

	SL	MD	AH	SA	LA
Holotype	58	34	51.5	128	34
Paratype 1	26	14	23.5	128	34
Paratype 2	37	21	27.5	110	38
Paratype 3	55	31.2	50	122	37
Paratype 4	40	22.6	34	128	37

*Holotype* – HNHM PAL 2023.7.1. (Figs 28–29), previously published as *Lithoconus antiquus* (KOVÁCS & VICIÁN 2014, figs 74–75, HNHM INV 2013.247).

*Paratype 1* – HNHM PAL 2023.8.1., previously published as *Lithoconus antiquus* (KOVÁCS & VICIÁN 2014, fig. 76, HNHM INV 2013.239).

*Paratype 2* – PCV.2018.08.01., Coll. Zoltán Vicián, (Fig. 33).

*Paratype 3* – HNHM PAL 2023.3.1. (Fig. 30).

*Paratype 4* – HNHM PAL 2023.4.1. (Figs 31–32).

*Type strata* – Lower Badenian (Middle Miocene) clayey sand (Lajta Limestone Formation).

*Type locality* – Letkés, W Börzsöny Mts, Hungary.

*Derivation of name* – In honour of László Strausz, Hungarian palaeontologist (1901–1988).

*Material* – Holotype, paratypes 1–4; 76 specimens (Letkés) and 1 specimen (Márkháza) in private collections.

*Diagnosis* – *Monteiroconus* species with moderately large shell, low spire, striate spire whorls, rounded shoulder, smooth body whorl, moderately deep, asymmetrically curved subsutural flexure, colour pattern of numerous spirals of subrectangular patches on the last whorl.

*Description* – Moderately large shell (max. SL 69). Low, conical spire, eroded protoconch, slightly convex and striate spire whorls. Rounded shoulder, maximum

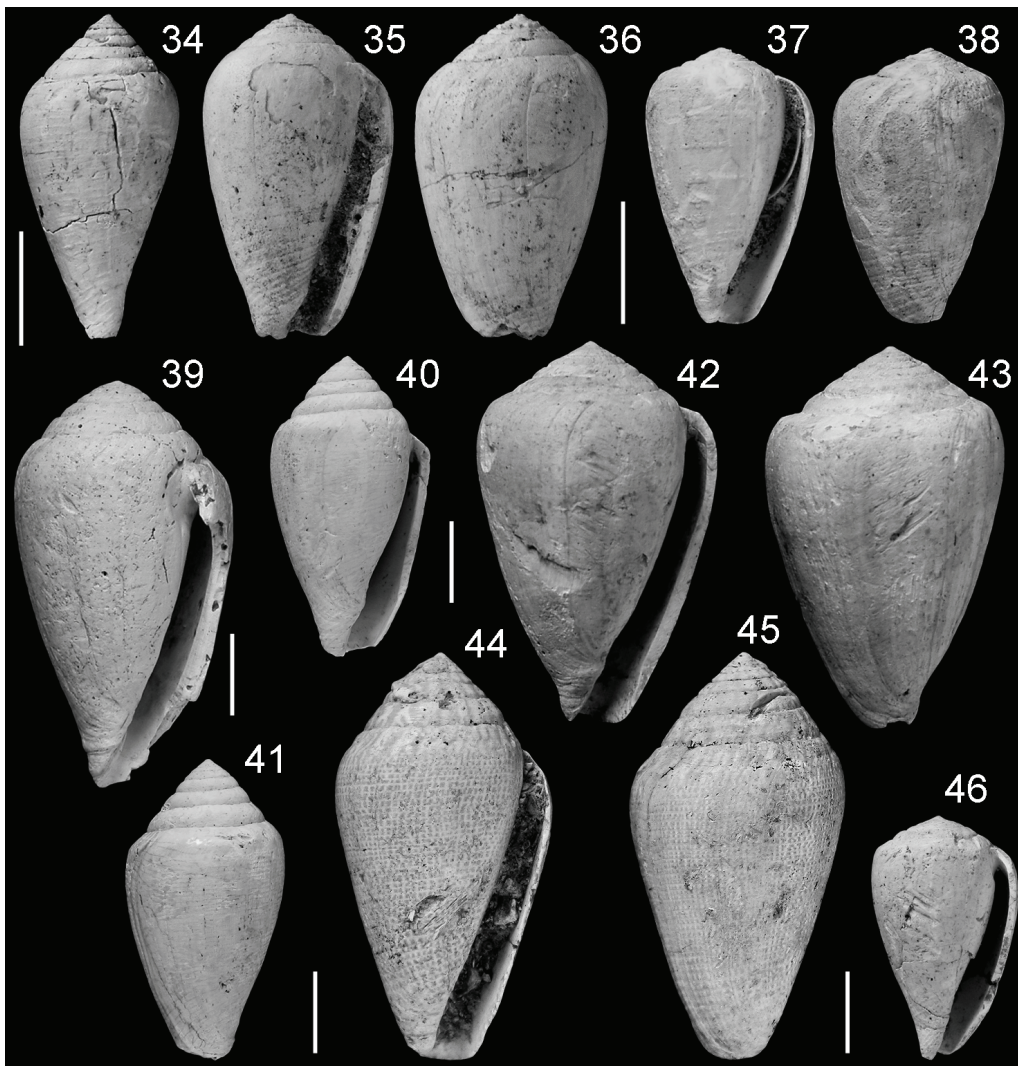
diameter slightly below the shoulder. Elongate, conical last whorl with weak concavity in the middle, widely spaced spiral cords on the lower half. Moderately narrow, anteriorly widening aperture. Moderately deep, asymmetrically curved subsutural flexure. The colour pattern is visible in normal light, it consists of broad and reddish flammulae on later spire whorls and shoulder, and approx. 20 spirals of reddish, subrectangular patches on the last whorl of adult specimens.

*Remarks* – Based on the revised diagnosis of *Monteiroconus* by HARZHAUSER & LANDAU (2016: 102) (moderately large to large, relatively solid shells, wide to moderately wide last whorl, low to almost flat spire, generally striate spire whorls, medium deep to deep, moderately to strongly curved and moderately to strongly asymmetrical subsutural flexure), the new species is assigned to this genus. The size and morphology of *Monteiroconus strauszi* n. sp. are close

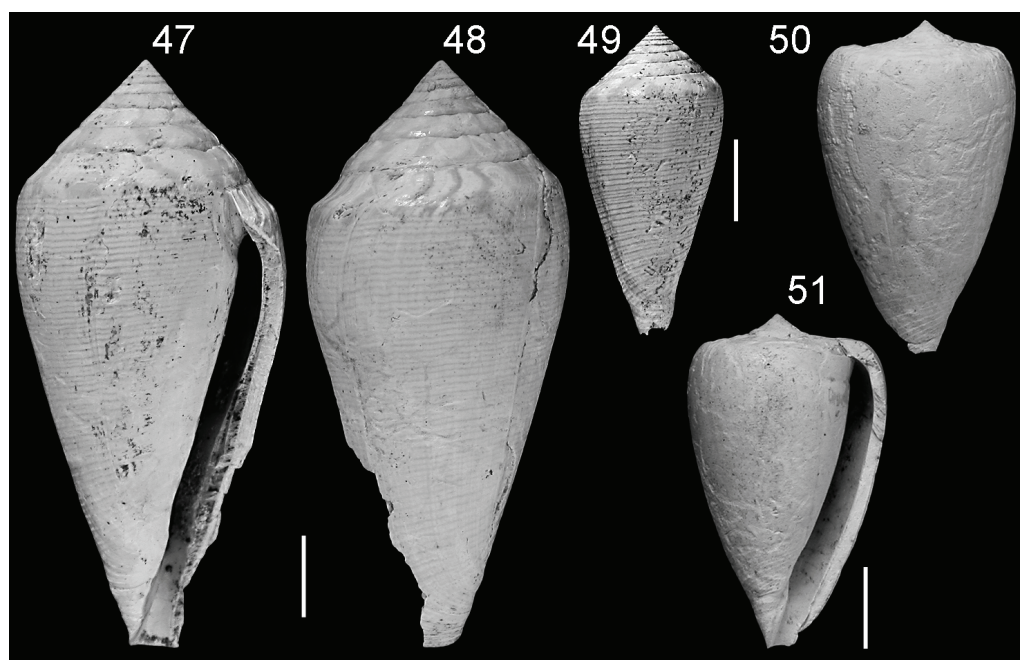


**Figs 28–33.** *Monteiroconus strauszi* n. sp., Letkés. – **Figs 28–29.** Holotype, SL 58 (1×), apertural and abapertural views. – **Fig. 30.** Paratype 3, SL 55 (1×), apertural view. – **Figs 31–32.** Paratype 4, SL 40 (1×), apertural and abapertural views. – **Fig. 33.** Paratype 2, SL 37 (1×), apertural view. Shell length (SL) in mm. Scale bar: 10 mm

to the holotype of *M. parvicaudatus* (SACCO 1893, pl. 3, fig. 25, refigured by FERRERO MORTARA *et al.* 1984, pl. 17, fig. 6) from the Middle Miocene of Italy, but the colour pattern clearly differs as *parvicaudatus* bears numerous densely



**Fig. 34.** *Lautoconus pelagicus* (Brocchi), Márkháza, SL 29 (1.4×), abapertural view. – **Figs 35–36.** *Lautoconus pestensis* Harzhauser et Landau, Márkháza, SL 27 (1.5×), apertural and abapertural views. – **Figs 37–38.** *Lautoconus quaggoides* Harzhauser et Landau, Márkháza, SL 22.5 (1.5×), apertural and abapertural views. – **Figs 39–41.** *Lautoconus ponderosus* (Brocchi), Bánd. – **Fig. 39.** SL 50 (1×), apertural view. – **Figs 40–41.** SL 37 (1×), apertural and abapertural views. – **Figs 42–43.** *Lautoconus pseudoponderosus* (Glibert), Bánd, SL 47 (1×), apertural and abapertural views. – **Figs 44–45.** *Leporiconus paratethyianus* Harzhauser et Landau, Bánd, SL 50 (1×), apertural and abapertural views. – **Fig. 46.** *Lautoconus* cf. *rotundus* (Hoernes et Auinger), Bánd, SL 30 (1×), apertural view. Shell length (SL) in mm. Scale bar: 10 mm



**Figs 47–49.** *Leporiconus suessi* (Hoernes et Auinger), Bánd. – **Figs 47–48.** SL 72 (1×), apertural and abapertural views. – **Fig. 49.** SL 38 (1×), abapertural view. – **Figs 50–51.** *Monteiroconus supracompressus* (Sacco), Márkháza, SL 41 (1×), abapertural and apertural views. Shell length (SL) in mm. Scale bar: 10 mm

spaced spirals of fine dashes. *Monteiroconus hoernesii* (Doderlein) is distinguishable in morphology by shorter shell, and smooth or weakly striate, canaliculate spire whorls (see HARZHAUSER & LANDAU 2016, pl. 26A–C). *Monteiroconus strauszi* n. sp. is characterized by moderate intraspecific variability in the height of spire.

*Monteiroconus supracompressus* (Sacco, 1893)  
(Figs 50–51)

1893 *Conus* (*Lithoconus*) *supracompressa* – SACCO, p. 20 (new name for *Conus mercati* in HÖRNES 1851, pl. 2, fig. 2).

2016 *Monteiroconus supracompressus* (Sacco) – HARZHAUSER & LANDAU, p. 114, figs 17V, 26F–H (*cum syn.*)

*Material* – Márkháza, 2 specimens; Bánd, 1 specimen; Letkés, 3 specimens.

*Remarks* – The specimen figured here with a strongly depressed spire is closely allied in morphology to that illustrated by HARZHAUSER & LANDAU (2016, fig. 26G).

*Distribution* – Middle Miocene: Central Paratethys (Austria, Czechia, and Hungary).

Genus *Phasmoconus* Mörch, 1852

Type species: *Conus radiatus* Gmelin, 1791, by subsequent designation

*Phasmoconus schroeckingeri* (Hoernes et Auinger, 1879)  
(Figs 52–53)

1879 *Conus (Chelyconus) Schroeckingeri* – HOERNES & AUINGER, p. 51, pl. 1, fig. 19.

2016 *Phasmoconus schroeckingeri* (Hoernes et Auinger) – HARZHAUSER & LANDAU, p. 127, figs 29I, 30B.

*Material* – Bánd, 1 specimen.

*Remarks* – The specimen is characterized by small, pyriform shell, low spire with pointed apex, tuberculate early and convex, striate late spire whorls, rounded shoulder, smooth, constricted last whorl with widely spaced spiral cords on the lower half and the base, and colour pattern of broad, reddish blotches on the shoulder and two bands of broad, reddish subquadrate blotches on the last whorl below the shoulder and below the mid-whorl. The morphology corresponds to that of *Phasmoconus schroeckingeri* (Hoernes et Auinger), however, it slightly differs by a somewhat lower spire and colour pattern with the absence of densely spaced, thin spirals. These differences may fit within the variability of the uncommon species which has hitherto been represented by only two specimens in the literature.

*Distribution* – Middle Miocene: Central Paratethys (Hungary and Romania).

Genus *Pseudonoduloconus* Tucker et Tenorio, 2009

Type species: *Conus carnalis* Sowerby III, 1879, by original designation

*Pseudonoduloconus austriacus* (Hoernes et Auinger, 1879)  
(Figs 56–57)

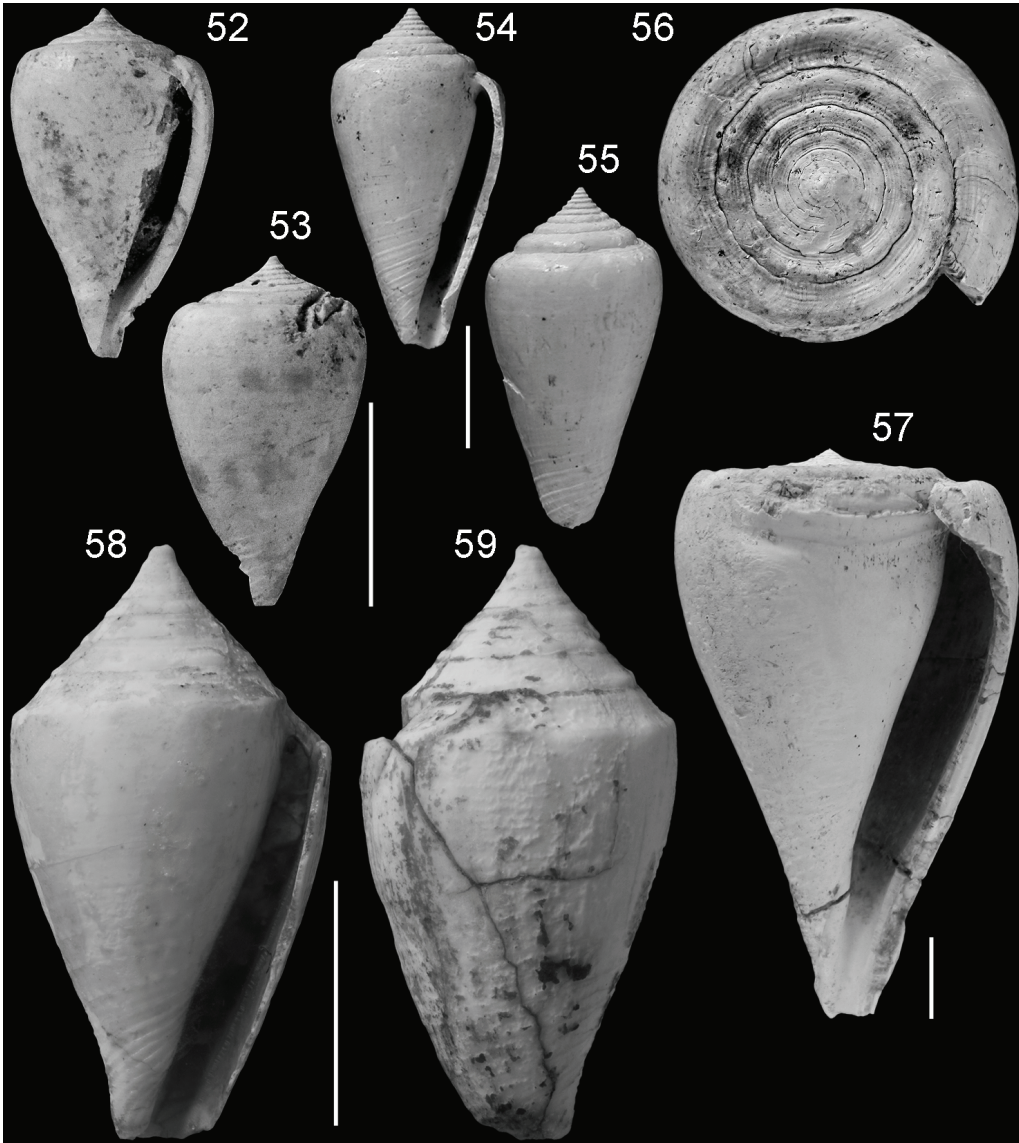
1879 *Conus (Dendroconus) austriacus* – HOERNES & AUINGER, p. 19, pl. 2, figs 2–3.

2016 *Pseudonoduloconus austriacus* (Hoernes et Auinger) – HARZHAUSER & LANDAU, p. 141, figs 30P, 33G–H (*cum syn.*)

*Material* – Bánd, 7 specimens; Letkés, 4 specimens.

*Remarks* – The specimens are characterized by large, pyriform shell and low spire with striate, nodulose spire whorls. The taxonomic revision of the species was accomplished by HARZHAUSER & LANDAU (2016).

*Distribution* – Middle Miocene: Central Paratethys (Austria, Hungary, Poland, and Romania), NE Atlantic (France). Late Miocene: Proto-Mediterranean Sea (?Italy).



**Figs 52–53.** *Phasmoconus schroeckingeri* (Hoernes et Auinger), Bánd, SL 17.5 (2.5×), apertural and abapertural views. – **Figs 54–55.** *Phasmoconus ottiliae* (Hoernes et Auinger), Bánd, SL 28.5 (1.5×), apertural and abapertural views. – **Figs 56–57.** *Pseudonoduloconus austriacus* (Hoernes et Auinger), Bánd, SL 70 (1×), apical and apertural views. – **Figs 58–59.** *Pseudonoduloconus wagneri* (Boettger), Letkés, 12.2 (6×), apertural and abapertural views. Shell length (SL) in mm. Scale bars: 52–57: 10 mm; 58–59: 5 mm

*Pseudonoduloconus wagneri* (Boettger, 1902)  
(Figs 58–59)

1902 *Conus* (*Stephanoconus*) *wagneri* n. sp. – BOETTGER, p. 7.

1934 *Conus* (*Stephanoconus*) *wagneri* Boettger – ZILCH, p. 276, pl. 22, figs 9a–b.

2016 *Pseudonoduloconus wagneri* (Boettger) – HARZHAUSER & LANDAU, p. 143, fig. 33I.

*Material* – Letkés, 1 specimen.

*Remarks* – Only the holotype of *Pseudonoduloconus wagneri* has hitherto been known. The size and morphology of the specimen illustrated here correspond to the revised description by HARZHAUSER & LANDAU (2016), however, one difference in the sculpture must be noted. The convex part of the last whorl is covered by four fine spiral cords on the upper half and four rows of small beads on the lower half.

*Distribution* – Middle Miocene: Central Paratethys (Hungary and Romania).

*Conus* sensu lato (see HARZHAUSER & LANDAU 2016: 144)

*Conus* s.l. *sturi* Hoernes et Auinger, 1879  
(Figs 64–65)

1879 *Conus* (*Chelyconus*) *Sturi* – HOERNES & AUINGER, p. 41, pl. 5, figs 9–10.

2016 *Conus* s.l. *sturi* Hoernes et Auinger – HARZHAUSER & LANDAU, p. 148, figs 30N, 34G–H  
(*cum syn.*)

*Material* – Márkháza, 11 specimens; Bánd, 3 specimens.

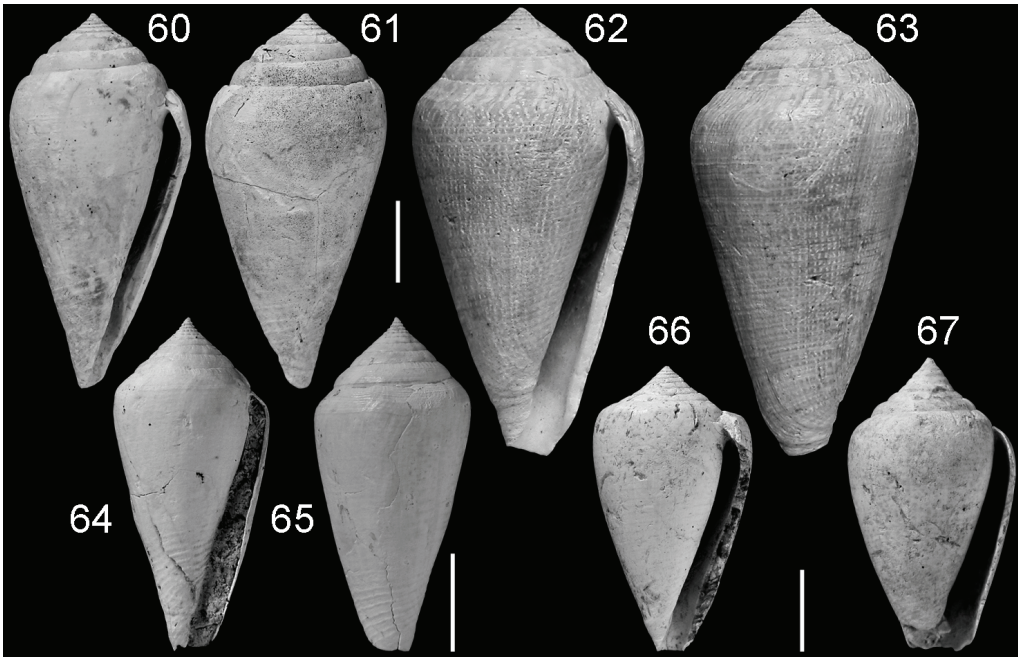
*Remarks* – The specimens are characterized by tuberculate and striate spire whorls and spiral sculpture of widely spaced cords on the last whorl. This morphology agrees well with the *Conus* s.l. *sturi* examples illustrated in the literature.

*Distribution* – Middle Miocene: Central Paratethys (?Bulgaria, Hungary, and Romania).

## CONCLUSION

New collecting works in Early Badenian localities of Márkháza, Bánd and Letkés (Hungary) yielded highly diverse gastropod assemblages from which the Conorbidae and Conidae material is recorded in this paper. Ten species are new records, others show extended palaeogeographical distribution in the Hungarian part of the Pannonian Basin. A single shell of the extremely rare Paratethyan species *Pseudonoduloconus wagneri* (Boettger) found at Letkés represents the first evidence from the Pannonian Basin and the second occurrence in the Central





**Figs 60–63.** *Conus* s.l. *mucronatolaevis* (Sacco), Báánd. – **Figs 60–61.** SL 46 (1×), apertural and abapertural views. – **Figs 62–63.** SL 55 (1×), apertural and abapertural views. – **Figs 64–65.** *Conus* s.l. *sturi* (Hoernes et Auinger), Márkháza, SL 34 (1.2×), apertural and abapertural views. – **Figs 66–67.** *Conus* s.l. *vindobonensis* (Hoernes et Auinger), Báánd. – **Fig. 66.** SL 35 (1×), apertural view. – **Fig. 67.** SL 36 (1×), apertural view. Shell length (SL) in mm. Scale bar: 10 mm

Paratethys. On the basis of the rich material a new species, *Monteiroconus strauszi* n. sp. is described from Letkés and Márkháza.

The Conoidea is characterized by a very high diversity in the Early Badenian Central Paratethys (KOVÁCS & VICIÁN 2021b). The superfamily has a strong thermophilic character; its acme was the result of immigration of thermophilic molluscs from the Mediterranean during the Mid-Miocene Climate Optimum. On the basis of new field works, similar – previously not recognized – high diversity can be observed in the Risssooidea, Muricidae, Buccinoidea, Tonnoidea, Ficoidea, and Cypraeoidea assemblages of the Central Paratethys.

\*

*Acknowledgements* – We are indebted to Alfréd Dulai (HNHM, Budapest) for his professional help. Constructive reviews by Radoslav Biskupič (Slovakia) helped to improve the manuscript. Fossil collector Tamás Németh (Balatonkenese, Hungary) kindly offered his private collections for study. We also thank Olga Piros and Tímea Szlepák for their library assistance. Domonkos Verestói-Kovács (Budapest) contributed to the illustration work.

## REFERENCES

- BAŁUK W. 1997: Middle Miocene (Badenian) gastropods from Korytnica, Poland; Part III. – *Acta Geologica Polonica* **47**(1–2): 3–75.
- BOETTGER O. 1897–1907: Zur Kenntnis der Fauna der mittelmiozänen Schichten von Kostež im Krassó-Szörényer Komitat. – *Verhandlungen und Mitteilungen des siebenbürgischen Vereins für Naturwissenschaften zu Hermannstadt* 1897: **46**(1896): 49–66; 1902: **51**(1901): 1–200; 1906: **54**(1904): 1–99; 1907: **55**(1905): 101–244.
- CHIRA C. & VOIA I. 2001: Middle Miocene (Badenian) Conidae from Lăpușiu de Sus, Romania: systematical and palaeoecological data. – *Studia Universitatis Babeş-Bolyai, Geologia* **46**(2): 151–160.
- CSEPREGHY-MEZNERICS I. 1954: A keletcserháti helvétai és tortónai fauna. (Helvetische und Tortonische fauna aus dem Östlichen Cserhátgebirge.) – *Jahrbuch der Ungarischen Geologischen Anstalt* **41**(4): 1–185.
- DULAI A. 2005: Badenian (Middle Miocene) Polyplacophora from the Central Paratethys (Bánd and Devecser, Bakony Mountains, Hungary). – *Fragmenta Palaeontologica Hungarica* **23**: 29–49.
- FEHSE D. & VICIÁN Z. 2004: A new *Zonarina* (Mollusca: Gastropoda: Cypraeidae) from the middle Miocene (Badenian) of Hungary. – *Földtani Közlöny* **134**(2): 201–208.
- FEHSE D. & VICIÁN Z. 2008: On the identity of *Projenneria neumayri* (HILBER, 1879) with the description of a new species of the genus *Projenneria* DOLIN, 1997 from the Badenian of the Central Paratethys (Mollusca: Gastropoda: Cypraeoidea). – *Földtani Közlöny* **138**(4): 357–362.
- FERRERO MORTARA E., MONTEFAMEGLIO L., NOVELLI M., OPESSE G., PAVIA G. & TAMPIERI R. 1984: *Catalogo dei tipi e degli esemplari figurati della collezione Bellardi e Sacco. Parte II.* – Museo Regionale di Scienze Naturali, Torino, 484 pp.
- HARZHAUSER M. & LANDAU B. 2016: A revision of the Neogene Conidae and Conorbidae (Gastropoda) of the Paratethys Sea. – *Zootaxa* **4210**(1): 1–178.  
<https://doi.org/10.11646/zootaxa.4210.1.1>
- HEGEDŰS GY. & JANKOVICH I. 1972: Badenien korallzátony Márkházáról. (Récif corallien du Badénien a Márkháza.) – *Jahresbericht der Ungarischen Geologischen Anstalt für 1970*: 39–53. (in Hungarian with French abstract)
- HOERNES R. & AUINGER M. 1879: Die Gasteropoden der Meeres-Ablagerungen der ersten und zweiten Miozänen Mediterran-Stufe in der Österreichisch-Ungarischen Monarchie. – *Abhandlungen der Kaiserlich-Königlichen Geologischen Reichsanstalt* **12**: 1–52, pls 1–6.
- HÖRNES M. 1851: Die fossilen Mollusken des Tertiär-Beckens von Wien. – *Abhandlungen der Kaiserlich-Königlichen Geologischen Reichsanstalt* **3**: 1–42, pls 1–5.
- KERCSMÁR Zs. (ed.) 2015: *Surface geology of Hungary.* – Geological and Geophysical Institute of Hungary, Budapest, 66 pp.
- KOJUMDGIEVA E. 1960: Le Tortonien du type viennois. – In: KOJUMDGIEVA E. & STRACHIMIROV B. 1960: *Les fossiles de Bulgarie, VII, Tortonien*, 1–246, Academie des Sciences de Bulgarie, Sofia, 317 pp.
- KÓKAY J. 1966: Geologische und paläontologische Untersuchung des Braunkohlengebietes von Herend – Márkó (Bakony-Gebirge, Ungarn). – *Geologica Hungarica, Series Palaeontologica* **36**: 1–147.
- KOVÁCS Z. 2018: New records of the genus *Euthria* (Mollusca, Buccinidae) in the Miocene Paratethys. – *Földtani Közlöny* **148**(2): 179–182.

- KOVÁCS Z. 2020: New Muricidae (Neogastropoda) faunas from the Middle Miocene of Hungary. – *Földtani Közlöny* **150**(3): 449–468. <https://doi.org/10.23928/foldt.kozl.2020.150.3.449>
- KOVÁCS Z. & BALÁZS P. 2016: Conidae (Neogastropoda) assemblage from the Middle Miocene of the Făget Basin (Romania) in the collection of the Hungarian Natural History Museum, Budapest. – *Fragmenta Palaeontologica Hungarica* **32**(2015): 11–48.
- KOVÁCS Z. & VICIÁN Z. 2014: Badenian (Middle Miocene) Conoidea (Neogastropoda) fauna from Letkés (N Hungary). – *Fragmenta Palaeontologica Hungarica* **30**(2013): 53–100.
- KOVÁCS Z. & VICIÁN Z. 2021a: New Cancellariidae (Neogastropoda) assemblages from the Middle Miocene of Hungary with description of a new species. – *Central European Geology* **64**(2): 59–73. <https://doi.org/10.1556/24.2020.00006>
- KOVÁCS Z. & VICIÁN Z. 2021b: Conoidea (Neogastropoda) assemblage from the Lower Badenian (Middle Miocene) deposits of Letkés (Hungary), Part II. (Borsoniidae, Cochlespiridae, Clavatulidae, Turridae, Fusiturridae). – *Földtani Közlöny* **151**(2): 137–158. <https://doi.org/10.23928/foldt.kozl.2021.151.2.137>
- LANDAU B. M., VAN DINGENEN F. & CEULEMANS L. 2020: The upper Miocene gastropods of northwestern France, 5. Conoidea. – *Cainozoic Research* **20**(1): 3–107.
- MAYER-EYMAR C. 1890: Diagnoses specierum novarum ex agris mollassicis seu neogenis, in Museo Turicensi conservatarum. – *Naturforschenden Gesellschaft, Zürich. Vierteljahrschrift* **35**: 290–301.
- NOSZKY J. 1940: A Cserhát-hegység földtani viszonyai. (Die Geologie des Cserhát-Gebirges.) – *Geologische Beschreibung Ungarischer Landschaften* **3**: 1–178, (179–283).
- PSARRAS C., KOSKERIDOU E. & MERLE D. 2021: Late Miocene Conidae (Mollusca: Gastropoda) of Crete (Greece). Part 1: genera *Conilithes* Swainson, 1840 and *Conus* (*Kalloconus*) da Motta, 1991. – *Geodiversitas* **43**(24): 1309–1339. <https://doi.org/10.5252/geodiversitas2021v43a24>
- PSARRAS C., MERLE D. & KOSKERIDOU E. 2022: Late Miocene Conidae (Mollusca: Gastropoda) of Crete (Greece). Part 2. – *European Journal of Taxonomy* **816**: 1–70. <https://doi.org/10.5852/ejt.2022.816.1747>
- PULLANDRE N., DUDA T. F., MEYER C., OLIVERA B. M. & BOUCHET P. 2015: One, four or 100 genera? A new classification of the cone snails. – *Journal of Molluscan Studies* **81**(1): 1–23. <https://doi.org/10.1093/mollus/eyu055>
- SACCO F. 1893: I molluschi dei terreni terziarii del Piemonte e della Liguria, Parte 13. – *Memorie della Reale Accademia delle scienze di Torino*, ser. 2, **44**, Fasc. 1 (Conidae): 1–54, Fasc. 2 (Conidae e Conorbidae): 55–143.
- STRAUSZ L. 1966: *Die miozän-mediterranen Gastropoden Ungarns*. – Budapest, Akadémiai Kiadó, 692 pp.
- VICIÁN Z., KROCK H. & KOVÁCS Z. 2017: New gastropod records from the Cenozoic of Hungary. – *Földtani Közlöny* **147**(3): 265–282. <https://doi.org/10.23928/foldt.kozl.2017.147.3.265>
- ZILCH A. 1934: Zur Fauna des Mittel-Miocäns von Kostej (Banat); Typus Bestimmung und Tafeln zu O. Boettger's Bearbeitungen. – *Senckenbergiana* **16**(1): 193–302.