Description of a new *Turritellinella* (Caenogastropoda: Turritellidae) from the Middle Miocene of the Central Paratethys Sea

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A new Paratethyan turritellid gastropod species, *Turritellinella devinensis* spec. nov., is described from the Upper Badenian (Middle Miocene) marine deposits of the Studienka Formation, Vienna Basin, Slovakia. The shells were found at the fossil-bearing locality near Rohožník and in several localities situated in the vicinity of Devín (borough of Bratislava) situated on the southern slope of the Devínska Kobyla Hill. *T. devinensis* spec. nov. is discussed and compared with other morphologically similar species. The habitat of the Badenian populations from the eastern margin of the Vienna Basin is specified and compared with the ecological conditions of extant *T. tricarinata* in present-day European seas.

Key words: Gastropoda, Turritellidae, *Turritellinella*, paleoecology, Miocene, Badenian, Vienna Basin, Central Paratethys

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INTRODUCTION

The genus *Turritellinella* Harzhauser & Landau, 2019 is a species-poor turritellid genus involving only two valid species (Harzhauser & Landau, 2019). The type species *Turritellinella tricarinata* (Brocchi, 1814) is among a few gastropod taxa with an origin in the Miocene and still surviving in modern seas. This turritellid was widespread during the Miocene to Pleistocene in the Mediterranean Sea and Atlantic (e.g., Landau et al., 2004; Harzhauser & Landau, 2019). From present-day seas, it is recorded from the Mediterranean Sea, Black Sea, Eastern Atlantic and North Africa (e.g., Poppe & Goto, 1991; Landau et al., 2004; Büyükmeriç et al., 2018; Harzhauser & Landau, 2019). The second representative, *T. subuliformis* (O. Boettger, 1907), is known from the Badenian (Middle Miocene) of the Central Paratethys Sea exclusively (e.g., Boettger, 1907; Zilch, 1934; Bałuk, 1975; Harzhauser & Landau, 2019). Until recently, both species were traditionally assigned to the genus *Turritella* Lamarck, 1799. Harzhauser & Landau (2019) established the genus *Turritellinella* for these two taxa, which is based on specific morphological features of the shell.

The finds of the here newly described *Turritellinella devinensis* spec. nov. were already mentioned in the papers of Švagrovský (1981) and Hyžný et al. (2012), but were ascribed to other turritellid species.

LOCALITIES

Konopiská

The palaeontological locality Konopiská (Fig. 1) comprises an area of the former clay pit and its vicinity, which is located in the eastern margin of the Vienna Basin, nearby the village of Rohožník (48°26'39"N, 17°09'53"E). The Upper Badenian and Lower Sarmatian (Middle Miocene) marine sediments are exposed in the pit (e.g., Fordinál et al., 2012, 2013; Biskupič, 2020, 2021). The studied Upper Badenian (Early Serravallian) strata of the Studienka Formation are largely made of massive calcareous clays (Fig. 2), with sporadic finger-like layers and interlayers of the shallow-water coarse-grained marginal facies of the Sandberg Member (e.g., Baráth et al., 1994; Hladilová et al., 1998; Lambert et al., 2008; Biskupič, 2020). The latter are comprised of sands, sands with gravels, sandy clays, and carbonate organodetritic marls and limestones (Biskupič, 2020). The Upper Badenian strata involve species-rich associations of marine invertebrate and vertebrate faunas (e.g., Čierna, 1973; Holec, 1973, 1975; Kučerová, 1986; Lambert et al., 2008; Hyžný & Gašparič, 2014; Biskupič, 2017; Sabol et al., 2021). The molluscs turned out to be the most diversified group and have often been the subject of paleontological investigations (e.g., Meszároš, 1986; Hladilová, 1991; Pek et al. 1997; Fuksi et al., 2011; Fuksi 2015a, 2015b; Ruman & Hudáčková, 2015; Biskupič, 2021). An

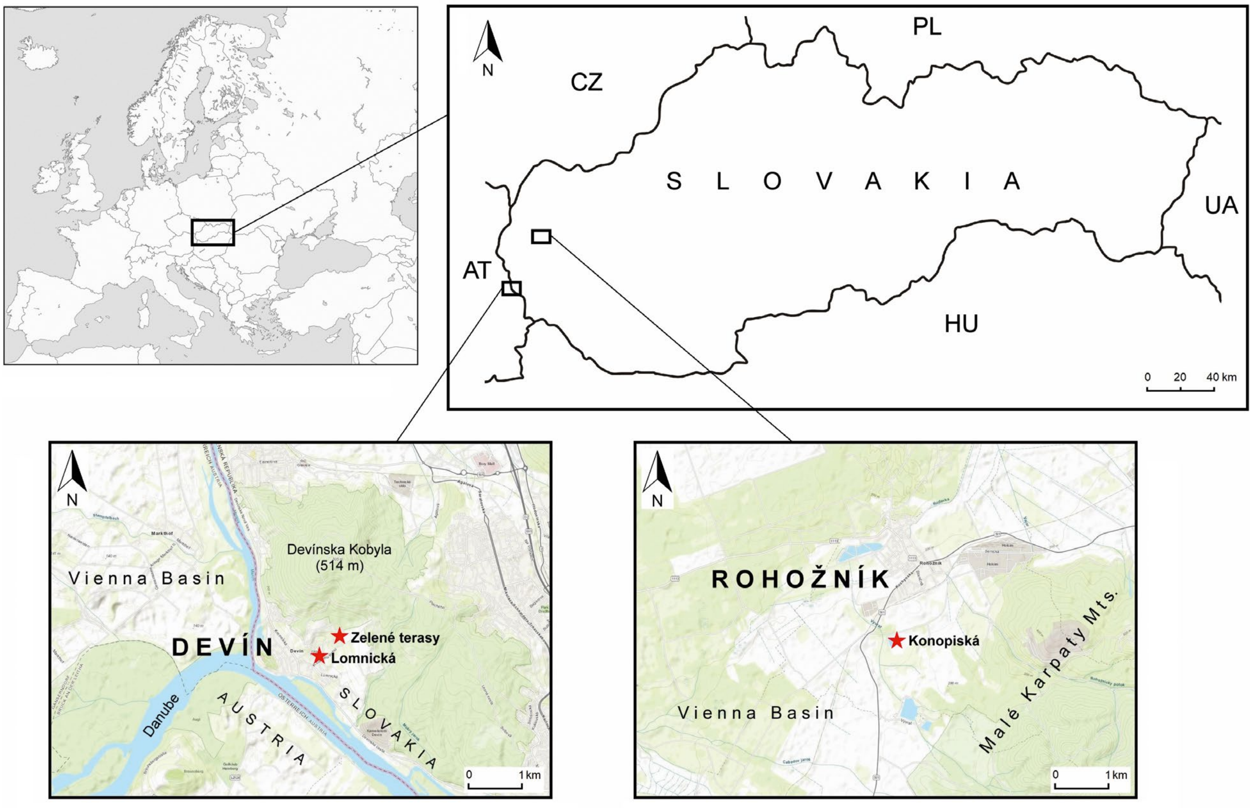

Fig. 1. Geographical position of the studied localities.

overview of early research, lithology, and a brief description of faunistic assemblages of the locality can be found in Biskupič (2020). The shells of *Turritellinella devinensis* spec. nov. were obtained from grey calcareous clays with bioturbation and brownish-yellow to greyish yellow clays.

Zelené terasy

The site is located in the eastern part of Devín (borough of Bratislava) (Fig. 1), at the junction of the eastern margin of the Vienna Basin and the southern edge of the Malé Karpaty Mountains (48°10'38"N, 16°59'50"E). The locality was initially an abandoned vineyard covering the southern slope of the Devínska Kobyla Hill (514 m) and was discovered during excavation works in 2012 when constructing the large residential complex named "Devín – Zelené terasy". Many extensive outcrops in the building yard revealed Badenian marine sediments. The age of these deposits was deduced from the associated biostratigraphic significant molluscan taxa, such as *Flabellipecten besseri* (Andrzejowski, 1830), *Pecten aduncus* Eichwald, 1830, *Pseudamussium lilli* (Pusch, 1837), *Acanthocardia turonica* (Hörnes, 1861) and *Archimediella carpathica* Harzhauser & Landau, 2019 that typically occurred in the Central Paratethys during the Badenian. In addition, respective facies have been lithologically correlated with adjacent localities of Lomnická, Terasy, Štítová and Glosusová lavica, corresponding to the Upper Badenian stage (see Hyžný et al. 2012). Heavy-bedded grey- to brown-yellow clays, fine aleuritic sands and sandy marls with massive concretions, fine-grained pale sands, and also the sporadic lens-like bodies and interlayers of corallinacean limestones were exposed at Zelené terasy and belongs to the Upper Badenian Studienka Formation. These fossiliferous strata yielded a wide spectrum of marine organisms, and were particularly rich in gastropods, bivalves, scaphopods, polychaetes, bryozoans, and rare echinoids. *T. devinensis* spec. nov. occurs in heavy-bedded grey- to brown-yellow clays, and fine aleuritic sands and sandy marls.

Lomnická

The locality is situated in the eastern margin of Devín (48°10'43"N, 16°59'46"E), which is in the southern slope of the Devínska Kobyla Hill (Fig. 1). The site was discovered during extensive excavation works in 2000, regarding the construction of a large residential complex. Many temporary outcrops were made there, that revealed the Upper Badenian clays of the Studienka Formation and several transitional facies of the Sandberg Member (Hyžný et al. 2012). The lithology and faunistic composition is very similar to that of the adjacent locality Zelené terasy. The complex of

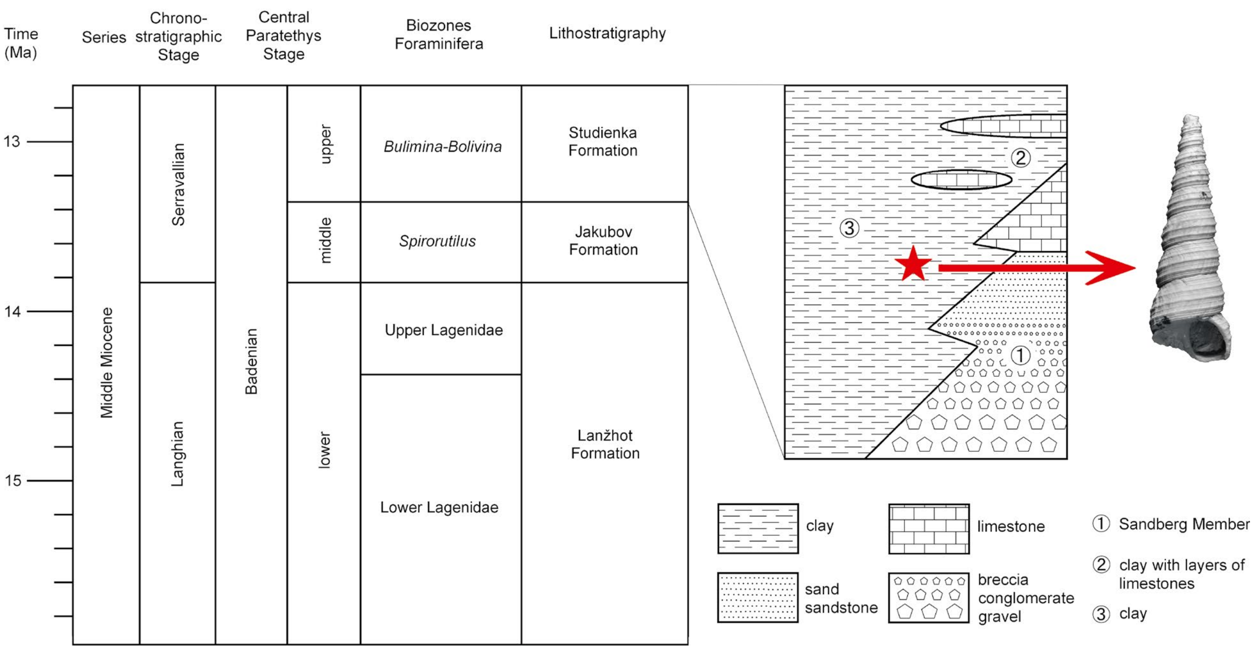

Fig. 2. The Middle Miocene (Badenian) chronostratigraphic and biostratigraphic zonation and lithostratigraphic units of the Vienna Basin (modified from Harzhauser et al., 2018), and lithology and lithostratigraphy of the Upper Badenian Studienka Formation where *Turritellinella devinensis* spec. nov. was found (modified from Fordinál et al., 2012).

strata is composed of heavy-bedded grey and green-yellow clays, fine aleuritic sands and sandy marls with massive concretions, brown- to grey-yellow fine-grained aleuritic sands and sandy marls, discontinuous intercalations of corallinacean limestones and breccias. The marine fauna is characterized mainly by abundant gastropods, bivalves, scaphopods, bryozoans, serpulid polychaetes, echinoids, decapods, chondrichthyans and bony fishes. More data about the lithology, stratigraphy and marine faunas, including a list of taxa, offers the paper of Hyžný et al. (2012). *T. devinensis* spec. nov. was found in heavy-bedded grey- to brown-yellow clays, and fine aleuritic sands and sandy marls.

"Northwest of Devín – Terasy" and "east of Devín"

Both sites and their molluscan assemblages were studied by Švagrovský (1981). According to him, the locality "northwest of Devín – Terasy" lies on the eastern border of Devín, on the southern slope of Devínska Kobyla, northwest of the neighbouring locality Devín – Terasy, and represents an outcrop in the vineyard. The second locality, "east of Devín", is composed of several small outcrops situated on the southern mountainside of the Devínska Kobyla Hill. However, the exact locations (GPS coordinates) and current status of these sites are unknown (they are probably abandoned or no longer exist). The exposed Upper Badenian grey to yellow-brown pelitic sediments and intercalations of fine-grained aleuritic sands and sandy marls included abundant gastropod and bivalve faunas (Švagrovský, 1981).

MATERIAL AND METHODS

The studied material includes 69 specimens and is mainly composed of moderately to poorly preserved individuals. Only a single shell with the first teleoconch whorl is available in the examined material; unfortunately, the protoconch is incomplete and broken. The specimens were collected from the paleontological sites in Rohožník (Konopiská) and Devín (Lomnická, Zelené terasy) during field work of the author in 1994-2018. The turritellids housed in the collection of the Natural History Museum of Slovak National Museum, Bratislava (Slovakia) (SNM-PM), originally studied and illustrated in the monograph of Švagrovský (1981), were also examined. The herein discussed conchological material is stored in the collection of SNM-PM.

Terminology of shell morphology, morphometric dimensions, measurements, and ratios used here are borrowed from Harzhauser & Landau (2019). Morphometric abbreviations are as follows: SL = shell length, MD = maximum diameter, PA = pleural angle, AA= apical angle, LSangle = lateral sinus angle, LSP = lateral sinus position, LSd = lateral sinus depth, n = number, μ = mean, σ = standard deviation.

SYSTEMATICS

Higher classification follows Bouchet et al. (2017); the taxonomic concept of turritellids follows Harzhauser & Landau (2019).

Class Gastropoda Cuvier, 1795
Subclass Caenogastropoda Cox, 1960
Superfamily Cerithioidea Fleming, 1822
Family Turritellidae Lovén, 1847
Subfamily Turritellinae Lovén, 1847

Genus *Turritellinella* Harzhauser & Landau, 2019

Type species (by original designation): *Turbo tricarinatus* Brocchi, 1814, Pliocene, Italy, Proto-Mediterranean.

Turritellinella devinensis spec. nov.

Figs 3-20
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Turritella (*Haustator*) *partschi quadricarinata* – Švagrovský, 1981: 127 (pars, non pl. 40, fig. 3 = *Ptychidia partschi* (Rolle, 1856)).
Turritella (*Archimediella*) *pythagoraica* – Švagrovský, 1981: 128, pl. 40 figs 1-2.

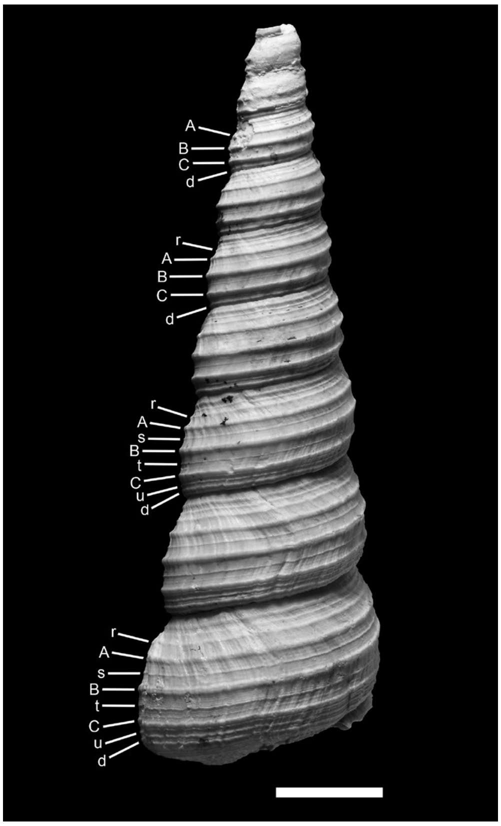


Fig. 3. Notation of spiral cords in *Turritellinella devinensis* spec. nov.: A, B, C, d = primary spiral cords, r, s, t, u = secondary spiral cords. Holotype, SNM-PM Z40242, Zelené terasy. Scale bar = 5 mm.

Material. — Konopiská: 42 specimens; Lomnická: 3 specimens; Zelené terasy: 19 specimens; "northwest of Devín – Terasy" (sensu Švagrovský, 1981): 3 specimens; "east of Devín" (sensu Švagrovský, 1981): 2 specimens.

Type material and dimensions. — Holotype: SNM-PM Z40242, Zelené terasy, SL: 33.10 mm, MD: 10.40 mm (Figs 4a-4b); Paratype 1: SNM-PM Z40243, Konopiská (clay pit), SL: 32.10 mm, MD: 11.10 mm (Figs 5a-5b); Paratype 2: SNM-PM Z40244, Zelené terasy, SL: 24.60 mm, MD: 8.40 mm (Figs 6a-6b).

Additional illustrated material and dimensions. — SNM-PM Z40245, Zelené terasy, SL: 17.40 mm, MD: 5.60 mm (Figs 7a-7b); SNM-PM Z40246, Zelené terasy, SL: 18.30 mm, MD: 7.20 mm (Figs 8a-8b); SNM-PM Z40247, Konopiská (clay pit), SL: 18.35 mm, MD: 5.60 mm (Figs 9a-9b); SNM-PM Z40248, Konopiská (clay pit), SL: 9.30 mm, MD: 3.15 mm (Fig. 10); SNM-PM Z17716, "northwest of Devín – Terasy", SL: 20.70 mm, MD: 7.70 mm (Figs 11a-11b); SNM-PM Z17404, "northwest of Devín – Terasy" (illustrated as *Turritella* (*Archimediella*) *pythagoraica* Hilber, 1882 in Švagrovský 1981, pl. 40, fig. 2), SL: 29 mm, MD: 10 mm (Figs 12a-12b); SNM-PM Z17530, "northwest of Devín – Terasy" (illustrated as *Turritella* (*Archimediella*) *pythagoraica* Hilber, 1882 in Švagrovský 1981, pl. 40, fig. 1), SL: 27 mm, MD: 10 mm (Figs 13a-13b); SNM-PM Z40259, Zelené terasy, SL: 40.20 mm, MD: 10.10 mm (Fig. 14).

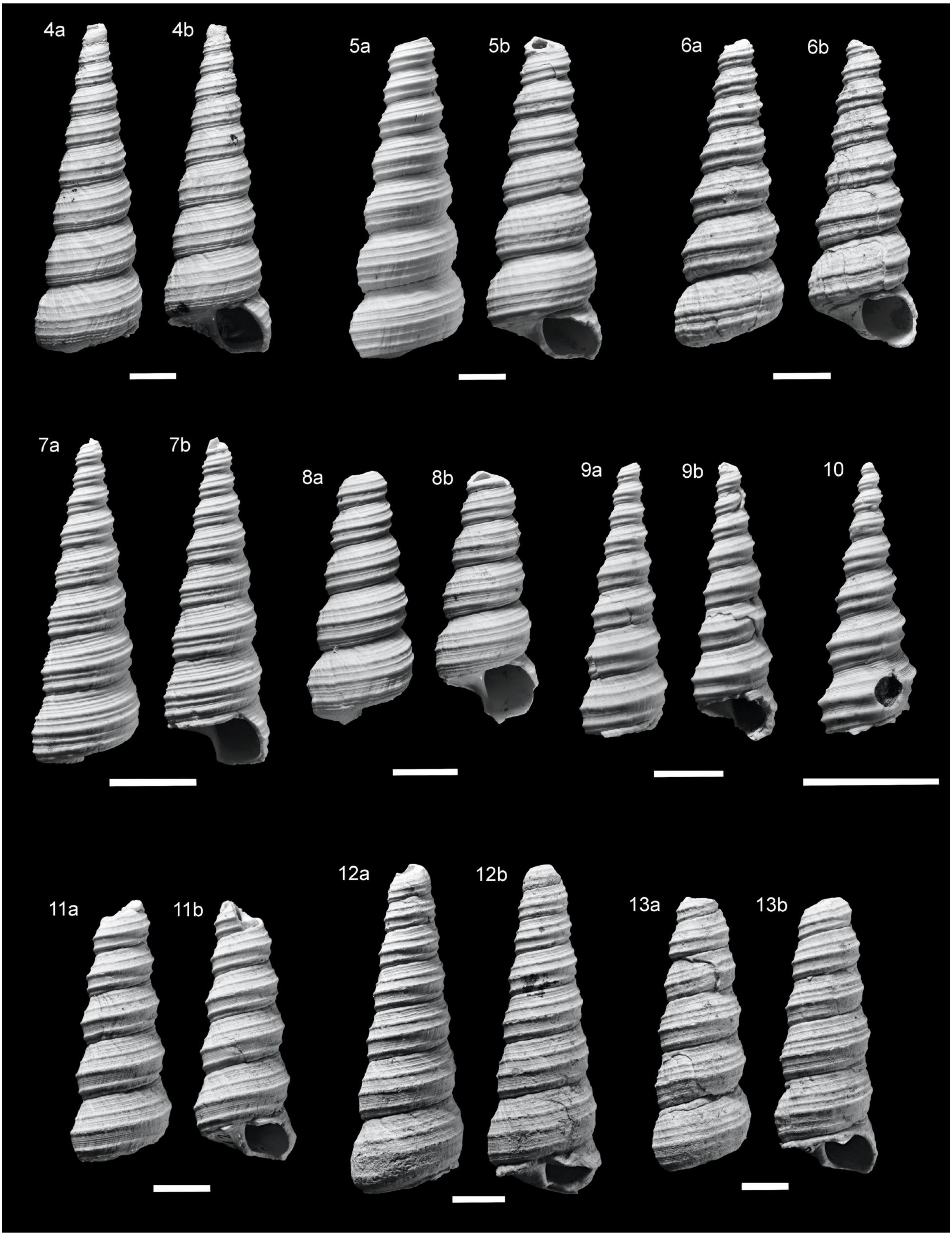
Additional material. — Rest specimens are labelled from SNM-PM Z40260 to SNM-PM Z40317.

Etymology. — Referring to the area of Devín from which the holotype specimen originates.

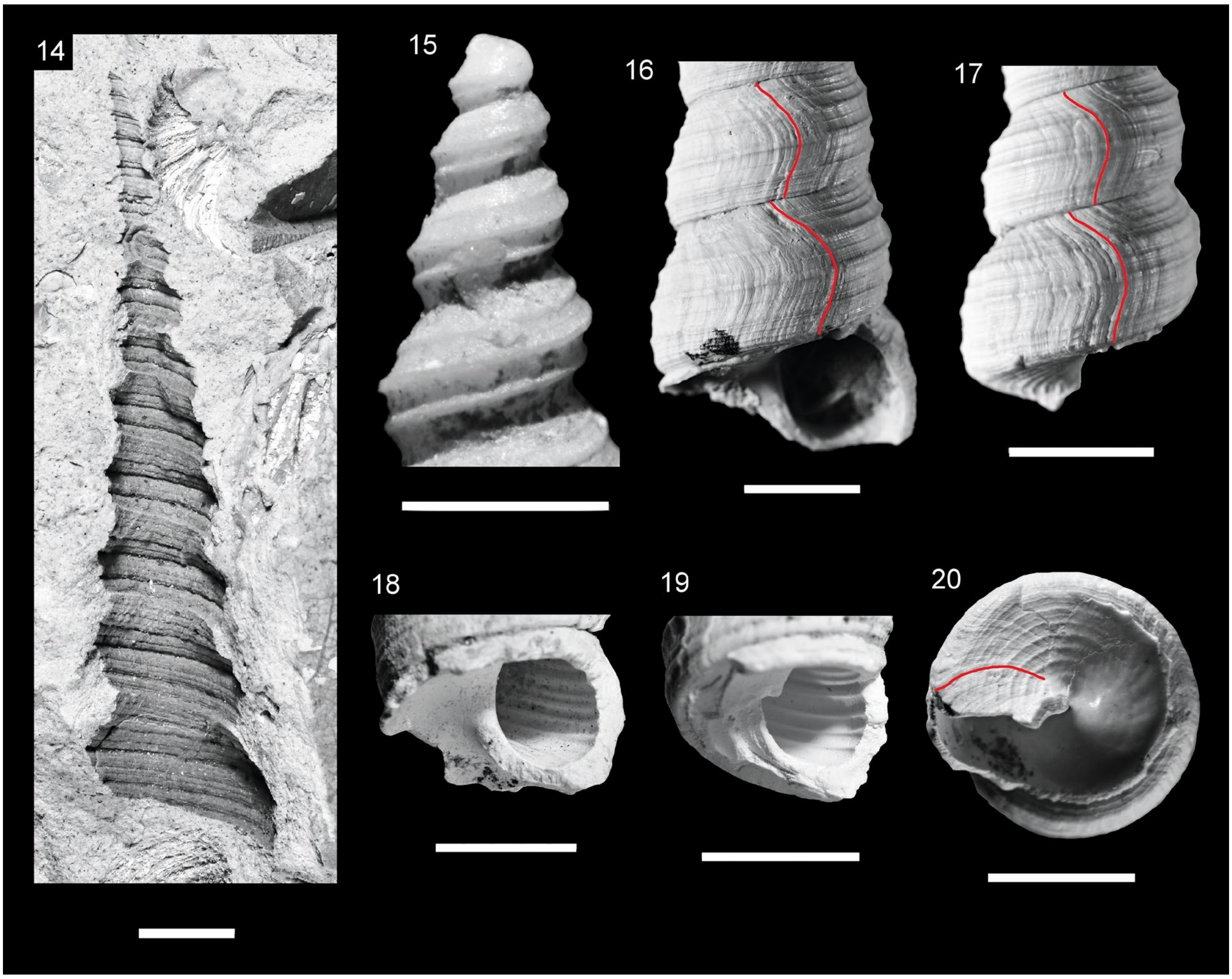
Type locality. — Devín – Zelené terasy, Vienna Basin, Slovakia.

Type stratum. — Heavy-bedded grey- to brown-yellow clays, and fine aleuritic sands and sandy marls of the Studienka Formation, Middle Miocene, Upper Badenian (= Early Serravallian), *Bulimina-Bolivina* Biozone.

Diagnosis. — Shell small-sized, turriculate, moderately slender, of about 14–15 whorls. Protoconch incomplete, destroyed. First teleoconch whorl convex, strong mid-whorl angulation, B prominent, C well-defined, A weaker, order of appearance of primary spiral cords B–C–A. Spiral sculpture strongly tricostate; early teleoconch whorls with distinctly convex profile, passing into convex-sided profile with slightly to strongly mid-whorl angulation of late teleoconch whorls. Spiral sculpture initially strongly tricostate, later composed of primary spiral cords A, B, C, and d, and fine secondary and tertiary spiral cords of variable num-



Figs 4-13. *Turritellinella devinensis* spec. nov. **Figs 4a-b.** Holotype, SNM-PM Z40242, Zelené terasy. **Figs 5a-b.** Paratype 1, SNM-PM Z40243, Konopiská (clay pit). **Figs 6a-b.** Paratype 2, SNM-PM Z40244, Zelené terasy. **Figs 7a-b.** SNM-PM Z40245, Zelené terasy. **Figs 8a-b.** SNM-PM Z40246, Zelené terasy. **Figs 9a-b.** SNM-PM Z40247, Konopiská (clay pit). **Fig. 10.** SNM-PM Z40248, Konopiská (clay pit). **Figs 11a-b.** SNM-PM Z17716, "northwest of Devín – Terasy". **Figs 12a-b.** SNM-PM Z17404, "northwest of Devín – Terasy". **Figs 13a-b.** SNM-PM Z17530, "northwest of Devín – Terasy". Scale bars = 5 mm.



Figs 14-20. *Turritellinella devinensis* spec. nov. **Fig. 14.** Imprint of the shell in sandstone concretion, snm-pm Z40259, Zelené terasy. **Fig. 15.** Detail of the early teleoconch whorls, snm-pm Z40260, Konopiská. **Fig. 16.** Detail of the sculpture in late teleoconch whorls (the lateral sinus is marked in red), holotype, snm-pm Z40242, Zelené terasy. **Fig. 17.** Detail of the sculpture in late teleoconch whorls (the lateral sinus is marked in red), snm-pm Z40246, Zelené terasy. **Fig. 18.** Internal sculpture (inner lirae) in late teleoconch whorl, snm-pm Z40261, Zelené terasy. **Fig. 19.** Internal sculpture (inner lirae) in late teleoconch whorl, snm-pm Z40262, Zelené terasy. **Fig. 20.** Basal view (the basal sinus is marked in red), snm-pm Z40246, Zelené terasy. **Figs 14, 16-20.** Scale bar = 5 mm. **Fig. 15.** Scale bar = 1 mm.

bers in interspaces, spiral cord C close abapical suture, cord A sometimes weaker. Sculpture variable, primary spiral cords prominent, secondaries sometimes of nearly uniform thickness. Lateral sinus moderate, deep; abapical position. Faint adapical and abapical inflection points.

Description. — Shell small-sized, turriculate, moderately slender, comprised of about 14–15 teleoconch whorls. Protoconch incomplete, destroyed. First teleoconch whorl bears primary cords B and C, soon accompanied by thin, weakly developed cord A. Cord B dominant, making whorl strongly angular, order of appearance of primary spiral cords B–C–A. Early neanic teleoconch whorls markedly convex, strongly tricostate, decorated by tiny, delicate, indistinct nodules developed in cross-sections of spiral cords and growth lines, giving cords nearly finely coarse appearance. Spiral sculpture more or less uniform, consisting of pronounced primary cords A, B, and C; cord B most prominent, cord A sometimes weakened, interspaces between primaries initially smooth or intercalated with very fine growth lines, secondaries and tertiaries. Suture well-developed, incised, linear. Later teleoconch whorls convex-sided, medial primary B sometimes dominated, forming mid-whorl angulation given whorls slightly angulated appearance. Sutural ramp often slightly convex, rarely flat to weakly concave. Spiral sculpture often becomes variable, consisting of prominent primaries A, B, C, and weak cord d, accompanied by secondary spiral cords (r, s, t) and fine tertiary spiral cords of variable number, primaries occasionally attenuated, whilst secondary and tertiary spirals raised somewhat strengthened, rivalling in strength with primaries. Indistinct secondary spiral cord u developed only exceptionally. Spiral cords usually smooth, sometimes bearing delicate, indistinct, flattened nodules in cross-sections with growth lines. Interspaces between primaries wide. Adapical primary A sometimes weaker, medial primary B and intermediate primary C somewhat stronger, cord C runs close abapical suture, primaries C and d separated by narrow interspace, cord d indistinct, just above abapical suture. Suture well-defined, incised, linear to slightly undulate. Whole surface of later teleoconch whorls covered by fine, densely spaced growth lines, sometimes passing into slightly coarser growth lines. In cross-sections with secondary and tertiary cords and in interspaces between primaries occasionally form very fine, discontinuous reticulate ornamentation. Lateral sinus with moderate angle, well-defined, characterized by abapical position of vertex, and deep depth. Two inflection points discernable; relatively weak inflection point with position close below adsutural suture, faint inflection point developed in abapical quarter of whorl, passes through tiny sinus into base. Last whorl incomplete, transition into base angulated, coinciding with peribasal spiral cord d. Base almost flat to weakly convex, with 5 to 6 wide-spaced narrow spiral cords and fine spiral threads in their interspaces, basal sinus opisthocyrt. Aperture not preserved, probably subcircular to subquadratic, based on cross-section of last whorl. Internal sculpture developed in late teleoconch whorls, consisting of 5–13 discontinuous palatal and basal spiral lirae.

Shell measurements and ratios. — SL (n = 5): μ = 31.8 mm (σ = 5.13 mm), MD (n = 5): μ = 10 mm (σ = 0.88 mm), AA (n = 5): μ=21.8° (σ = 2.03°), PA (n = 5): μ = 16.6° (σ = 0.48°). Lateral sinus (n = 5): LS angle = 18.2° (σ = 0.74°), LSP = 1.03 (σ = 0.14), LSd = 3.96 (σ = 0.40).

Remarks. — The extant *Turritellinella tricarinata* (Brocchi, 1814) is morphologically very similar to *T. devinensis* spec. nov. but differs from it mainly in its larger size, somewhat narrower pleural angle, and higher whorls; the primaries A, B and C are almost of equal strength; spiral cord C is running higher above the subsutural suture (cf. Brocchi, 1814; Sacco, 1895; Cerulli-Irelli, 1912; Harmer, 1916; Malatesta, 1974; Venzo & Pelosio, 1963; Palla, 1967; Caprotti, 1975, 1976; Fretter & Graham, 1981; González-Delgado, 1986; Cavallo & Repetto, 1992; Borghi & Vecchi, 2005; Chirli, 2006; Landau et al., 2004, 2011; Chirli & Linse, 2011; Moshkovitz, 2012; Harzhauser & Landau, 2019).

During previous paleontological research at Devínska Kobyla, *T. devinensis* sp. nov. was found in a wide area of Devín but was determined incorrectly, as concluded from a revision of the published material stored in SNM-PM. Švagrovský (1981: 128, pl. 40 figs 1-2) figured two shells that he identified as *Turritella* (*Archimediella*) *pythagoraica* Hilber, 1882. These specimens bear typical morphological features typical for the new species, such as well-defined three primary spiral cords accompanied by several secondary and tertiary cords, and a slightly to sharply developed mid-whorl angulation. Likewise, material treated as *Turritella* (*Haustator*) *partschi quadricarinata* Sieber, 1958 (cf. Švagrovský, 1981: 127) shows several concordant features with *T. devinensis* spec. nov. Hyžný et al. (2012), summarizing the paleontological localities and diversity of the Middle Miocene marine faunas from Devínska Kobyla, misidentified the herein described material collected from Lomnická as *Turritella* (*Turritella*) *tricarinata* (Brocchi).

From the Badenian of the Caransebeş-Mehadia Basin in Romania, Hinculov (1968: 134, pl. 32 figs 6a-b) reported a shell identified as *Turritella* (*Turritella*) *tricarinata communis* that is similar to the new one. The early teleoconch whorls have rounded, slightly carinate profiles and are composed of tricostate spiral sculpture. The latest teleoconch whorls are clearly strongly convex, with prominent mid-whorl angulation and bearing three primary spiral cords (A, B, C) accompanied by several secondary cords. This specimen bears several conchological characters that correspond to the overall shell morphology of *T. devinensis* spec. nov., but due to incomplete preservation of the material and its poor illustration, the species affiliation of this shell is unclear.

From the Badenian of Šentjernej in the Krka Basin (Slovenia), Mikuž (2009: pl. 1 fig. 19) figured a specimen that he determined as *Turritella* (*Haustator*) *tricarinata* cf. *communis* Risso, 1826. The shell is slender and consist of convex teleoconch whorls, of which the early whorls are decorated by three primary spiral cords (A, B, C) of a relatively equal strength. On the latest teleoconch whorls, the primary spiral cords become somewhat attenuated, whereas the secondary and tertiary spiral cords are raised in the interspaces between the primaries and are better defined. Although this specimen seems to be conspecific with *T. devinensis* spec. nov., the character of the sculpture does not allow its reliable identification.

The shells illustrated by Csepreghy-Meznerics (1956: pl. 2 figs 31-33), Strausz (1966: pl. 3 fig. 20) and Sieber (1960: pl. 1 fig. 27) are similar to *T. devinensis* spec. nov. as well, but their affiliation to this taxon cannot for a certainty confirmed. Although they were tentatively placed in *T. subuliformis* (O. Boettger, 1907) by Harzhauser & Landau (2019), their status stays unclear. *Turritellinella subuliformis* is a similar, closely related turritellid congener only known from the Badenian Paratethys. From the extant *T. devinensis* spec. nov. it differs primarily in its smaller-sized shell, narrower, indistinctive, and weakened primaries, profuse, well-defined secondary and tertiary spiral cords developed mainly in later teleoconch whorls, and a lesser number of inner lirae (cf. Zilch, 1934; Bałuk, 1975; Harzhauser & Landau, 2019).

Paleoecology. — At Konopiská, the species occurred in the lowermost and the uppermost parts of the pelitic section that reflected moderately deep sublittoral settings influenced by occasional lowered oxygen content near the bottom (Biskupič, 2020, 2021). In contrast, the species is entirely missing in the middle part of the clayey strata that is characterized by a species-poor (but specimen-rich) molluscan community with an extraordinary prevalence of the r-strategist bivalve *Corbula gibba* (Olivi, 1792), indicating worsening conditions near the bottom with a higher frequency or higher magnitude of hypoxic events (Biskupič, 2020). Episodes of sea floor dysoxia are assumed by Hyžný et al. (2012) at Lomnická. Unstable environmental conditions near the sea bottom (e.g., lowered oxygen content, occasional hypoxic events) are expected at Zelené terasy based on a similar taxonomic composition of the molluscan fauna, which is characterized by the mass occurrence of the pollution-tolerant and opportunistic bivalve *Corbula gibba* (Olivi, 1792) and by the scavenger gastropod *Tritia illovensis* (Hoernes & Auinger, 1882), dominating the monotypic molluscan assemblages.

The turritellid was also retrieved from fine-grained silts, silty sands and sandstone concretions that were exposed at all studied localities near Devín (Lomnická; Zelené terasy; "northwest of Devín Terasy"; "east of Devín"). The bivalve genera *Nucula* (cf. Wilson & Davis, 1984; Holmes et al., 2002; Holmes & Miller, 2006), *Saccella* (cf. Baustian & Rabalais, 2009; Kuk-Dzul & Díaz-Castañeda, 2016) and *Corbula* (cf. Hrs-Brenko, 2006; Zuschin et al, 2007) are able to tolerate reduced oxygen content or temporary hypoxia. Their common occurrence may indicate a habitat influenced by lowered water dynamics or reduced levels of oxygen near the sea floor. The presence of the abundant suspension-feeding bivalves *Pseudamussium*, *Neopycnodonte*, *Cyclocardia*, *Venus*, *Glossus*, *Thracia*, and *Corbula*, the turritellid gastropods *Archimediella*, *Oligodia*, and *Turritellinella*, and the serpulid polychaetes *Protula* point to sufficient supply of nutrients. These strata were most likely deposited in the middle neritic zone, in conditions characterized by lower energy paleoenvironments with possible episodes of lowered oxygen contents nearby the sea bottom.

Distribution. — In the Central Paratethys realm, the species was found in the Middle Miocene (Upper Badenian) of Slovakia (Vienna Basin) at following localities: Konopiská (this paper); Lomnická (Hyžný et al., 2012), Zelené terasy (this paper), "northwest of Devín – Terasy" (Švagrovský, 1981), and "east of Devín" (Švagrovský, 1981).

DISCUSSION

(Paleo)Ecology of closely related species

The modern populations of closely similar *Turritellinella tricarinata* (Brocchi, 1814) are found in a wide spectrum of habitats, such as in muddy bottoms (Pérès & Picard, 1964; Fretter & Graham, 1981; Keegan & Mercer, 1986; Poppe & Goto, 1991; Moshkovitz, 2012; Manarini et al., 2019), muddy sand (Poppe & Goto, 1991; Manarini et al., 2019), sand (van Straaten, 1960; de Bruyne, 2004), muddy gravel (Yonge, 1946; Fretter & Graham, 1981) or rocky and gravely bottoms (van Straaten, 1960). The species usually occurs very abundantly and lives in colonies (Pérès & Picard, 1964; Fretter & Graham, 1981; Poppe & Goto, 1991; Moshkovitz, 2012; Rueda et al., 2015) in depths between 10-200 m (Poppe & Goto, 1991; Fretter & Graham, 1981; de Bruyne, 2004; Moshkovitz, 2012; Manarini et al., 2019). This turritellid also exceptionally occurs in shallow-water seagrass environments (Rueda et al., 2009) or in coralligenous reef habitats (Casellato & Stefanon, 2008), it was observed at 5-7 m depths (Snigirov et al., 2013) or reaches the boundary below 200 m (Gofas et al., 2014; Moya-Urbano et al., 2016). The species does not tolerate the deterioration of habitat conditions and hypoxia, which causes its decreasing abundance, or it completely avoids the affected environment (Gallmetzer et al., 2017; Tomašových et al., 2018, 2020; Scheidl et al., 2021).

As can be deduced from the abovementioned overview, the habitat preference of extant *T. tricarinata* is different to those described herein for *T. devinensis* spec. nov. from the Badenian Vienna Basin (e.g., lowered water dynamics near the sea floor, seasonal hypoxic events).

The closely related fossil species, *T. subuliformis* (O. Boettger, 1907), was widespread during the Lower Badenian (Middle Miocene) in the Central Paratethys Sea, and lived in partly similar conditions as the Vienna Basin populations of *T. devinensis* spec. nov., and inhabited middle to outer neritic environments with soft bottoms (Harzhauser & Landau, 2019).

Intraspecific variability and morphotypes within *Turritellinella*

Turritellinella tricarinata (Brocchi, 1814), the type species of the genus, is characterized by its relatively broad geographic and stratigraphic range with occurrence in present-day seas (e.g., Poppe & Goto, 1991; Landau et al., 2004; Büyükmeriç et al., 2018; Harzhauser & Landau, 2019). Moreover, it has an extremely variable shell morphology which caused much confusion and erroneous interpretation during the history of malacological and paleontological investigations. Altogether up to 18 fossil and modern species or subspecies including morphotypes were described that are currently considered junior synonyms of *T. tricarinata* (cf. Landau et al., 2004; Harzhauser & Landau 2019; MolluscaBase, 2022). As noted by Landau et al. (2004), the spatial and temporal variability of the spiral sculpture can be considered a result of evolutionary change within the species complex. This opinion was also adopted by Harzhauser & Landau (2019), who accepted *T. tricarinata* as one valid species. The taxonomy, phylogeny, evolutionary changes of the species complex as well as intraspecific variability of the sculpture are also discussed by Kotaka (1960), Caprotti (1975) and Borghi & Vecchi (2005). Although the Paratethyan *T. subuliformis* (O. Boettger, 1907) is similar to *T. tricarinata*, it was accepted as a valid species (Harzhauser & Landau, 2019).

Even though the herein-examined *Turritellinella* specimens from the Vienna Basin could represent another regional morph of *T. tricarinata*, they are reliably separated from the nominal species by clear morphological differences. Moreover, both species are ecologically and paleogeographically separated. The modern populations of the eastern Atlantic-Mediterranean *T. tricarinata* prefer a coarse- to fine-grained sea bottom within the infra- to circalittoral zone, whilst *T. devinensis* spec. nov. preferred paleoenvironments characterized by somewhat unstable and deteriorated conditions near the sea bottom in the circalittoral zone and was distributed only in a restricted area of the eastern Vienna Basin (Central Paratethys Sea) for a relatively short time during the Upper Badenian (Early Serravallian).

CONCLUSIONS

A new Turritellidae species, *Turritellinella devinensis* spec. nov., is described from the Upper Badenian (Early Serravallian) Studienka Formation in southwestern Slovakia. The conchological material derives from the localities surroundings Rohožník and Devín, situated in the eastern marginal part of the Vienna Basin.

Taking into account the morphological, (paleo)geographical and (paleo)ecological differences between the *T. tricarinata* (Brocchi, 1814) and the Badenian Vienna Basin *Turritellinella*, the studied shells are separated from the Pliocene type and described as new. The species was distributed in the eastern Vienna Basin of the Central Paratethys Sea during the Upper Badenian (Early Serravallian), where it occupied clayey to silty-sandy sea floors with a bathymetric range from middle to outer neritic environments (circalittoral zone), and where it was exposed to conditions of seasonal hypoxia and episodically worsening aeration near the sea floor.

The occurrence of *T. devinensis* spec. nov. in the Vienna Basin is regarded as the first evidence of the genus *Turritellinella* in the Upper Badenian (Early Serravallian) of the Central Paratethys Sea.

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