Middle Miocene chitons (Polyplacophora) from the Slovak part of the Vienna Basin and the Danube Basin (Central Paratethys)

Andrej Ruman & Natália Hlavatá Hudáčková

Department of Geology and Paleontology, Faculty of Natural Sciences, Comenius University, Mlynská dolina, Ilkovičova 6, 842 15 Bratislava, Slovakia; winchestersk@yahoo.com, hudackova@fns.uniba.sk

AGEOS

Strednomiocénne chitóny (Polyplacophora) zo slovenskej časti Viedenskej a Dunajskej panvy (Centrálna Paratetýda)

Abstract: We describe species-rich chiton assemblages from the Middle Miocene of the Slovak part of the Vienna Basin and the Danube Basin (Central Paratethys). They were found at five localities, including Devínska Nová Ves brickyard, Devínska Nová Ves-Útočnica, Rohožník clay pit, Kúty-45 borehole and Dubová. Thirteen species belong to eight genera from the families Leptochitonidae, Hanleyidae, Callochitonidae, Chitonidae, Tonicellidae and Acanthochitonidae. They occur predominantly in redeposited, moderately-sorted rhodolith-rich or well-sorted bioclastic layers of the Late Badenian age, and belong to lineages that presently inhabit warm-temperate and tropical regions.

Key words: Polyplacophora, Miocene, Badenian, Vienna Basin, Danube Basin, Central Paratethys

1. INTRODUCTION

Chitons serve as paleoecological, biogeographic and biostratigraphical indicators of marginal-marine and shelf environments (Baluk, 1971). In this study, we analyze fossil chitons from four localities from the Slovak part of the Vienna Basin and from one locality from the Danube Basin, and document new occurrences of chitons in the Middle Miocene sediments of these two basins. Chitons were documented by Tomašových (1998) and Kováč et al. (1999) from the northern (Slovakian) part of the Vienna Basin. They are described for the first time from the Middle Miocene of the Danube Basin in this work. In addition to analyses of chitons, we also assess the composition of co-occurring assemblages with foraminifers and calcareous nannoplankton in order to place the chiton occurrences into biostratigraphic and environmental framework.

2. LOCALITIES AND METHODS

The material comes from localities situated in the western part of the Slovak Republic (Fig. 1) from the Vienna Basin (VB) and the Danube Basin (DB). All studied localities are of the Badenian age, based on calcareous nannoplankton, foraminifera and molluscs.

Foraminifers were collected from the >0.071 mm fraction from the samples containing chiton valves. When no material was available, material from the closest sample was sieved. Chiton valves were picked up from the >0.071 mm fraction (Tab. 1). All molluscs presented in the samples were taxonomicaly identified.

All specimens are stored in the Slovak National Museum under numbers Z 38495–Z 38562.

2.1. Dubová (DB)

The locality is situated in the Danube Basin´s north-western margin (Blatné Depression) at the eastern foot of the Malé Karpaty

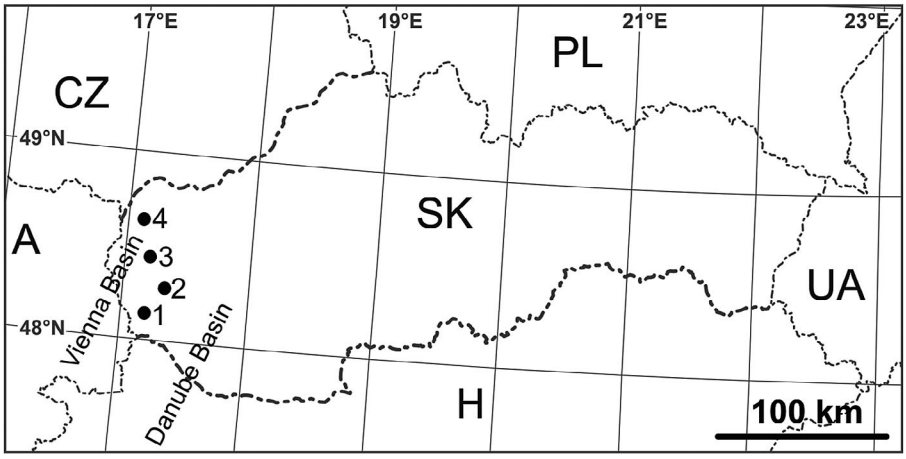

Fig. 1. Location map showing the Vienna Basin and Danube Basin localities. Explanatory notes: (1) Devínska Nová Ves-Útočnica, Devínska Nová Ves brickyard; (2) Dubová; (3) Rohožník clay pit; (4) Kúty-45 borehole.

Manuscript received: 24th July 2015
Revised version accepted: 23rd November 2015

Mountains (Fig. 1). It was formed by an about 2.5 m deep outcrop, excavated in 2008 for the purpose of winery building construction. Siliciclastic sediments, mostly silts, clays and sands, were very rich in fossil fauna and flora. On the basis of the foraminiferal association, nannoplankton and the occurrence of the gastropod *Agapilia picta tuberculata*, these sediments can be placed into the Upper Badenian Ammonia vienensis Biozone that is equivalent to the Bulimina-Bolivina Zone (Hladilová & Fordinál, 2013; Jamrich, 2013). The most abundant molluscan taxa are *Sandbergeria perpusilla, Loripes (Microloripes) dentatus, Agapilia picta tuberculata* and *Bittium* (*Bittium*) *reticulatum* (Appendix 1). Chiton valves were found in multiple beds, including the bed 1 (2.5 m above the base of the section), 2 (2.4 m), 3 (2.3 m), 13 (1.1 m), 17 (0.7 m) and 19 (0.5 m).

2.2. Devínska Nová Ves brickyard (VB)

The locality is situated in the western margin of Bratislava´s district of Devínska Nová Ves on the southern side of the road leading to the town of Stupava (Fig. 1). This locality is presently a waste pit and no longer accessible. Up to 20 m thick sequence of dark gray calcareous clays of the Studienka Formation with rare, 1 cm thick silty layers were exposed in an about 250 m long section. The foraminiferal assemblages document the lower part of the Bulimina-Bolivina Biozone (Hudáčková & Kováč, 1993; Jamrich & Halásová, 2010). The Sr^{86}/Sr^{87} dating based on the tests of benthic foraminifera *Pappina neudorfensis* implies that the section is 13.58 Myr old (Hudáčková et al. 2003[a]). Paleoenvironmental conditions were inferred by Hudáčková et al. (2003[b]) and Kováčová & Hudáčková (2009) on the basis of foraminifers and by Tomášových (1998) on the basis of molluscs.

Molluscan assemblages in the clays were dominated by *Nucula* (*Nucula*) *nucleus, Nucula* (*Nucula*) *mayeri, Solemya* (*Solemya*) *doderleini, Amussium denudatum, Amusium* (*Palliolum*) *bittneri, Tellina* (*Peronaea*) *planata, Macoma elliptica, Corbula* (*Varicorbula*) *gibba, Agapilia picta, Pseudamnicola immunata, Bittium* (*Bittium*) *reticulatum, Euspira catena helicina, Turbonilla* (*Pyrgolampros*) *biornata*, and by pelagic gastropods *Limacina valvatina* and *Limacina miorostralis* (Appendix 1). Chiton valves were found in a very thin (2–3 cm), lensoid tempestitic layer situated in the lower part of the section. This layer consists of clay with dispersed silt and fine sand and very well-sorted (< 1–2 mm) allochtonous bioclastic debris. It has a variable thickness and

Tab. 1. Number of the chiton valves found in the studied localities. Explanatory note: Number in the brackets indicates the number of head valves – intermediate valves – tail valves.

	DNV - Útočnica (1) "žltý piesok"	DNV - Útočnica (2) "žltý silt"	DNV brick yard	Rohožník clay pit (1) "litotamniová vrstva"	Rohožník clay pit (3) "Hornáčková jama"	Rohožník clay pit (5) "glosusový horizont"	Rohožník clay pit (6) "nadglosusový horizont"	Kúty-45 borehole (7)	Kúty-45 borehole (19)	Kúty-45 borehole (20)	Kúty-45 borehole (27)	Dubová (1)	Dubová (2)	Dubová (3)	Dubová (13)	Dubová (17)	Dubová (19)
***Leptochiton* sp.**				0 - 3 - 0	15 - 119 - 21		0 - 9 - 1										
***Leptochiton sulci* (Bałuk)**			6 - 54 - 11	0 - 1 - 0	101-706 - 125		0 - 31 - 1										
***Parachiton africanus* (Nierstrasz)**			4 - 37 - 5	0 - 1 - 1	2 - 38 - 13		0 - 4 - 0										
***Lepidopleurus cajetanus* (Poli)**														0 - 1 - 0	0 - 1 - 0		
***Hanleya multigranosa* (Reuss)**					1 - 3 - 1		0 - 4 - 0										
***Lepidochitona lepida* (Reuss)**			1 - 14 - 2	0 - 2 - 0	22 - 295 - 19		1 - 9 - 1					0 - 0 - 1	0 - 1 - 0				
***Callochiton septemvalvis* (Montagu)**			0 - 3 - 1		33 - 471 - 41		3 - 17 - 1	0 - 0 - 1									
***Chiton corallinus* (Reuss)**		0 - 1 - 0	15 - 102 - 17	1 - 5 - 0	76 - 547 - 68		22 - 62 - 18									0 - 1 - 0	
***Chiton olivaceus* Splenger**					1 - 27 - 2		0 - 3 - 0										
***Acanthochitona faluniensis* (Rochebrune)**	0 - 2 - 1		22 - 213 - 26	3 - 78 - 9	147 - 1063 - 163	0 - 2 - 0	16 - 104 - 24		0 - 2 - 1		0 - 1 - 0						0 - 1 - 0
***Acanthochitona sandeciana* Bałuk**					0 - 12 - 16												
***Craspedochiton cf. minutulus* Bałuk**			2 - 37 - 6	0 - 3 - 0	2 - 42 - 5		0 - 8 - 1										
***Cryptoplax weinlandi* Šulc**		0 - 3 - 0								0 - 1 - 0	0 - 2 - 1						

pinches laterally out. The debris mostly consists of molluscan shells, foraminifers, bryozoans, echinoids, ostracods, brachiopods, fish remains, and carbonized plant remains. Molluscs are rarely present as fragments of adults, but mostly as complete and disarticulated juvenile valves. Almost 50 species were determined (personal observation). Most chiton valves belong to the juvenile specimens, only a couple of them are derived from adult individuals.

2.3. Devínska Nová Ves-Útočnica (VB)

The locality also known as Devínska Nová Ves vineyards or Sútočnica is situated in the field on a hill elevation, situated approximately 1 km eastward from the Bratislava district of Devínska Nová Ves (Fig. 1). Švagrovský (1981) described 36 molluscan species but did not specify sedimentological setting. The hill is nowadays covered by agricultural fields with an about 30 cm thick layer of plough. Silts, sands and sandstones stratigraphically equivalent to the Sandberg Formation (Švagrovský, 1981; Hyžný et al., 2012) were exposed in small dispersed digs with a high horizontal variation in facies composition. Incomplete outcrop conditions allow us to reconstruct a composite section. The lowermost part is formed by a white, coarse-grained sand with echinoids (*Scutella* and *Clypeaster*). The specimen-rich molluscan assemblage is represented by chalky, locally still articulated valves. Most common bivalves were *Glycymeris* (*Glycymeris*) *pilosa deshayesi*, *Linga* (*Linga*) *columbella*, *Megaxinus incrassatus*, *Codakia* (*Codakia*) *leonina*, *Anadara* (*Anadara*) *turonica*, *Anadara* (*Anadara*) *diluvii*, pectinids and oysters. Gastropods were represented mainly by *Turritella* and *Clavatula* (Appendix 1). Higher, fine-grained yellow sands are laterally replaced by silty sands with clay admixture. Rarely, concretions of a variable diameter (up to 1.5 m in size) were observed. Molluscan assemblage is represented mainly by pectinids, oysters, *Glycymeris* (*Glycymeris*) *pilosa deshayesi*, *Parvilucina* (*Microloripes*) *dentata*, *Linga* (*Linga*) *columbella*, *Circomphalus subplicata*, *Diloma* (*Paroxystele*) *orientale* and turritellids (Appendix 1). Specimens of the genus *Linga* are preserved articulated. Blocks of rhodolith limestones are scattered across the hill, mostly around the top, but were not found in any of the digs. Three valves of the *Acanthochitona faluniensis* were found in yellow sands and one valve of the *Chiton corallinus* and three valves of the *Cryptoplax weinlandi* in yellow silty sands. Chitons valves found at this locality are preserved mostly with abraded tegmental layer.

2.4. Rohožník clay pit (VB)

A former clay pit, nowadays completely flooded by underground water, is situated close to the town of Rohožník, aproximately 1 km southward from the railway station. Sediments mainly consist of dark-gray calcareous clays, muddy bioclastic sands, and (redeposited) rhodolith-bioclastic interbeds. The Badenian interval belongs to the Studienka Formation. It is overlain by the Sarmatian clays and sands with redeposited Badenian assemblages (Baráth et al., 1994). Dark gray calcareous clays are characterized by high abundance of *Nucula* (*Nucula*) *nucleus*, *Corbula* (*Varicorbula*) *gibba*, and *Hinia* (*Hinia*) *illovensis*.

Bioclastic intercalations forming lenses and beds of variable thickness contain species- and specimen-rich molluscan assemblages, with more than 300 species (personal observation). The most abundant species are *Nucula* (*Nucula*) *nucleus*, *Anadara* (*Anadara*) *diluvii*, *Anadara* (*Anadara*) *fichteli*, *Striarca papillifera*, *Glycymeris* (*Glycymeris*) *pilosa deshayesi*, *Chlamys* (*Aequipecten*) *elegans*, *Cubitostrea digitalina*, *Chama* (*Chama*) *gryphoides*, *Corbula* (*Varicorbula*) *gibba*, *Gibbula* sp., *Turboella* (*Turboella*) *acuticosta*, *Alvania* spp., *Rissoina* (*Rissoina*) *podolica*, *Bittium* (*Bittium*) *reticulatum*, *Alaba costellata anomala*, *Erato* (*Erato*) *elongata*, *Euspira catena helicina*, *Hinia* (*Tritonella*) *daciae*, *Mitrella bittneri*, *Mitra* (*Ebenomitra*) *ebenus*, *Conus* sp., *Bela* sp., *Turbonilla separata*, and *Chrysallida* (*Parthenina*) *interstincta*. Sarmatian sediments are characterized by *Ervilia* sp., *Irus* sp., *Limnocardium* sp., *Mactra* sp., *Bittium* (*Bittium*) *reticulatum*, *Cerithium rubiginosum*, *Clavatula* sp., *Agapilia picta*, *Dorsanum* (*Duplicata*) *duplicatum* and *Pirenella picta picta*. More than 4,000 chiton valves were found in bioclastic layers, with only a few fragments being found in dark gray clays.

2.5. Kúty-45 borehole (VB)

The Kúty-45 borehole was drilled in 1999 for prospecting purposes on the western side of the Malé Karpaty Mountains, near the town of Kúty in the eastern margin of the Záhorie Lowland.

The sediments are formed by clays, sandy clays, silts, sands, and redeposited rhodolith limestones, and also by biolithic limestone with red alge (*Archaeolithothamnium senesi*, *Archaeolithothamnium intermedium*, *Lithothamnium subtile*, *Lithothamnium praefruticulosum*, *Lithothamnium ramosissimum*, *Lithophyllum capederi*, *Mezophyllum korytzae*) (Kováč et al., 1999).

Based on calcareous nannoplankton and foraminifers, this section was assigned to the Badenian (Kováč et al., 1999). Molluscs were represented mainly by *Nucula sp.*, *Striarca lactea*, *Cubitostrea digitalina*, *Parvilucina (Microloripes) dentata*, *Corbula (Varicorbula) gibba*, *Gibbula (Colliculus) affinis pseudoangulata*, *Astraea (Bolma) meynardi*, *Alvania spp.*, *Rissoina (Rissoina) podolica*, *Rissoina (Zebinella) decussata*, *Turritella spp.*, *Sandbergeria perpusilla*, *Alaba costellata anomala*, *Cerithium spp.* and *Bittium (Bittium) reticulatum*. Bryozoans, polychetes, brachiopods, ostracods, foraminifers, and remains of fishes were common. Only nine disarticulated valves of chitons were found between 487 and 502 m. The valves were partly damaged and fragmented during the sieving.

3. RESULTS

Systematic account given by Sirenko (2006) is mostly followed in our study. Explanatory notes: CP (Central Paratethys); the number in the brackets indicates the number of head valves – intermediate valves – tail valves.

Class POLYPLACOPHORA Gray, 1821
Subclass LORICATA Schumacher, 1817
Order LEPIDOPLEURIDA Thiele, 1910
Suborder LEPIDOPLEURINA Thiele, 1910
Family Leptochitonidae Dall, 1889
Genus *Leptochiton* Gray, 1847

Leptochiton sulci (Bałuk, 1971)
(Fig. 2.2-2.6)

1934 *Lepidopleurus cf. cancellatus* (Capellini) – J. Šulc, p. 6-7.
1971 *Lepidopleurus sulci* n. sp. – W. Bałuk, p. 455-456, pl. 2, fig. 1-4.
1984 *Lepidopleurus sulci* Bałuk – W. Bałuk, p. 285, pl. 2, fig. 1-3, pl. 3, fig. 1-2, pl. 4, fig. 4.
1988 *Leptochiton sulci* (Bałuk) – W. Macioszczyk, p. 51-52, pl. 1, fig. 8a-8b.
1988 *Leptochiton (Leptochiton) sulci* (Bałuk) – B. Studencka & W. Studencki, p. 38-39, pl. 1, fig. 4.
1998 *Acanthochitona* sp. – A. Tomašových, p. 362, pl. 1, fig. 7-8.

Material: Devínska Nová Ves brickyard (4-37-5), Rohožník clay pit 1 (0-1-0), Rohožník clay pit 3 (101-706-125), Rohožník clay pit 6 (0-31-1).

Occurrences in the Badenian sediments of the CP: Slovakia (Rohožník: this paper; Devínska Nová Ves: Tomašových, 1998), Poland (Gieraszowice, Korytnica, Rybnitsa, Weglinek: Bałuk, 1971; Macioszczyk, 1988, Studencka & Studencki, 1988), Austria (Steinabrunn: Šulc, 1934).

Notes: Sculpture of the tegmentum is ornamented by nodes arranged in rows in the central part of the intermediate valves. Each node posses 4-6 pores. Arrangement of the nodes in the lateral areas is radial or random. In the postmucronal area of the tail valve and on the head valve, granules are oval or prolonged and form a radial patern.

Leptochiton sp.
(Fig. 3.2-3.6)

Material: Devínska Nová Ves brickyard (6-54-11), Rohožník clay pit 1 (0-3-0), Rohožník clay pit 3 (15-119-21), Rohožník clay pit 6 (0-9-1).

Notes: Head valve is semicircular and posseses minute, randomly arranged granulation. Granules have 5-8 aesthete pores, both on the top and on the peripheral margin. Rectangular intermediate valves vary in leght of the central area and have the rounded shape in the frontal view. Tail valves are ovoidal, without any distinct diagonal ridge. Arrangement of the granules is random in the antemucronal area and concentric in postmucronal area. Differences in the shape and sculpture do not allow us to attribute our specimens to any known species.

Genus Parachiton Thiele, 1909
Parachiton africanus (Nierstrasz, 1906)
(Fig. 2.1)

1934 *Lepidopleurus (Parachiton) thielei* n. sp. – J. Šulc, p. 7-8, pl. 1, fig. 4-5.
1971 *Lepidopleurus thielei* Šulc – W. Bałuk, p. 454-455, pl. 1, fig. 8.
1984 *Lepidopleurus africanus* Nierstrasz – W. Bałuk, p. 286-287, pl. 1, fig. 1-2.
2004 *Lepidopleurus (Parachiton)* aff. *africanus* Nierstrasz – B. Dell´Angelo, p. 29-30, pl. 2, fig. 2, 6.

Material: Rohožník clay pit 1 (0-1-1), Rohožník clay pit 3 (2-38-13), Rohožník clay pit 6 (0-4-0).

Occurrences in the Badenian sediments of the CP: Slovakia (Rohožník: this paper), Poland (Korytnica: Bałuk, 1971), Austria (Steinabrunn: Šulc, 1934).

Notes: Head valve and central area of the intermediate valves is sculptured with closely spaced nodes. Nodes are very flat and join togather to the form of rows. Ornamentation on the lateral areas of the intermediate valves is rather smooth or with radial lines.

The species has been found in the Plio-Pliocene Italian localities (Laghi et al., 1981; Dell´Angelo & Smriglio, 1999). Sirenko (2006) consider genus *Parachiton* as a distint from the genus *Lepidopleurus*. *Parachiton africanus* is the only Mediterranean species of this genus, all other species inhabit the Indo-Pacific (Kaas & Van Belle, 1985; Dell´Angelo, 2015). It is a very rare species inhabiting depths from 30 to 120 m (Oran, Algeria; Golfo di Tarano, Italy; Costa Brava, Spain; Corsica).

Genus Lepidopleurus Risso, 1826
Lepidopleurus cajetanus (Poli, 1791)
(Fig. 5.4)

1962 *Lepidopleurus (L.) cajetanus* (Poli) – A. Malatesta, p. 146, fig. 1-2.
1971 *Lepidopleurus decoratus* (Reuss) – W. Bałuk, p. 453, pl. 1, fig. 1-4.
1984 *Lepidopleurus cajetanus* (Poli) – W. Bałuk, p. 284-285, pl. 4, fig. 1-2.
1988 *Lepidopleurus cajetanus* (Poli) – B. Studencka & W. Studencki, p. 39, pl. 1, fig. 1-3.
2005 *Lepidopleurus (Lepidopleurus) cajetanus* (Poli) – A. Dulai, p. 30-33, pl. 1, fig. 1-10; pl. 2, fig. 1-6.
2010 *Lepidopleurus cajetanus* (Poli) – B. Studencka & A. Dulai, p. 261-264, text-fig. 3 A-G.

Material: Dubová 3 (0-1-0), Dubová 13 (0-1-0).

Occurrences in the Badenian sediments of the CP: Slovakia (Dubová: this paper), Czech Republic (Borač, Kninice, Rudoltice: Šulc, 1934), Austria (Pötzleinsdorf, Steinabrunn: Šulc, 1934), Hungary (Bánd: Dulai, 2005), Romania (Coştei: Zilch, 1934; Lăpugiu de Sus: Dell'Angelo et al., 2007), Poland (Korytnica: Bałuk, 1971, 1984), Ukraine (Podhorce, Szuszkovce: Studencka & Dulai, 2010).

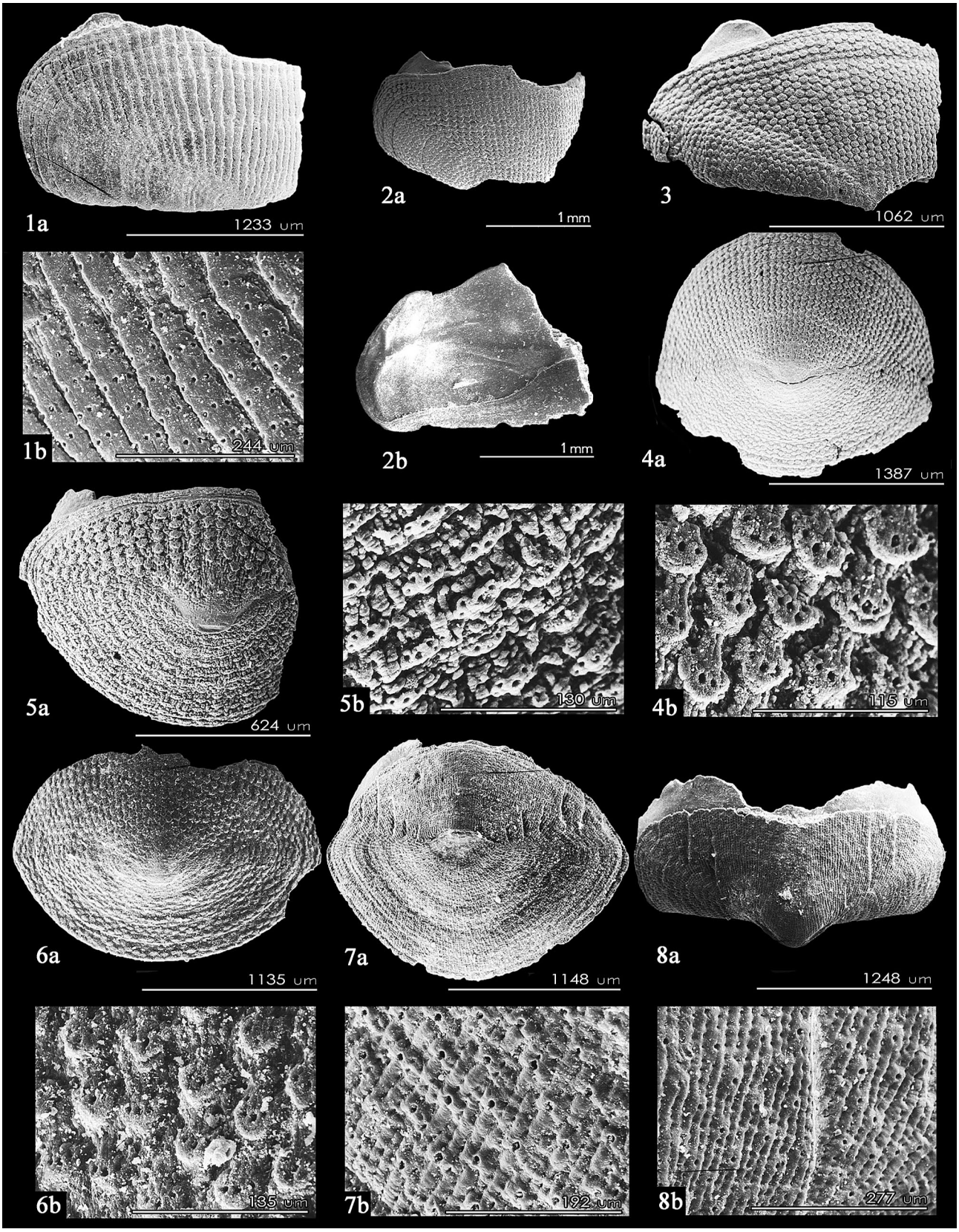

Fig. 2. (1) *Leptochiton africanus* **(Nierstrasz, 1906); 1a: dorsal surface of the intermediate valve; 1b: detail of the central area, Rohožník clay pit (3). (2-5)** *Leptochiton sulci* **(Bałuk, 1971); 2a, 3: dorsal surface of the intermediate valve; 2b: ventral surface of the intermediate valve, Rohožník clay pit (3). 4a, 5a: dorsal surface of the tail valve; 4b: detail of the postmucronal area; 5b: detail of the antemucronal area, Rohožník clay pit (3). (6)** *Leptochiton cf. sulci* **(Bałuk, 1971); 6a: dorsal surface of the tail valve; 6b: detail of the antemucronal area, Rohožník clay pit (3). (7-8)** *Callochiton septemvalvis* **(Montagu, 1803); 7a: dorsal surface of the tail valve; 7b: detail of the postmucronal area; 8a: dorsal surface of the intermediate valve; 8b: detail of the central area, Rohožník clay pit (3).**

Notes: Our investigated specimens display traces of abrasion on the outer surface. Nodes of the central area are not clearly visible but can be traced by presence of pores and are arranged in the longitudial rows. In the lateral area, commarginal growth lines are presented. This species is recently distributed in the Mediterranean Sea and in the Atlantic Ocean, ranging from the Iberian Peninsula to the Canary Islands (Malatesta, 1962). It is known from the Miocene of the Central Paratethys and the Plio-Pleistocene of the Mediterranean Basin (Italy, France, Spain) and Pleistocene of the Rhodes Islands (Garilli et al., 2005).

Family Hanleyidae Bergenhayn, 1955
Genus *Hanleya* Gray, 1857

Hanleya multigranosa (Reuss, 1860)
(Fig. 5.2-5.3)

1860 *Chiton multigranosus* m. n. sp. – A. E. Reuss, p. 259, pl. 8, fig. 8.
1895 *Chiton multigranosus* Reuss – V. J. Procházka, p. 99.
1934 *Hanleya multigranosa* (Rss.) – J. Šulc, p. 9-10, pl. 1, fig. 7-12.
1971 *Hanleya? multigranosa* (Reuss) – W. Bałuk, p. 456-457, pl. 1, fig. 5-7.
1984 *Hanleya multigranosa* (Reuss) – W. Bałuk, p. 287, pl. 5, fig. 1a-1b.

Material: Rohožník clay pit 3 (1-3-1), Rohožník clay pit 6 (0-1-0).

Occurrences in the Badenian sediments of the CP: Slovakia (Rohožník), Czech Republic (Porzteich, Rudoltice: Reuss, 1860; Procházka, 1895; Šulc, 1934), Poland (Korytnica: Bałuk, 1971, 1984), Romania (Coştei: Šulc, 1934).

Notes: Tegmentum of the valves is sculptured by granules of the variable shape. Granules posses up to 12 pores, but are often abraded.

Some authors consider *Hanleya multigranosa* to be the ancestral species of the Recent species *Hanleya hanleyi* (Šulc, 1934; Malatesta, 1962). Sirenko (2014) suggests that Pleistocene *Hanleya multigranosa* from Parma (Italy) could belong to the species *Hanleya mediterranea*. *Hanleya hanleyi* inhabits the Atlantic Ocean from the Barents Sea to the Canary Islands, the Mediterranean Sea and waters around Iceland, Greenland and the eastern coast of North America. It ranges from the intertidal zone to the depth of 555 m (Kaas & Van Belle, 1985; Sirenko, 2014). *Hanleya mediterranea* occurs in the Mediterranean Sea in deeper environments (50-200 m; Sirenko, 2014).

Order CHITONIDA Thiele, 1909
Suborder CHITONINA Thiele, 1909
Superfamily CHITONOIDEA Rafinesque, 1815
Family Callochitonidae Plate, 1901
Genus *Calochiton* Gray, 1847

Callochiton septemvalvis (Montagu, 1803)
(Fig. 2.7, 2.8, 3.1)

1860 *Chiton rariplicatus* m. n. sp. – A. E. Reuss, p. 258-259, pl. 8, fig. 9-11.
1895 *Chiton rariplicatus* Reuss – V. J. Procházka, p. 100.
1934 *„Chiton" rariplicatus* (Rss.) – J. Šulc, p. 27-28, pl. 2, fig. 5.
1971 *Callochiton rariplicatus* (Reuss) – W. Bałuk, p. 461-462, pl. 5, fig. 1-5.
1977 *Callochiton rariplicatus* (Reuss) – G. Jakubowski & T. Musiał, p. 77-78, pl. 3, fig. 2.
1984 *Callochiton laevis* (Montagu) – W. Bałuk, p. 290.
1988 *Callochiton laevis* (Montagu) – B. Studencka & W. Studencki, p. 40, pl. 4, fig. 4.
1988 *Callochiton laevis* (Montagu) – W. Macioszczyk, p. 54, pl. 3, fig. 13a-13b, 14a-14b.
1999 *Callochiton rariplicatus* (Reuss) – A. Ruman in M. Kováč, pl. 2, fig. 26.
1999 *Callochiton septemvalvis* (Montagu) – B. Dell'Angelo & C. Smriglio, p. 125, pl. 40-41, fig. 55-63.
2009 *Callochiton septemvalvis* (Montagu) – E. Koskeridou et al., p. 314-315, pl. 8, fig. 3, 4.
2013 *Callochiton septemvalvis* (Montagu) – B. Dell'Angelo et al., p. 83, pl. 5 N-P.

Material: Devínska Nová Ves brickyard (0-3-1), Rohožník clay pit 3 (33-471-41), Rohožník clay pit 6 (3-17-1), borehole Kúty-45 sample 7 (0-0-1).

Occurrences in the Badenian sediments of the CP: Slovakia (Devínska Nová Ves, Rohožník: this paper, borehole Kúty-45: Kováč et al., 1999), Czech Republic (Knínice, Rudoltice: Reuss, 1860; Šulc, 1934), Poland (Korytnica, Lychów, Monastyrz, Nawodzice Rybnica, Węglin, Weglinek: Bałuk, 1965, 1971, 1984; Jakubowski & Musiał, 1977; Macioszczyk 1988; Studencka & Studencki, 1988), Austria (Steinabrunn: Šulc, 1934).

Notes: Tegmentum of the head valve consists of the fine nodes. Pleural area of the intermediate valves and antemucronal area of the tail valve with stiking folds. Arrangement of the pores forms typical grooves and ribs, paralel in the central and pleural area and in the antemucronal atea. In the lateral area, ribs run radialy from the apex. Mucro is distinct, postmucronal area sculptured with radial ribs, crossed by undistinct concentric lines.

Due to the wide variability of this species it is frequently used synonymously by paleontologists and also by taxonomists working with living representatives. It was also found in the Late Miocene of Italy (Dell'Angelo & Smriglio, 1999), Pleistocene sediments in Italy (Malatesta, 1962) and Greece (Koskeridou et al., 2009). Nowadays, it inhabits the Mediterranean, Adriatic Sea, Aegean Sea, Canary Islands and the east coast of the Atlantic from Spain to the north coast of Norway (Malatesta, 1962; Laghi 1977; Dell'Angelo & Smriglio, 1999).

Family Chitonidae Rafinesque, 1815
Genus *Chiton* Linnaeus, 1758

Chiton corallinus (Risso, 1826)
(Fig. 3.7, 4.1)

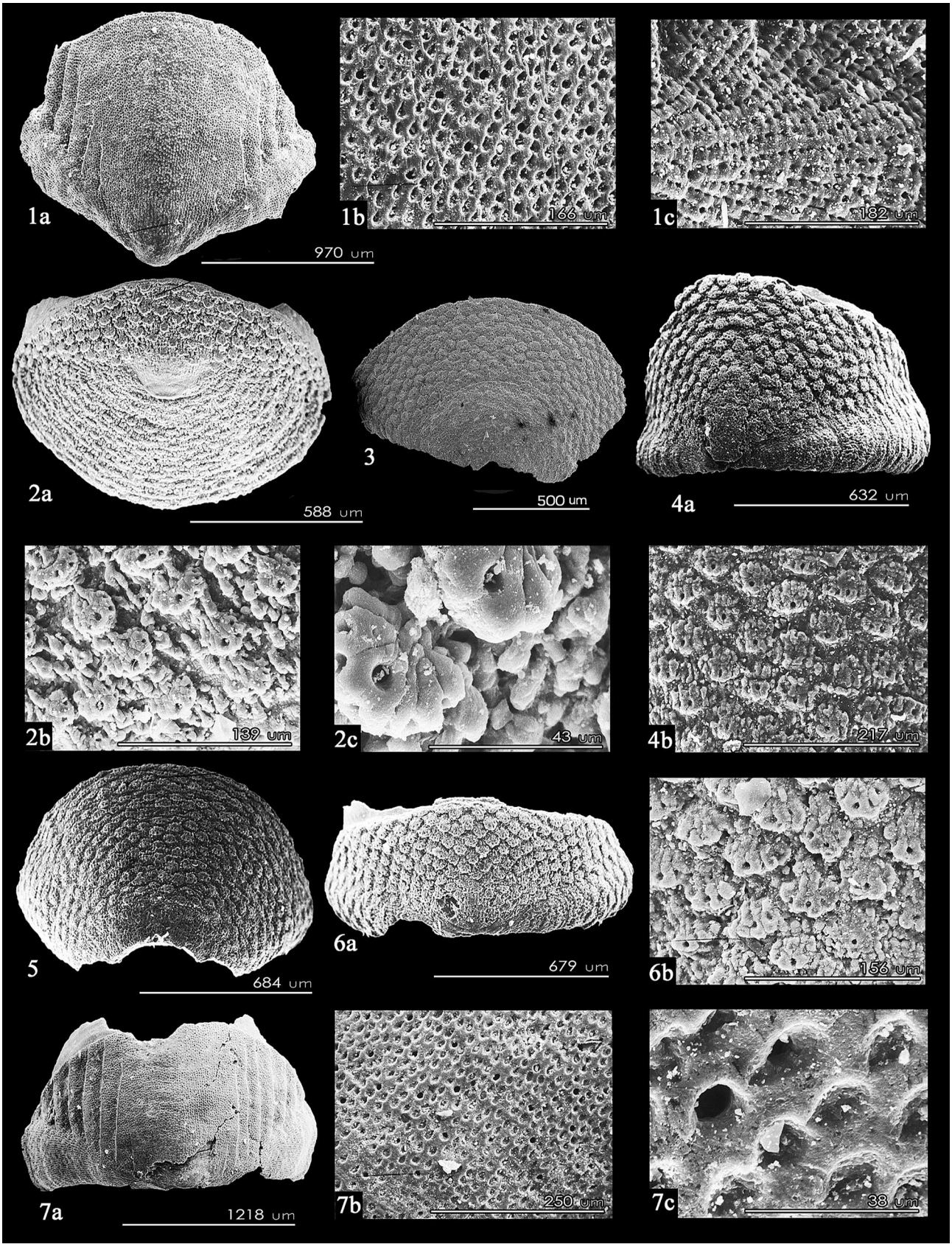

Fig. 3. (1) *Callochiton septemvalvis* **(Montagu, 1803); 1a: dorsal surface of the intermediate valve; 1b, c: detail of the central area (1b: jugal area; 1c: pleural area), Rohožník clay pit (3). (2-6)** *Leptochiton* **sp. 2a: dorsal surface of the tail valve; 2b,c: detail of the antemucronal area; 4a, 6a: dorsal surface of the intermediate valve; 4b, 6b: detail of the central area; 3, 5: dorsal surface of the head valve; Rohožník clay pit (3). (7)** *Chiton corallinus* **(Risso, 1826); 7a: dorsal surface of the intermediate valve; 7b, 7c: detail of the central area (7b: jugal area; 7c: pleural area), Rohožník clay pit (3).**

1860 *Chiton denudatus* m. n. sp. – A. E. Reuss, p. 55, pl. 8, fig. 14-15.
1934 *Chiton* (*Clathropleura*) *corallinus denudatus* Rss. – J. Šulc, p. 24-25, pl. 2, fig. 44-45.
1962 *Chiton (Chiton) corallinus* (Risso) – A. Malatesta, p. 163-164, fig. 20.
1971 *Chiton denudatus* Reuss – W. Bałuk, p. 462-463, pl. 5, fig. 9-11.
1984 *Chiton corallinus* (Risso) – W. Bałuk, p. 290-291.
1988 *Chiton corallinus* (Risso) - B. Studencka & W. Studencki, p. 41, pl. 3, fig. 1-4.
1988 *Chiton corallinus* (Risso) - W. Macioszczyk, p. 54-55, pl. 3, fig. 1-3.
2003 *Chiton corallinus* (Risso) – A. Kroh, p. 133, pl. 1, fig. 2-3.
2005 *Chiton corallinus* (Risso) – A. Dulai, p. 35-38, pl. 4, fig. 1-4.
2007 *Chiton (Rhyssoplax) corallinus* (Risso) – B. Dell'Angelo et al., p. 43-44, fig. 4c.
2010 *Chiton corallinus* (Risso) – B. Studencka & A. Dulai, p. 265-266.
2013 Chiton corallinus (Montagu) – B. Dell'Angelo et al., p. 85-87, pl. 6 A-S.

Material: Devínska Nová Ves-Útočnica 2 (0-1-0), Devínska Nová Ves brickyard (15-102- 17), Rohožník clay pit 1 (1-5-0), Rohožník clay pit 3 (76-541-68), Rohožník clay pit 6 (22-62-18), Dubová 17 (0-1-0).

Occurrences in the Badenian sediments of the CP: Slovakia (Devínska Nová Ves, Rohožník, Dubová: this paper), the Czech Republic (Knínice, Rudoltice, Zidlochovice: Procházka, 1895; Šulc, 1934), Poland (Korytnica, Lychów, Nawodzice Rybnica, Węglin, Weglinek: Bałuk, 1971, 1984; Macioszczyk 1988; Studencka & Studencki, 1988), Austria (Steinabrunn, Grund: Šulc, 1934; Kroh, 2003), Hungary (Bánd: Dulai, 2005), Romania (Lăpugiu de Sus: Dell'Angelo et al., 2007), Ukraine (Varovtsi: Studencka & Dulai, 2010).

Notes: Head valve is almost smooth with delicate radial ribs. Intermesiate valves on the pleural and tail valves in the antemucronal area posess striking pararel ribs (6-10). Lateral area of the intermediate valves is smooth with sculpture of delicate depressions. Pores are arranged randomly.

Bałuk (1971) considered the species *Chiton denudatus* as the Miocene ancestor of the species *Chiton corallinus*, but later in the paper from 1984 owing to a lack of significant taxonomic features, abandoned this hypothesis. Studencka & Studencki (1988) mention the discovery of intermediate valves in the sediments of the upper Badenian localities Varovtsy by Khmelnitsky in Ukraine. *Chiton corallinus* was found in the Italian Late Miocene, Pliocene (Modena) and Pleistocene sites (Palermo, Catania and Sicily) (Malatesta, 1962; Laghi, 1977; Dell'Angelo et al., 1999). It is also known from the Pleistocene of Greece (Koskeridou et al., 2009).

Today, it is a very abundant taxon in the Atlantic Oceam (Morocco) and all over the Mediterranean, especially in its western part. It inhabits various types of substrates, however, it is most frequent at buildups with coralline algae at depths ranging from 30 to 100 m (Poppe & Goto, 1991; Dell'Angelo & Smriglio, 1999).

Chiton olivaceus Spengler, 1797
(Fig. 4.2)

1860 *Chiton siculus* Gray – A. E. Reuss, p. 257-258, pl. 8, fig. 1-3.
1895 *Chiton siculus* Gray – V. J. Procházka, p. 100.
1930 *Chiton* sp. – K. Skoczylasówna, p. 68, pl. 1, fig. 8.
1934 *Chiton bohemicus* (Rochebrune) – J. Šulc, p. 25-26, pl. 2, fig. 48, 50-54.
1962 *Chiton (Ch.) olivaceus* Splenger – A. Malatesta, p. 161-162, fig. 18.
1965 *Chiton bohemicus* (Rochebrune) – W. Bałuk, p. 368-369, pl. 1, fig. 5-6.
1988 *Chiton olivaceus* Splenger - W. Macioszczyk, p. 54, pl. 3, fig. 4-6.
2005 *Chiton (Rhyssoplax) olivaceus* Splenger – A. Dulai, p. 38-39, pl. 3, fig. 6-8.
2007 *Chiton (Rhyssoplax) olivaceus* Splenger – B. Dell'Angelo et al., p. 42-43, fig. 4 d,f.
2010 *Chiton olivaceus* Splenger - B. Studencka & A. Dulai, p. 266, text-fig. 5 A-B.
2013 *Chiton olivaceus* Splenger - B. Dell'Angelo et al., p. 85, pl. 5 S-V.

Material: Rohožník clay pit 3 (1-27-2), Rohožník clay pit 6 (0-3-0).

Occurrences in the Badenian sediments of the CP: Slovakia (Rohožník: this paper), Czech Republic (Borač, Knínice, Porzteich, Rousnice, Rudoltice: Šulc, 1934), Poland (Lychów, Niskowa, Węglin, Weglinek: Skoczylasówna, 1930; Bałuk, 1965; Macioszczyk, 1988), Austria (Pötzleinsdorf: Šulc, 1934), Hungary (Bánd: Dulai, 2005), Romania (Basesti, Buituri, Coştei: Šulc, 1934, Zilch, 1934; Marinescu, 1964; Lăpugiu de Sus: Dell'Angelo et al., 2007), Ukraine (Varovtsi: Studencka & Dulai, 2010).

Notes: Head valve and antemucronal area of the tail valve is sculptured with ribs and grooves. Intermesiate valve posess striking paralel folds in the pleural area. Lateral area consists of three radial grooves. Antemucronal and postmucronal area of the tail valve is ornamented by commarginal growth lines.

This species was found at the Upper Badenian site of Varovtsy by Khmelnitsky in the Ukraine (Studencka & Studencki, 1988). It is known from the Tortonian of the Italy (Dell´Angelo et al., 1999). *Chiton olivaceus* var. *plioparva* was found in the Italian Pliocene localities in Piacenziano, Savona Valsesia, in France (Normandy, Biot by Nice), Italy Modena (Tabiano) and Gallina (Malatesta, 1962; Dell´Angelo et al., 2013). It is a very abundant species in the Pleistocene sediments in the entire Apennine peninsula, Sicily (Malatesta, 1962) and Greece and Cyprus (Koskeridou et al., 2009). Also, it was found in many Pleistocene sites of the Mediterranean (lower Pleistocene: Livorno, Rome, Sicily - Messina; middle Pleistocene: Cafri, Carrubbare, Livorno, Reggio Calabria, Sicily - Catania, Milazzo, Palermo; upper Pleistocene: Ischia, Livorno, Olbia, Reggio Calabria, Sardinia) (Malatesta, 1962). Nowadays, this

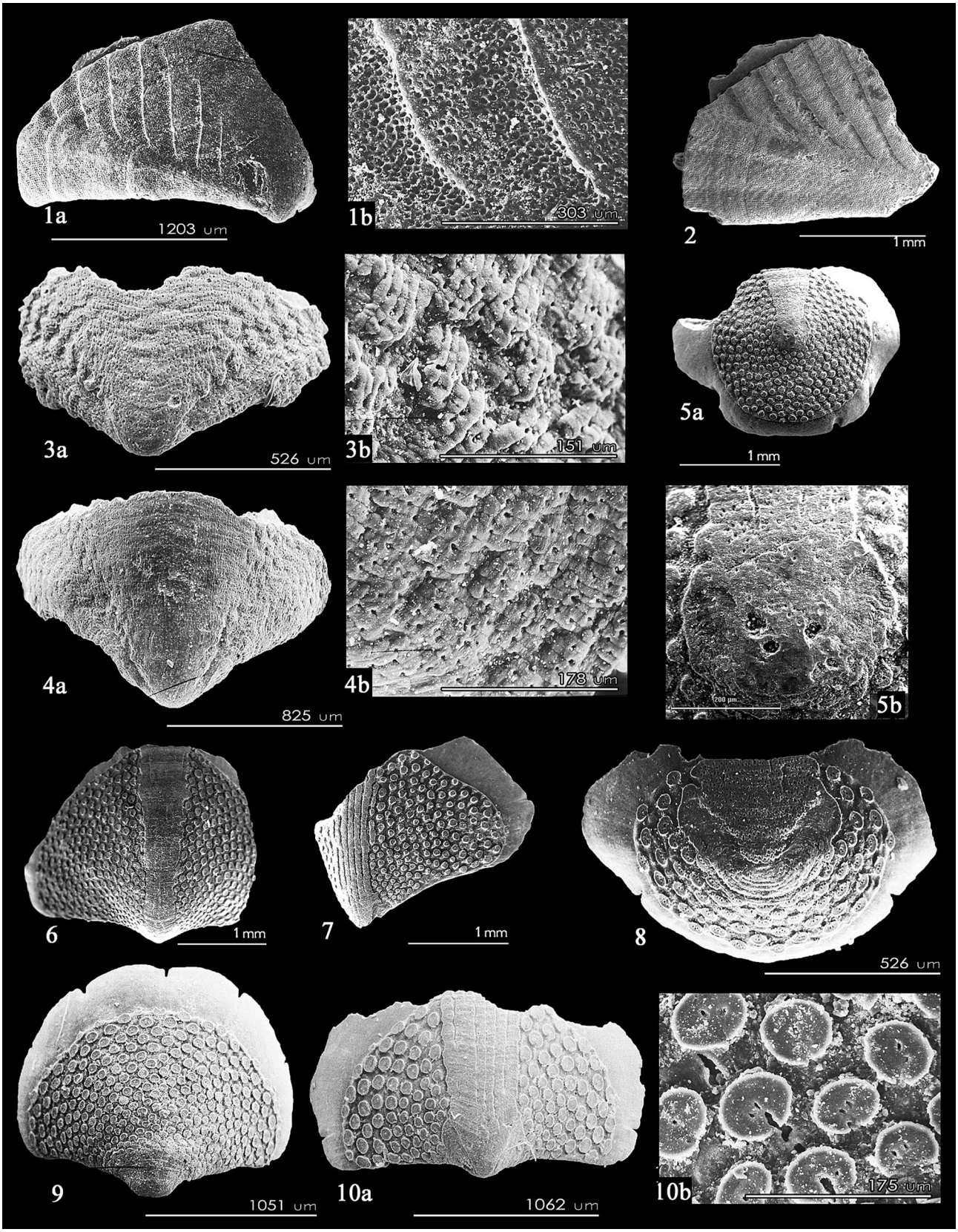

Fig. 4. (1) *Chiton corallinus* **(Risso, 1826); 1a: dorsal surface of the intermediate valve; 1b, detail of the pleural area; Rohožník clay pit (3). (2)** *Chiton olivaceus* **Splenger, 1797; dorsal surface of the intermediate valve; Rohožník clay pit (3). (3,4)** *Craspedochiton* **cf.** *minutulus* **Bałuk, 1971; 5a, 6a: dorsal surface of the intermediate valve; 5b, 6b: detail of the lateropleural area; Rohožník clay pit (3). (5-10)** *Acanthochitona faluniensis* **(Rochebrune, 1883); 5a, 8: dorsal surface of the tail valve; 5b: detail of the dorsal surface in the mucro area; 6, 7, 10a: dorsal surface of the intermediate valve; 10b: detail of the dorsal surface; 9: dorsal surface of the head valve; Rohožník clay pit (3).**

species inhabits the European and even the African coast of the Mediterranean Sea (in the Adriatic and the Aegean Sea). It was also discovered around the Canary Islands (Malatesta, 1962), Marmara Sea and Atlantic (Portugal and Morocco; Dell´Angelo & Smriglio, 1999).

Suborder ACANTHOCHITONINA Bergenhayn, 1930
Superfamily MOPALIOIDAE Dall, 1889
Family Tonicellidae Simorth, 1894
Subfamily Tonicelinae Simorth, 1894
Genus *Lepidochitona* Gray, 1821

Lepidochitona lepida (Reuss, 1860)
(Fig. 5.6)

1860 *Chiton lepidus* m. n. sp. – Reuss, p. 259, pl. 8, fig. 12-13.
1895 *Chiton lepidus* Reuss – V. J. Procházka, p. 99-100.
1934 *Middendorfia lepida* (Reuss) – J. Šulc, p. 10-11, pl. 1, fig. 13-15.
1950 *Chiton lepidus* Reuss – Csepreghy-Meznerics, p. 15.
1965 *Lepidochitona* sp. – W. Bałuk, p. 370-371, pl. 1, fig. 8.
1971 *Lepidochitona lepida* (Reuss) – W. Bałuk, p. 459-460, pl. 4, fig. 6-12.
1984 *Lepidochitona lepida* (Reuss) – W. Bałuk, p. 288-289, pl. 7, fig. 1-3.
1988 *Lepidochitona lepida* (Reuss) – W. Macioszczyk, p. 53.
1988 *Lepidochitona lepida* (Reuss) – B. Studencka & W. Studencki, p. 39-40, pl. 2, fig. 1, 3.
2001 *Lepidochitona lepida* (Reuss) – A. Dulai, p. 41-43, pl. 1, fig. 1-6.
2010 *Lepidochitona lepida* (Reuss) – B. Studencka & A. Dulai, p. 267-268, text-fig. 6 A-B.

Material: Devínska Nová Ves brickyard (1-14-2), Rohožník clay pit 1 (0-2-0), Rohožník clay pit 3 (22-295-19), Rohožník clay pit 6 (1-9-1), Dubová 1 (0-0-1), Dubová 2 (0-1-0).

Occurrences in the Badenian sediments of the CP: Slovakia (Devínska Nová Ves, Rohožník, Dubová: this paper), Czech Republic (Rudoltice: Reuss, 1860; Šulc, 1934), Poland (Korytnica, Lychów, Nawodzice, Niskowa, Rybnica, Węglin, Weglinek: Bałuk, 1965, 1971, 1984; Macioszczyk 1988; Studencka & Studencki, 1988), Hungary (Hidas, Szokolya: Csepreghy-Meznerics, 1950; Dulai, 2001), Romania (Coştei, Lăpugiu: Šulc, 1934), Ukraine (Podhorce and Varovtsi: Studencka & Dulai, 2010).

Notes: Tegmental sculpture of our investigated material is variable. Some specimens resemble *Lepidochitona subgranosa* described by Baluk (1984). Tegmentum of the intermediate valves is sculptured by rough elongated nodes. Nodes are arranged in irregular rows, in the lateral areas are even more irregular. Tegmentum of the head valve consists of the radial rows of nodes. Ornamentation of the tail valve is similar in antemucronal and postmucronal areas, mucro is undistinct.

Lepidochitona lepida was described from the Upper Badenian Ukrainian locality Varovtsy by Khmelintsky (Studencka & Studencki, 1988). Malatesta (1962) suggested that this species is an ancestor to the Lepidochitona corrugata that presently inhabits Mediterranean waters together with the species *Lepidochitona caprearum* (= *Middendorfia caprearum, Lepidochitona corrugata*) (Malatesta, 1962; Studencka & Studencki, 1988). *Lepidochitona caprearum* is very common in the Italian Late Miocene, Pliocene and Pleistocene localities (Messina, Carrubbare in Reggio Calabria, Nizzeti in Catania), Pleistocene of Greece (Koskeridou et al., 2009; Dell´Angelo et al., 2013) and is also widely distributed in the Mediterranean Sea, Black Sea, Marmara Sea and Atlantic Ocean (Malatesta, 1962; Dell´Angelo & Smriglio, 1999).

Superfamily Cryptoplacoidea H. & A. Adams, 1858
Family Acanthochitonidae Pilsbry, 1893
Genus *Acanthochitona* Gray, 1821

Acanthochitona faluniensis (Rochebrune, 1883)
(Fig. 4.5-4.10)

1934 *Acanthochiton faluniensis* Rochebrune – J. Šulc, p. 17-18, pl. 1, fig. 29, pl. 2, fig. 30-32, text-fig. 2.
1977 *Acanthochitona faluniensis* (Rochebrune) – G. Jakubowski & T. Musiał, p. 78, pl. 3, fig. 3a-3b.
1979 *Acanthochitona communis* (Risso) – G. Jakubowski & T. Musiał, p. 51, pl. 2, fig. 3.
1984 *Acanthochitona faluniensis* (Rochebrune) – W. Bałuk, p. 291-292, pl. 8, fig. 1-5.
1988 *Acanthochitona faluniensis* (Rochebrune) – B. Studencka & W. Studencki, p. 41, pl. 4, fig. 3.
1988 *Acanthochitona faluniensis* (Rochebrune) – W. Macioszczyk, p. 55, pl. 3, fig. 8-9.
1998 *Acanthochitona fasciularis* (Linnaeus) – A. Tomašových, p. 362, pl. 1, fig. 1-6.
1999 *Acanthochitona faluniensis* (Rochebrune) – A. Ruman in M. Kováč et al., pl. 2, fig. 1-2.
2001 *Acanthochitona faluniensis* (Rochebrune) – A. Dulai, p. 43, pl. 2, fig. 1-3.
2005 *Acanthochitona faluniensis* (Rochebrune) – A. Dulai, p. 39-40, pl. 4, fig. 5-10, pl. 5, fig. 1-4.
2006 *Acanthochitona faluniensis* (Rochebrune) – K. Zágoršek, p. 96, fig. 1.
2007 *Acanthochitona fascicularis* (Linnaeus) – B. Dell'Angelo, p. 44-45, fig. 4e.
2010 *Acanthochitona faluniensis* (Rochebrune) – B. Studencka & A. Dulai, p. 268-270, text-fig. 7A-F.

Material: Devínska Nová Ves-Útočnica 1 (0-2-1), Devínska Nová Ves brickyard (22-213-26), Rohožník clay pit 1 (3-78-9), Rohožník clay pit 3 (147-1056-163) Rohožník clay pit 5 (0-2-0), Rohožník clay pit 6 (16-104-24), borehole Kúty - 45 sample 19 (0-2-1), sample 27 (0-1-0), Dubová 19 (0-1-0).

Occurrences in the Badenian sediments of the CP: It is the most prevalent Badenian chiton species. It was found in Slovakia (Kúty; Rohožník; Devínska Nová Ves: Tomašových, 1998; Kováč et al., 1999 and this paper), the Czech Republic (Rudelsdorf: Kroh, 2003; Knínice, Rudoltice, Sudice, Židlochovice: Šulc, 1934; Drnovice; Zágoršek, 2006), Poland (Korytnica, Lychów,

Miasteczko, Monastyrz, Navodzice Rybnica, Trzesiny, Węglini, Weglinek: Bałuk, 1971, 1984; Jakubowski & Musiał, 1977, 1979; Studencka & Studencki, 1988; Macioszczyk, 1988), Austria (Niederleis, Steinabrunn: Šulc, 1934; Kroh, 2003), Hungary (Bánd: Dulai, 2005; Várpalota: Dulai, 2001; Szokolya: Studencka & Studencki, 1988), Romania (Buituri: Zilch, 1934; Lăpugiu de Sus: Dell'Angelo et al., 2007), Ukraine (Olesko, Szuszkowce, Varovtsi: Studencka & Dulai, 2010).

Notes: Tegmentum of the intermediate valves lateral zone is ornamented by flattened rounded nodes. Elongated elevation runs from the nodes toward the apex. Diameter of the nodes slightely increases toward posterior margin. Mostly 2 to 4 pores are present on each node. Jugal area is formed by 5 to 12 closely packed ribs divided by narrow but distinct grooves. Pores on the ribs are irregularely arranged. Prominent apophyses are very thick. Head valve is semicircular with nodes on entire tegmental surface but with ribbed, porous apex without nodes. Insertion plate is cut mostly by 5 to 6 slits. Tail valve has tegmentum of semicircular shape. Striking wing-like sutural laminaes form distinct jugal sinus. Sculpture of the antemucronal area between jugal sinus and mucro differs completely and is formed by flat, slightly grooved, surfacewith ornamentation of ireegularely spaced pores.

Recent members of the genus *Acanthochitona* inhabit a relatively broad range of environments. *Acanthochitona fascicularis* is a deep-water taxon (Poppe & Goto, 1991), with occurrences in the Mediterranean and along the eastern margin of the Atlantic Ocean from Azores, Canary Islands and Morocco to Norway (Malatesta, 1962; Dell´Angelo et al., 2013). In contrast, *Acanthochitona crinita*, which is morphologically related to *Acanthochitona faluniensis*, occurs under rocks in the sandy bottom environments at depths between 0 and 3 m (Poppe & Goto, 1991) in the Mediterranean Sea and the Atlantic Ocean (Dell´Angelo & Smriglio, 1999).

Acanthochitona sandeciana Bałuk, 1965
(Fig. 5.1)

1934 *Acanthochiton* sp. III – J. Šulc, p. 20, text-fig. 4.
1965 *Acanthochitona sandeciana* n. sp. – W. Bałuk, p. 371-372, 374, pl. 1, fig. 9-11.
1984 *Acanthochitona sandeciana* Bałuk – W. Bałuk, p. 292, pl. 9, fig. 1a-1b.

Material: Rohožník clay pit 3 (0-12-16).

Occurrences in the Badenian sediments of the CP: Slovakia (Rohožník: this paper), Poland (Korytnica, Niskowa: Bałuk, 1965, 1984), Austria (Pötzleinsdorf: Šulc, 1934).

Notes: Sculpture of the tegmentum is similar to that presented by *Acanthochitona faluniensis* but with more delicate and denser nodes.

Genus *Craspedochiton* Shuttleworth, 1853

Craspedochiton cf. minutulus Bałuk, 1971
(Fig. 4.3, 4.4)

1971 *Craspedochiton minutulus* n. sp. – W. Bałuk, p. 465-466, pl. 6, fig. 9-13.
1984 *Craspedochiton minutulus* Bałuk – W. Bałuk, p. 293-294, pl. 10, fig. 1-5, pl. 11, fig. 1-7.
1988 *Craspedochiton minutulus* Bałuk – W. Macioszczyk, p. 55, pl. 4, fig. 1-2, 3a-3b, 4a-c.

Material: Devínska Nová Ves brickyard (2-37-6), Rohožník clay pit 1 (0-3-0), Rohožník clay pit 3 (2-42-5), Rohožník clay pit 6 (0-8-1).

Occurrences in the Badenian sediments of the CP: Slovakia (Devínska Nová Ves, Rohožník: this paper), Poland (Korytnica, Lychów, Węglin, Weglinek: Bałuk, 1971, 1984; Macioszczyk, 1988).

Notes: Intermediate valves have tegmental sculpturing similar to those described by Bałuk (1984, 1988) with more smooter or without any nodes jugal area.

No representatives related to this species occur in the Mediterranean or in the Eastern Atlantic seas. Recent members of the genus *Craspedochiton* occur around Africa, the Philippines, New Zealand and Australia (Smith, 1960).

Family Cryptoplacidae H. & A. Adams, 1858
Genus *Cryptoplax* de Blainville, 1818

Cryptoplax weinlandi Šulc, 1934
(Fig. 5.5)

1934 *Cryptoplax weinlandi* (Rolle) Šulc – J. Šulc, p. 21-23, pl. 2, fig. 36-40.
1934 *Cryptoplax weinlandi* Šulc – A. Zilch, p. 199, pl. 1, fig. 18-22.
1956 *Cryptoplax weinlandi* Šulc – R. Sieber, p. 238.
1964 *Cryptoplax weinlandi* Šulc – J. Marinescu, p. 183-184, pl. 4, fig. a-e.
1971 *Cryptoplax weinlandi* Šulc – W. Bałuk, p. 466, pl. 6, fig. 1-8.
1984 *Cryptoplax weinlandi* Šulc – W. Bałuk, p. 294.
1999 *Cryptoplax weinlandi* Šulc – A. Ruman in M. Kováč et al., pl. 2, fig. 3-4.
2001 *Cryptoplax weinlandi* Šulc – A. Dulai, p. 45, pl. 2, fig. 4-6, pl. 3, fig. 1-6.
2003 *Cryptoplax weinlandi* Šulc – A. Kroh, p. 235-236, pl. 1, fig. 8-12.
2005 *Cryptoplax weinlandi* Šulc – A. Dulai, p. 40-44, pl. 5, fig. 5-12, pl. 6, fig. 1-11, pl. 7, fig. 1-12.
2006 *Cryptoplax weinlandi* Šulc – K. Zágoršek, p. 98, fig. 2.
2007 *Cryptoplax weinlandi* Šulc – B. Dell'Angelo, p. 45-47, fig. 5.

Material: Devínska Nová Ves Útočnica 2 (0-3-0), borehole Kúty-45 sample 20 (0-1-0), borehole Kúty-45 sample 27 (0-2-1).

Occurrences in the Badenian sediments of the CP: This species is relatively abundant in the Badenian of the Central Paratethys.

It is known in Slovakia (Devínska Nová Ves, borehole Kúty – 45: Kováč et al., 1999 and this paper), the Czech Republic (Borač, Knínice, Lysice, Nový Rybník (Porzteich), Rudoltice, Sudice, Židlochovice: Šulc, 1934; Zilch, 1934; Vranovice: Zágoršek, 2006), Poland (Korytnica: Bałuk, 1971, 1984), Austria (Forchtenau, Niederleis, Nodendorf, Steinabrunn: Šulc, 1934; Zilch, 1934; Sieber, 1956; Kroh, 2003), Hungary (Szokolya, Bánd, Devecser: Dulai, 2001; 2005), Romania (Bujturi, Coştei, Lăpugiu, Orsova: Šulc, 1934; Zilch, 1934; Marinescu, 1964; Dell'Angelo et al., 2007).

Notes: Elongated valves are relatively large, reaching to 7 mm in length. Ornamentation composes of striking longitudial depressions and ribs. Outher surface is usually abraded, but pores are still visible in the jugal area.

In addition to this species, the genus *Cryptoplax* is represented by the species *C. margitae* in the Central Paratethys. This species differs from the *C. weinlandi* by ornamentation made by granular ridges (not smooth) and by pores emerging on the ventral side in the jugal areas of the valves that have an oval shape (Dulai, 2001). Recent representatives of the genus *Cryptolax* occur in the tropics of the Indo-Pacific and Red Sea (Smith, 1960). Recent species *C. striata* from the South Australia is an opportunistic omnivorous chiton grazing on algae and sponges (Kangas & Shepherd, 1984).

4. DISCUSSION AND CONCLUSIONS

28 species in total occur in the upper Badenian of the Central Paratethys: *Leptochiton boettgeri* (Šulc), *Leptochiton* cf. *cancellatus* (Sowerby), *Leptochiton srameki* (Šulc), *Leptochiton sulci* (Bałuk), *Parachiton africanus* (Sirenko), *Lepidopleurus cajetanus* (Poli), *Lepidopleurus benoisti* (Rochebrune), *Hanleya multigranosa* (Reuss), *Ischnochiton korytnicensis* Bałuk, *Ischnochiton rissoi* (Payradeau), *Lepidochitona boravicensis* Šulc, *Lepidochitona lepida* (Reuss), *Lepidochitona subgranosa* Bałuk, *Callochiton septemvalvis* (Montagu), *Callochiton zigzag* Šulc, *Chiton corallinus* (Reuss), *Chiton juttneri* Šulc, *Chiton olivaceus* Splenger, *Acanthochitona fascicularis* (Linnaeus), *Acanthochitona faluniensis* (Rochebrune), *Acanthochitona plana* Šulc, *Acanthochitona sandeciana* Bałuk, *Craspedochiton minutulus* Bałuk, *Craspedochiton profascicularis* (Boettger), *Craspedochiton schafferi* Šulc, *Craspedochiton steinabrunensis* Šulc, *Cryptoplax weinlandi* Šulc, *Cryptoplax margitae* Dulai. Therefore, thirteen species of the Badenian chitons described here represent more than a third of all known chiton species from the Central Paratethys. They belong to six families, including Leptochitonidae, Hanleyidae, Callochitonidae, Chitonidae, Tonicellidae and Acanthochitonidae are described. The most common in the collected material were *Leptochiton sulci* (20 %), *Chiton corallinus* (19 %) and *Callochiton septemvalvis* (11 %). Other species contribute with less than 10 % (Pl. 1).

Species such as *Parachiton africanus*, *Callochiton septemvalvis*, *Chiton olivaceus* and *Chiton corallinus* survive to the present and inhabit the Mediterranean Sea. Other Middle Miocene species can represent extinct lineages or ancestral species of those species that live today in the Mediterranean Sea. *Cryptoplax weinlandi* and *Craspedochiton minutulus* occur in the Middle Miocene of the Central Paratethys only. Recent members of the genus *Cryptoplax* occur in the warm tropical seas of the Indian Ocean, Pacific Ocean and the Red Sea (Smith, 1960; Kangas & Shepherd, 1984). *Cryptoplax weinlandi* was relatively widespread during the Early Badenian in the northern part of the Central Paratethys (although not in Romania). However, its range gradually shifted southward during the Late Badenian (Studencka & Studencki, 1988; Kroh, 2003). This observation is supported by its absence at the localities Devínska Nová Ves brickyard and Rohožník clay pit, where other species occur at high abundances. Therefore, the temporal decline in abundance of this genus and its southward range shift may be explained by a gradual southward shift of warm water masses in the Central Paratethys during the Badenian. However, very rare valves of *Cryptoplax weinlandi* at localities Devínska Nová Ves-Útočnica and Kúty-45 borehole may indicate that short-term increase in temperature (Hudáčková et al., 2003b; Báldi, 2006; Kováčová & Hudáčková 2009) still allowed northward range extension of this species during the Late Badenian.

Although stratigraphic range of *Craspedochiton minutulus* is limited to the Late Badenian, several other species of the genus *Craspedochiton* occur in the Lower and Upper Badenian of the Central Paratethys (Studencka & Studencki, 1988; Studencka & Dulai, 2010) and in northern Italy (Laghi, 1977). Species of the genus *Craspedochiton* in present-day seas are predominantly limited to warm tropical waters of the Indo-Pacific region. Due to high relative abundance and a short stratigraphic range of several chiton species in the Central Paratethys, these species could become a good biostratigraphic tool. For example, *Acanthochitona faluniensis* is restricted to the Miocene but occurs at a very high relative abundance in the northern part of the Vienna Basin (Devínska Nová Ves brickyard = 45 %, Devínska Nová Ves-Útočnica 1 = 100 %, Rohožník clay pit 1 = 84 %, Rohožník clay pit 3 = 33 %, Rohožník clay pit 5 = 100 %, Rohožník clay pit 6 = 43 %, Kúty-45 borehole = 55 %) and also at other localities in the Central Paratethys. Its phylogenetic relation to other taxa remains unclear, although Laghi (1977) synonymized it with the recent species *Acanthochitona fascicularis* living in the Mediterranean and the east coast of the Atlantic from the Canary Islands to the south of Great Britain. *Acanthochitona fascicularis* is the largest Mediterranean chiton living on solid substrates such as rocks, pebbles and molluscan shells.

The most species-rich assemblage of benthic foraminifera was found in the Rohožník sample. The high diversity is probably caused by spatial and temporal mixing of assemblages derived from two marine and environments, including a shallow, marginal marine environment and a deeper-shelf environment. The first environment is dominated by epiphyte taxa dwelling in the leaves of sea grass (*Lobatula*, *Tretomphalus*, *Asterigerina*) and by keeled elphidia together with small miliolide taxa (*Pseudotriloculina, Quinqueloculina* and *Miliolina*) dwelling in the rhizoidal system. The second environment is represented by foraminifers with deeper-water affinity (*Melonis, Cassidulina, Globocassidulina*). Such mixed types of assemblages were detected in all samples with chitons. Redeposited assemblage derived from patch-reefs occur (*Borelis* and thick walled *Quinqueloculina*) in the Kúty-45 (7) and at the Dubová. In the Kúty-45 (20, 27) and Devínska

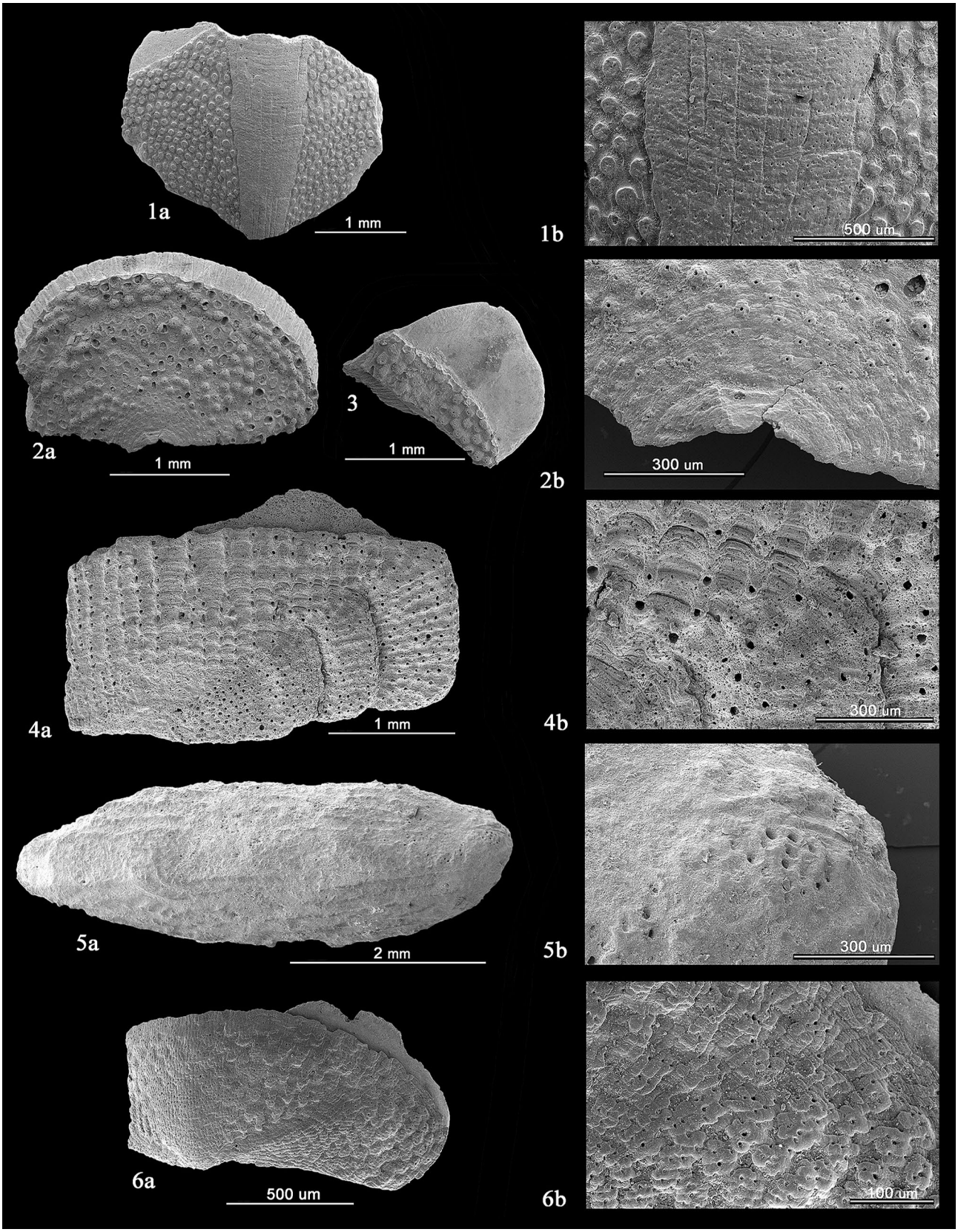

Fig. 5. (1) *Acanthochitona sandeciana* **Baluk, 1965; 1a: dorsal surface of the intermediate valve; 1b: detail of the dorsal surface; Rohožník clay pit (3). (2,3)** *Hanleya multigranosa* **(Reuss, 1860); 2a: dorsal surface of the head valve; 2b: detail of the apex; 3: fragment of the intermediate valve with apophysis; Rohožník clay pit (3). (4)** *Lepidopleurus cajetanus* **(Poli, 1791); 4a: dorsal surface of the intermediate valve; 4b: detail of the dorsal surface; Dubová (13). (5)** *Cryptoplax weinlandi* **Šulc, 1934; 5a: dorsal surface of the intermediate valve; 5b: detail of the apex; Devínska Nová Ves-Útočnica. (5)** *Lepidochitona lepida* **(Reuss, 1860); 5a: dorsal surface of the intermediate valve; 5b: detail of the dorsal surface; Rohožník clay pit (3).**

Nová Ves brickyard (13, 14), deeper marine assemblages prevail, but shallow-water epiphytic genera such as *Lobatula* and *Asterigerinata* or *Discorbis* are rare. All samples are assigned to the Upper Badenian, although some foraminifers in the Dubová imply the Sarmatian age (*Nonion biporus, Shackoinella imperatoria, Elphidium hauerinum*) (Koubová & Hudáčková, 2010).

The chiton assemblages occur in allochthonous bioclastic layers that form intercalations in massive sets of calcareous clays at Devínska Nová Ves brickyard and Rohožník clay pit. In the Devínska Nová Ves brickyard, a good sorting and a very small size of bioclastic debris implies that the several cm-thick layer was generated by a distal part of episodic current of tempestitic or turbiditic origin. In contrast, a poor sorting and coarse-grained debris with a large percentage of rhodoliths at the locality Rohožník clay pit suggest that these layers were deposited in the more proximal part of the current.

At the locality of the Kúty-45 borehole, where chitons occur in a complex of the fore-bioherm area, respectively directly in central parts of the bioherm formed by red algae. In this case, we suggest that chiton valves were subjected to a very short transport. The assemblage from Devínska Nová Ves-Útočnica is difficult to compare with other assemblages because chiton valves are rare.

Acknowledgement: We thank Alfred Dulai and Bruno Dell'Angelo for their insightful comments on the paper and Ján Schlögl and Adam Tomašových for editorial comments. We thank the Slovak Research and Development Agency (APVV-0099-11) for funding.

References

Báldi K., 2006: Paleoceanography and climate of the Badenian (Middle Miocene 16.4-13.0 Ma) in the Central Paratethys based on foraminifera and stable isotope ($\delta^{13}C$ and $\delta^{18}O$) evidence. *International Journal of Earth Sciences*, 95, 119–142.

Bałuk W., 1965: Chitony z piasków tortonskych kotliny Sadeckiej. *Acta Paleontologica Polonica*, 10, 3, 365–378.

Bałuk W., 1971: Lower Tortonian chitons from the Korytnica clays, southern slopes of the Holy Cross Mts. *Acta Geologica Polonica*, 21, 3, 449–472.

Bałuk W., 1984: Additional data on chitons and cuttelfish from the Korytnica Clays (Middle Miocene; Holy Cross Mountains, Central Poland). *Acta Geologica Polonica*, 34, 3–4, 281–297.

Csepreghy-Mezneric I. 1950: A Hidasi (Baranya M.) tortonai fauna. *Annales Instituti Geologici Publici Hungarici*, 39, 2, 3–106.

Dell'Angelo B., Grigis M. & Bonfitto A., 2007: Notes on fossil chitons. 2. Polyplacophora from the Middle Miocene of Lăpugiu (Romania). *Bollettino Malacologico*, 43, 39–50.

Dell'Angelo B., Landau B. & Robert Marquet R., 2004: Polyplacophora from the Early Pliocene of Estepona (Málaga, southwest Spain). *Bollettino Malacologico*, 5, 25–44.

Dell'Angelo B. & Smriglio C. 1999: Chitoni viventi del Mediterraneo. Edizioni Evolver, Roma, 1–256.

Dell'Angelo B. & Sosso M., 2015: Polyplacophora from the Miocene of North Italy. Part 1: Leptochitonidae, Hanleyidae, Ischnochitonidae and Callistoplacidae. *Rivista Italiana di Paleontologia e Stratigrafia*, 121, 2, 217–242.

Dell'Angelo B., Sosso M., Prudenza M. & Bonfitto A., 2013: Notes on Fossil Chitons. 5. Polyplacophora from the Pliocene of Western Liguria, Northwest Italy. *Rivista Italiana di Paleontologia e Stratigrafia*, 119, 1, 65–107.

Dulai A., 2001: Middle Miocene (Badenian) Polyplacophora (Mollusca) remains from borehole Szokolya-2 (Bözsöny Mts, Hungary, central Paratethys). *Fragmenta paleontologica Hungarica*, 19, 39–49.

Dulai A., 2005: Badenian (Middle Miocene) Polyplacophora fromthe Central Paratethys (Bánd and Devecser, Bakony Mountains, Hungary). *Fragmenta Palaeontologica Hungarica*, 23, 29–50.

Garilli V., Dell´Angelo B. & Vardala-Theodorou E., 2005: Polyplacophora fom the Pleistocene of Kyllini (NW Peloponnese, Greece). *Bollettino della Societa Paleontologica Italiana*, 44, 2, 127–144.

Hladilová Š. & Fordinál F., 2013: Upper Badenian Molluscs (Gastropoda, Bivalvia, Scaphopoda) from the Modra-Kráľová locality (Danube Basin, Slovakia). *Mineralia Slovaca* 45, 35–44.

Hudáčková N., Halásová E., Fordinál K., Sabol M., Joniak P. & Kráľ J., 2003[a]: Biostratigraphy and radiometric dating in the Vienna Basin Neogene (Slovak part). *Slovak Geological Magazine*, 9, 4, 233–235.

Hudáčková N., Banasová M., Reháková D., Halásová E. & Lintnerová O., 2003[b]: Distribution of planctonic and benthic foraminifera in correlation with calcareous dinoflagellate cysts derived from the Devínska Nová Ves clay pit (the Late Badenian lectotype locality) and their evidence for environmental reconstruction, sequence and biostratigraphy. *EEDEN*, Birth of the new world, Stará Lesná, 41–43.

Hudáčková N. & Kováč M., 1993: Zmeny sedimentačného prostredia východnej časti viedenskej panvy vo vrchnom bádene a sarmate. *Mineralia Slovaca*, 25, 3, 202–210.

Hyžný M., Hudáčková N., Biskupič R., Rybár S., Fuksi T., Halásová E., Zágoršek K., Jamrich M. & Ledvák P., 2012: Devínska Kobyla – a window into the Middle Miocene shallow-water marine environments of the Central Paratethys (Vienna Basin, Slovakia). *Acta Geologica Slovaca*, 4, 2, 95–111.

Jakubowski G. & Musiał T., 1977: Lithology and fauna from the Upper Tortonian sands of Monastyrz and Dlugi Goraj (Southern Rostocze, Poland). *Prace Muzeum Ziemi*, 26, 63–126.

Jakubowski G. & Musiał T., 1979: Lithology and fauna of the Middle Miocene deposits of Trzesiny (Rostocze Tomaszowskie Region, South-eastern Poland). *Prace Muzeum Ziemi*, 32, 37–70.

Jamrich M., 2013: Biostratigrafia a paleoekológia vrchnoseravalských (sarmatských) sedimentov Dunajskej a slovenskej časti Viedenskej panvy na základe vápnitých nanofosílií. *Dissertation thesis*, PrifUK Bratislava, 151 p.

Jamrich M. & Halásová E., 2010: Vývoj spoločenstiev vápnitých nanofosílií Viedenskej panvy ako odraz paleoenvironmentálnych zmien počas vrchného bádenu (Devínska Nová Ves – tehelňa). *Acta Geologica Slovaca*, 2, 2, 123–140.

Kaas P. & Van Belle R.A., 1985: Monograph of Living chitons (Mollusca: Polyplacophora). Volume 1. Order Neoloricata: Lepidopleurina. E.J. Brill/ Dr. W. Backhuys, Leiden, 1–240.

Kangas M. & Shepherd S.A., 1984: Distribution and feeding of chitons in a boulder habitat at West Island, South Australia. *Journal of the Malacological Society of Australia*, 6, 101–111.

Koskeridou E., Vardala-Theodorou E. & Moissette P., 2009: Pliocene and Pleistocene shallow-water chitons (Mollusca) from Rhodes Island, Greece. *Neues Jahrbuch für Geologie und Paläontologie - Abhandlungen,* 251, 3, 303–330.

Koubová I. & Hudáčková N., 2010: Foraminiferal successions in the shallow water Sarmatian sediments from the MZ 93 borehole (Vienna Basin, Slovak part). *Acta Geologica Slovaca*, 2, 1, 47–58.

Kováč M., Baráth I., Halásová E., Hudáčková N., Slamková M., Sitár V., Bartakovicsová A., Španihelová E. & Ruman A., 1999: Sedimentologické, biostratigrafické a štruktúrne vyhodnotenie jadier vrtu Kúty 45. Manuscript (archive Nafta Gbely), 1–36.

Kováčová M. & Hudáčková N., 2009: Late Badenian foraminifers from the Vienna Basin (Central Paratethys): Stable isotope study and paleoecological implications. *Geologica Carpathica*, 60, 1, 59–70.

Kroh A., 2003: The Polyplacophora (Mollusca) of the Langhian (Lower Badenian) of the Molasse Zone and the Northern Vienna Basin (Austria). *Annalen des Naturhistorischen Museums in Wien*, 104A, 129–143.

Laghi G.F., 1977: Polyplacophora (Mollusca) neogenici dell´Appennino settentrionale. *Bollettino della Società Paleontologica Italiana*, 16, 1, 87–115.

Laghi G.F., Russo F. & Dell´Angelo B., 1981: Recenti ritrovamenti di *Lepidopleurus* (*Parachiton*) *africanus* Nierstrasz, 1906 (Polyplacophora, Mollusca). *Atti della Società dei Naturalisti e Matematici di Modena*, 111, 1–7.

Macioszczyk W., 1988: Polyplacophora from the Badenian deposits of Weglinek, Weglin and Lychów (Western Rostocze – Poland). *Prace Muzeum Ziemi – Prace Paleozoologiczne*, 40, 47–58.

Malatesta A., 1962: Mediterranean Polyplacophora Cenozoic and Recent. *Geologica Romana*, 1, 145–171.

Marinescu J., 1964: Reprezentanti ai clasei Amphineura in Miocenul din Oltenia. *Dari de Seama ale Sedintelor*, 50, 1, 179–185.

Poppe G.T. & Goto Y., 1991: European Seashells. Volume I (Polyplacophora, Caudofoveata, Solenogastra, Gastropoda). Christa Hemmen Verlag, Wiesbaden, 1–340.

Procházka V.J., 1895. Miocean východočeský. *Archiv pro přírodověcké prozkoumáni Čech*, 10, 2, 1–149.

Reuss A.E., 1860: Die marinen Tertiärschichten Böhmens und ihre Versteinerungen. *Sitzungsberichte der Mathematischen-Naturwissenschaften Classe der Kaiserlichen Akademie der Wissenschaften*, 34, 207–285.

Sieber R., 1956: Die Tortonfauna von Mattersburg und Forchtenau (Burgenland). *Verhandlungen der Geologischen Bundesanstalt*, 1958, 2, 142–155.

Sirenko B., 2006: New outlook on the system of chitons (Mollusca: Polyplacophora). *Venus*, 65, 27–49.

Sirenko B., 2014: Composition of the genus Hanleya (Mollusca: Polyplacophora: Lepidopleurida), with the description of two new species. *Journal of Natural History*, 48, 45–48, 2913–2945.

Skoczylasówna K., 1930: Przyczynek do znajomosci miocenu kotliny sadeckiej. *Rocznik Polskiego Towarzystwa Geologicznego*, 6, 50–72.

Smith A.G., 1960: Amphineura. In: MOORE, R. C. (Ed.): Treatise on invertebrate paleontology; Part I, Mollusca 1, University of Kansas Press, 1–350.

Studencka B. & Studencki W., 1988: Polyplacophora from the Badenian (Middle Miocene) marine sandy facies of the Holy Cross Mts. (Central Poland). *Prace Muzeum Ziemi – Prace Paleozoologiczne*, 40, 37–46.

Studencka B. & Dulai A., 2010: Chitons (Mollusca: Polyplacophora) from the Middle Miocene sandy facies of Ukraine, Central Paratethys. *Acta Geologica Polonica*, 60, 257–274.

Špička V., 1966: Paleogeografie a tektogeneze Vídeňské pánve a příspěvek k její naftově geologické problematice. *Rozpravy Československé Akademie Věd, Řada matematicko- přírodních Věd*, 76, 12, 1–72.

Šulc J., 1934: Studie über die fossilen Chitonen – I. Die fossilen Chitonen im Neogen des Wienwr Beckens und der angrezenden Gebiete. *Annalen des Naturhistorischen Museums in Wien*, 47, 1–31.

Švagrovský J., 1981: Lithofazielle Entwicklung und Molluskenfauna des oberen Badeniens (Miozän M4d) in dem Gebiet Bratislava-Devínska Nová Ves. *Západné Karpaty, Séria Paleontológia*, 7, 1–204.

Tomašových A., 1998: Bádenské mäkkýše z tehelne Devínska Nová Ves (Bratislava, Slovensko). *Mineralia Slovaca*, 30, 357–386.

Zilch A., 1934: Zur Fauna des Mittel-Miozänes von Kostej (Banat). *Senkenbergiana*, 16, 1–6, 193–302.

Appendix 1. List of the molluscs species from the studied localities.

	DNV-b.y.	DNV-Útoč.	Kúty-45	Dubová	Rohožník
Abra sp.				1	
Acanthocardia schafferi (Kautsky)		1			
Acteocina lajonkaireana (Basterot)				1	
Agapilia picta (Férussac)	1			1	
Agapilia picta tuberculata (Schréter in Horusitzky)				1	
Alaba costellata anomala (Eichwald)		1	1	1	1
Alvania (Alvania) alata Bałuk				1	
Alvania (Alvania) helenae Boettger				1	
Alvania (Alvania) montagui miocaenica Sacco			1		
Alvania (Alvania) oceani (d´Orbigny)			1	1	
Alvania (Alvania) venus (Orbigny)			1		1
Alvania (Alvinia) alexandrae (Boettger)				1	1
Alvania perregularis (Sacco)				1	
Alvania (Taramellina) partschi Hoernes					1
Alvania spp.		1	1	1	
Alvania zetlandica (Montagu)				1	
Amussium (Palliolum) bittneri Toula	1				
Amussium cristatum badense (Fontannes)		1			
Amussium denudatum (Reuss)	1				
Anadara (Anadara) diluvii (Lamarck)		1			1
Anadara (Anadara) fichteli (Deshayes)					1
Anadara turonica Dujardin		1			
Ancilla (Ancilla) glandiformis Lamarck		1			
Angulus (Oudardia) compressus (Brocchi)				1	
Anodontia (Loripinus) fragilis (Philippi)		1			
Anomia (Anomia) ephippium rugulosostriata Brocchi in Bronn		1			
Aporrhais pespelecani alatus (Eichwald)		1		1	
Architectonica (Architectonica) monilifera (Bronn)		1			
Architectonica sp. ?		1	1		
Arcoperna ? serricea (Bronn)		1			
Astraea (Bolma) meynardi (Michelotti)			1		
Atrina pectinata vindobonensis (Sacco)		1			
Azorinus antiquatus (Pultney)		1			
Barbatia (Barbatia) barbata (Linnaeus)					1
Bela polyacanthata (Boettger)				1	
Bela sparsa (Boettger)				1	
Bela spp.			1	1	1
Bela subcylindrata (Boettger)		1			
Bittium reticulatum (Costa)	1	1	1	1	1
Bittium schwartzi (Hörnes)		1		1	
Bolma perangulata Sacco		1			
Bolma tuberculata (Serres)		1			
Caecum (Caecum) trachea (Montagu)				1	
Callista italica (Defrance)		1		1	
Callistoma sp.		1			
Calyptrea chinensis (Linnaeus)			1	1	
Cancellaria (Merica) fenestrata Eichwald		1			
Cardita deshayesi Hoernes		1			
Cardites partschi (Münster in Goldfuss)		1		1	
Cardium hians Brocchi		1		1	
Cardium (Parvicardium) holubicense Hilber		1			
Cerastoderma plicata (Eichwald)				1	
Cerastoderma sp.				1	
Cerithiopsis (Dizoniopsis) bilineata (Hoernes)		1			
Cerithiopsis (Cerithiopsis) tubercularis (Montagu)				1	
Cerithium (Ptychocerithium) bronni Partsch in Hoernes		1	1	1	
Cerithium (Ptychocerithium) procrenatum Sacco		1		1	
Cerithium (Thericium) europaeum Mayer				1	
Cerithium (Thericium) turonicum Mayer				1	
Cerithium (Thericium) vulgatum Bruguiére			1		
Cerithium rubiginosum Eichwald				1	
Cerithium sp.				1	
Cingula sp.				1	
Circomphalus subplicatus (d´Orbigny)		1		1	
Clausinella scalaris (Bronn)		1		1	
Clavagella (Stirpulina) bacillum (Brocchi)		1			
Clavatula oliviae (Hoernes et Auinger)				1	
Clavatula (Clavatula) granulatocincta (Münster)		1			
Clavatula spp.		1		1	
Codakia (Codakia) leonina (Basterot)		1			
Codakia sp.		1			
Columbella curta Dujardin		1			
Congeria (Andrusovioconcha) sandbergeri Andrussov				1	
Conus dujardini Deshayes		1			
Conus spp.		1	1	1	1
Corbula (Caryocorbula) basteroti Hörnes				1	
Corbula (Corbula) carinata Dujardin				1	
Corbula (Varicorbula) gibba (Olivi)	1	1	1		1

Appendix 1. (continue) List of the molluscs species from the studied localities.

	DNV-b.y.	DNV-Útoč.	Kúty-45	Dubová	Rohožník
Crassadoma multistriata (Poli)				1	
Crepidula (Janacus) crepidula (Linnaeus)		1			
Ctena (Ctena) exigua (Eichwald)		1			
Cubitostrea digitalina (Eichwald)		1	1	1	1
Cyclocardia (Scalaricardita) scalaris (Sowerby)			1		
Cylichna sp.				1	
Cyllenia ancillariaeformis (Grateloup)				1	
Cyllenia sp.				1	
Cythara (Mangelia) sp.				1	
Cythara (Mangelia) sp. ?				1	
Dentaliidae indet.		1			
Dentalium (Antalis) badense Partsch		1			
Diloma (Paroxystele) orientale (Cossmann et Peyrot)		1		1	
Diodora (Diodora) graeca (Linnaeus)		1			
Diplodonta rotundata (Montagu)				1	
Divalinga ornata (Agassiz)				1	
Donacilla cornea (Poli)				1	
Donax sp.				1	
Drillia pustulata Brocchi		1			
Duplicata duplicata (Sowerby)				1	
Emarginula sp.		1			
Ensis sp.				1	
Eomiltha transversa (Bronn)		1		1	
Erato (Erato) elongata Seguenza		1			1
Ervilia pusilla (Philippi) + *Ervilia* sp.			1	1	
Erycina (Erycina) truncata Wood		1			
Euspira helicina (Brocchi)	1	1		1	1
Euthriofusus virgineus (Grateloup)		1			
Ficus (Ficus) condita Brongniart		1			
Fissidentalium badense (Partsch in Hoernes)					1
Flabellipecten besseri (Andrzejowski)		1		1	
Fossarus costatus Brocchi			1		
Flabellipecten leythajanus (Partsch)				1	
Flabellipecten solarium (Lamarck)		1			
Gari (Gobraeus) labordei (Basterot)				1	
Gari (Psammobia) affinis (Dujardin) ?		1			
Gari spp.				1	
Gastrochaena sp.		1			
Genota sp.		1			
Gibbula (Colliculus) affinis pseudoangulata Boettger		1	1	1	

	DNV-b.y.	DNV-Útoč.	Kúty-45	Dubová	Rohožník
Gibbula biangulata Eichwald		1			
Gibbula (Gibbula) buchi (Dubois)		1			
Gibbula sp.			1		1
Glossus (Glossus) hoernesi (Dall)		1			
Glycymeris (Glycymeris) deshayesi (Mayer)		1		1	1
Gouldia (Gouldia) minima (Montagu)		1	1	1	
Granulolabium bicinctum (Brocchi)				1	
Hadriania coelata (Dujardin)		1			
Hadriania excoelata (Cossmann et Peyrot)		1			
Hiatella (Hiatella) arctica (Linnaeus)				1	
Hinia (Uzita) rosthorni (Hoernes)		1			
Hydrobia frauenfeldi Hörnes				1	
Hydrobia immutata Frauenfeld		1			
Hydrobia sp.				1	
Chama austriaca Hoernes		1			
Chama (Chama) gryphina Lamarck		1			
Chama (Chama) gryphoides Linnaeus		1	1		1
Chama sp.				1	
Chlamys (Chlamys) multistriata (Poli)		1	1		
Chlamys (Aequipecten) elegans (Andrzejowski)		1			1
Chlamys (Aequipecten) malvinae (Dubois)		1			
Chlamys sp.				1	
Chrysallida (Parthenina) interstincta (Montagu)		1			1
Irus (Irus) irus (Linnaeus)				1	
Hinia (Tritonella) daciae (Hoernes et Auinger)					1
Laevicardium cyprium (Brocchi)		1			
Latirus valenciennesi (Grateloup) ?		1			
Leiostraca jaskiewiczi Bałuk		1			
Leiostraca sp. ?				1	
Leucorhynchia sp.			1		
Limacina miorostralis (Kautsky)	1				
Limacina valvatina (Reuss)	1				
Linga (Linga) columbella (Lamarck)		1			
Lithophaga sp.				1	
Loripes (Loripes) dujardini (Deshayes)				1	
Loripes (Microloripes) dentatus (Defrance)		1	1	1	
Lucinoma borealis (Linnaeus)				1	
Macoma elliptica Brocchi	1				
Manzonia (Alvania) miocrassicosta (Sacco)				1	
Megacardita jouaneti (Basterot)		1			

Appendix 1. (continue) List of the molluscs species from the studied localities.

	DNV-b.y.	DNV-Útoč.	Kúty-45	Dubová	Rohožník
Megacardita laticosta (Eichwald)		1			
Megaxinus bellardinus (Bronn)		1			
Megaxinus (Megaxinus) incrassatus (Dubois)		1		1	
Megaxinus (Megaxinus) transversus (Bronn)				1	
Megaxinus sp.				1	
Mitra (Ebenomitra) ebenus Lamarck		1			1
Mitrella bittneri (Hoernes et Auinger)					1
Mitrella sp.		1		1	
Modiola sp.				1	
Modiolula sp.				1	
Modiolula volhynica (Eichwald)				1	
Mohrensternia sp. ?				1	
Muricidae indet.				1	
Muricopsis cristata (Brocchi)		1			
Musculus sp.		1			
Myrtea (Myrtea) spinifera (Montagu)		1			
Nassarius cf. kostejanus (Boettger)				1	
Nassarius dujardini (Deshayes)				1	
Nassarius serraticosta (Bronn)				1	
Nassarius schoenni (Hoernes & Auinger)				1	
Nassarius schoenni (Hoernes & Auinger) ?				1	
Nassarius sp.				1	
Nassarius striatulus (Eichwald)				1	
Nassarius subprismaticus (Hoernes & Auinger)				1	
Natica sp.				1	
Natica tigrina Defrance		1		1	
Nemocardium sp.		1			
Nucula (Nucula) nucleus (Linnaeus)	1	1			1
Nucula (Nucula) mayeri M. Hoernes	1				
Nucula sp.			1		
Odostomia plicata (Montagu)				1	
Odostomia sp.		1	1	1	
Onoba semicostata (Montagu)				1	
Oppenheimopecten aduncus (Eichwald)				1	
Ostrea (Ostrea) lamellosa Brocchi		1			
Ostrea sp.			1	1	
Oudardia sp. ?				1	
Panopea (Panopea) menardi Deshayes		1			
Parvicardium holubicense (Hilber)				1	
Parvicardium minimum (Philippi)				1	
Parvicardium papillosum (Poli)				1	

	DNV-b.y.	DNV-Útoč.	Kúty-45	Dubová	Rohožník
Parvicardium subhispidum (Hilber)		1	1	1	
Pecten (Oppenheimopecten) aduncus Eichwald		1			
Pectinidae indet.				1	
Pelecyora (Cordiopsis) islandicoides (Lamarck)				1	
Petaloconchus (Macrophragma) intortus (Lamarck)		1		1	
Pholas sp.				1	
Polinices redemptus (Michelotti)		1		1	
Polinices sp.		1		1	
Pseudamnicola immutata (Frauenfeld)	1			1	
Pyramidella plicosa (Bronn)		1			
Retusa truncatula (Bruguière)		1	1	1	
Ringicula (Ringicula) auriculata ssp.		1		1	
Ringicula (Ringicuella) elongata Morlet		1			
Ringicula sp.				1	
Rissoa acuticosta (Sacco)				1	
Rissoa clotho Hörnes				1	
Rissoidae indet.				1	
Rissoina (Rissoina) podolica Cossmann			1		1
Rissoina (Zebinella) decussata (Montagu)			1		
Sandbergeria perpusilla (Grateloup)			1	1	
Scala sp.		1		1	
Scaphander lignarius (Linnaeus)		1			
Seila (Seila) trilineata (Philippi)			1		
Semicassis sp.		1			
Sinum striatum (Serres)		1			
Smaragdia expansa (Hoernes)		1			
Solemya (Solemya) doderleini (Mayer)	1				
Spondylus crassicostata Lamarck		1			
Striarca lactea (Linnaeus)			1		
Striarca papillifera (M. Hoernes)			1		1
Sveltia lyrata (Brocchi)				1	
Teinostoma (Idioraphe) minimum Boettger				1	
Teinostoma (Solariorbis) microdiscus (Boettger)				1	
Teinostoma callosum Boettger				1	
Teinostoma sp.			1		
Tellina planata Linnaeus	1	1		1	
Tellina sp.				1	
Terebra *pertusa* Basterot		1			
Terebra striata Gray				1	
Terebra (Striatoterebrum) basteroti Nyst		1			
Terebra (Terebra) acuminata Borson		1			

Appendix 1. (continue) List of the molluscs species from the studied localities.

	DNV-b.y.	DNV-Útoč.	Kúty-45	Dubová	Rohožník
Teredo sp.		1			
Timoclea (Parvivenus) marginata (Hörnes)				1	
Timoclea (Timoclea) ovata (Pennant)				1	
Tornus cf. pseudotinostoma (Boettger)				1	
Tornus globosus Boettger				1	
Tornus parvillimus (Sacco)				1	
Trachycardium sp.		1			
Tricolia (Tricolia) eichwaldi (Hörnes)		1	1	1	
Tricolia sp.			1		
Trigonostoma scrobiculatum (Hoernes)		1			
Triphora (Triphora) perversa (Linnaeus)		1	1		
Trochus miliaris Brocchi		1			
Turboella (Turboella) acuticosta Sacco		1			1
Turboella clotho (Hornes)		1			
Turbonilla (Pyrgolampros) biornata Boettger	1			1	
Turbonilla (Strioturbonilla) banatica Boettger				1	
Turbonilla bimonilifera Boettger				1	
Turbonilla scala (Laws)				1	
Turbonilla separata Boettger					1

	DNV-b.y.	DNV-Útoč.	Kúty-45	Dubová	Rohožník
Turbonilla spp.		1	1		
Turbonilla (Sulcoturbonilla) turricula (Eichwald)		1			
Turritella (Archimediella) bicarinata Eichwald		1	1		
Turritella (Archimediella) dertonensis Mayer				1	
Turritella (Archimediella) erronea Cossmann in Friedberg		1		1	
Turritella (Archimediella) erronea erronea Cossmann in Friedberg			1		
Turritella (Haustator) badensis Sacco		1		1	
Turritella (Haustator) partschi (Rolle)				1	
Turritella (Haustator) tricincta Borson		1			
Turritella (Zaria) spirata (Brocchi)		1	1	1	
Turritella (Zaria) subangulata (Brocchi)				1	
Turritella spp.		1	1	1	
Venerupis sp.				1	
Venus cincta Eichwald		1			
Vexillium (Uromitra) ebenus paraleucozona (Boettger)		1			
Vexillium vindobonense Friedberg		1			