EARLY SARMATIAN (MIDDLE MIOCENE) MOLLUSCS FROM RĂCĂŞTIA (ROMANIA)

Dan Mircea Tămaș [1*], Alexandra Tămaș[2] & Mirela Violetta Popa[3]

Abstract Our paper is a contribution to the taxonomical investigation of Sarmatian molluscs from Răcăştia, Romania. From samples collected in this area we have described, systematically assigned and illustrated 29 molluscs species, of which three bivalves and 26 gastropods. The identified fauna is assigned to the *Mohrensternia* zone, of Early Sarmatian age.

Keywords: bivalves, gastropods, taxonomy, Early Sarmatian, Răcăştia, Romania

INTRODUCTION

Răcăştia village is located 5 km north-west from Hunedoara town (Fig. 1), in the eastern part of Poiana Ruscă Mountains, in the Strei Basin. The basement consists of sericitic-chloritic schists, crystalline limestones and dolomites (Gheorghiu, 1954a, 1954b; Gherasi et al., 1968). These are overlain by breccia, conglomerates, gravels, sands, marls, clays, coal seams, limestones, gypsum and volcanic rocks, of Badenian and Early Sarmatian ages (Gaál, 1911; Gheorghiu, 1954b; Gheorghiu et al., 1962; Gherasi et al., 1968).
The mollusc fauna from Răcăştia was previously studied by Hauer and Stache (1863), Gaál (1911) and Gheorghiu (1954b). From the same deposits, other authors have described foraminifers (Gheorghiu, 1954b) and bryozoans (Zágoršek et al., 2008).

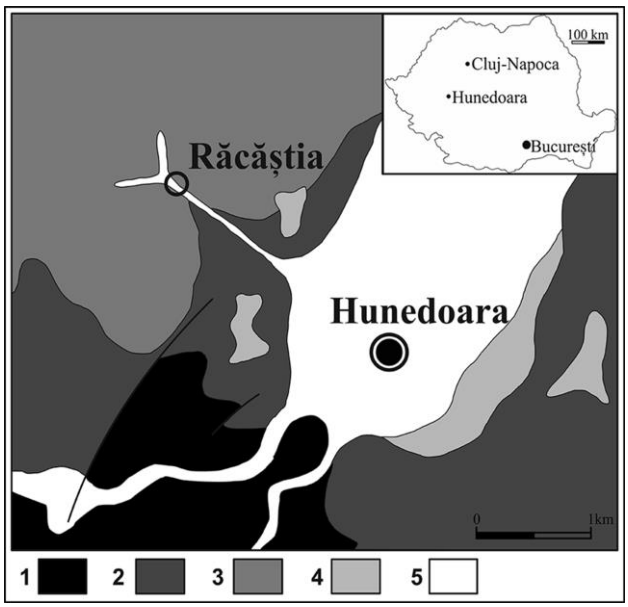

Fig. 1 – Simplified geological map of Răcăştia region (after Mureşan et al., 1980). **1** Carboniferous. **2** Badenian. **3** Sarmatian. **4** Quaternary. **5** Holocene.

MATERIALS AND METHODS

The studied outcrop is located in Răcăştia, along Petac brook. There, sandstones, sands and clays build-up a 4.55 m succession. We have collected samples that were prepared following the standard procedure (drying, rinsing through 63µm-mesh sieve and hand-picking). The morphological elements of the shell were described following the method of Cox (1960). We have measured the following morphological parameters: for bivalves, the anterior-posterior diameter (d.a.p.), and the umbono-ventral diameter (d.u.v.); for gastropods, the maximum height (h) and the shell width (l).
Some of the studied specimens (among which, the ones illustrated in this paper) were donated to the Museum of Paleontology, Babeș-Bolyai University, Cluj-Napoca (MPBBU).

SYSTEMATIC PALEONTOLOGY

The bivalves' systematic assignment follows the classification of Moore (1969), while for gastropods we have used the classification of Bouchet and Rocroi (2005).

Class Bivalvia Linnaeus, 1758
Superfamily Mactracea Lamarck, 1809
Family Mesodesmatidae Gray, 1839
Genus *Ervilia* Turton, 1822
Ervilia dissita (Eichwald, 1830)
Fig. 2a
1830 *Crassatella dissita* n. sp. – Eichwald, p. 207
1852 *Crassatella dissita* – Eichwald, pl. 5, fig. 24
1853 *Crassatella dissita* m. – Eichwald, p.92
1935 *Ervilia dissita* Eichwald – Kolesnikov, p. 39, pl. 3, figs. 9-16
1954 *Ervilia dissita dissita* (Eichwald) – Papp, p. 88, pl. 11, figs. 18-21
1959 *Ervilia dissita dissita* Eichwald – Boda, p. 689, pl. 13, figs. 5-10
1969 *Ervilia dissita dissita* (Eichwald) – Kojumdgieva, p. 27, pl. 8, figs. 1-3
1971 *Ervilia dissita dissita* (Eichwald) - Nicorici, p. 220, pl. 2, fig. 13
1971 *Ervilia dissita dissita* (Eichwald) – Švagrovsky, p. 185, pl. 11, fig. 1-9, pl. 12, figs. 1-5
1978 *Ervilia dissita dissita* Eichwald – Ionesi and Gräf, pl. 1, figs. 1-10
2001 *Ervilia dissita* (Eichwald) – Ţibuleac, pl. 1, fig. 3
2011 *Ervilia dissita* (Eichwald) – Harzhauser et al., fig. 3.4

[1*]Department of Geology, Babeş-Bolyai University, Kogălniceanu 1, 400084 Cluj-Napoca, Romania, popa_alexandraaa@yahoo.com
[2]Department of Geology, Babeş-Bolyai University, Kogălniceanu 1, 400084 Cluj-Napoca, Romania, tamas_dan_mircea@yahoo.com
[3]Department of Geology, Babeş-Bolyai University, Kogălniceanu 1, 400084 Cluj-Napoca, Romania, mirela.popa@ubbcluj.ro

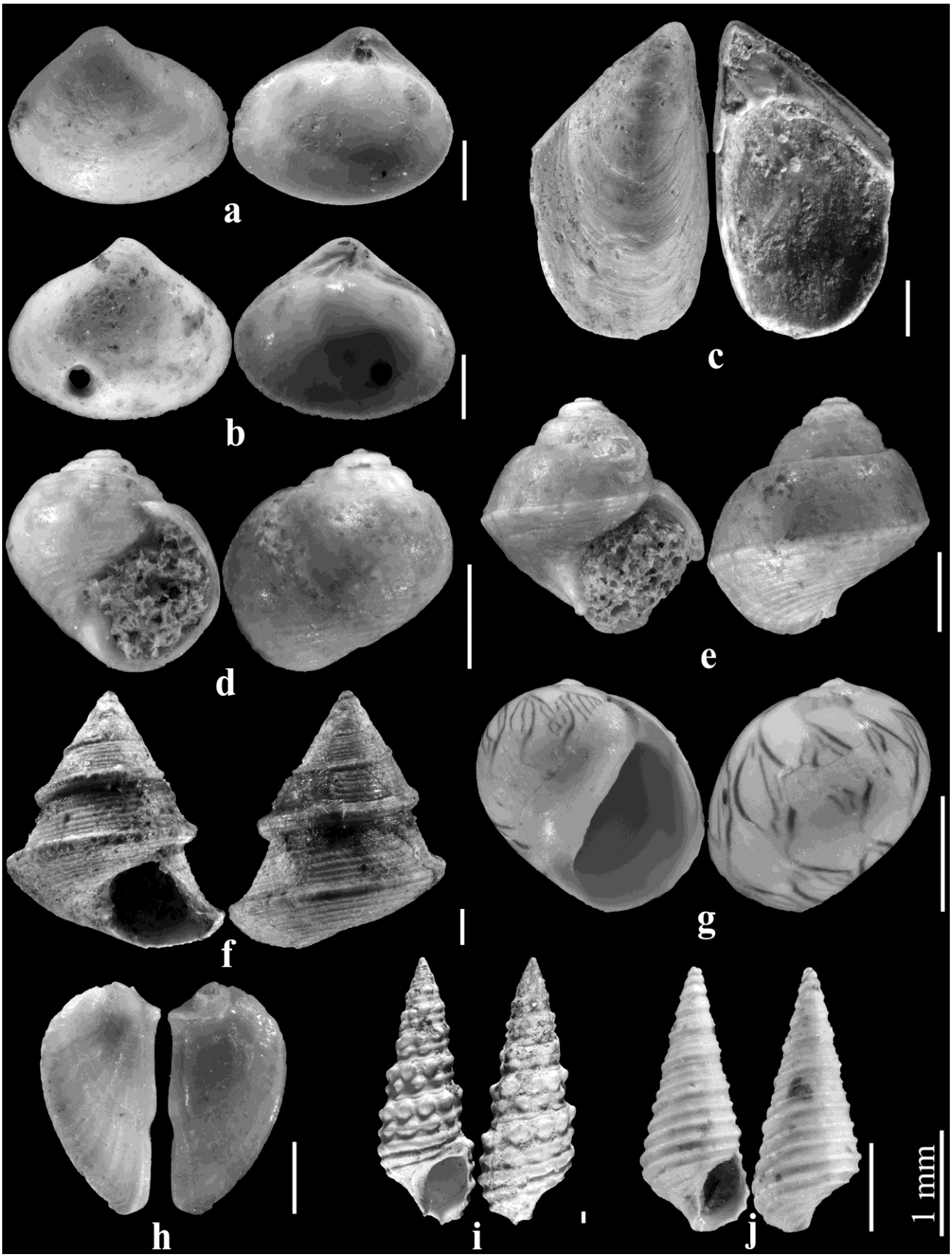

Fig. 2 a *Ervilia dissita* (Eichwald, 1830). **b** *Ervilia trigonula* Sokolov, 1899. **c** *Mytilopsis sarmatica* Kojumdgieva, 1968. **d** *Gibbula hoernesi* (Jekelius, 1944). **e** *Calliostoma*? *angulatum spirocarinatum* (Papp, 1954). **f** *Calliostoma*? *marginatum* (Eichwald, 1830), **g, h** *Agapilia picta* (Férussac, 1825) (**h** –*Agapilia picta* opercula), **i, j** *Granulolabium bicinctum* (Brocchi, 1814) (**j** – juvenile).

Samples: 29 valves (14 right and 15 left ones) (5 valves MPBBU 23881).
Dimensions: max. 6.5 mm d.u.v. and 5 mm d.a.p.
Description: small-sized specimens, relatively convex valves with triangular outline. The valves present an unequal profile and they are ornamented by fine concentric growth lines. Slightly eccentric, opistogyre umbo. Heterodont dentition.
Distribution: species is omnipresent in Sarmatian deposits. Identified in: Romania (Kolesnikov, 1935; Nicorici, 1971; Ionesi and Gräf, 1978; Ţibuleac, 2001; Lukeneder et al., 2011), Bulgaria (Kolesnikov, 1935; Kojumdgieva, 1969), Austria (Papp, 1954; Harzhauser et al., 2011; Lukeneder et al., 2011), Hungary (Boda, 1959), Slovakia (Švagrovsky, 1971) and Ukraine (Lukeneder et al., 2011).

Ervilia trigonula Sokolov, 1899
Fig. 2b
1899 *Ervilia trigonula* n. sp. – Sokolov, p. 23, fig. 11, 12, pl. 2, figs. 36-41
1935 *Ervilia trigonula* Sokolov – Kolesnikov, p. 37, pl. 3, figs. 7, 8
1940 *Ervilia trigonula* Sokolov – Simionescu and Barbu, p. 144, pl. 8, figs. 14-16
1959 *Ervilia trigonula* (Sokolov) – Boda, p. 689, pl. 13, fig. 4
1969 *Ervilia trigonula* Sokolov – Kojumdgieva, p. 27, pl. 7, figs. 17, 18
1971 *Ervilia trigonula* Sokolov – Švagrovsky, p. 183, pl. 20, figs. 1-12
1976 *Ervilia trigonula* Sokolov – Ionesi et al., pl. 1, fig. 22
1978 *Ervilia trigonula* Sokolov – Ionesi and Gräf, pl. 1, figs. 14-18
2001 *Ervilia trigonula* Sokolov – Ţibuleac, pl. 1, fig. 4
Samples: 33 valves (17 right and 16 left ones) (5 valves MPBBU 23882).
Dimensions: max. 4.37 mm d.a.p. and 3.44 mm d.u.v.
Description: small-sized specimens. Slightly convex valves, with almost equilateral triangular outline. Relatively sharper, opistogyre umbo located in the median area. Heterodont dentition.
Distribution: identified in Romania (Kolesnikov, 1935; Simionescu and Barbu, 1940; Ionesi et al., 1976; Ionesi and Gräf, 1978; Ţibuleac, 2001), Bulgaria (Kolesnikov, 1935; Kojumdgieva, 1969), Hungary (Boda, 1959) and Slovakia (Švagrovsky, 1971).

Superfamily Dreissenacea Gray in Turton, 1840
Family Dreissenidae Gray in Turton, 1840
Genus *Mytilopsis* Conrad, 1868
Mytilopsis sarmatica (Kojumdgieva, 1968)
Fig. 2c
1968 *Congeria sarmatica* n.sp. – Kojumdgieva, p. 196-197, pl. 1, figs. 17-21
1969 *Congeria sarmatica* Kojumdgieva – Kojumdgieva, p. 14, pl. 1, figs. 17-21
Samples: 268 valves (135 right and 133 left ones) (6 valves MPBBU 23883).
Dimensions: max. 7.18 mm d.a.p. and 12.1 mm d.u.v.
Description: thin, convex valves with triangular outline and concentric ornaments, with growth lines. Almost straight anterior margin, the posterior originally straight then slightly convex. Adult specimens with carina almost parallel to the anterior margin. Prosogyre umbo. Very poorly outlined, dysodont dentition.
Distribution: identified in Bulgaria (Kojumdgieva, 1969).
Observations: This species was also cited by Ionesi et al., 2005, but the species identified in Răcăştia are not so alike to those. According to Harzhauser and Mandic (2010) this species should be assigned to the genus *Mytilopsis* because the genus *Congeria* is a Pannonian development.

Class Gastropoda Cuvier, 1797
Superfamily Trochoidea Rafinesque, 1815
Family Trochidae Rafinesque, 1815
Genus *Gibbula* Risso, 1826
Gibbula hoernesi (Jekelius, 1944)
Fig. 2d
1856 *Trochus pictus* Eichwald – Hörnes, p. 456, pl. 46, figs. 10, 12 (non *Trochus pictus* Eichwald)
1944 *Gibbula hoernesi* n. nom. – Jekelius, p. 44
1954 *Gibbula hoernesi* Jekelius – Papp, p. 11, pl. 1, figs. 7, 8, 14-22
part 1959 *Gibbula hoernesi* Jekelius – Boda, p. 703, pl. 22, figs. 8-22, pl. 23, fig. 1
1971 *Gibbula hoernesi* Jekelius – Nicorici, p. 222, pl. 3, figs. 22-24
Samples: 29 specimens (3 specimens MPBBU 23884).
Dimensions: max. h= 4.2 mm, l= 4.5 mm.
Description: globular-shaped shell. Strongly incised suture. Teleoconch ornamented by spiral threads, but not present in all the studied specimens. The last whorl represents 75-80% of the total shell height and it is ornamented by more or less visible spiral threads and a blunt carina in the medial area. Oval, holostome aperture.
Distribution: species identified in Austria (Hörnes, 1856; Papp, 1954), Romania (Jekelius, 1944; Nicorici, 1971), Hungary (Boda, 1959).

Family Calliostomatidae Thiele, 1924
Genus *Calliostoma* Swainson, 1840
Calliostoma? angulatum spirocarinatum (Papp, 1954)
Fig. 2e
1954 *Gibbula angulata spirocarinata* n. ssp. – Papp, p. 11, pl. 1, figs. 9-13
1959 *Calliostoma angulatum spirocarinatum* (Papp) – Boda, p. 702, pl. 22, figs. 4, 5
1971 *Calliostoma angulatum spirocarinatum* (Papp) – Švagrovsky, p. 201, pl. 25, figs. 8-12
1999 *Calliostoma angulatum spirocarinatum* (Papp) – Filipescu et al., pl. 3, fig. 1
Samples: 19 specimens (4 specimens MPBBU 23885).
Dimensions: max. h= 2.94 mm, l= 2.94 mm.
Description: small, conical-rounded shell. The whorls' outline is almost flat towards the top, and then convex towards the base. Ornamentation with very fine spiral threads. Last whorl represents about 75% of the total shell height; it is ornamented by a sharp spiral carina; in some specimens, fine spiral threads are noticeable. Locally, some specimens also show colored areas. Holostome aperture with rounded polygonal outline.

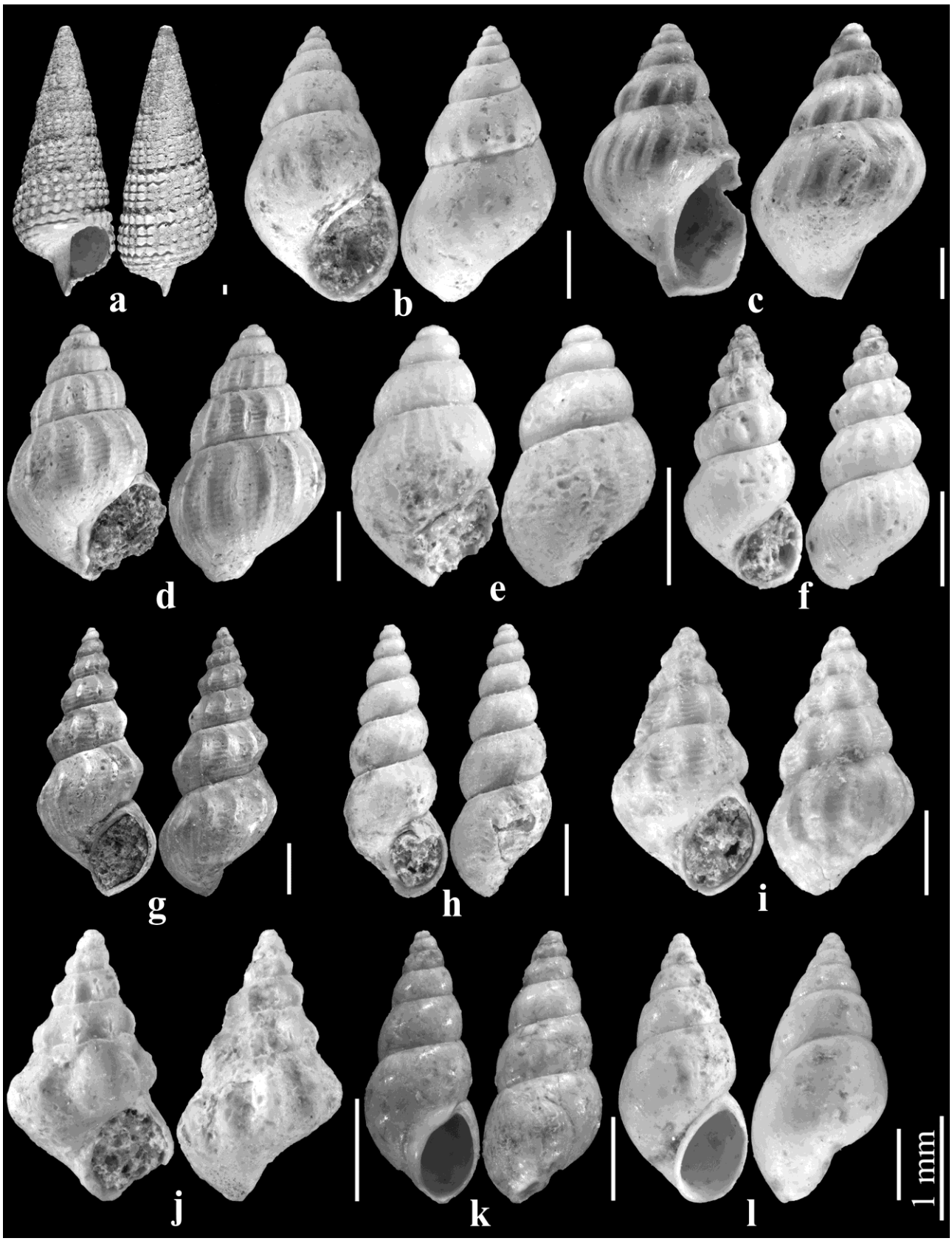

Fig. 3 a *Terebralia lignitarum* (Eichwald, 1830). **b** *Rissoa turricula* Eichwald, 1853. **c** *Mohrensternia inflata* Andrzejowsky in Hörnes, 1856. **d** *Mohrensternia pseudinflata* Hilber, 1897. **e** *Mohrensternia multicostata* Seneš, 1953. **f** *Mohrensternia angulata* Eichwald, 1830. **g** *Mohrensternia pseudoangulata politioanei* Jekelius, 1944. **h** *Mohrensternia banatica* (Jekelius, 1944). **i** *Mohrensternia sarmatica* Friedberg, 1923. **j** *Mohrensternia soceni* Jekelius, 1944. **k** *Hydrobia frauenfeldi* Hörnes, 1856. **l** *Hydrobia*? *stagnalis* (Baster, 1765).

Distribution: species identified in Sarmatian deposits in Austria (Papp, 1954), Hungary (Boda, 1959), Slovakia (Švagrovsky, 1971) and Romania (Filipescu et al., 1999).
Observations: The correct placement of this species to the genus *Calliostoma* is in question, because according to Hickman and McLean, 1990, the protoconch of this genus is characterized by a honeycomb pattern. This pattern could not be observed with the stereomicroscope.

Calliostoma? *marginatum* (Eichwald, 1830)
Fig. 2f
1830 *Trochus marginatus* n. sp. – Eichwald, p. 220
1852 *Trochus marginatus* – Eichwald, pl. 9, fig. 13
1853 *Trochus marginatus* m. – Eichwald, p. 225
1935 *Trochus marginatus* Eichwald – Kolesnikov, p. 156, pl. 21, figs. 39-41
1940 *Trochus marginatus* Eichwald – Simionescu and Barbu, p. 20, pl. 4, figs. 15-18
1959 *Calliostoma marginatum* (Eichwald) – Boda, p. 700, pl. 21, figs. 21, 22
1971 *Calliostoma marginatum* (Eichwald) – Švagrovsky, p. 213, pl. 27, fig. 4
2004 *Calliostoma marginatum* (Eichwald) – Harzhauser and Piller, fig. 10.1
Samples: 25 specimens (4 specimens MPBBU 23886).
Dimensions: max. h= 7.19 mm, l= 6.25 mm.
Description: conical shell with relatively straight profile, and maximum 7 whorls. Large apical angle (about 65º). Protoconch with about 2.5 whorls. Teleoconch ornamented by a series of spiral cords; above the suture it shows a more pronounced carina. The last whorl represents about 65% of the total shell height. Polygonal aperture with rounded lower side.
Distribution: species identified in Romania (Kolesnikov, 1935; Simionescu and Barbu, 1940), Austria (Harzhauser and Piller, 2004), Bulgaria (Kolesnikov, 1935), Hungary (Boda, 1959) and Slovakia (Švagrovsky, 1971).
Observations: the correct placement of this species to the genus *Calliostoma* is in question, because according to Hickman and McLean, 1990, the protoconch of this genus is characterized by a honeycomb pattern. This pattern could not be observed with the stereomicroscope.

Superfamily Neritoidea Rafinesque, 1815
Family Neritidae Rafinesque, 1815
Genus *Agapilia* Harzhauser and Kowalke, 2001
Agapilia picta (Férussac, 1825)
Figs. 2g, h
1825 *Neritina picta* n. sp. – Férussac, figs. 4-7
1830 *Neritina picta* m. – Eichwald, p. 218
1954 *Clithon pictus pictus* (Férussac) – Papp, p. 21, pl. 5, figs. 1-3
1959 *Clithon pictus pictus* (Férussac) – Boda, p. 727, pl. 33, figs. 5-7
1969 *Clithon pictus pictus* (Férussac) – Kojumdgieva, p. 59, pl. 22, figs. 1-4
1971 *Clithon pictus pictus* (Férussac) – Nicorici, p. 222, pl. 3, figs. 29-46
1971 *Clithon pictus* (Férussac) – Švagrovsky, p. 222, pl. 28, figs. 3-5, 7-12
1995 *Clithon pictus* (Férussac) – Zalinská and Fordinál, pl. 25, fig. 7
1999 *Theodoxus pictus pictus* (Férussac) – Filipescu et al., pl. 3, fig. 2
2001 *Agapilia picta* (Férussac) – Harzhauser and Kowalke, p. 356, figs. 2.5-10
2004 *Agapilia picta* (Férussac) – Harzhauser, p.15, pl. 1, figs. 7-9
2008 *Agapilia picta* (Férussac) – Mandic et al., fig. 7e
Samples: 444 specimens (10 specimens MPBBU 23887).
Dimensions: max. h= 5.75 mm, l= 5.54 mm.
Description: globular shell with incised suture consisting of about three whorls increasing rapidly in width. Ornamentation consisting of various colored patterns. Last whorl represents about 80–90% of the total shell height. Holostome aperture with semi-circular morphology. Relatively extended labrum with plain callus. Opercula were identified besides the shells (Fig. 2h).
Distribution: species identified in Sarmatian deposits in Austria (Papp, 1954; Harzhauser and Kowalke, 2001; Harzhauser, 2004), Romania (Nicorici, 1971; Filipescu et al., 1999), Bulgaria (Kojumdgieva, 1969), Hungary (Boda, 1959) and Slovakia (Švagrovsky, 1971; Zalinská and Fordinál, 1995).

Superfamily Cerithioidea Fleming, 1822
Family Potamididae H. and A. Adams, 1854
Genus *Granulolabium* Cossmann, 1889
Granulolabium bicinctum (Brocchi, 1814)
Figs. 2i, j
1814 *Murex bicinctus* – Brocchi, p. 446, pl. 9, fig. 13
1852 *Cerithium bicinctum* – Eichwald, pl. 7, fig. 15
1853 *Cerithium bicinctum* m. – Eichwald, p.155
1856 *Cerithium pictum* Baster – Hörnes, p. 394, pl. 41, figs. 15, 17
1940 *Cerithium pictum* Baster – Simionescu and Barbu, p. 87, pl. 1, figs. 41, 42
1944 *Pirenella picta* Defrance – Jekelius, p. 76, pl. 18, fig. 1-34, pl. 19, figs. 1-18
1954 *Pirenella picta picta* (Defrance) – Papp, p. 39, pl. 6, figs. 1-12
1959 *Pirenella picta picta* (Defrance) – Boda, p. 711 pl. 25, fig. 15-19, pl. 26, figs. 1-5
1969 *Pirenella picta picta* (Defrance) – Kojumdgieva, p. 92, pl. 32, figs. 15, 16
1971 *Pirenella picta picta* (Baster) – Švagrovsky, p. 326, pl. 56, figs. 1-5
1978 *Pirenella picta picta* (Defrance) – Ionesi and Gräf, pl. 6, figs. 14-18
1990 *Pirenella picta picta* (Defrance) – Moisescu, p. 204, pl. 4, figs. 3a, b
1999 *Pirenella picta picta* (Baster) – Filipescu et al., pl. 3, fig. 19
2001 *Granulolabium bicinctum* (Brocchi) – Harzhauser and Kowalke, fig. 4.10
2002 *Granulolabium bicinctum* (Brocchi) – Harzhauser and Kowalke, p.66, pl. 11, figs.1-8, pl. 13, figs. 1-3
2008 *Granulolabium bicinctum* (Brocchi) – Mandic et al., fig. 7h
2010 *Granulolabium bicinctum* (Brocchi) – Toth et al., figs. 6b, c
2011 *Granulolabium bicinctum* (Brocchi) – Harzhauser et al., fig. 3.7

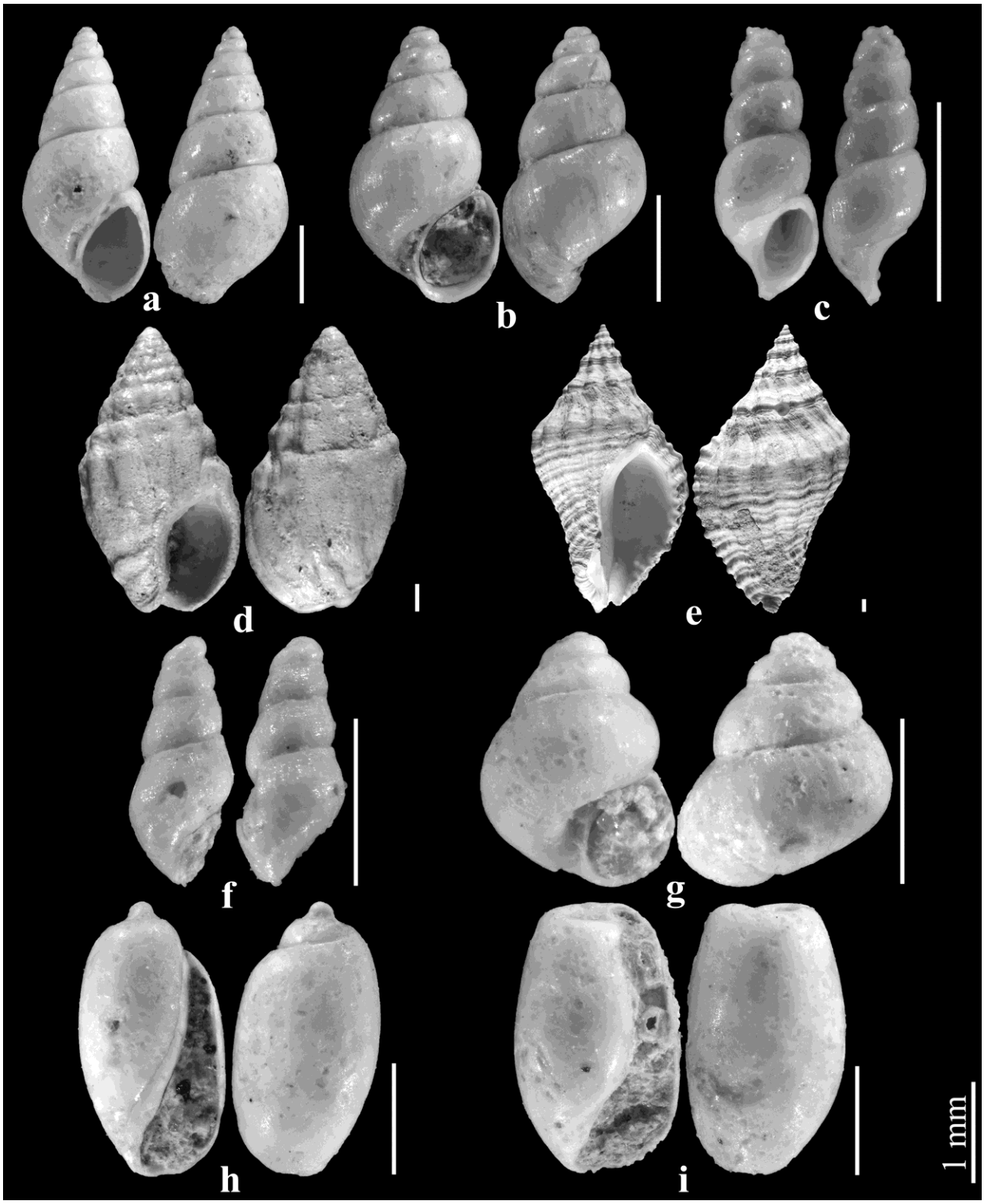

Fig. 4 a *Hydrobia suturata* Fuchs, 1873. **b** *Hydrobia soceni* Jekelius, 1944. **c** *Caspia (Socenia) graciliformis* Papp, 1954. **d** *Duplicata duplicata* (Sowerby, 1832). **e** *Ocenebra striata* (Eichwald, 1853). **f** *Odostomia* sp. **g** *Valvata*? *soceni wiesenensis* Papp, 1954. **h** *Acteocina lajonkaireana* (Basterot, 1825). **i** *Retusa truncatula* (Bruguiére, 1953).

2011 *Granulolabium bicinctum* (Brocchi) – Lukeneder et al., figs. 4I, J

Samples: 807 specimens (10 specimens MPBBU 23888)

Dimensions: max. h= 23 mm, l= 9 mm.

Description: conical elongated and slightly scalariform shell consisting of 10-11 whorls. The protoconch is missing in larger specimens. In juvenile forms, protoconch consists of about two plain whorls. The teleoconch is ornamented by two spiral cords on the first whorls, and then followed by an additional one.

Knots are present on the three spiral cords, more prominent on the sub-suture spiral cord. Suture only

poorly incised. The last whorl represents about 50% of the total shell height. Oval siphonostome aperture.
Distribution: species omnipresent in Sarmatian deposits: Austria (Hörnes, 1856; Papp, 1954; Harzhauser and Kowalke, 2001, 2002; Mandic et al., 2008; Harzhauser et al., 2011; Lukeneder et al., 2011), Romania (Kolesnikov, 1935; Simionescu and Barbu, 1940; Jekelius, 1944; Ionesi and Gräf, 1978; Moisescu, 1990; Filipescu et al., 1999; Lukeneder et al., 2011), Bulgaria (Kolesnikov, 1935; Kojumdgieva, 1969), Hungary (Boda, 1959; Toth et al., 2010), Slovakia (Švagrovsky, 1971) and Ukraine (Lukeneder et al., 2011).

Family Terebrellidae Delpey, 1941
Genus *Terebralia* Swainson, 1840
Terebralia lignitarum (Eichwald, 1830)
Fig. 3a
1830 *Cerithium lignitarum* n. sp. – Eichwald, p. 224
1852 *Cerithium lignitarum* – Eichwald, pl. 7, fig. 20
1853 *Cerithium lignitarum* m. – Eichwald, p. 146
1940 *Cerithium lignitarum* Eichwald – Simionescu and Barbu, p. 75, pl. 1, figs. 1-5
1944 *Terebralia lignitarum* (Eichwald) – Jekelius, p. 82
1971 *Terebralia lignitarum* (Eichwald) – Švagrovsky, p. 342, pl. 58, figs. 7-9
Samples: 7 specimens (4 specimens MPBBU 23889)
Dimensions: max. h= 28 mm, l= 10.5 mm.
Description: large conical shell consisting of maximum 12 whorls showing straight margin outline and well-defined sutures. Apical angle is about 30º. Teleoconch ornamented by four spiral cords intersected by 20-30 axial ribs. Knots form at the intersection between spiral cords and axial ribs, with identical outline along all the spiral cords. On the last whorls a fifth spiral cord with knots can be present, over the suture, but clearly less evidenced. The last whorl represents about 45% of the total shell height. Small oval, siphonostome aperture.
Distribution: species identified in Romania (Simionescu and Barbu, 1940), Hungary (Boda, 1959) and Slovakia (Švagrovsky, 1971).

Superfamily Rissooidea Gray, 1847
Family Rissooidae Gray, 1847
Genus *Rissoa* Desmarest, 1814
Rissoa turricula Eichwald, 1830
Fig. 3b
1830 *Rissoa turricula* n. sp. – Eichwald, p. 218
1852 *Rissoa turricula* – Eichwald, pl. 10, fig. 9
1853 *Rissoa turricula* m. – Eichwald, p. 267
1944 *Rissoa soceni* n. sp. – Jekelius, p. 68, pl. 14, figs. 9, 10
1971 *Rissoa soceni* Jekelius – Švagrovsky, p. 258, pl. 37, fig. 1-9, pl. 38, figs. 1-4
2004 *Rissoa turricula* Eichwald – Kowalke and Harzhauser, p. 115, fig. 4A
2004 *Rissoa turricula* (Eichwald) – Harzhauser and Piller, fig. 10.3
Samples: 29 specimens (5 specimens MPBBU 23890)
Dimensions: max. h= 4.13 mm, l= 2.19 mm.
Description: large conical shell consisting of 5–6 whorls. Apical angle is about 55º. In some cases, the ornamentation starts on the third whorl, and in general fades on the second half of the last whorl. Ornamentation consists of 10–16 axial straight ribs with maximum convexity over the suture. Last whorl represents about 65% of the total shell height. Oval, holostome aperture slightly narrowing in the upper side. Varix on the external lip.
Distribution: species identified in Romania (Jekelius, 1944), Slovakia (Švagrovsky, 1971) and Austria (Harzhauser and Piller, 2004; Kowalke and Harzhauser, 2004).

Genus *Mohrensternia* Stoliczka, 1868
Mohrensternia inflata (Hörnes, 1856)
Fig. 3c
part 1856 *Mohrensternia inflata* Andrzejowsky – Hörnes, p. 576, pl. 48, fig. 22b
1935 *Mohrensternia inflata* Hörnes – Kolesnikov, p. 211, pl. 27, figs. 3-6
1944 *Mohrensternia inflata* Andrzejowsky – Jekelius, p. 69, pl. 14, figs. 16-18
1954 *Mohrensternia inflata* Andrzejowsky – Papp, p. 34, pl. 12, figs. 12-17
1959 *Rissoa (Mohrensternia) inflata inflata* Andrzejowsky – Boda, p. 705, pl. 23, figs. 6-11
1969 *Mohrensternia inflata inflata* (Andrzejowsky) – Kojundgieva, p. 83, pl. 30, figs. 7-11
1971 *Rissoa (Mohrensternia) inflata inflata* (Andrzejowsky) – Nicorici, p. 225, pl. 4, figs. 21-25
1971 *Mohrensternia inflata* Hörnes - Švagrovsky, p. 282, pl. 43, figs. 1-12
1999 *Mohrensternia inflata* Andrusov – Filipescu et al., pl. 3, fig. 13
2004 *Mohrensternia inflata* Hörnes – Kowalke and Harzhauser, p. 127, figs. 10A, B
2005 *Mohrensternia inflata* Hörnes – Anistratenko, p. 377, fig. 4A
2011 *Mohrensternia inflata* Hörnes – Lukeneder et al., fig. 4O
Samples: 78 specimens (6 specimens MPBBU 23891).
Dimensions: max. h= 6.2 mm, l= 4.44 mm.
Description: large conical shell, with 6 whorls. Apical angle is 55–60º. Protoconch consists of about 2.5 whorls. Teleoconch ornamented by 12–14 orthocline to opisthocyrt axial ribs that fade towards the plain shell base. Last whorl represents 65–70% of the total shell height. Wide, oval holostome aperture slightly narrowing towards the upper side.
Distribution: species widely distributed in Early Sarmatian deposits in Austria (Hörnes, 1856; Papp, 1954; Kowalke and Harzhauser, 2004; Lukeneder et al., 2011), Romania (Kolesnikov, 1935; Jekelius, 1944; Nicorici, 1971; Filipescu et al., 1999; Lukeneder et al., 2011), Bulgaria (Kolesnikov, 1935; Kojumdgieva, 1969), Hungary (Boda, 1959), Slovakia (Švagrovsky, 1971) Poland (Anistratenko, 2005) and Ukraine (Anistratenko, 2005; Lukeneder et al., 2011).

Mohrensternia pseudinflata Hilber, 1897
Fig. 3d
1897 *Mohrensternia pseudinflata* n. sp – Hilber, p. 202
1897 *Mohrensternia graecensis* n. sp – Hilber, p. 202, fig. 19
1944 *Mohrensternia pseudoinflata* Hilber – Jekelius, p. 70, pl. 14, figs. 19-21

1971 *Rissoa (Mohrensternia) pseudoinflata* (Hilber) – Nicorici, p. 226, pl. 5, figs. 3-5
1971 *Mohrensternia pseudoinflata* Hilber – Švagrovsky, p. 285, pl. 44, figs. 6-9
1972 *Mohrensternia inflata pseudoinflata* (Hilber) – Ionesi and Ionesi, pl. 4, figs. 14-16
2005 *Mohrensternia pseudinflata* Hilber – Anistratenko, p. 380, fig. 4B
Samples: 18 specimens (2 specimens MPBBU 23892).
Dimensions: max. h= 3.72 mm, l= 2.52 mm.
Description: large conical shell consisting of 5–6 whorls. Apical angle is about 50º. Protoconch consists of about 2.5 whorls. Teleoconch ornamented by 14–16 orthocline to opisthocyrt axial ribs intersected by prominent spiral cords. Last whorl represents about 65% of the total shell height. Wide, oval holostome aperture slightly narrowing towards the upper side.
Distribution: species identified in Romania (Jekelius, 1944; Nicorici, 1971; Ionesi and Ionesi, 1972), Slovakia (Švagrovsky, 1971), Poland and Ukraine (Anistratenko, 2005).
Observations: Anistratenko (2005) pointed out that the correct name for this species should be *M. pseudinflata* as it was first described by Hilber in 1897, instead of *M. pseudoinflata* as it is often misspelled.

Mohrensternia multicostata Seneš, 1953.
Fig. 3e
1959 *Rissoa (Mohrensternia) inflata multicostata* Seneš – Boda, p. 706, pl. 24, figs. 11, 12
1971 *Rissoa (Mohrensternia) inflata multicostata* Seneš – Nicorici, p. 226, figs. 35, 36
1971 *Mohrensternia multicostata* Seneš – Švagrovsky, p. 287, pl. 44, figs. 1-5
1999 *Mohrensternia multicostata* Seneš – Filipescu et al., pl. 3, fig. 15
Samples: 14 specimens (2 specimens MPBBU 23893).
Dimensions: max. h= 3.88 mm, l= 2.55 mm.
Description: large conical shell consisting of 4-5 whorls, increasing rapidly in width. Apical angle is about 60º. Ornamentation represented by max. 26 narrow and closely-located, slightly orthocline axial ribs. Axial ribs intersected by a series of spiral threads. The spaces between the ribs are wider than the axial ribs. The last whorl represents about 70% of the total shell height. Wide, oval holostome aperture slightly narrowing towards the upper side.
Distribution: besides species of *Mohrensternia* this species was identified in Hungary (Boda, 1959), Romania (Nicorici, 1971; Filipescu et al., 1999) and Slovakia (Švagrovsky, 1971).

Mohrensternia angulata Eichwald, 1830
Fig. 3f
1830 *Rissoa angulata* n. sp – Eichwald, p. 218
1852 *Rissoa angulata* - Eichwald, pl. 10, fig. 10
1853 *Rissoa angulata* m. - Eichwald, p. 268
1935 *Mohrensternia angulata* Eichwald – Kolesnikov, pl. 27, figs. 1, 2
1940 *Mohrensternia angulata* Eichwald – Simionescu and Barbu, p. 71, pl. 6, fig. 16
1944 *Mohrensternia angulata* Eichwald – Jekelius, p. 71, pl. 15, figs. 7, 8
1959 *Rissoa (Mohrensternia) angulata angulata* Eichwald – Boda, p. 707, pl. 24, figs. 12-16
1971 *Rissoa (Mohrensternia) angulata angulata* Eichwald - Nicorici, p. 226, pl. 5, figs. 6-11
1971 *Mohrensternia angulata* Eichwald – Švagrovsky, p. 294, pl. 46, figs. 1-9
1994 *Mohrensternia angulata* Eichwald – Fordinál and Zalinská, pl. 12, fig. 1
1999 *Mohrensternia angulata* Eichwald – Filipescu et al., pl. 3, fig. 11
2004 *Mohrensternia angulata* Eichwald – Kowalke and Harzhauser, p. 125, figs. 9A, B
2005 *Mohrensternia angulata* Eichwald – Anistratenko, p. 383, figs. 5D, E, 6A, B
Samples: 72 specimens (6 specimens MPBBU 23894).
Dimensions: max. h= 3.16 mm, l= 1.4 mm.
Description: elongated conical shell with max. 6–7 whorls. Apical angle is about 40º. Protoconch consists of about 2.25 whorls. Teleoconch ornamented by 10–12, sometimes up to 14 orthocline to slightly opisthocyrt axial ribs showing maximum convexity in the median area. Strongly incised suture. Last whorl represents 50–55% of the total shell height. In some specimens, ornamentation tends to become less prominent or even fade on the last whorl. Wide, ovoid holostome aperture, slightly narrowing towards the upper side.
Distribution: species identified in Romania (Kolesnikov, 1935; Simionescu and Barbu, 1940; Jekelius, 1944; Nicorici, 1971; Filipescu et al., 1999), Bulgaria (Kolesnikov, 1935), Hungary (Boda, 1959; Toth et al., 2010), Slovakia (Švagrovsky, 1971; Fordinál and Zalinská, 1994), Czech Republic (Kowalke and Harzhauser, 2004), Poland and Ukraine (Anistratenko, 2005).

Mohrensternia pseudoangulata politioanei Jekelius, 1944
Fig. 3g
1944 *Mohrensternia pseudoangulata politioanei* n. var. – Jekelius, p. 72, pl. 15, figs. 11-15
1971 *Mohrensternia pseudoangulata politioanei* Jekelius – Švagrovsky, p. 299, pl. 48, figs. 1-7
2004 *Mohrensternia pseudoangulata politioanei* Jekelius - Kowalke and Harzhauser, p. 129, fig. 11A
Samples: 53 specimens (5 specimens MPBBU 23895).
Dimensions: max. h= 5.44 mm, l= 2.5 mm.
Description: elongated conical shell consisting of max. 7 whorls. Apical angle of 35–38º. Protoconch consists of about 2.25 whorls. Teleoconch ornamented by 10–12 very prominent orthocline to opisthocyrt axial ribs, showing maximum convexity in the median area. Axial ribs intersected by fine spiral cords. The shape confers an overall prominent convex to angular outline to the whorls. Strongly incised suture. Last whorl represents about 50% of the total shell height. Ovoid holostome aperture slightly narrowing towards the upper side. Occasionally, labrum may be slightly detached from the shell.
Distribution: species identified in Early Sarmatian deposits in Romania (Jekelius, 1944), Slovakia (Švagrovsky, 1971), Austria (Kowalke and Harzhauser, 2004), Poland and Ukraine (Anistratenko, 2005).

Mohrensternia banatica (Jekelius, 1944)

Fig. 3h
1944 *Mohrensternia pseudoangulata banatica* n. var. – Jekelius, p. 72, pl. 15, figs. 16-18
1954 *Mohrensternia banatica* (Jekelius) – Papp, p. 36, pl. 5, figs. 30-33
1971 *Mohrensternia banatica* (Jekelius) – Švagrovsky, p. 301, pl. 49, figs. 1-12
1994 *Mohrensternia banatica* Jekelius – Fordinál and Zalinská, pl. 12, fig. 2
1995 *Mohrensternia banatica* Jekelius – Zalinská and Fordinál, pl. 25, fig. 3
2004 *Mohrensternia banatica* (Jekelius) – Kowalke and Harzhauser, p. 126, fig. 9C
2005 *Mohrensternia banatica* (Jekelius) – Anistratenko, p. 386, figs. 7D, E
Samples: 55 specimens (5 specimens MPBBU 23896).
Dimensions: max. h= 3.94 mm, l= 1.44 mm.
Description: elongated conical shell, consisting of maximum 7 whorls. Apical angle is about 30º. Protoconch consists of about 2.5 whorls. Teleoconch ornamented by 14–16 orthocline to opisthocyrt axial ribs intersected by more or less obvious spiral threads. Last whorl represents 45–50% of the total shell height. Ovoid holostome aperture.
Distribution: species identified in Romania (Jekelius, 1944), Austria (Papp, 1954; Kowalke and Harzhauser, 2004), Slovakia (Švagrovsky, 1971; Fordinál and Zalinská, 1994; Zalinská and Fordinál, 1995), Poland and Ukraine (Anistratenko, 2005).

Mohrensternia sarmatica Friedberg, 1923
Fig. 3i
1923 *Mohrensternia sarmatica* n. sp. – Friedberg, p. 389, pl. 23, figs. 8-10
1923 *Mohrensternia sarmatica* n. sp. – Friedberg, p. 389, pl. 23, figs. 11-12
1944 *Mohrensternia sarmatica* Friedberg – Jekelius, p. 70, pl. 15, figs. 1-3
1959 *Mohrensternia inflata sarmatica* Friedberg – Boda, p. 705, pl. 23, figs. 12-14
1969 *Mohrensternia inflata sarmatica* Friedberg – Kojumdgieva, p. 83, pl. 30, figs. 1-3
1971 *Rissoa (Mohrensternia) inflata sarmatica* Friedberg – Nicorici, p. 225, pl. 4, figs. 26-31
1971 *Mohrensternia sarmatica* Friedberg – Švagrovsky, p. 306, pl. 51, figs. 1-10
1999 *Mohrensternia sarmatica* Friedberg – Filipescu et al., pl. 3, fig. 18
2004 *Mohrensternia sarmatica* Friedberg – Harzhauser and Piller, fig. 10.4
2004 *Mohrensternia sarmatica* Friedberg – Kowalke and Harzhauser, p. 129
2005 *Mohrensternia sarmatica* Friedberg – Anistratenko, p. 381, figs. 5A-C
Samples: 108 specimens (7 specimens MPBBU 23897).
Dimensions: max. h= 3.2 mm, l= 1.88 mm.
Description: conical shell consisting of max. 6 whorls. Apical angle is 45–50º. Protoconch consists of about 2.5 whorls. Teleoconch ornamented by 12–14, slightly orthocline axial ribs showing maximum convexity in the median area. Axial ribs may or may not be intersected by a series of more or less obvious spiral threads. Last whorl represents 60–65% of the total shell height. Oval holostome aperture, narrowing towards the upper side.
Distribution: species identified in Romania (Jekelius, 1944; Nicorici, 1971; Filipescu et al., 1999), Austria (Harzhauser and Piller, 2004; Kowalke and Harzhauser, 2004), Bulgaria (Kojumdgieva, 1969), Hungary (Boda, 1959), Slovakia (Švagrovsky, 1971) Poland and Ukraine (Anistratenko, 2005).
Observations: after comparing the holotypes of species *M. sarmatica* and *M. pseudosarmatica*, separated by Friedberg, 1923, Anistratenko (2005, p. 381) proposed that the two names become synonyms under *M. sarmatica*, considering the separation of the two species as subjective.

Mohrensternia soceni Jekelius, 1944
Fig. 3j
1944 *Mohrensternia soceni* n. sp. – Jekelius, p. 71, pl. 15, figs. 4-6
1971 *Mohrensternia soceni* Jekelius – Švagrovsky, p. 315, pl. 53, figs. 1-5
1994 *Mohrensternia soceni* Jekelius – Fordinál and Zalinská, pl. 12, figs. 5, 6
2004 *Mohrensternia soceni* Jekelius – Kowalke and Harzhauser, p. 130, fig. 11B
Samples: 29 specimens (4 specimens MPBBU 23898).
Dimensions: max. h= 2.8 mm, l= 1.77 mm.
Description: large conical shell consisting of 5–6 whorls. Apical angle is about 50º. Protoconch consists of about 2.5 whorls. Teleoconch ornamented by 10 almost straight, very prominent axial ribs, strongly convex to angular with maximum convexity located over the suture. Last whorl represents 60–65% of the total shell height. Wide oval aperture with the outline following the prominent convexity of the whorls towards the upper side.
Distribution: species identified at Soceni, Romania (Jekelius, 1944), but also in Slovakia (Švagrovsky, 1971; Fordinál and Zalinská, 1994) and Austria (Kowalke and Harzhauser, 2004).

Family Hydrobiidae Stimpson, 1865
Genus *Hydrobia* Handmann, 1821
Hydrobia frauenfeldi Hörnes, 1856
Fig. 3k
1856 *Paludina frauenfeldi* Hörn. – Hörnes, p. 582, pl. 47, figs. 18a, b
1935 *Hydrobia elongata* Eichwald – Kolesnikov, p. 214, pl. 27, figs. 18-21
1944 *Hydrobia frauenfeldi* Hörnes – Jekelius, p. 57, pl. 9, figs. 1-6
1954 *Hydrobia frauenfeldi frauenfeldi* (Hörnes) – Papp, p. 27, pl. 3, figs. 8-11
1959 *Hydrobia frauenfeldi* Hörnes – Boda, p. 731, pl. 34, figs. 9-11
1969 *Hydrobia frauenfeldi frauenfeldi* (Hörnes) - Kojumdgieva, p. 87, pl. 31, figs. 4-6
1971 *Hydrobia frauenfeldi frauenfeldi* (Hörnes) - Nicorici, p. 223, pl. 3, figs. 55-58
1971 *Hydrobia elongata* (Eichwald) – Švagrovsky, p. 231, pl. 30, figs. 1-9
1972 *Hydrobia frauenfeldi* Hörnes – Ionesi and Ionesi, pl. 4, figs. 25, 26

1990 *Hydrobia frauenfeldi* Hörnes – Moisescu, pl. 1, figs. 4a, b, 5a, b
1995 *Hydrobia elongata* (Eichwald) – Zalinská and Fordinál, pl. 25, fig. 2
1999 *Hydrobia frauenfeldi* Hörnes – Filipescu et al., pl. 3, fig. 5
2001 *Hydrobia elongata* (Eichwald) – Ţibuleac, pl. 2, fig. 27
2002 *Hydrobia frauenfeldi* Hörnes – Harzhauser and Kowalke, p.72, pl. 11, figs. 9-12
Samples: 636 specimens (5 specimens MPBBU 23899)
Dimensions: max. h= 3.56 mm, l= 1.37 mm.
Description: elongated conical shell consisting of 6 whorls. Apical angle is about 35º. The whorls show homogeneous width increments and a convex outline. Last whorl represents about 55% of the total shell height. Oval aperture slightly narrowing towards the upper side. In some specimens, the umbilicus is fully covered.
Distribution: *Hydrobia frauenfeldi* is widely distributed in Sarmatian deposits in Austria (Hörnes, 1856; Papp, 1954; Harzhauser and Kowalke, 2002), Romania (Kolesnikov, 1935; Jekelius, 1944; Nicorici, 1971, Ionesi and Ionesi, 1972; Moisescu, 1990; Filipescu et al., 1999; Ţibuleac, 2001), Bulgaria (Kolesnikov, 1935; Kojumdgieva, 1969), Hungary (Boda, 1959) and Slovakia (Švagrovsky, 1971; Zalinská and Fordinál, 1995).

Hydrobia? *stagnalis* (Baster, 1765)
Fig. 3l
1856 *Paludina stagnalis* Baster – Hörnes, p. 586, pl. 47, fig. 22
1954 *Hydrobia stagnalis stagnalis* (Baster) – Papp, p. 26, pl. 3, figs. 12, 13
1959 *Hydrobia stagnalis stagnalis* (Baster) – Boda, p. 731, pl. 34, figs. 12-14
1971 *Hydrobia stagnalis stagnalis* (Baster) – Švagrovsky, p. 233, pl. 31, figs. 1-8
1990 *Hydrobia stagnalis stagnalis* (Baster) – Moisescu, pl. 1, figs. 6a, b
1995 *Hydrobia stagnalis* (Baster) – Zalinská and Fordinál, pl. 25, fig. 1
1999 *Hydrobia* cf. *stagnalis* (Baster) – Filipescu et al., pl. 3, fig. 6
Samples: 279 specimens (5 specimens MPBBU 23900)
Dimensions: max. h= 4.13 mm, l= 2 mm.
Description: large conical shell consisting of max. 6–7 whorls. Apical angle is about 45º. Whorls increasing rapidly in width. Convex to flattened outline of the whorls. Suture moderate to strongly incised. Last whorl represents 60–65% of the total shell height and is significantly wide. Oval holostome aperture, sometimes slightly narrowing towards the upper side.
Distribution: species identified in Austria (Hörnes, 1856, Papp, 1954), Romania (Moisescu, 1990, Filipescu et al., 1999), Hungary (Boda, 1959) and Slovakia (Švagrovsky, 1971, Zalinská and Fordinál, 1995).
Observations: This extant species is considered to be a synonym of *Heleobia stagnorum* (Gmelin, 1791). The Sarmatian species is not cospecific with the species mentioned above, so this might not be the correct name for this species.

Hydrobia suturata (Fuchs, 1873)
Fig. 4a
1873 *Melania suturata* n. sp. – Fuchs, p. 25, pl. 4, figs. 24, 25
1944 *Hydrobia suturata* Fuchs – Jekelius, p. 58, pl. 9, figs. 14-16
1954 *Hydrobia frauenfeldi suturata* Fuchs – Papp, p. 27, pl. 3, figs. 1, 2
part 1959 *Hydrobia stagnalis suturata* Fuchs – Boda, p. 732, pl. 34, figs. 15, 16
1969 *Hydrobia frauenfeldi suturata* (Fuchs) – Kojumdgieva, p. 87, pl. 31, figs. 7-11
1971 *Hydrobia frauenfeldi suturata* (Fuchs) – Nicorici, p. 224, pl. 3, figs. 53, 54
1971 *Hydrobia suturata* (Fuchs) – Švagrovsky, p. 237, pl. 33, figs. 1-5
1999 *Hydrobia suturata* Fuchs – Filipescu et al., pl. 3, fig. 7
Samples: 324 specimens (5 specimens MPBBU 23901).
Dimensions: max. h= 4.81 mm, l= 2.25 mm.
Description: conical shell consisting of 6 whorls. Apical angle is about 35º. The margins of the first two whorls are slightly rounded while the others are flattened. Whorls are separated by strongly incised sutures are separated by strongly incised sutures. The last whorl represents 60–65% of the total shell height. Ovoid holostome aperture narrowing towards the upper side.
Distribution: species identified in Romania (Jekelius, 1944; Nicorici, 1971; Filipescu et al., 1999), Austria (Papp, 1954), Bulgaria (Kojumdgieva, 1969), Hungary (Boda, 1959) and Slovakia (Švagrovsky, 1971).

Hydrobia soceni Jekelius, 1944
Fig. 4b
1944 *Hydrobia soceni* n. sp. – Jekelius, p.60, pl. 11, figs. 1-6
1971 *Hydrobia soceni* Jekelius – Švagrovsky, p. 242, pl. 34, figs. 1-9
1979 *Hydrobia soceni* Jekelius – Boda, p. 635, 733, pl. 34, fig. 20
2004 *Hydrobia soceni* Jekelius – Ionesi and Ţabără, pl. 4, figs. 8, 9
Samples: 297 specimens (12 specimens MPBBU 23902).
Dimensions: max. h= 3.34 mm, l= 1.8 mm.
Description: conical shell with maximum 5 whorls. Apical angle is about 45º. The whorls have a strongly rounded outline and they are increasing rapidly in width. Very deep suture. Teleoconch ornamented by growth lines. Last whorl represents about 70% of the total shell height. In some specimens, towards the last whorl the labrum is thickened. Ovoid holostome aperture.
Distribution: species identified in Romania (Jekelius, 1944; Ionesi and Ţabără), Hungary (Boda, 1959) and Slovakia (Švagrovsky, 1971).

Genus *Caspia* Dybowski, 1888
Subgenus *Socenia* Jekelius, 1944
Caspia (Socenia) graciliformis Papp, 1954
Fig. 4c
1954 *Caspia (Socenia) graciliformis* n. sp. – Papp, p. 30, pl. 4, figs. 25, 33-39
1971 *Caspia graciliformis* Papp – Švagrovsky, p. 253, pl. 36, figs. 13, 14

1999 *Caspia graciliformis* Papp – Filipescu et al., pl. 3, fig. 10
2002 *Caspia (Socenia) graciliformis* Papp – Harzhauser and Kowalke, p. 73, pl. 9, figs. 5, 10
Samples: 7 specimens (3 specimens MPBBU 23903).
Dimensions: max. h= 1.38 mm, l= 0.49 mm.
Description: elongated cylindrical shell consisting of 5 whorls. Very small apical angle. Whorls register regular and constant, low rate width increments. Convex outline of the whorls. Very deep sutures. Last whorl represents about 60% of the total shell height. Oval, elongated aperture.
Distribution: species identified in Austria (Papp, 1954; Harzhauser and Kowalke, 2002), Slovakia (Švagrovsky, 1971) and Romania (Filipescu et al., 1999).

Superfamily Buccinoidea Rafinesque, 1815
Family Nassariidae Iredale, 1916
Genus *Duplicata* Zhizhchenko in Kolesnikov, 1939
Duplicata duplicata (Sowerby, 1832)
Fig. 4d
1832 *Buccinum duplicatum* n. sp. – Soverby in Sedgwick and Murchinson, p.420, pl. 39, fig. 14
1935 *Buccinum duplicatum* Sowerby – Kolesnikov, p. 243, pl. 29, figs. 7-9
1940 *Buccinum duplicatum* Sowerby – Simionescu and Barbu, p. 102, pl. 3, figs. 1, 2
1954 *Dorsanum duplicatum duplicatum* (Sowerby) – Papp, p. 51, pl. 8, figs. 1-5, 8-10
1959 *Dorsanum duplicatum duplicatum* (Sowerby) – Boda, p. 623, 719, pl. 30, figs. 1-3
1969 *Dorsanum duplicatum duplicatum* (Sowerby) – Kojumdgieva, p. 104, pl. 35, figs. 8-11
1971 *Dorsanum duplicatum duplicatum* (Sowerby) – Švagrovsky, p. 381, pl. 67, figs. 1-14
1972 *Dorsanum duplicatum* (Sowerby) – Ionesi and Ionesi, pl. 3, fig. 26
1978 *Dorsanum duplicatum duplicatum* (Sowerby) – Ionesi and Gräf, pl. 5, fig. 9
2001 *Dorsanum duplicatum duplicatum* (Sowerby) – Ţibuleac, pl. 2, figs. 19a, b
part 2004 *Duplicata duplicata* (Sowerby) – Harzhauser and Kowalke, p. 34, pl. 5, figs. 7-9, pl. 7, figs. 11, 12
2004 *Dorsanum duplicatum* (Sowerby) – Ionesi and Ţabără, pl. 4, fig. 16
2011 *Duplicata duplicata* (Sowerby) – Harzhauser et al., fig. 3.10
Samples: one specimen (MPBBU 23904)
Dimensions: h= 10.5 mm, l= 6 mm.
Description: conical-ovoid shell consisting of 7 whorls. Apical angle is 55º. Protoconch consists of about 1.25 whorls. Ornamentation consists of prominent axial ribs that become flatter towards the upper side under the suture and separated by a small groove from the rest of the rib. This imprints a slightly scalariform outline to the shell margins. Last whorl represents 70% of the total shell height. Siphonostome aperture narrowing towards the upper side.
Distribution: species is frequent in Sarmatian deposits in Romania (Kolesnikov, 1935; Simionescu and Barbu, 1940; Jekelius, 1944; Ionesi and Ionesi, 1972; Ionesi and Gräf, 1978; Ţibuleac, 2001; Ionesi and Ţabără, 2004), Austria (Papp, 1954; Harzhauser and Kowalke, 2004; Harzhauser et al., 2011), Bulgaria (Kolesnikov, 1935; Kojumdgieva, 1969), Hungary (Boda, 1959) and Slovakia (Švagrovsky, 1971).

Superfamily Muricoidea Rafinesque, 1815
Family Muricidae Rafinesque, 1815
Genus *Ocenebra* Jousseaume, 1880
Ocenebra striata (Eichwald, 1853)
Fig. 4e
1830 *Tritonium striatum* n. sp. – Eichwald, p. 225
1852 *Fusus striatus* – Eichwald, pl. 8, fig. 2
1853 *Fusus striatus* – Eichwald, p. 176
1954 *Ocinebrina sublavata striata* (Eichwald) – Papp, p. 48, pl. 9, figs. 1-4
2008 *Ocenebra striata* (Eichwald) – Mandic et al., fig. 7j
Samples: 6 specimens (3 specimens MPBBU 23905)
Dimensions: max. h= 23 mm, l= 12.5 mm.
Description: fusiform elongated shell consisting of 6 whorls. Apical angle is 55–60º. Protoconch consists of about 3 plain whorls with a slightly scalariform outline. Teleoconch ornamented by 9–12 axial ribs intersected by numerous spiral cords and threads. The last whorl represents about 80% of the total shell height. Oval, elongated siphonostome aperture. Long and narrow siphonal canal. Thick labrum.
Distribution: species identified in Austria (Hörnes, 1856; Papp, 1954), Romania (Kolesnikov, 1935; Simionescu and Barbu, 1940), Bulgaria (Kolesnikov, 1935), Hungary (Boda, 1959) and Slovakia (Švagrovsky, 1971).

Superfamily Pyramidelloidea Gray, 1840
Family Pyramidellidae Gray, 1840
Genus *Odostomia* Fleming, 1817
Odostomia sp.
Fig. 4f
part 1971 *Odostomia perrara* Boettger – Švagrovsky, p. 366, pl. 64, figs. 7-9
Samples: 5 specimens (3 specimens MPBBU 23906)
Dimensions: max. h= 1.5 mm, l= 0.56 mm.
Description: elongated conical shell consisting of 5 whorls registering regular width increments. Very small apical angle. Heterostrophic and buried protoconch. Slightly convex outline of the whorls with maximum convexity towards their lower side. Moderately to strongly incised suture, that is a bit inclined. The last whorl represents about 60% of the total shell height. The oval holostome aperture is slightly narrowing towards the upper side.
Distribution: In Sarmatian deposits identified in Slovakia (Švagrovsky, 1971).
Observations: This species is the same as part of the species *Odostomia perrara* identified by Švagrovsky, 1971 in the sarmatian deposits of Slovakia, but it is different from the species *Odostomia perrara* described by Boettger, 1902 (p. 101), and illustrated by Zilch, 1934 (pl. 12, fig. 20-21). The differences between this species and the one described by Boettger are: the shell outline (more slender, less conical), the convexity of the whorls, which is in the lower part instead of an symmetric convexity, like in Boettger and the fact that the suture line is more inclined than in the one of Boettger that has an almost horizontal suture line.

Superfamily Valvatoidea Gray, 1840
Family Valvatidae Gray, 1840
Genus *Valvata* Müller, 1774
Valvata? *soceni wiesenensis* Papp, 1954
Fig. 4g
1954 *Valvata (Turrivalvata) soceni wiesenensis* n. ssp. – Papp, p. 25, pl. 3, figs. 23, 24
1969 *Valvata soceni wiesenensis* Papp - Švagrovsky, p. 229, pl. 29, figs. 7-16
1976 *Valvata soceni wiesenensis* Papp – Ionesi et al., pl. 1, figs. 17, 18
1990 *Valvata (Turrivalvata) soceni wiesenensis* Papp – Moisescu, pl. 1, figs. 1a, b, 2a, b
1999 *Valvata soceni wiesenensis* Papp – Filipescu et al., pl. 3, fig. 4
Samples: 39 specimens (5 specimens MPBBU 23907)
Dimensions: max. h= 3 mm, l= 2.1 mm.
Description: small conical-ovoid, umbilicated shell consisting of 5 whorls. Large apical angle. Protoconch with almost planspiral convolutions. Well-defined suture separating strongly convex whorls. Last whorl represents about 80% of the total shell height. Almost circular holostome aperture.
Distribution: species identified in Austria (Papp, 1954), Romania (Ionesi et al., 1976, Filipescu et al., 1999) and Slovakia (Švagrovsky, 1971).
Observations: This species could not be clearly attributed to the genus *Valvata* because the fine details of the protoconch could not be observed with the stereomicroscope.

Superfamily Philinoidea Gray, 1850
Family Cylichnidae H. and A. Adams, 1854
Genus *Acteocina* Gray, 1847
Acteocina lajonkaireana (Basterot, 1825)
Fig. 4h
1825 *Bulla lajonkaireana* n. sp. – Basterot, p. 22, pl. 1, fig. 25
1935 *Bulla lajonkaireana* Eichwald – Kolesnikov, p. 283, pl. 33, figs. 1-4
1940 *Bulla lajonkaireana* Basterot – Simionescu et Barbu, p. 126, pl. 6, figs. 40, 41
1944 *Bulla lajonkaireana* Basterot – Jekelius, p. 90, pl. 26, figs. 1-7
1954 *Acteocina lajonkaireana lajonkaireana* (Eichwald) – Papp, p. 60, pl. 10, figs. 4-7
1959 *Acteocina lajonkaireana lajonkaireana* (Basterot) – Boda, p. 725, pl. 32, figs. 6, 7, 13-18
1969 *Acteocina lajonkaireana lajonkaireana* (Basterot) – Kojumdgieva, p. 117, pl. 39, figs. 9-11, 14, 15
1971 *Acteocina (Acteocina) lajonkaireana lajonkaireana* (Basterot) - Nicorici, p. 231, pl. 7, figs. 19-22
1971 *Acteocina lajonkaireana lajonkaireana* (Basterot) - Švagrovsky, p. 406, pl. 71, figs. 1-6
1972 *Acteocina lajonkaireana lajonkaireana* (Basterot) - Ionesi and Ionesi, pl. 3, figs. 37-40, pl. 4, figs. 1, 2
1994 *Acteocina lajonkaireana* (Basterot) – Fordinál and Zalinská, pl. 12, fig. 9
1995 *Acteocina lajonkaireana* (Basterot) – Zalinská and Fordinál, pl. 25, fig. 4
1999 *Acteocina lajonkaireana lajonkaireana* (Basterot) – Filipescu et al., pl. 3, fig. 21
2001 *Acteocina lajonkaireana lajonkaireana* (Basterot) – Ţibuleac, pl. 2, figs. 29, 30
2002 *Acteocina lajonkaireana* (Basterot) – Harzhauser and Kowalke, p. 74, pl. 13, figs. 18, 19
2004 *Acteocina lajonkaireana lajonkaireana* (Basterot) – Ionesi and Ţabără, pl. 4, fig. 10
2008 *Acteocina lajonkaireana* (Basterot) – Mandic et al., fig. 7f
2011 *Acteocina lajonkaireana* (Basterot) – Lukeneder et al., fig. 4W
Samples: 156 specimens (5 specimens MPBBU 23908)
Dimensions: max. h= 4 mm, l= 1.8 mm.
Description: conical-tubular shell consisting of about 4 whorls. Heterostrophic protoconch. Very deep suture. The last whorl represents about 95% of the total shell height. Oval aperture narrowing towards the upper side and widening towards the lower one. Relatively more extended labrum.
Distribution: species identified in Romania (Kolesnikov, 1935; Simionescu and Barbu, 1940; Jekelius, 1944; Ionesi and Ionesi, 1972; Filipescu et al., 1999; Ţibuleac, 2001; Ionesi and Ţabără, 2004; Lukeneder et al., 2011), Austria (Papp, 1954; Harzhauser and Kowalke, 2002; Mandic et al., 2008; Lukeneder et al., 2011), Bulgaria (Kolesnikov, 1935; Kojumdgieva, 1969), Hungary (Boda, 1959), Slovakia (Švagrovsky, 1971; Fordinál and Zalinská, 1994; Zalinská and Fordinál, 1995) and Ukraine (Lukeneder et al., 2011).

Family Retusidae THIELE, 1925
Genus *Retusa* BROWN, 1827
Retusa truncatula (Bruguiére, 1792)
Fig. 4i
1792 *Bulle truncatule* n. sp. – Bruguiére, p. 377
1814 *Bulla truncatula* Bruguiére – Brocchi, p. 275
1940 *Bulla truncatula* Bruguiére – Simionescu and Barbu, p. 129, pl. 6, figs. 44, 45
1944 *Bulla truncatula* Bruguiére – Jekelius, p. 91, pl. 26, figs. 13-16
1971 *Retusa truncatula truncatula* (Bruguiére) – Švagrovsky, p. 419, pl. 72, figs. 1-6
1972 *Retusa truncatula* (Bruguiére) – Ionesi and Ionesi, pl. 4, figs. 6-10
2011 *Retusa truncatula* (Bruguiére) – Lukeneder et al., fig. 4X
Samples: 10 specimens (3 specimens MPBBU 23909)
Dimensions: max. h= 2.94 mm, l= 1.75 mm.
Description: cylindrical, involute shell, the last whorl fully covering the previous ones. Elongated aperture that narrows towards the upper side and widening towards the lower one.
Distribution: species identified in occurrences in Romania (Simionescu and Barbu, 1940; Jekelius, 1944; Ionesi and Ionesi, 1972; Lukeneder et al., 2011), Austria (Lukeneder et al., 2011), Slovakia (Švagrovsky, 1971) and Ukraine (Lukeneder et al., 2011).

CONCLUSIONS

We have studied the outcrop in Răcăştia and have described a mollusc assemblage consisting of three species of bivalves: *Ervilia dissita*, *Ervilia trigonula* and *Mytilopsis sarmatica*, and 26 species of gastropods. The

identified bivalves were assigned to two families: Mesodesmatidae and Dreissenidae. The gastropods are: *Gibbula hoernesi*, *Calliostoma*? *angulatum spirocarinatum*, *Calliostoma*? *marginatum*, *Agapilia picta*, *Granulolabium bicinctum*, *Terebralia lignitarum*, *Rissoa turricula*, *Mohrensternia inflata*, *Mohrensternia pseudinflata*, *Mohrensternia multicostata*, *Mohrensternia angulata*, *Mohrensternia pseudoangulata politioanei*, *Mohrensternia banatica*, *Mohrensternia sarmatica*, *Mohrensternia soceni*, *Hydrobia frauenfeldi*, *Hydrobia*? *stagnalis*, *Hydrobia suturata*, *Hydrobia soceni*, *Caspia (Socenia) graciliformis*, *Duplicata duplicata*, *Ocenebra striata*, *Odostomia* sp., *Valvata*? *soceni wiesenensis*, *Acteocina lajonkaireana* and *Retusa truncatula*. These have been assigned to 13 families: Trochidae, Calliostomatidae, Neritidae, Potamididae, Terebrellidae, Rissooidae, Hydrobiidae, Nassariidae, Muricidae, Pyramidellidae, Valvatidae, Cylichnidae and Retusidae.

Similar fauna was identified in other occurrences in Romania, as well as in other countries with Central Paratethys deposits: Austria, Bulgaria, Czech Republic, Poland, Slovakia, Ukraine and Hungary.

The studied mollusc assemblage is representative for the *Mohrensternia* biozone (Papp, 1956). The corresponding host deposits were assigned to the Early Sarmatian.

ACKNOWLEDGMENTS

We would like to thank Dr. Harzhauser Mathias and Dr. Popescu Gheorghe for the careful review and for the suggestions and corrections that strongly improved the original manuscript. We also like to thank Pop Dana for the help she offered with the English translation.

REFERENCES

Anistratenko, V., 2005. Morphology and taxonomy of Late Badenian to Sarmatian *Mohrensternia* (Gastropoda: Rissoidea) of the Central Paratethys. Acta Geologica Polonica, 55 (4): 371-392.

Basterot, B., 1825. Description géologique du bassin tertiaire du S.O. de la France. Mémoire de la Société de Histoire Naturelle, Paris 11, 100 pp.

Boda, J., 1959. Das Sarmat in Ungarn und seine Invertebraten-Fauna. Annales Instituti Geologici Publici Hungarici, Budapest, 47 (3): 569-862.

Boettger, O., 1902. Zur Kenntnis der Fauna der Mittelmiocänen Schichten von Kostej im Krassó-Szörényer Komitat. Vehrandlungen und Mitteilungen des siebenbürgischen Vereins Naturwissenschaften zu Hermannstadt, 51: 200 pp.

Bouchet, Ph. & Rocroi, J. P., 2005. Classification and Nomenclator of Gastropod Families, International Journal of Malacology, 47 (1-2), 397 pp.

Brocchi, G. V., 1814. Conchinologia fossile subapennina, con osservazioni sugli Appenini e sulsuolo adjacente. Dalla Stamperia Reale, Milano. 712 pp.

Bruguiére, J. G., 1789-1792. Encyclopédique méthodique. Histoire naturelle des vers. Tome premier. Panckoucke, Paris, 757 pp.

Cox, L. R., 1960. General characteristics of Gastropoda. In: R.C. Moore (ed.), Treatise on Invertebrate Paleontology. Part I. Mollusca 1, I84–I169. Geological Society of America and University of Kansas Press, Lawrence.

Eichwald, E., 1830. Naturhistorische Skizze von Lithauen, Volhynien und Podolien in Geognostisch-Mineralogischer, Botanischer und Zoologischer Hinsicht, 256 pp.

Eichwald, E., 1852. Lethaea Rossica ou Le Monde Primitif de la Russie, Atlas, 14 planches, Stouttgart.

Eichwald, E., 1853. Lethaea Rossica ou Paléontologie de la Russie 3, dernière période. 533 pp.

Férussac, D., 1825. Notice sur l'animal du gerne argonaute, Argonauta Linne. Memoirs of the Natural History Society of Paris, 2: 160-175.

Filipescu, S., Popa, M. & Wanek, F., 1999. The signifiance of some sarmatian faunas from the Southwestern part of the Pădurea Craiului mountains (Romania). Acta Palaeontologica Romaniae, 2: 163-169.

Fordinál, K. & Zalinská, A., 1994. Sarmatian Fauna from the Stretava and Kochnovce Formations in the Sečovce Area (Albinovská horka, Eastern Slovakian basin). Geologické práce, Geologický ústav Dionýza Štúra, Bratislava, 99: 77-82.

Friedberg, W., 1911-1928. Mioczaki miocenskie ziem Polskich. Czesc I. Slimaki I lodkonogi. Mollusca miocaenica Poloniae. Pars I. Gastropoda et Scaphopoda. 631 pp.

Fuchs, T., 1873. Beiträge zur Kenntnis fossiler Binnenfaunen. VI. Neue Conchylienarten aus den Congerien-Schichten und aus Ablagerungen der sarmatischen Stufe. Jahrbuch der k.k. geologischen Reichsanstalt 23: 19–26.

Gaál, St., 1911. Die sarmatische Gastropodenfauna von Rákosd im Komitat Hunyad. Mitteilungen aus dem Jahrbuche der Königlichen. Ungarischen Geologischen Reichsanstalt, 18 (1): 1-97.

Gheorghiu, C., 1954a. The Miocene from the lower Strei Basin. Dări de seamă ale şedinţelor, Comitetul Geologic, 38 (1950-1951): 44-51, Bucureşti (in Romanian).

Gheorghiu, C., 1954b. Geological study of the Mureşului Valley between Deva and Dobra. Anuarul Comitetului Geologic, 27: 78-174.

Gheorghiu, C., Zberea, A., Visarion, M. & Calotă, C., 1962. New data on the structure of the Strei inferior Basin as a result of geological and geophysical studies. Dări de seamă ale şedinţelor, Comitetul Geologic, 32: 97-165.

Gherasii, N., Mureşan, M.,Mureşan, G., Krautner, F., Krautner, H., Lupu, M., Marinescu, F., Savu, H. & Arghir-Drăgulescu, A., 1968. Geological map of Romania, scale 1:200000, 25 Deva sheet. Institut of Geology, Bucureşti.

Harzhauser, M. & Kowalke, T., 2001. Early Miocene brackish-water Mollusca from the Eastern Mediterranean and from the Central Paratethys – a faunistic and ecological comparison by selected faunas. Journal of the Czech Geological Society, 46 (3-4): 353-374.

Harzhauser, M. & Kowalke, T., 2002. Sarmatian (Late Middle Miocene) Gastropod Assemblages of the Central Paratethys. Facies, 46 (1): 57-82.

Harzhauser, M. & Kowalke, T., 2004. Survey of the Nassariid Gastropods in the Neogene Paratethys (Mollusca: Caenogastropoda: Buccinoidea). Archiv für Molluskenkunde, 133 (1/2): 1-63.

Harzhauser, M. & Mandic, O., 2010. Neogene dreissenids in Central Europe: evolutionary shifts and diversity changes. In: van der Velde, G., Rajagopal, S., bij de Vaate, A. (Eds.) The Zebra Mussel in Europe. Backhuys Publishers, Leiden, 11-28, 426-478.

Harzhauser, M. & Piller, W.E., 2004. The Early Sarmatian – hidden seesaw changes. Courier Forschungs–Institut Senchenberg, 246: 89-111.

Harzhauser, M., 2004. Oligocene Gastropod Faunas of the Eastern Mediterranean (Mesohellenic Trough/Greece and Esfahan-Sirjan Basin/Central Iran). Courier Forschungs–Institut Senchenberg, 284: 93-181.

Harzhauser, M., Daxner-Hock, G., Gohlich, U.B. & Nagel, D., 2011. Complex faunal mixing in the early Pannonian palaeo-Danube Delta (Late Miocene, Gaweinstal, Lower Austria). Annalen des Naturhistorischen Museums in Wien, 113 (A): 167-208.

Hauer, F.R. von & Stache, G., 1863. Geologie Siebenbürgens, Wien, Wilhelm Braumuller, 636 pp.

Hickman, C.S. & McLean, J.H., 1990. Systematic revision and suprageneric classification of trochacean gastropods. – Natural History Museum of Los Angeles County, Science Series, 35: 1-169.

Hilber, V., 1897. Die sarmatischen Schichten vom Waldhof bei Wetzelsdorf, SW Graz. Mittelungen des Naturwissenschaftichen Vereins der Steiermark, 33: 182-204.[not seen]

Hörnes, M. 1856, Die fossilen Mollusken des Tertiaer-Beckens von Wien. I. Univalven. Abhandlungen der kaiserlichkoeniglichen Geologischen Reichsanstalt, Wien, 3, pp. 417-537.

Ionesi, B. & Gräf, I., 1978. Das Sarmat aus dem südöstlichen Teil des Siebenbürgischen Beckens (Gebiet Chinuşu - Fişer). Zeitschrift für Geologische Wissenschaften 6 (1978): 571-603.

Ionesi, B. & Ionesi, V., 1972. On the presence of Buglovian deposits in the Pericarpathyan Unit. Viişoara-Brăteşti region. Analele Ştiinţifice ale Universităţii Alexandru Ioan Cuza din Iaşi, Geologia, 18 (2): 72-94.

Ionesi, B. & Ţabără, D., 2004. Faune de Mollusques de la fornation de Şcheia (Plate-Forme Moldave). Acta Palaeontologica Romaniae, 4: 163-174.

Ionesi, B., Brînzilă, M. & Puieţu, G., 1976. Some observations on the Sarmatian fauna from Soceni (Poliţioanei Valley). Anuarul Muzeului de Ştiinţe Naturale, Piatra Neamţ, Seria Geologie-Geografie, 3: 220-227.

Ionesi, L., Ionesi, B., Lungu, A., Rosca, V. & Ionesi, V., 2005. Sarmatianul mediu si superior de pe Platforma Moldoveneasca, Editura Academiei Romane, Bucuresti, 558 pp.

Jekelius, E., 1944. Sarmat und pont von Soceni (Banat). Memoriile Institutului Geologic al României, Bucureşti, 5, 167 pp.

Kojumdgieva, E., 1968. Representatives of the Congeria genus from the Neogene of North-Western Bulgaria and their phylogeny and paleoecology. Izv. Gheol. Intitut ser. Paleontologia, 17, Sofia [in Bulgarian].

Kojumdgieva, E., 1969. The fossils of Bulgaria VIII Sarmatian. Academie Bulgarie des Sciences, Sofia, 132 pp. [in Bulgarian].

Kolesnikov, V. P., 1935. Sarmatian Molluscs. Paleontologia SSSR, Akademia Nauk SSSR, Leningrad, X (2), 507 pp. [in Russian].

Kowalke, T. & Harzhauser, M., 2004. Early ontogeny and palaeoecology of the Mid-Miocene rissoid gastropods of the Central Paratethys. Acta Palaeontologica Polonica, 49 (1): 111-134.

Lukeneder, S, Zuschin, M, Harzhauser, M. & Mandic, O., 2011. Spatiotemporal signals and palaeoenvironments of endemic molluscan assemblages in the marine system of the Sarmatian Paratethys. Acta Palaeontologica Polonica 56 (4): 767–784. http://dx.doi.org/10.4202/app.2010.0046

Mandic, O., Harzhauser, M. & Roetzel, R., 2008. Benthic mass-mortality events on a Middle Miocene incised-valley tidal-flat (North Alpine Foredeep Basin). Facies, 54 (3): 343-359. http://dx.doi.org/10.1007/s10347-008-0144-6

Moisescu, V., 1990. Contributions à la connaissance de la Faune de Mollusques Volhyniens du Couloir de Făget (Banat de NE). Dări de seama ale şedinţelor, Institutul de Geologie şi Geofizică, 73/3 (1987): 195-211.

Moore, R. C., 1969. Treatise on Invertebrate Paleontology, Part. I, Mollusca I, p. 351; Part. N., I, Mollusca 6, Bivalvia, p. 489; Part. N II, Mollusca 6 Bivalvia, p. 952, Geological Society of America and the University of Kansas Press, Lawrence, Kansas.

Mureşan, M., Mureşan, Georgeta., Kräutner, H., Kräutner, F., Ţicleanu, N., Stancu, J., Popescu, A. & Popescu, Gh., 1980. Geological map of Romania, scale 1:50000, 89d Hunedoara sheet. Institute of Geology, Bucureşti.

Nicorici, E., 1971. The Sarmatian fauna from Vârciorog (Vadului Basin). Studii şi cercetări de Geologie, Geofizică, Geografie, Seria Geologie, 16 (1): 215-232.

Papp, A., 1954. Die Mollusken fauna im Sarmat des Wiener Beckens. Mitteilungen der Geologischen Gesellschaft in Wien, 45 (1952): 1-112.

Papp, A., 1956. Fazies und Gliederung der Sarmats im Wiener Becken. Mitteilungen der Geologischen Gesellschaft in Wien, 47 (1954): 35 - 98.

Sedgwick, A. & Murchinson, R. I., 1832. A sketch of the structure of the Eastern Alps. Transactions of the Geological Society of London, 3(2): 301-420.

Simionescu, I. & Barbu, I. Z., 1940. La faune sarmatienne de Roumanie. Memoriile institutului geologic al României, Bucureşti, 3, 194 pp.

Sokolov, N. A., 1899. Die Schichten mit "Venus konkensis" am Flusse Konka, Memoires du Comité Géologique, St. Petersburg, 9 (5), 108 pp.

Švagrovsky, J., 1971. Das Sarmat der tschechoslowakei und seine molluskenfauna. Acta Geologica et Geographica universitatis comenianae Geologica, Bratislava, 20, 473 pp.

Ţibuleac, P., 2001. New geological section with Volhynian-Basarabian boundary in the western part of

the Moldavian Platform. Studii şi cercetări (Geologie-Geografie), 6(2001): 73-82.

Toth, E., Gorog, A., Lecuyer, C., Moissette, P., Batler, V. & Monostori, M., 2010. Paleoenvironmental reconstruction of the Sarmatian (Middle Miocene) Central Paratethys based on palaeontological an geochemical analyses of foraminifera, ostracods, gastropods and rodents. Geological Magazine, 147 (2):299-314. http://dx.doi.org/10.1017/S0016756809990203

Zágoršek, K., Silye, L. & Szabó, B., 2008. New Bryozoa from the Sarmatian (Middle Miocene deposits of the Cerna-Strei Depression, Romania). Studia Universitatis Babeş - Bolyai, Geologia, 53 (1): 25-29.

Zalinská, A. & Fordinál, K., 1995. Lower Sarmatian Fauna from Drillhole K-3 (Eastern Slovakian Basin). Geologické práce, Geologický ústav Dionýza Štúra, Bratislava, 100: 71-75.

Zilch, A., 1934. Zur fauna des Mittel - Miöcans von Kostej (Banat). Sonderabdruck aus Senckenbergiana, 16(4/6): 193 - 302.