# Annotated checklist of the Pannonian microflora, evertebrate and vertebrate community from Studienka, Vienna Basin

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## Abstract

Diversified microfloral and faunal community has been found in the psammitic and aleuritic deposits of the Vienna Basin. The sediments are assigned to the Pannonian, zone E corresponding with regional cycle CPC 7 dated to the period 10.5? – 8.2? Ma. Mass occurrence of the eutrophic green algae and a mixed taphocenosis of the freshwater and brackish ostracods is documented. They are associated with the Paratethys mollusc fauna and the fish otoliths belonging to the genera *Atherina* sp., *Gobius* sp., *Solea* sp. and *Sciaena* sp.

## Introduction

Locality Studienka-Vlčie jamy is situated on right bank of the river Rudava, on left sight of the road No. 590 leading from Studienka to Malacky (Fig. 1). The outcrops of 6 m high expose the clastic deposits. A sequence starts with psammitic and aleuritic deposits free of the fossils and terminates by marshy sedimentation (lignite) with predominant coniferous pollen assemblage. The sedimentation continues with bioturbated clay and grey and brown silt with rare ostracod valves. The diversified plant, evertebrate and vertebrate community appears in clayey horizons No. 8 and No. 9. The overlaying laminated clays preserve rare freshwater and brackish ostracods. Generally, a grain size decreases upward and it changes from sand to silt and clay. This fining-upward could be considered as a progressive lost of velocity of the water environment and calmer sedimentation.

## Microflora

### Algae

Two green microalgae species are documented. Their mass occurrence is observed in the sample No. 8+9 (Tab. 1). *Botryococcus braunii* Kutzing, 1849 is represented by colonial and solitary forms (30 %). Its solitary form occurs in the samples 10 and 13. This freshwater alga belonging to the Chlorophyta is distributed in oligotrophic and in some eutrophic fresh waters, brackish and saline ponds, lakes, and reservoirs throughout the world in a wide variety of climates.

The complete tests and the fragments of *Pediastrum duplex* Meyen, 1829 represent 40 % of all documented microflora specimens. Its occurrence signalizes the freshwater eutrophic environments, in particular, standing water bodies such as ponds and lakes.

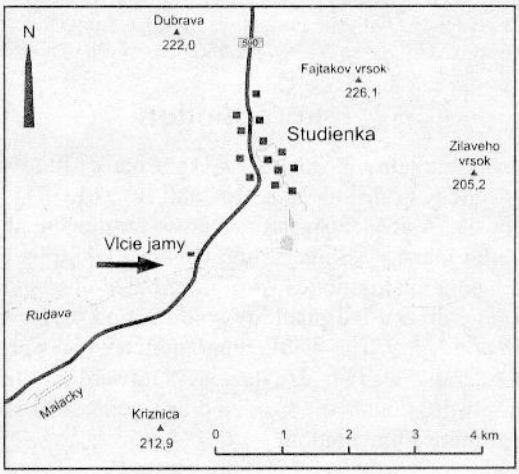




Figure 1. Geographic sketch of the outcrop Studienka-Vlčie jamy.

**Pollen**

The pollen occur in the samples No. 5, No. 8+9, No. 10, No. 13, No. 14 (Tab. 1). The higher relief affected the composition of vegetation after afforestation of the mountains which is documented by the incidence of the coniferous woody plants taxa *Abiespollenites, Zonalapollenites, Cedripites, Piceapollis and Pinuspollenites*. Rare deciduous taxa are represented by *Caryapollenites simplex*, *Intratriporopollenites instructus* (*Tilia* type) and *Juglanspollenites verus* – all arctotertiary elements.

## Ostracoda

Ostracods were recorded in samples No. 6.2, No. 7.2., No. 8+9, No. 11 and No. 13 (Tab. 1). The samples are poor on species and individuals besides sample No. 8+9 with well preserved community composed of 21 species, which are the following:

*Cyprideis heterostigma* (Reuss, 1850) is a fossil species of the Pannonian Lake. Its valves represent 60 % of specimens (counted from the first 400 valves). It associates frequently with caspibrackish *Amplocypris*, which is represented by two species – *Amplocypris recta* (Reuss, 1850) and *Amplocypris* sp. A.

*Candona* ex. gr. *neglecta* Sars, 1887 is the second the most abundant species in Studienka-Vlčie jamy, represented mostly by juvenils. A recent *Candona neglecta* is a freshwater species found also in a salty inland and coastal waters with salinity range 0.5 –16 ‰.

*Darwinula stevensoni* (Brady & Robertson, 1870), generally freshwater cosmopolite species, tolerates an increase of salinity up to 15 ‰; thermoeuryplastic.

*Vestalenula pagliolii* (Pinto & Kotzian, 1961) is living in riverine pools and lakes of Brazil (Martens et al. 1997; Rossetti, Martens 1998).

*Fabaeformiscandona balatonica* (Daday, 1894) prefers different freshwater biotopes.

*Cyclocypris laevis* (O.F. Müller, 1776) inhabits very variable freshwater milieu. It tolerates a low salinity up to 8 ‰.

*Cypria ophtalmica* (Jurine, 1820) is a freshwater, cosmopolite and very common species tolerating a wide range of environmental conditions.

*Fabaeformiscandona fabaeformis* (Fischer, 1851), freshwater, reported only from shallow environment, tolerates a slight increase in salt content.

*Eucypris* aff. *dulcifons* Diebel & Pietrzeniuk, 1969 is a fossil species occurring in the Pleistocene freshwater deposits of the Central Europe (Griffiths, 1995).

*Heterocypris salina* (Brady, 1868) prefers salty coastal and inland water bodies living also in pure freshwater habitats.

Other 9 species are kept in open nomenclature. The determined genera are largely present in the continental habitats of the Palearctic bioprovince (Meisch, 2000). Only *Mediocytherideis* is recorded from the Paratethys area, where is known from caspibrackish associations. *Candona* sp. A, *Potamocypris* and possibly *Paralimnocythere* species could be seen as the new species.

*Candona* sp. A
*Eucypris* sp. A
*Ilyocypris* sp. A
*Mediocytherideis* sp. A
*Paralimnocythere* sp. A
*Paralimnocythere* sp. B
*Potamocypris* sp. A
*Potamocypris* sp. B
*Pseudocandona* sp. A

## Mollusca

The mostly damaged valves of the molluscs are abundant in the sample 8+9 (Tab. 1).

**Gastropoda**

*Bithynia* cf. *jurinaci* Brusina, 1884
*Bithynia* sp.
*Bithynia* (operculum)
*Theodoxus* sp.
*Valvata obtusaeformis* Loerenthey, 1911
*Valvata* sp.

Both *Valvata obtusaeformis* and *Bithynia* cf. *jurinaci* are known from the Pannonian Lake and they could indicate standing water habitats (Fordinál 1997; Harzhauser, Tempfer, 2004). Optimal depth for development of *Valvata* and *Bithynia* is 1.5-3 m, but they can live at depths 70-80 m (Frömmig 1956). *Theodoxus* inhabits always shallow lagoons and submerged delta plains (Müller et al. 1999).

**Bivalvia**

*Mytilopsis* cf. *neumayri* (Andrusov, 1897) – only disarticulated valves were found. The species is largely distributed in the Central Paratethys area (Fordinál 1997). It is an inhabitant of running waters (Harzhauser, Tempfer 2004).

? *Unio* sp. – large and heavy damaged valves with concentric ribs could be assigned to freshwater *Unio*.

Adrian and Paul (1864) refer *Melanopsis bouei* and small *Congeria* from freshwater deposits situated southward from Studienka.

## Fish remnants

The fish teeth, broken bones (ribs, vertebrae), scales and otoliths were found in samples 8+9 (Tab. 1).

**Otoliths**

They are the most important part of the fish remnants and they improve paleobiological properties of the water environment. We determined 4 genera. The other otoliths are kept in open nomenclature for instant and they are attributed to the family Sciaenidae and the superorder Acanthopterygii.

*Atherina* sp. – occurs above sand bottom near the coast, in river mouths and brackish lagoons at depths of 0-100 m.

*Gobius* sp. – Gobiidae live mainly in marine environment but they occur also in brackish and fresh water.

*Solea* sp. – genus is known from the neritic and shallow water deposits.

*Sciaena* sp. – neritic fishes described from warm shallow marine and estuarian environment.

| Microflora | | | | | | Ostracoda | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Taxon / Sample** | **14** | **13** | **10** | **8+9** | **5** | **Taxon / Sample** | **13** | **11** | **8+9** | **7.2** | **6.2** |
| *Abiespollenites cedroides* | | | | 20 | 3 | *Amplocypris recta* | ° | | ° | | |
| *Abiespollenites dubius* | | | | 18 | 24 | *Amplocypris* sp. A | | | ° | | |
| *Abiespollenites latisaccatus* | | | | 9 | | *Candona* ex. gr. *neglecta* | ° | °° | °° | ° | |
| *Abiespollenites maximus* | 1 | | 3 | 5 | | *Candona* sp. A | ° | ° | ° | | |
| *Abiespollenites microsaccoides* | | | | 3 | | *Cyclocypris laevis* | | | ° | | |
| *Alnipollenites verus* | | | | | 3 | *Cypria ophtalmica* | | | ° | | ° |
| *Botryococcus braunii* (colonial) | | | 22 | 133 | | *Cyprideis heterostigma* | ° | ° | °°° | °° | ° |
| *Botryococcus braunii* (solitaire) | | 9 | 14 | 40 | 1 | *Darwinula stevensoni* | °° | ° | ° | | ° |
| *Caryapollenites simplex* | | | | 4 | | *Eucypris* aff. *dulcifons* | ° | | ° | | |
| *Cathayapollenites* sp. | | | | 5 | | *Eucypris* sp. A | | | ° | | |
| *Cedripites miocaenicus* | | 2 | | 15 | 2 | *Fabaeformiscandona balatonica* | ° | ° | ° | | °° |
| *Gramineae* | | | | 2 | | *Fabaeformiscandona fabaeformis* | | | ° | ° | |
| *Intratriporopollenites instructus* | | | | 2 | | *Heterocypris salina* | | | ° | ° | ° |
| *Juglanspollenites verus* | | | | 1 | | *Ilyocypris* sp. A | ° | ° | ° | | ° |
| *Pediastrum duplex* complete tests | | | 13 | 83 | | *Mediocytherideis* sp. A | | | ° | | |
| *Pediastrum duplex* fragments | | | 34 | 145 | | *Paralimnocythere* sp. A | ° | | ° | | |
| *Piceapollis tobollicus* | | 1 | | 2 | 1 | *Paralimnocythere* sp. B | ° | | ° | | |
| *Pinuspollenites* cf. *alatus* | | 2 | | 11 | 19 | *Potamocypris* sp. A | | | ° | | |
| *Pinuspollenites* cf. *peuceformis* | | | | 3 | 6 | *Potamocypris* sp. B | | | ° | | |
| *Pinuspollenites labdacus* | | | | | 12 | *Pseudocandona* sp. A | | | ° | ° | |
| *Pinuspollenites latisaccatus* | | | | 4 | 4 | *Vestalenula pagliolii* | | | ° | ° | |
| *Pinuspollenites microalatus* | | | | | 4 | | | | | | |
| *Pinuspollenites* sp. | | 13 | 1 | 29 | | | | | | | |
| *Pinuspollenites sylvestris* type | | | 16 | 14 | | **Mollusca** | | | | | |
| *Podocarpidites nageiaformis* | | | | 2 | 1 | *Bithynia* cf. *jurinaci* | | | 1 | | |
| *Quercoidites* sp. | | | | 1 | | *Bithynia* sp. | | | 2 | | |
| *Sciadopytispollenites* sp. | | | 1 | 4 | 3 | *Bithynia* (operculum) | | | 20 | | |
| Taxodiaceae | | | | 2 | 1 | *Mytilopsis* cf. *neumayri* | | | 14 | | |
| *Zonalapollenites igniculus* | | | | 11 | 3 | *Theodoxus* sp. | | | °° | | |
| *Zonalapollenites minimus* | | | | 1 | | ? *Unio* sp. | | | ° | | |
| *Zonalapollenites viridifluminipites* | | 1 | | 2 | | *Valvata obtusaeformis* | | | 3 | | |
| algae-unknown | | | | | 2 | *Valvata* sp. | | | 58 | | |
| **Fish otholits** of the sample No. 8+9 | | | | | | | | | | | |
| *Atherina* sp., *Gobius* sp., *Solea* sp., *Sciaena* sp., Sciaenidae gen. et spec. indet; Acanthopterygii gen. et spec. indet. | | | | | | | | | | | |

Table 1. List of microflora and fauna from Studienka-Vlčie jamy. Abbreviations: ° present; °° abundant; °°° very abundant.

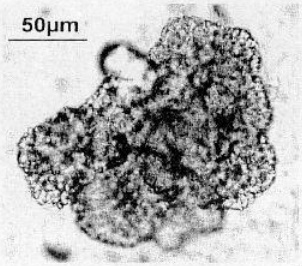
## Stratigraphy

The assemblage is relatively poorer on biostratigraphic markers than other Pannonian localities in the Vienna Basin. *Mytilopsis neumayri* appears in the Karpatian of Austria and later its occurrence continues in the Pannonian deposits of the Pannonian Lake. Its presence could indicate Mytilopsis neumayri/Mytilopsis zahalkai Zone (Harzhauser, Tempfer 2004), however *Mytilopsis zahalkai* is not observed in studied deposits. *Bithynia jurinaci* extends in the Pannonian, zone C-H. *Valvata obtusaeformis* is the Pannonian species ranged to the zones E-H (Fordinál 1997).

*Amplocypris recta* (Reuss) is known from the Pannonian D-E. Later, a presence and an intensive evolution of *Amplocypris* is concentrated to the southern part of the Pannonian Lake. *Darwinula stevensoni*, ancient parthenogenetic species, is living since the Oligocene till the Recent (Meisch 2000). *Vestalenula pagliolii, Fabaeformiscandona fabaeformis, F. balatonica* and *Heterocypris salina* have also very long stratigraphic extension. Their first appearances are recorded from the Miocene (first two species), resp. from the Middle Miocene and they live up till now (Janz 1997; Meisch 2000; Pipík, Bodergat 2003; Pipík, Bodergat in press). The freshwater ostracods appear in the Vienna Basin in the Pannonian F and their frequent occurrence continues in the zones G-H (Kováč et al. 1998). *Cyprideis heterostigma* has the most restricted stratigraphic extension. Its presence would assign the deposits from Studienka-Vlčie jamy to the Pannonian, zone E (Jiříček, 1983, 1985) which corresponds with the regional cycle CPC 7 dated to the period 10.5? – 8.2? (Kováč 2000).

Plate 1 (next page). Characteristic fossils of the locality Studienka-Vlčie jamy, horizons No. 8 and No. 9. Abbreviations: LV – left valve; RV – right valve.

1. *Botryococcus braunii* Kutzing, 1849, colonial form
2. *Pediastrum duplex* Meyen, 1829
3. *Ilyocypris* sp., LV, external lateral view
4. *Potamocypris* sp. A, LV, external lateral view
5. *Fabaeformiscandona balatonica* (Daday, 1894), LV, external lateral view
6. *Candona* sp. A, LV, external lateral view
7. *Fabaeformiscandona fabaeformis* (Fischer, 1851), LV, external lateral view
8. *Cypria ophtalmica* (Jurine, 1820), LV, external lateral view
9. *Candona* ex gr. *neglecta* Sars, 1887, RV, external lateral view
10. *Darwinula stevensoni* (Brady & Robertson, 1870), LV, external lateral view
11. *Vestalenula pagliolii* (Pinto & Kotzian, 1961), LV, external lateral view
12. *Paralimnocythere* sp. A, RV, external lateral view
13. *Cyprideis heterostigma* (Reuss, 1850), LV, external lateral view
14. *Amplocypris recta* (Reuss, 1850), LV, external lateral view
15. *Mediocytherideis* sp., RV, external lateral view
16. *Gobius* sp.
17. *Atherina* sp.
18. *Valvata obtusaeformis* Loerenthey, 1911
19. *Bithynia* cf. *jurinaci* Brusina, 1884
20. *Theodoxus* sp.
21. *Mytilopsis* cf. *neumayri* (Andrusov, 1897)

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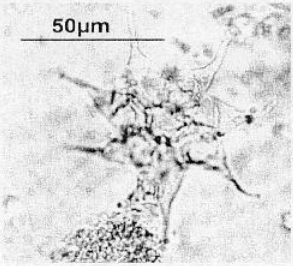


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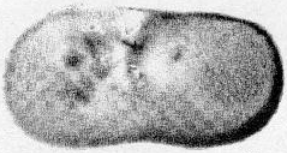

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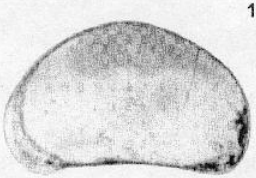

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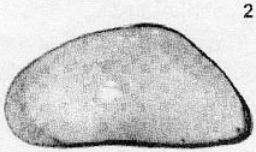

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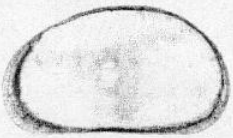

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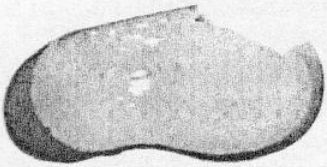

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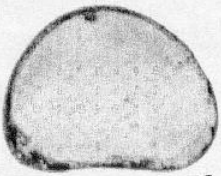

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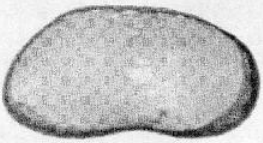

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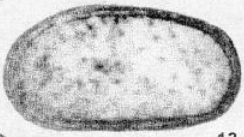

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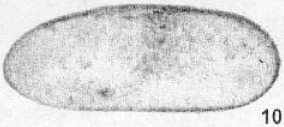

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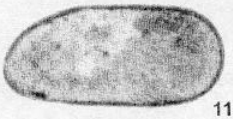

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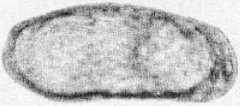

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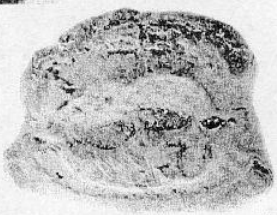

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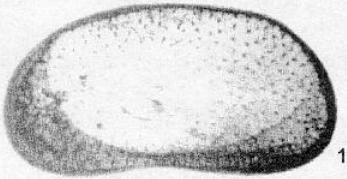

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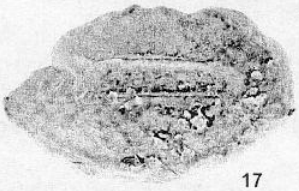

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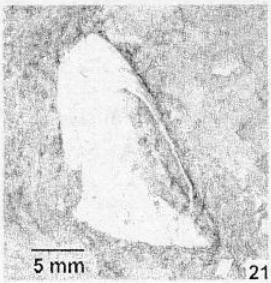

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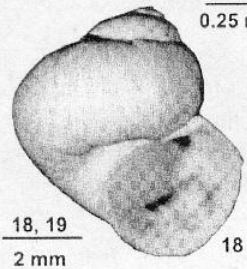

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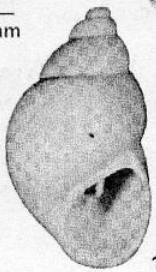

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20

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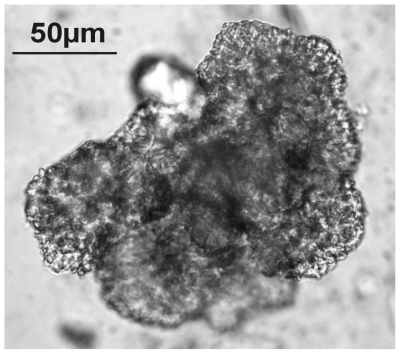


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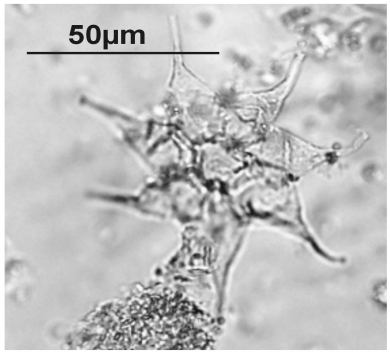


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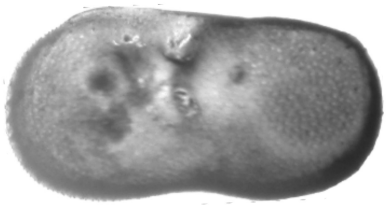

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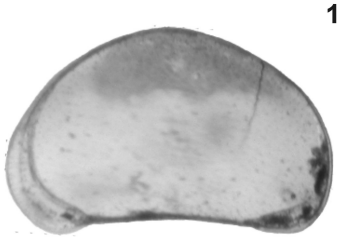

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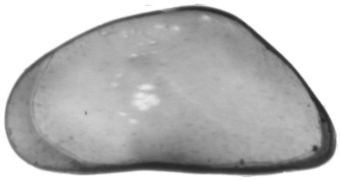

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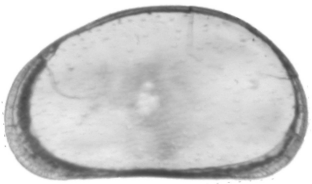

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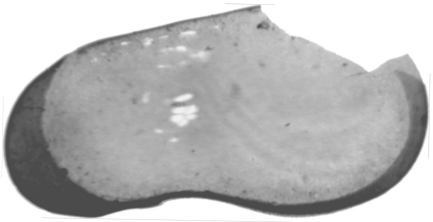

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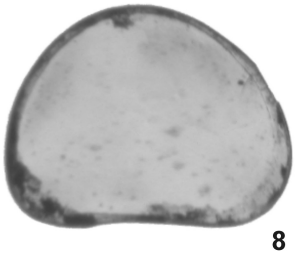

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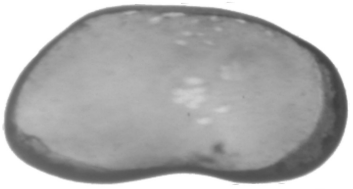


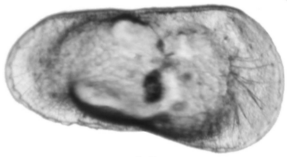
9

4, 8, 10-12, 15

0.25 mm

10

11



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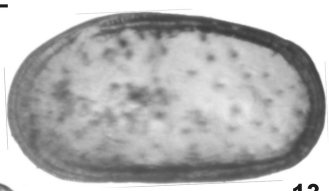
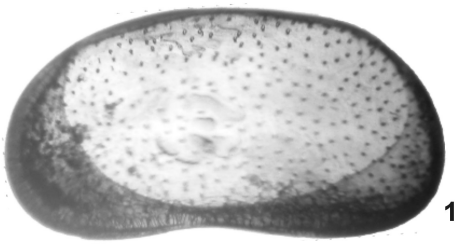


13

3, 5-7, 9, 13, 16, 17

0.25 mm



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14

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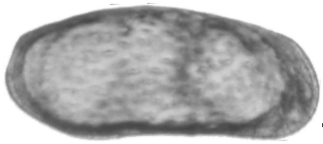

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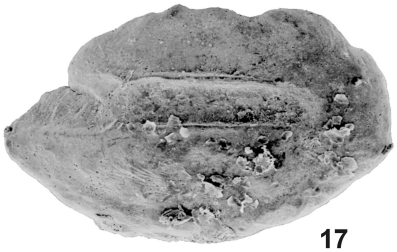

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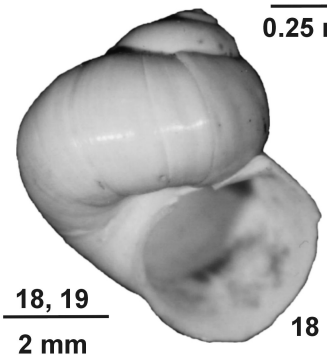
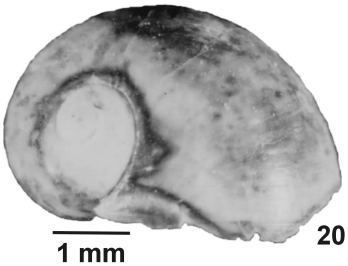


18, 19

2 mm

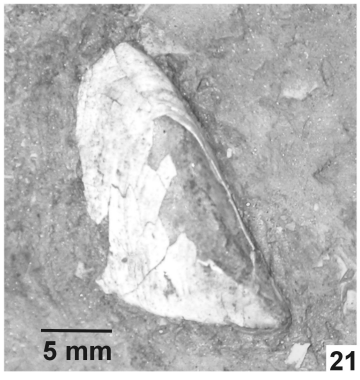
18

19



1 mm

20




21