

CHAPTER V

SYSTEMATIC PALEONTOLOGY

This chapter presents the findings from microfossils study included ostracods, conodonts and tentaculitoids, emphasizing the taxonomy, classification, and identification. Descriptions of morphological features are provided to aid in the accurate identification of species.

5.1 Ostracod

A total of 586 complete carapaces without disarticulated valves, adults and juvenile mixed assemblage were recovered from 12 limestone samples (19KT01-03 collected from lower unit, 19KT04-08 collected from middle unit, 19KT09-12 collected from upper unit) and deposited at micropaleontological laboratory, Suranaree University of Technology. A total of 34 ostracod species were identified, belonging to 17 genera and 11 families.

The classification in this study follows the framework established by Moore (1961).

Class OSTRACODA Latreille, 1802

Subclass PODOCOPA Müller, 1894

Order PODOCOPIDA Sars, 1866

Suborder PODOCOPINA Sars, 1866

Superfamily BAIRDIOCYPRIDOIDEA Shaver, 1961

Family PACHYDOMELLIDAE Berdan and Sohn, 1961

Genus *Ampuloides* Polenova, 1952

Type species: *Ampuloides verrucosa* Polenova, 1952

Ampuloides cf. quadrata Jiang in Wei et al., 1983

(Figure 5.1)

Occurrence: Sample 19KT06.

Study material: 2 specimens.

Dimension: Length = 0.58 – 0.60 mm, Height = 0.33 – 0.36 mm

Remarks: The specimen resembles *Ampuloides quadrata* Jiang, 1983, discovered in the Middle Devonian Huaning Formation in Yunnan (Wei et al., 1983). The carapace has a straight ventral border, giving it a sub-rectangular shape in lateral view. However, the posterior border of *A. quadrata* is bigger than the specimens in this study.

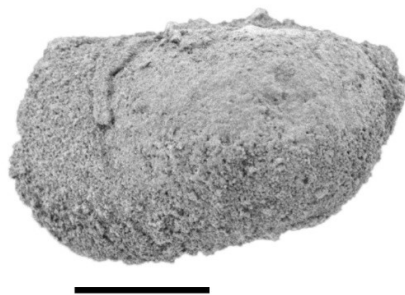


Figure 5.1 *Ampuloides cf. quadrata*; left lateral view. Scale bar = 0.2 mm.

Ampuloides thungsamedensis Promduang and Chitnarin, 2025

(Figures. 5.2)

Occurrence: Samples 19KT01, 02, 04, 05, 06, 07.

Study material: 46 specimens.

Dimensions: Length = 0.46-0.62 mm, Height = 0.28-0.35 mm.

Remarks: The new ostracod species *Ampuloides thungsamedensis* is distinguishable from *A. quadrata* from the Middle Devonian of Guizhou (Wei et al., 1983) by the absence of the sub-rectangular carapace in lateral view. Although the overall shape and size of the carapace closely resemble *A. beckeri* Nazik, 2020, from the Late Devonian of Mongolia (Nazik et al., 2020), the cardinal extremities of the left valve in *A. thungsamedensis* are positioned at the dorsal border. This species shares similarities with *A. vissouensis* Casier and Pr  at, 1996, from the upper Eifelian to lower Givetian in

the Pic de Vissou quarry, Montagne Noire, France (Casier and Pr  at, 1996) but can be differentiated by its smoothly rounded free margin on the left valve and a small surface protuberance. Juveniles are fusiform when viewed dorsally and ventrally (Figure 5.2F), while adults possess a robust carapace with an inflated posterior section (Figures 5.2D-E).

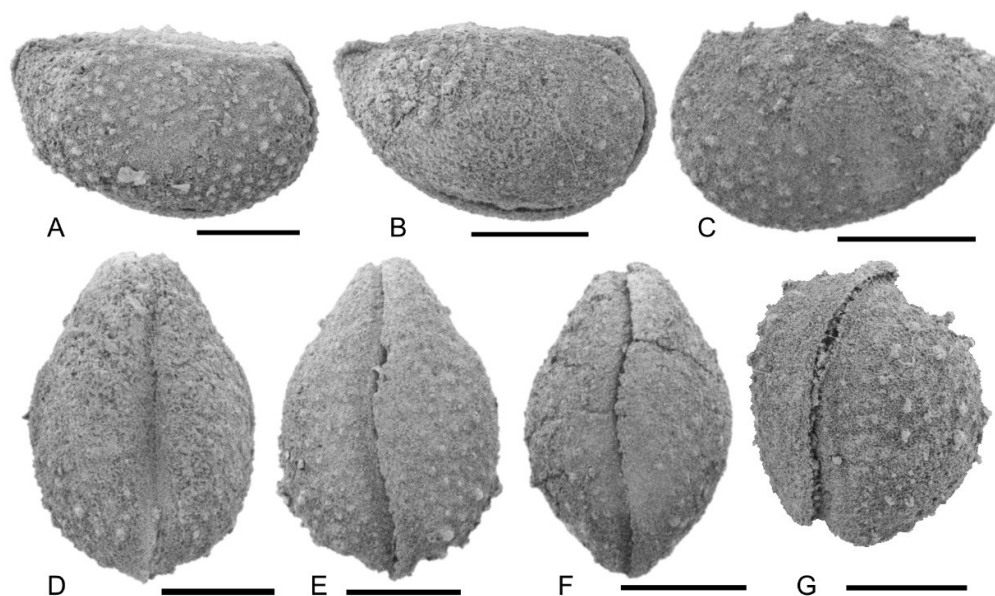


Figure 5.2 *Ampuloides thungsamedensis*, A-B, left lateral view, C. right lateral view. D. dorsal view, E-F, ventral view, G. oblique postero-ventral view showing shallow furrow that run parallel to free margin. Scale bar = 0.2 mm.

Ampuloides sp. A

(Figure 5.3)

Occurrence: Samples 19KT01-02.

Study material: 7 specimens.

Dimension: Length = 0.44-0.58 mm, Height = 0.30-0.41 mm.

Remarks: The specimens can be distinguished from *Ampuloides thungsamedensis* by having greater Height/Length ratio, pointed cardinal extremities, and a swollen dorsal border that arches higher than the dorsum.

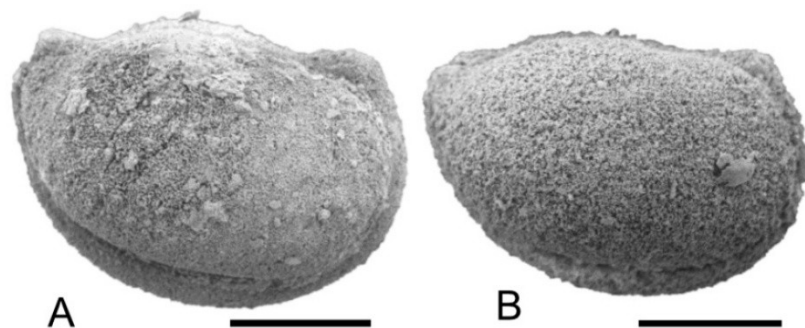


Figure 5.3 *Ampuloides* sp. A; right lateral view. Scale bar = 0.2 mm.

Ampuloides sp. B

(Figure 5.4)

Occurrence: Samples 19KT01, 04, 05.

Study material: 9 specimens.

Dimension: Length = 0.58-0.59 mm, Height = 0.41-0.47 mm.

Remarks: The specimen is set apart from *Ampuloides thungsamedensis* by having sub-rectangular shape, straight posteroventral border, rounded yet prominent cardinal extremities that rise higher than the dorsal border, a swollen median area, and a prominent surface protuberance.

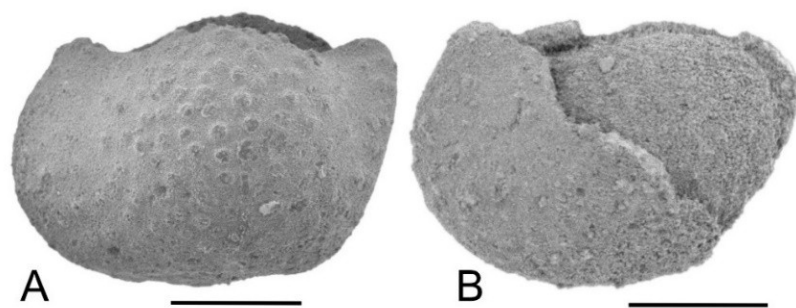


Figure 5.4 *Ampuloides* sp. B; left lateral view. Scale bar = 0.2 mm.

Genus *Microcheilinella* Geis, 1933

Type species: *Microcheilinella distortus* Geis, 1932

Microcheilinella cf. larionovae Polenova 1955 in Wei et al., 1983

(Figure 5.5)

Occurrence: samples 19KT04-06.

Study material: 13 specimens.

Dimension: Length = 0.53-0.54 mm, Height = 0.29-0.30 mm.

Remarks: The species closely resemble *Microcheilinella larionovae* Polenova, 1955 in Wei et al. (1983) from the Middle Devonian of Ghuizhu (Wei et al., 1983) due to its ovate-oblong shape in lateral view and a dorsal border that is straight to slightly convex, running parallel to the ventral border.



Figure 5.5 *Microcheilinella cf. larionovae*; right lateral view. Scale bar = 0.2 mm.

Microcheilinella cf. obrima Jiang in Wei et al., 1983

(Figure 5.6)

Occurrence: Samples 19KT05, 06.

Study material: 12 specimens.

Dimension: Length = 0.37-0.65 mm, Height = 0.18-0.36 mm.

Remarks: This species has a similarity with *Microcheilinella obrima* Jiang in Wei et al., 1983, from the Middle Devonian of the Ghuizhu (Wei et al., 1983). However, differences are observed at the anterior border and posterior border, where the maximum convexities are positioned at mid-height in the specimens from this study, but below mid-height in *M. obrima* Jiang in Wei et al. (1983).

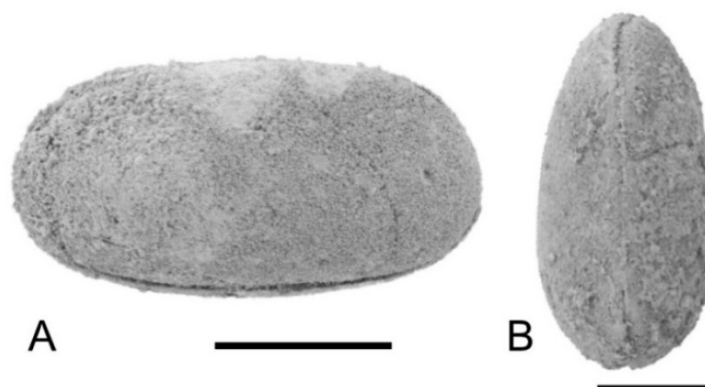


Figure 5.6 *Microcheilinella* cf. *obrima*, A. right lateral view, B. dorsal view. Scale bar = 0.2 mm.

Microcheilinella sp. A

(Figure 5.7)

Occurrence: Samples 19KT01, 02, 04.

Study material: 12 specimens.

Dimension: Length = 0.47-0.53 mm, Height = 0.30-0.34 mm.

Remarks: The specimen is distinguished from *Microcheilinella* species by having a more swollen carapace. In contrast to *M. xuanheensis* Wang, 2015 in Song et al., 2022 from the Late Silurian of southern Tibet, China, it exhibits a less pronounced swelling and features more rounded AB and PB.

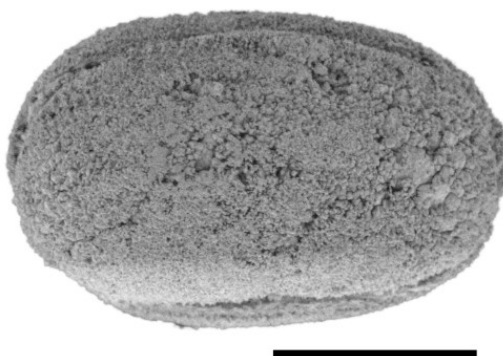


Figure 5.7 *Microcheilinella* sp. A; right lateral view. Scale bar = 0.2 mm.

Microcheilinella sp. B

(Figure 5.8)

Occurrence: Samples 19KT01, 03, 05, 06.**Study material:** 26 specimens.**Dimension:** Length = 0.44-0.55 mm, Height = 0.28-0.35 mm.

Remarks: This *Microcheilinella* species shows some resemblance to the genus *Newsomites* Morris and Hill, 1952 but lacks the pointed posterior ends. Its overall shape closely matches *Decoranewsomites multicavus* Rozhdestvenskaja, 1972 from Montagne Noire, France (Casier and Lethiers, 1997), though it lacks ornamentation, preventing its classification within *Decoranewsomites* Casier and Lethiers, 1997.



Figure 5.8 *Microcheilinella* sp. B; right lateral view. Scale bar = 0.2 mm.

Microcheilinella? sp.

(Figure 5.9)

Occurrence: Sample 19KT02.**Study material:** 2 specimens.**Dimension:** Length = 0.46-0.51 mm, Height = 0.26-0.29 mm.

Remarks: This species generally resembles *Microcheilinella* sp. B described in this study, but is distinctly shorter in height, resulting in a more oblong outline. The dorsal margin is nearly straight. Although its overall shape is similar to *Decoranewsomites angelicus* Casier and Lethiers, 1997, the specimen cannot be confidently assigned to *Decoranewsomites* because it is poorly preserved and does not show the surface

ornamentation that typically characterizes the genus. Given these limitations and its closer resemblance to other members of this community, the specimen is provisionally referred to *Microcheilinella*.

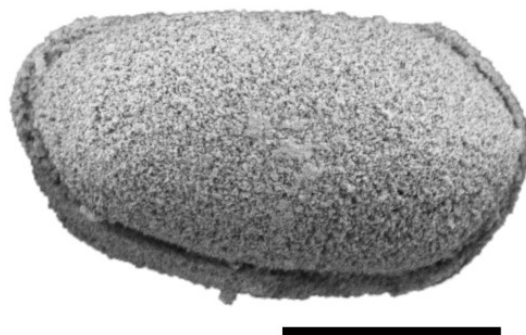


Figure 5.9 *Microcheilinella*? Sp.; right lateral view. Scale bar = 0.2 mm.

Family BAIRDIOCYPRIDIDAE Shaver, 1961

Genus Bairdiocypris Kegel, 1932

Type species: Bairdiocypris gerolsteinensis Kegel, 1932

Bairdiocypris cf. uliatlensis prava Wang and Shi in Hou, 1988

(Figure 5.10)

Occurrence: Samples 19KT02, 06, 07.

Study material: 19 specimens.

Dimension: Length = 0.36-0.88 mm, Height = 0.22-0.56 mm.

Remarks: The specimen closely resembles *Bairdiocypris uliatlensis prava* Wang and Shi (in Hou et al., 1988) from the Lower Devonian Yangmaba Formation at the Guixi-Shawozi section.

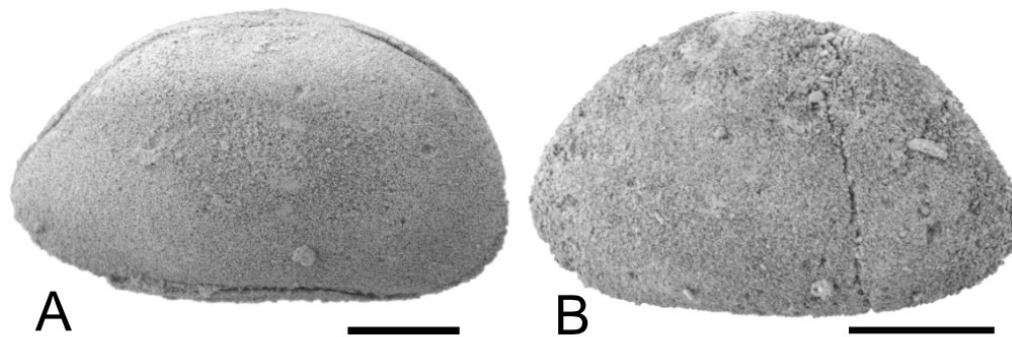


Figure 5.10 *Bairdiocypris* cf. *uliatlensis prava*; A. right lateral view, B. left lateral view. Scale bar = 0.2 mm.

Bairdiocypris cf. *uliatlensis alta* Wei in Hou, 1988

(Figure 5.11)

Occurrence: Samples 19KT01, 03, 05.

Study material: 18 specimens.

Dimension: Length = 0.52 - 0.73 mm, Height = 0.35 - 0.45 mm.

Remarks: In lateral view, the specimen exhibits a subtriangular shape, resembling *Bairdiocypris uliatlensis alta* Wei in Hou, 1988 from the Upper Devonian Tugiaozi Formation, China. However, it is distinguished by a longer carapace.

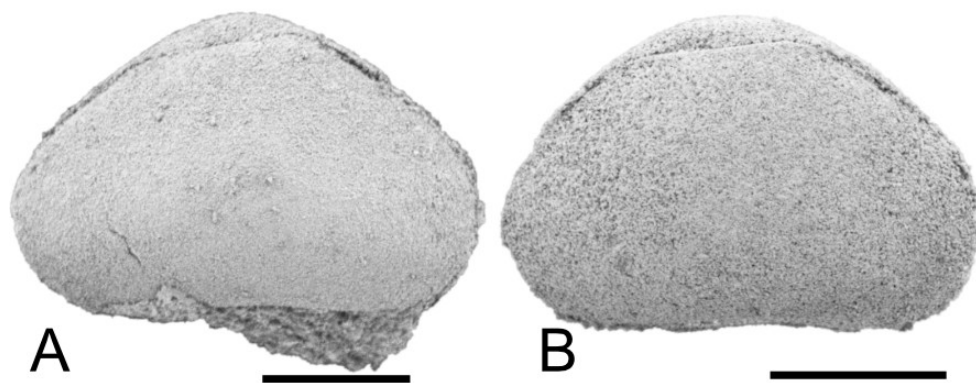


Figure 5.11 *Bairdiocypris* cf. *uliatlensis alta*; right lateral view. Scale bar = 0.2 mm.

Bairdiocypris cf. plicata Wang, 1983

(Figure 5.12)

Occurrence: Samples 19KT02, 04, 05, 06.

Study material: 15 specimens.

Dimension: Length = 0.41 - 1.20 mm, Height = 0.29 - 0.77 mm.

Remarks: The specimen having a similarity with *Bairdiocypris plicata* Wang, 1983 of the Middle Devonian Sipai Formation, China (Wang, 1983) but is distinguished by a less inclined posterodorsal border.



Figure 5.12 *Bairdiocypris cf. plicata*; right lateral view. Scale bar = 0.2 mm.

Bairdiocypris cf. tschemyschensis (Samoilova et Smirnova) in Hou, 1988

(Figure 5.13)

Occurrence: Sample 19KT04.

Study material: 14 specimens.

Dimension: Length = 0.71 - 1.02 mm, Height = 0.47 - 0.68 mm.

Remarks: The specimen features a small, rounded anterior border and a large, rounded posterior border, with maximum Height at mid-Length, resembling *Bairdiocypris tschemyschensis* (Samoilova and Smirnova) in Hou et al., 1988 from the Upper Devonian Tuqiaozi Formation, China.

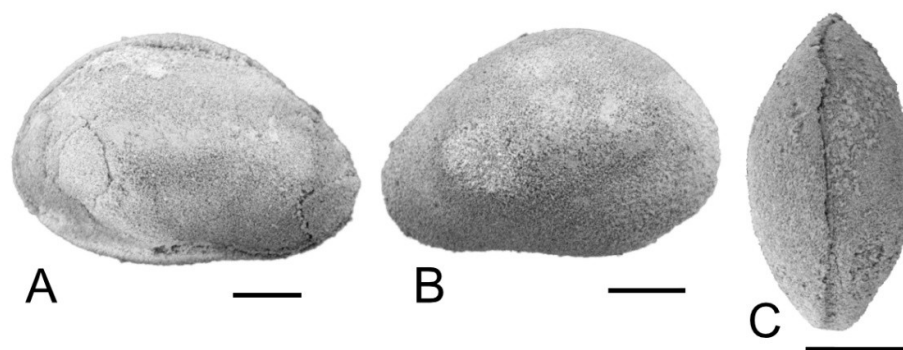


Figure 5.13 *Bairdiocypris* cf. *tschemyschensis*; A. right lateral view, B. left lateral view, C. dorsal view. Scale bar = 0.2 mm.

Bairdiocypris sp.

(Figure 5.14)

Occurrence: Samples 19KT05-07.

Study material: 6 specimens.

Dimension: Length = 0.33 - 0.69 mm, Height = 0.22 - 0.46 mm

Remarks: This species has a subtriangular shape in lateral view, but its outline is more round compared to other *Bairdiocypris* species examined in this study. However, due to poor preservation and the limited number of available carapaces, it is not possible to assigned to a species.

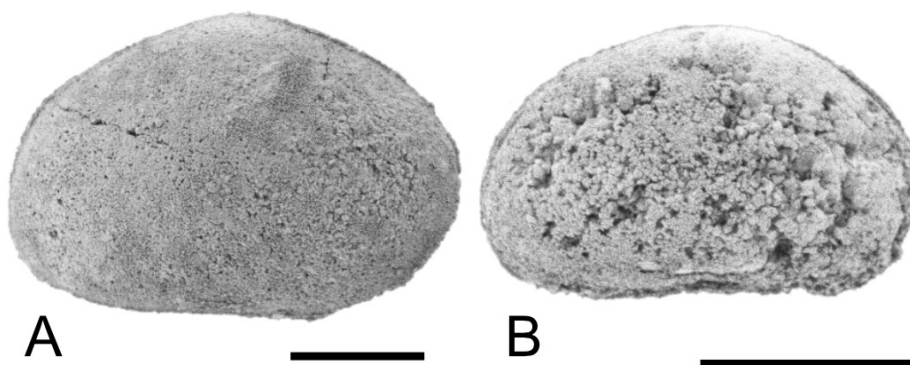


Figure 5.14 *Bairdiocypris* sp.; right lateral view. Scale bar = 0.2 mm.

Genus *Baschkirina* Rozhdestvenskaja, 1959

Type species. *Baschkirina memorabilis* Rozhdestvenskaja, 1959

***Baschkirina?* sp.**

(Figure 5.15)

Occurrence: Samples 19KT01-07.

Study material: 15 specimens.

Dimension: Length = 0.45 – 0.51 mm, Height = 0.25 – 0.29 mm.

Remarks: This species shows a subtriangular outline, with a broadly rounded anterior and a narrower, rounded posterior. The dorsal and ventral margins are straight, with the dorsal margin inclined posteriorly. It is uncertainly assigned to *Baschkirina* due to its irregular trapezoidal shape in lateral view and the presence of angular bends along the dorsal margin. However, due to poor preservation and the morphological resemblance to certain *Acratia* forms, a definitive assignment remains problematic.

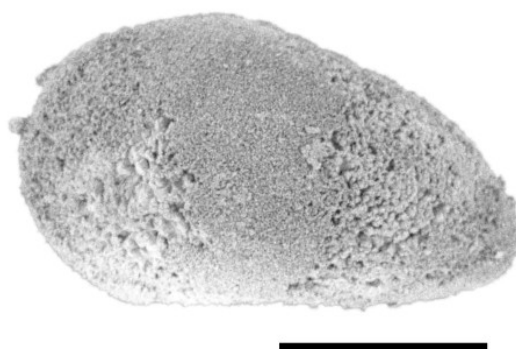


Figure 5.15 *Baschkirina?* sp.; left lateral view. Scale bar = 0.2 mm.

Family RECTELLIDAE Neckaja, 1966

Genus *Rectella* Neckaja, 1958

Type species: *Mica inaequalis* Neckaja, 1952

Rectella? sp.

(Figure 5.16)

Occurrence: Samples 19KT02.**Study material:** 3 specimens.**Dimension:** Length = 0.67 mm, Height = 0.31 mm.

Remarks: This species has been assigned to *Rectella* based on its overall shape, characterized by parallel, straight dorsal and ventral margins, and rounded anterior and posterior ends. However, due to poor preservation and the limited number of specimens, a specific identification is difficult, as this form also closely resembles several other genera.



Figure 5.16 *Rectella?* sp.; left lateral view. Scale bar = 0.2 mm.

Family KRAUSELLIDAE Berdan, 1961

Genus *Pseudorayella* Neckaja in Abushik et al. 1960Type species: *Pseudorayella scala* Neckaja in Abushik et al., 1960*Pseudorayella* sp.

(Figure 5.17)

Occurrence: Samples 19KT01-07.**Study material:** 128 specimens.**Dimension:** Length = 0.41 – 0.83 mm, Height = 0.21 – 0.41 mm.

Remarks: The specimen closely resembles *Pseudorayella? ellipsis* (Li, 1989) in Wang, 2015 from the Upper Ordovician of Sichuan, China, which is noted for its oblong-elliptical carapace in lateral view, with nearly symmetrical dorsal and ventral convexity, and convex anterior and posterior ends. In dorsal view, it has a biconvex shape, with maximum convexity at the middle. However, the studied specimens show a more pronounced dorsal convexity and are larger than *P? ellipsis* (Li, 1989).

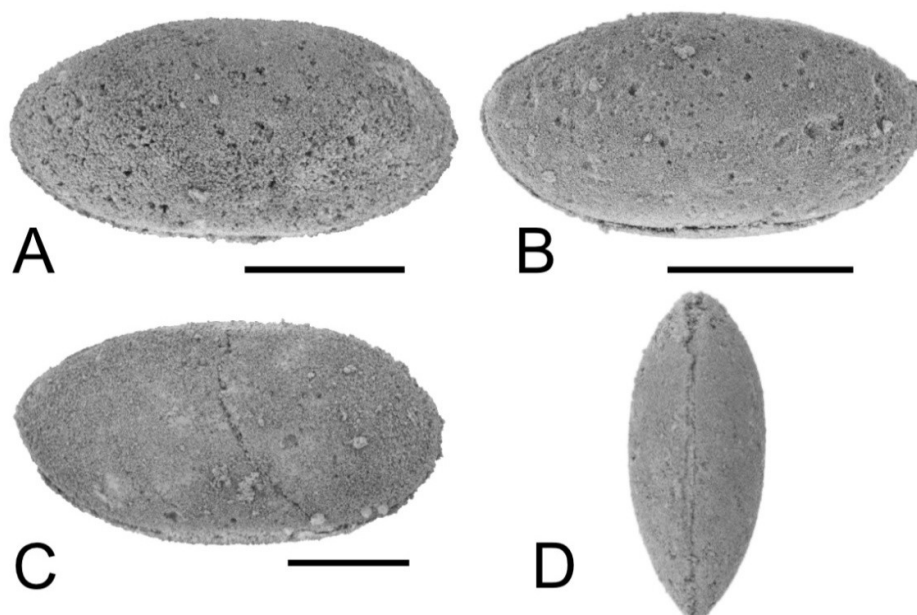


Figure 5.17 *Pseudorayella* sp.; A-C, right lateral view, D. dorsal view Scale bar = 0.2 mm.

Superfamily BAIRDIOIDEA Sars, 1888

Family ACRATIIDAE Gründel, 1962

Genus *Acratia* Delo, 1930

Type species: *Acratia typica* Delo, 1930

***Acratia* sp.**

(Figure 5.18)

Occurrence: Samples 19KT01-02.

Study material: 10 specimens.

Dimension: Length = 0.69 – 0.80 mm, Height = 0.28 – 0.31 mm.

Remarks: This species has been assigned to *Acratia* based on its beaked anterior, which points downward, and its narrow posterior, with convex dorsal and ventral margins. It shares similarities with *Acratia* (*Cooperuna*) *tichonovitchi* Egorov, 1953, from the Late Devonian of the Holy Cross Mountains, Poland (plate 21, fig. 6 in Olempska, 1979), particularly the flattened, downward-deflected anterior and the pointed posterior. However, it differs in possessing a concave posteroventral border and a convex ventral margin.

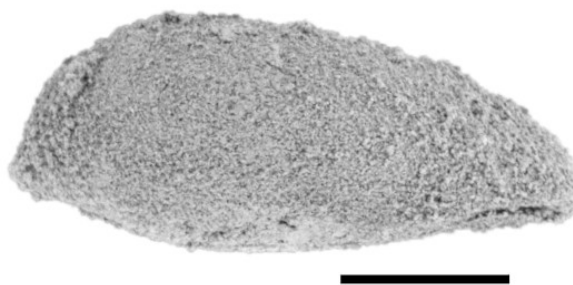


Figure 5.18 *Acratia* sp.; left lateral view. Scale bar = 0.2 mm.

Family BAIRDIIDAE Sars, 1888

Genus *Bairdia* McCoy, 1844

Type species: *Bairdia curtus* McCoy, 1844

***Bairdia* sp. A**

(Figure 5.19)

Occurrence: Samples 19KT01, 02, 04, 05, 07.

Study material: 21 specimens.

Dimension: Length = 0.61 - 0.90 mm, Height = 0.31 – 0.44 mm.

Remarks: The specimens exhibit a typical bairdian shape, characterized by a gently convex dorsal border and a straight hinge line that accounts for approximately one-third of the total length. The left valve is larger than the right and overlaps along the

free margin, although this overlap is less distinct along the ventral border. The ventral margin is straight to slightly concave. Both anterior and posterior ends are pointed but asymmetrical. The overall outline resembles that of *Bairdia* (*Orthobairdia*) nov. sp. C, aff. *philippovae* Egorov, 1953, from the Late Devonian Schmidt Quarry in Germany (Casier et al., 1999) but differs in exhibiting a biconvex dorsal view. It also closely resembles *Bairdia* sp. A aff. *buschminae* Crasquin, 1985 (plate 4, figs. 4a, b, Casier et al., 2005) but can be distinguished by its more pointed anterior end.

***Bairdia* sp. B**

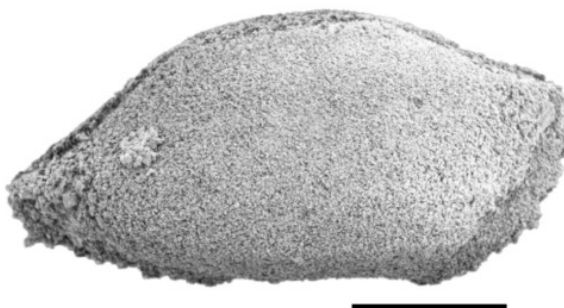


Figure 5.19 *Bairdia* sp. A; right lateral view Scale bar = 0.2 mm.

(Figure 5.20)

Occurrence: Samples 19KT02, 04.

Study material: 2 specimens.

Dimension: Length = 0.58 - 0.73 mm, Height = 0.30 – 0.36 mm.

Remarks: The specimens have a similar outline to *Bairdia* sp. A from this study but differ from having punctate surface. This species also shares a very similar outline with *Bairdia* (*Bairdia*) cf. *finifracta* Blumenstengel, 1970, from the Late Devonian Schmidt quarry in Germany (figs. 4.8a, b Casier et al., 1999) but differs by its punctate surface.

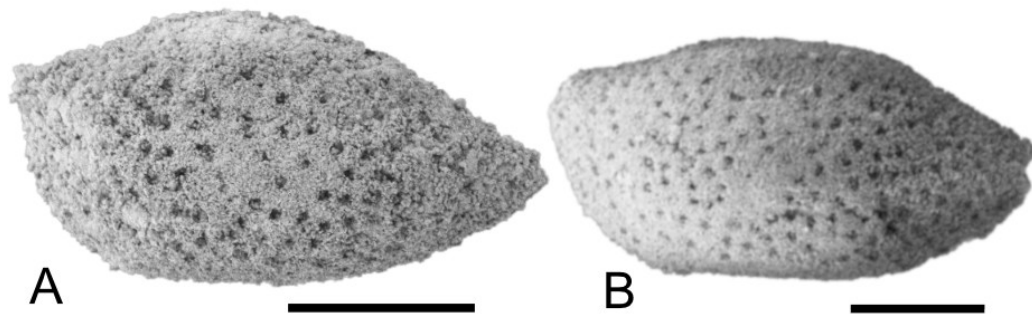


Figure 5.20 *Bairdia* sp. B; left lateral view. Scale bar = 0.2 mm.

Genus *Fabalitypris* Cooper, 1946

Type species: *Fabalitypris wileyensis* Cooper, 1946

Fabalitypris sp.

(Figure 5.21)

Occurrence: Samples 19KT01-03, 05-07.

Study material: 56 specimens.

Dimension: Length = 0.40 - 0.61 mm, Height = 0.18 - 0.31 mm.

Remarks: This species has been assigned to *Fabalitypris* based on its elongate subovate shape in lateral view, with a rounded anterior and a rounded to subtriangular posterior. However, due to its simple morphology and poor preservation, it is difficult to assign it accurately to a specific species.

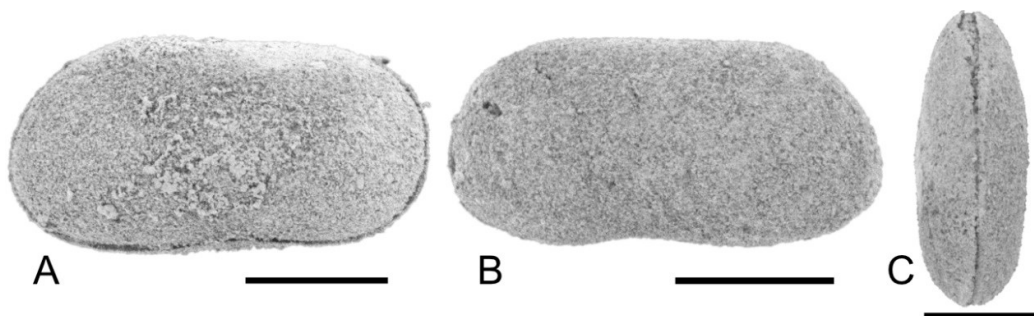


Figure 5.21 *Fabalitypris* sp.; A. right lateral view, B. left lateral view, C. dorsal view.

Scale bar = 0.2 mm.

Bairdioidae indet.1

(Figure 5.22)

Occurrence: Samples 19KT01-07.**Study material:** 36 specimens.**Dimension:** Length = 0.53 - 0.73 mm, Height = 0.29 – 0.36 mm.

Remarks: This species exhibits a straight dorsal margin, a gently convex ventral margin, a broadly rounded anterior, and a posterior that tapers gradually to a small, rounded end. The left valve is larger than the right and overlaps it along the free margin. In dorsal view, the carapace appears biconvex with a smooth surface. Its general morphology resembles several genera, including *Bairdia*, though the anterior is more rounded, and *Fabalicypis*, but the ventral margin lacks the straight or concave. As a result, the species remains undetermined.



Figure 5.22 Bairdioidae indet.1; A. right lateral view, B. dorsal view. Scale bar = 0.2 mm.

Bairdioidae indet.2

(Figure 5.23)

Occurrence: Samples 19KT05, 06.**Study material:** 1 complete and 4 broken carapaces.**Dimension:** Length = 0.43 mm, Height = 0.21 mm.

Remarks: The carapace is oblong in lateral view. The dorsal border is straight and slopes posteriorly, while the ventral border is also straight. Both the anterodorsal and posterodorsal borders are convex. The anterior border has an acute point located approximately one-third of the distance from the ventral margin. The posterior border is subangular, with its pointed end positioned lower than that of the anterior border. The right valve is slightly larger than the left and exhibits weak overlap along the free margin. Prominent spines are present at mid-length on the lateral surface of the ventral border of both valves, oriented posteriorly. In dorsal view, the carapace is gently biconvex. Due to poor carapace preservation and the limited number of specimens, determination is challenging, as they do not appear to fit within any known genus of Bairdioidea.

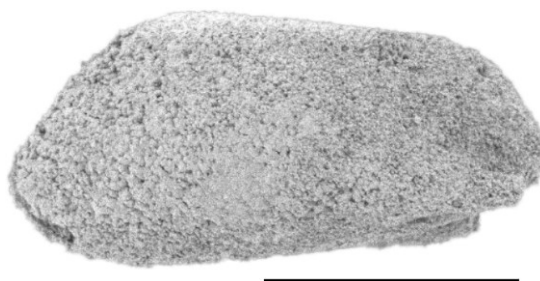


Figure 5.23 Bairdioidea indet. 2; left lateral view. Scale bar = 0.2 mm.

Suborder METACOPINA Sylvester-Bradley, 1961

Superfamily HEALDIOIDEA Harlton, 1933

Family HEALDIIDAE Harlton, 1933

Genus *Cytherellina* Jones and Holl, 1869

Type species: *Beyrichia siliqua* Jones, 1855 subsequently designated by Jones and Holl, 1869

***Cytherellina* sp. A**

(Figure 5.24)

Occurrence: Samples 19KT01, 05, 06, 07.

Study material: 7 specimens.

Dimension: Length = 0.36 - 0.39 mm, Height = 0.18 – 0.20 mm.

Remarks: The specimens have been assigned to *Cytherellina* based on their elongate carapace, with the greatest height situated in the posterior half, rounded anterior and posterior margins, and smooth surface texture. However, due to poor preservation and the limited number of specimens, determination at the species level is not possible.

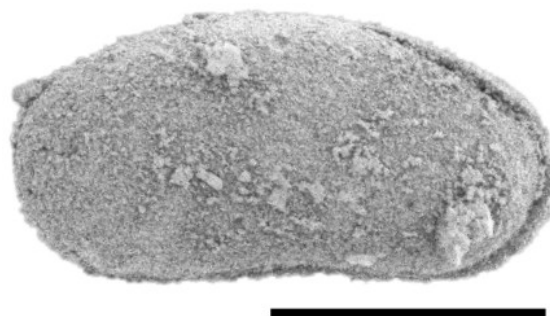


Figure 5.24 *Cytherellina* sp. A; right lateral view. Scale bar = 0.2 mm.

Cytherellina sp. B

(Figure 5.25)

Occurrence: Samples 19KT01-04.

Study material: 18 specimens.

Dimension: Length = 0.54 – 1.27 mm, Height = 0.26 – 0.58 mm.

Remarks: The species has been assigned to *Cytherellina* based on its elongate carapace, with the maximum height located in the posterior half, rounded anterior and posterior margins, and smooth surface. However, the specimens differ from *C. sp. A* by having longer carapaces and a narrower, almost pointed posterior. Due to the poor preservation of the carapaces, specific classification remains difficult.

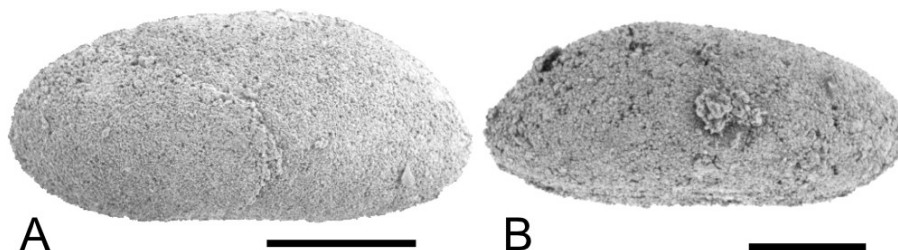


Figure 5.25 *Cytherellina* sp. B; A. left lateral view, B. right lateral view. Scale bar = 0.2 mm.

Genus *Healdia* Roundy, 1926

Type species: *Healdia simplex* Roundy, 1926

Healdia sp.

(Figure 5.26)

Occurrence: Samples 19KT05, 07.

Study material: 3 specimens.

Dimension: Length = 0.58 – 1.05 mm, Height = 0.35 – 0.67 mm.

Remarks: The specimen is assigned to the family Healdiidae due to its short, smooth carapace. It is placed in *Healdia* based on a distinct, sub-vertical posterior ridge on both valves, which differentiates it from *Healdianella* Posner, 1951. Additionally, it is distinguished from *Waylandella* Coryell and Billings, 1932 by its shorter carapace and dorsal angulation. Despite these characteristics, the specimen does not fully correspond to any previously described *Healdia* species.



Figure 5.26 *Healdia* sp.; A. right lateral view, B. dorsal view. Scale bar = 0.2 mm.

Genus *Kummerowia* Adamczak, 1976

Type species: *Kummerowia prima* Adamczak, 1976

***Kummerowia?* sp.**

(Figure 5.27)

Occurrence: Sample 19KT05.

Study material: 4 specimens.

Dimension: Length = 0.56 - 0.81 mm, Height = 0.30 – 0.43 mm.

Remarks: The species is classified uncertainty as *Kummerowia*. The carapace shape closely resembles that of *Kummerowia prima*, which has been identified in the Middle Devonian of Poland (Adamczak, 1976) and the Middle Devonian Yangmaba Formation in China (Hou, 1988).

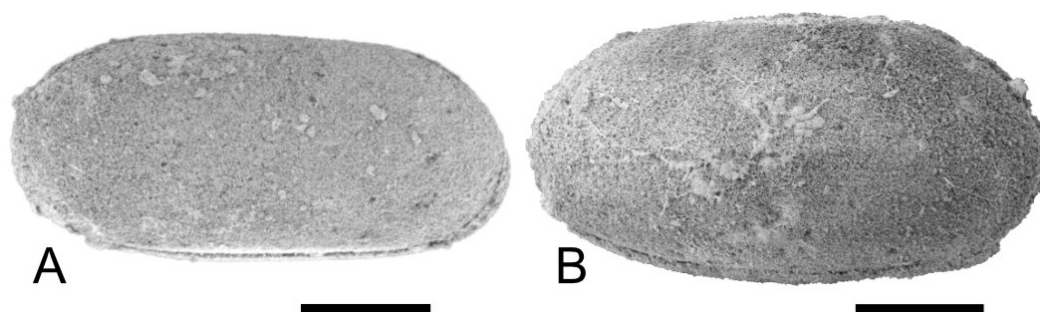


Figure 5.27 *Kummerowia?* Sp.; right lateral view. Scale Bar = 0.2 mm.

Order PALAEOCOPIDA Henningsmoen, 1953

Suborder PALAEOCOPINA Henningsmoen, 1953

Superfamily APARCHITOIDEA Ulrich and Bassler, 1923

Family APARCHITIDAE Ulrich and Bassler, 1923

Genus *Aparchites* Jones, 1889

Type species: *Aparchites whiteavesi* Jones, 1889

Aparchites* cf. *messleriformis Polenova, 1960 in Polenova, 1968

(Figure 5.28)

Occurrence: Sample 19KT02-06.

Study material: 19 specimens.

Dimensions: Length = 0.48 – 0.61 mm, Height = 0.38 – 0.47 mm.

Remarks: The species is classified under the genus *Aparchites* due to their carapace shape. They are similar to *A. messleriformis* Polenova, 1960 in Polenova, 1968, which has been found in the Lower Devonian of Salair, Russia, and in the Middle Devonian Sipai Formation, China (Wang, 1983).

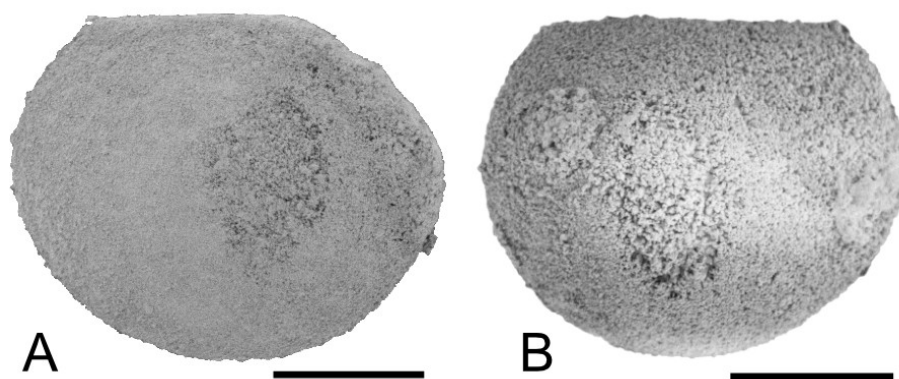


Figure 5.28 *Aparchites* cf. *messleriformis*; left lateral view. Scale bar = 0.2 mm.

Aparchites sp.

(Figure 5.29)

Occurrence: Samples 19KT02, 05, 06.

Study material: 7 specimens.

Dimension: Length = 0.40 – 0.60 mm, Height = 0.31 – 0.44 mm.

Remarks: The species is similar to *Aparchites productus* Polenova, 1960 *sensu* Polenova, 1968), which has been documented in the Lower Devonian rocks of Salair, Russia, and the Lower Devonian Ganxi Formation in China (Hou, 1988). However, more well-preserved material is required for a more detailed assessment of their classification.

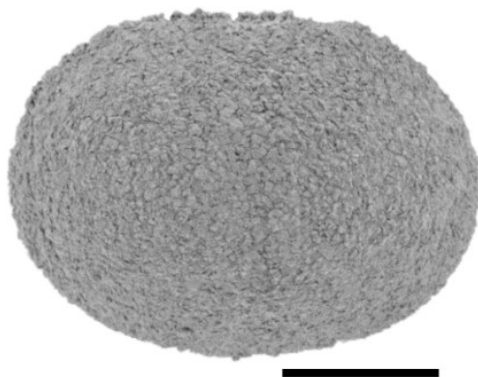


Figure 5.29 *Aparchites* sp. left lateral view. Scale bar = 0.2 mm.

Genus *Brevidorsa* Neckaja, 1973

Type species: *Brevidorsa brevidorsata* Neckaja, 1973

***Brevidorsa* sp.**

(Figure 5.30)

Occurrence: Samples 19KT05-07.

Study material: 12 specimens.

Dimension: Length = 0.49 – 0.95 mm, Height = 0.38 – 0.75 mm.

Remarks: This species has been assigned to *Brevidorsa*, based on right valve overlapping left valve and overreaching right valve in dorsal border with short ridges on free margin of both valves. Compared to *B. sichuanensis* Wang, 2015 from the Silurian Pulu Formation, Nyalam region, southern Tibet, China (fig. 3B, Song et al., 2022), the species has a straighter and longer dorsal border.

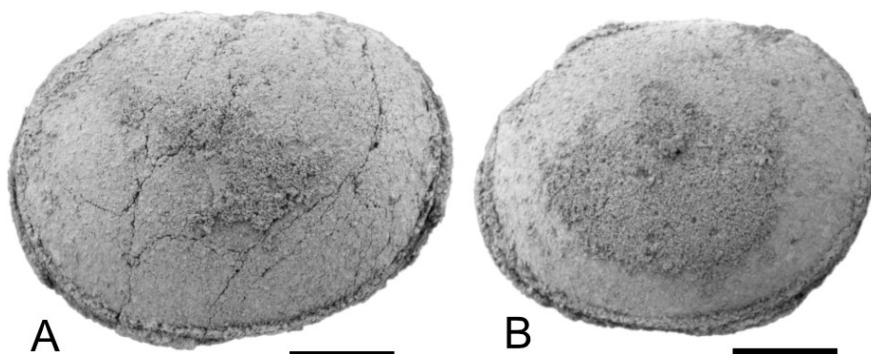


Figure 5.30 *Brevidorsa* sp.; left lateral view. Scale bar = 0.2 mm.

Suborder PARAPARCHITICOPINA Gramm in Gramm and Ivanov (1975)

Superfamily PARAPARCHITOIDEA Scott, 1959

Family PARAPARCHITIDAE Scott, 1959

Genus *Samarella* Polenova, 1952

Type species: *Samarella crassa* Polenova, 1952

***Samarella* sp.**

(Figure 5.31)

Occurrence: Sample 19KT07.

Study material: 1 specimen.

Dimension: Length = 0.38 mm, Height = 0.26 mm.

Remarks: This species has been assigned to *Samarella* by having a convex dorsal border, both rounded ends, and right valve overlapping left valve in ventral border and reverse overreach in dorsal border. The outline in lateral view is very similar to *S. cf. laevinodosa* Becker, 1964 from the Givetian of the Fromelennes Formation, Ardennes, France (fig. 8C, Maillet et al., 2013) but differs in having more overlapping in ventral border and less overlapping in anterodorsal. Compared to *S. cf. laevinodosa* Becker, 1964 from the Early Givetian, Hanonet Formation, France (plate 1, fig. 14, Casier et al., 2011), the species is very similar in lateral outline, but without a detailed description or a figure of the dorsal view, it could possibly be a different species.

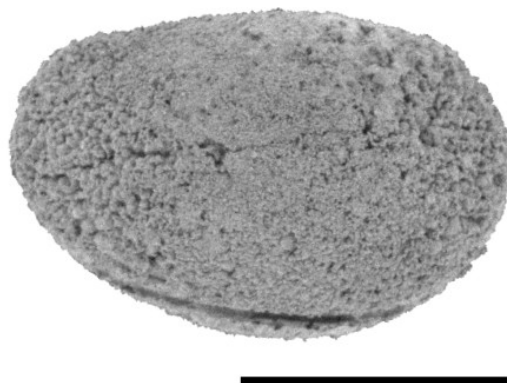


Figure 5.31 *Samarella* sp.; left lateral view. Scale bar = 0.2 mm.

Genus *Coelonella* Stewart, 1936

Type Species: *Isochilinal scapha* Stewart, 1930

***Coelonella* sp.**

(Figure 5.32)

Occurrence: Sample 19KT02-04, 06.

Study material: 31 specimens.

Dimension: Length = 0.35-0.50 mm, Height = 0.47-0.77 mm.

Remarks: This species has been assigned to *Coelonella* based on its subovoid shape. Right valve overlapping left valve along the free margin, extending to the ventral margin. The posterior margin is depressed along the hinge. However, due to poor preservation, assigning it to a specific species is not possible.

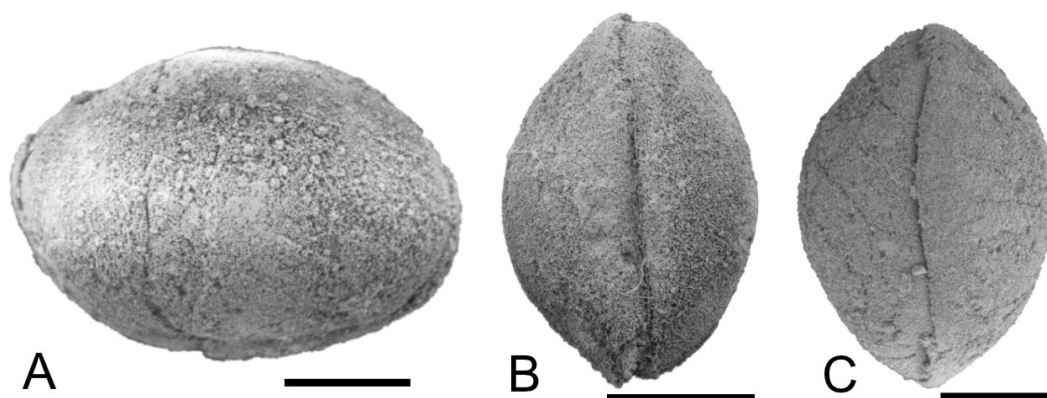


Figure 5.32 *Coelonella* sp.; A. right lateral view, B. dorsal view, C. ventral view. Scale bar = 0.2 mm.

Suborder PLATYCOPINA Sars, 1866

Superfamily KLOEDENELLOIDEA Ulrich and Bassler, 1908

Family KNOXITIDAE Egorov, 1950

Genus *Knoxella* Egorov, 1950

Type species: *Knoxella semilukiana* Egorov, 1950

Knoxiella? sp.

(Figure 5.33)

Occurrence: Sample 19KT06.**Study material:** 1 specimen.**Dimension:** Length = 0.60 mm, Height = 0.36 mm.

Remarks: The specimens show characteristics resembles *Knoxiella* cf. *tuqiaoensis* Wei, 1988 *sensu* Song et al., 2018 from Yangdi section in Guangxi, South China (Song et al., 2018); however, poor preservation limits further identification. Additionally, they are comparable to *K. complanata* Kummerow, 1939 *sensu* Guillam et al., 2022 from the Blue Snake Section, Guizhou, China (Guillam et al., 2022), but they can be differentiated by the lack of a reticulated surface.

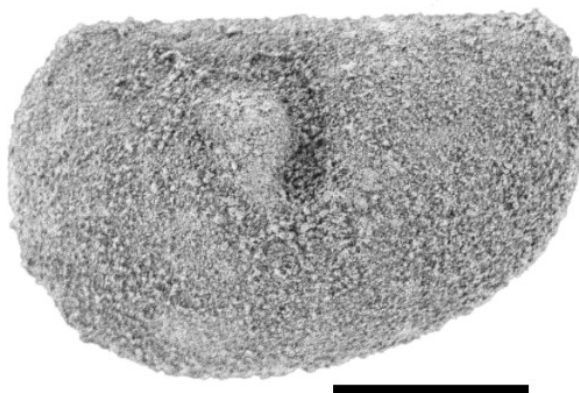


Figure 5.33 *Knoxiella?* sp.; left lateral view. Scale bar = 0.2 mm.

Suborder ERIDOSTRACA Adamczak, 1961

Family ERIDOCONCHIDAE Henningsmoen, 1953

Eridoconchidae indet.

(Figure 5.34)

Occurrence: Samples 19KT06-07.**Study material:** 6 specimens.**Dimension:** Length = 0.56-0.68 mm, Height = 0.43-0.48 mm.

Remarks: The specimens have concentric ridges which are closely spaced and much thinner than those found in *Eridostracina* species (e.g., Olempska et al., 2015; Song et al., 2016), which may be a result of poor preservation.

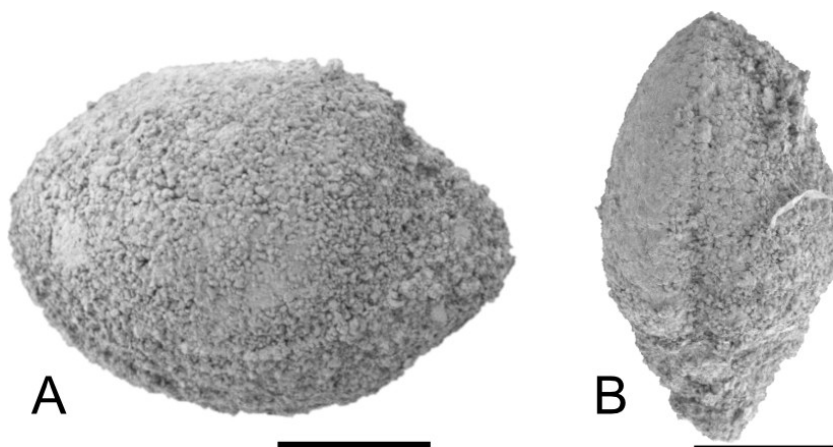


Figure 5.34 Eridoconchidae indet.; A. left lateral view, B. dorsal view. Scale bar = 0.2 mm.

5.2 Conodont

A total of 103 specimens were recovered from 8 limestone samples (U1L, U1M, U1U from the lower unit; U2L, U2U from the middle unit; U3L, U3M, U3U from the upper unit). These specimens, identified as 7 species, 5 genera, and are housed at the micropaleontological laboratory of Suranaree University of Technology

The suprageneric classification is followed Sweet (1988). The synonymy list is shortened and contains only the first or necessary description.

Phylum CHORDATA Bateson, 1886

Class CAVIDONTI Sweet, 1988

Order BELODELLIDA Sweet, 1988

Family BELODELLIDAE Khodalevich and Chernikh, 1973

Genus *Belodella* Ethington, 1959

Type species - *Belodella devonicus* (Stauffer, 1940)

Belodella resima (Philip, 1965)

(Figure 5.35)

1965 *Belodella resimus* Philip, pl. 8, figs. 15–17.

Occurrence: sample U1L, U1M, U1U, U2L, U2U, U3L, U3M.

Study materials: 62 specimens.

Remarks: The specimens have been assigned to *Belodella resima* based on the compressed, symmetrical triangular or subtriangular cross-section of the basal cavity, the presence of small denticles on the posterior, and an anterolateral flange-like costa visible in the inner lateral view (Anderson, 2003). In this study, only S0 and S1 elements were recognized. The S0 element has an untwisted cusp, while the S1 element has a similar shape but with a twisted cusp. The S0 and S1 elements of *B. resima* are very similar in shape to the S3 element of *B. anomalis* Cooper, 1974, differing only in the presence of denticles on the anterior of the element. If these denticles cannot be discerned, the specimen should be assigned to *B. resima* (Farrel, 2004). This may lead to an inflated count of *B. resima* elements. However, since the S0 and S1 elements of *B. anomalis*, which have denticles appearing laterally at the base of the cusp, could not be identified, the specimens should be assigned to *B. resima*.

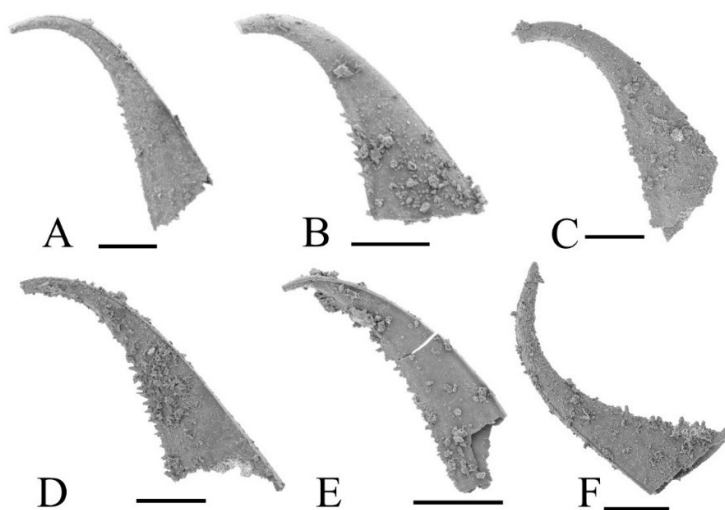


Figure 5.35 *Belodella resima*; A. Inner lateral view of S0 element, B. Outer lateral view of S0 element, C. Outer lateral view of S0 element D. Inner lateral view of S0 element, E. Inner lateral view of S1 element, F. Inner lateral view of S1? element. Scale bar = 0.2 mm.

Belodella sp.

(Figure 5.36)

Occurrence: U1L, U1M, U3L.**Study materials:** 10 specimens.

Remarks: the specimen differs from *Belodella resima* from having asymmetrical triangular cross-section of basal cavity (the inner side is shorter than outer side), the shape has less compressed and has longitudinal costae (or ridges) that appear on posterior and anterior.

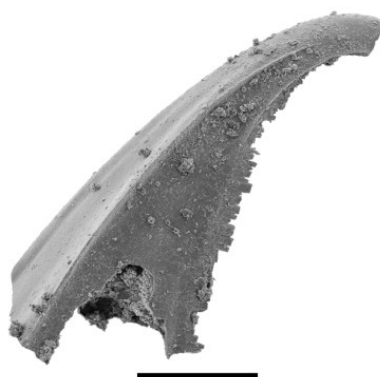


Figure 5.36 *Belodella* sp.; Inner lateral view. Scale bar = 0.2 mm.

Class CONODONTA Pander, 1856

Order OZARKODINIDA Dzik, 1976

Family SPATHOGNATHODONTODAE Hass, 1959

Genus *Ozarkodina* Branson and Mehl, 1933Type species - *Ozarkodina confluens* Branson and Mehl, 1933*Ozarkodina crista* (Walliser, 1964)

(Figure 5.37)

1964 *Spathognathodus cristus* Walliser, p. 74-75, Pl. 9, fig. 3; Pl. 21, figs. 7-13.**Occurrence:** U1M.**Study materials:** 2 specimens.

Remarks: The specimens have been assigned to *Ozarkodina crista* based on the presence of fused denticles above the basal cavity toward the posterior end, an asymmetrical basal cavity, and the termination of the blade at the posterior of the basal cavity. The specimen in this study (Figure 5.37D) exhibits unfused denticles, which align with the description of the α_3 morph by Viira and Aldridge (1998).

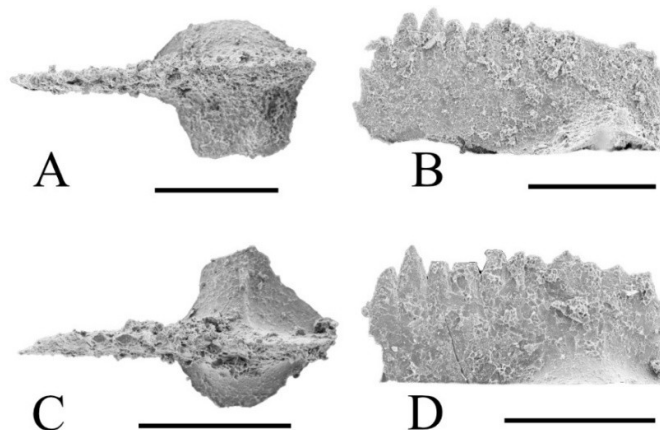


Figure 5.37 *Ozarkodina crista*; A-B same specimen: A, Top view of P1 element, B. lateral view of P1 element; C-D same specimen: C. Top view of P1 element, D. Lateral view of P1 element. Scale bar = 0.2 mm.

Genus *Wurmiella* Murphy, Valenzuela-Rios and Carls, 2004

Type species - *Ozarkodina excavata tuma* Murphy and Matti, 1983

Wurmiella* cf. *excavata (Branson and Mehl, 1933)

(Figure 5.38)

Occurrence: U1L, U1M, U1U, U2L, U3L.

Study materials: 15 specimens.

Remarks: The genus *Wurmiella* was proposed by Murphy et al. (2004) to include the *excavata* group, which was previously classified under the genus *Ozarkodina*. The specimens examined in this study resemble *W. excavata* based on the presence of uniformly sized denticles, a basal cavity extending along the entire process of the elements, and a straight or slightly curved P1 element. *W. excavata* exhibits a high

degree of variation in P1 elements (e.g., Corradini and Corrigan, 2010; Mathieson et al., 2016). In this study, two variants were recognized. Figures 5.38A–E show similarities to those illustrated by Corradini and Corrigan (2010) and Corrigan et al. (2014), while Figures 5.38F and G resemble those of Takahashi et al. (2017).

Figure 5.38C was previously assigned to *W. cf. inclinata* by Promduang and Chitnarin (2025) based on its overall shape. Upon reconsideration, however, the specimen was found to lack the prominent cusp characteristic of *W. inclinata* and instead exhibits greater similarity to *W. excavata*, as illustrated by Corrigan et al. (2014) and Corradini and Corrigan (2010). Therefore, the specimen has been reassigned to *W. cf. excavata*.

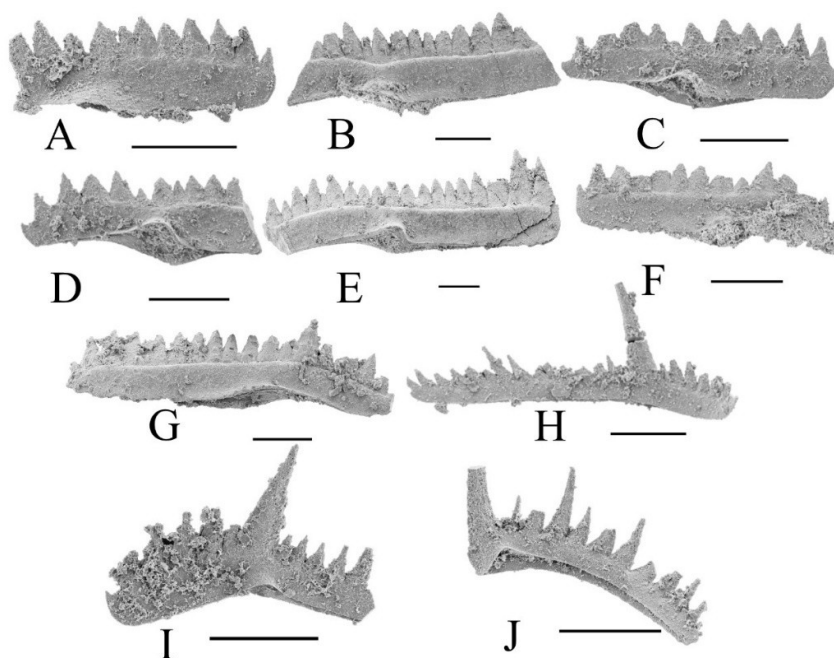


Figure 5.38 *Wurmiella cf. excavata*; A. Lateral view of a juvenile P1 element, B. Lateral view of an adult P1 element, C. Lateral view of a juvenile P1 element, D. Lateral view of a juvenile P1 element, E. Lateral view of an adult P1 element, F. Lateral view of a Juvenile P1 element, G. Lateral view of an adult P1 element, H. Lateral view of S2 element, I. Lateral view of P2 element, J. Lateral view of M element. Scale bar = 0.2 mm.

Genus *Zieglerodina* Murphy, Valenzuela-Rios and Carls, 2004

Type species *Spathognathodus remscheidensis* Ziegler, 1960

Zieglerodina eladioi Valenzuela-Rios, 1994

(Figure 5.39)

1994 *Ozarkodina eladioi* n. sp. Valenzuela-Rios, p. 59-63, pl. 5, figs 1-35.

2019 *Zieglerodina eladioi* (Valenzuela-Rios, 1994) Corrigan and Corradini, figs 2-3

Occurrence: U1L, U1U, U2L.

Study materials: 8 specimens.

Remarks: *Zieglerodina* was established by Murphy et al. (2004) to include the "remscheidensis Group" of Ozarkodinids. *Z. eladioi* was recently reconstructed with a complete apparatus by Corrigan and Corradini (2019), consisting of P1 carminate, P2 angulate, M dolabrate, S0 alate, S1 digyrate, and S2 bipennate elements. In this study, only P2, M, S1, and S2 elements were recognized, characterized by "the alternate denticulation with spike-like denticles" (Corrigan and Corradini, 2019).

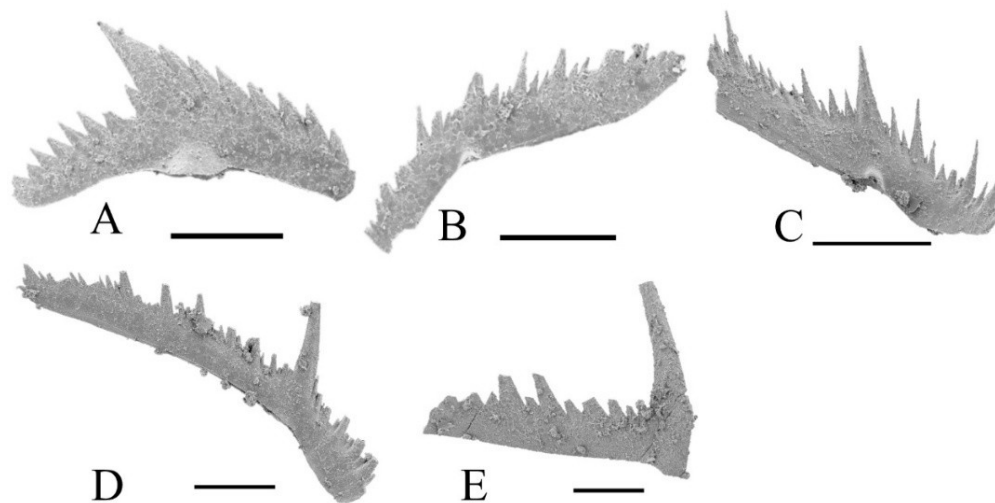


Figure 5.39 *Zieglerodina eladioi*; A. Lateral view of P2 element, B. Lateral view of S2 element, C. Lateral view of S2 element, D. Lateral view of S1 element, E. Lateral view of M element. Scale bar = 0.2 mm.

Zieglerodina sp.

(Figure 5.40)

Occurrence: U1U.**Study materials:** 1 specimen.

Remarks: The specimen has a very similar outline to *Zieglerodina remscheidensis* Ziegler, 1960; however, the cusp is broken, preventing accurate identification. The study sample also shares similarities with *Z.* sp. (Figure 6H) illustrated by Hušková and Slavík (2020).

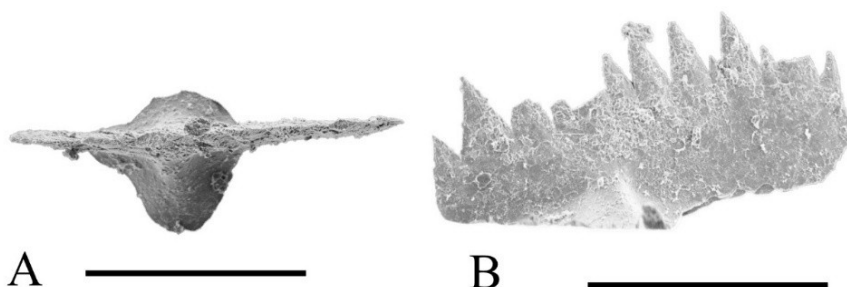


Figure 5.40 *Zieglerodina* sp.; A-B same specimen; A. Top view of P1 element, B. Lateral view of P1 element. Scale bar = 0.2 mm.

Family STRACHANOGNATHIDAE Bergström, 1981

Genus *Pseudooneotodus* Drygant, 1974*Pseudooneotodus beckmanni* (Bischoff and Sannemann, 1958)

(Figure 5.41)

1958 *Oneotodus?* *beckmanni* Bischoff and Sannemann, p. 98, pl. 15, figs. 22-25.**Occurrence:** U1U, U2L, U2U, U3L.**Study materials:** 5 specimens.

Remarks: The specimens have been assigned to *Pseudooneotodus beckmanni* based on their "squat conical element with a single apical denticle and an ovoidal to subtriangular base" (Corradini, 2007).

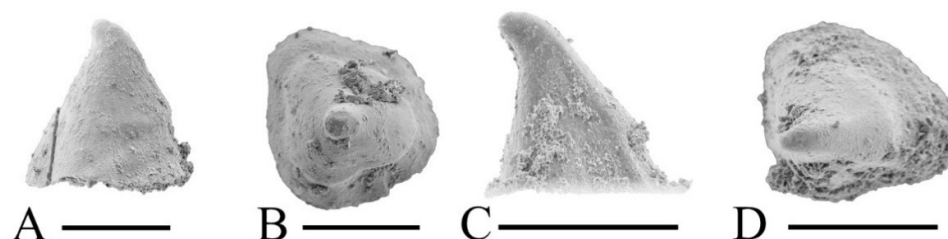


Figure 5.41 *Pseudooneotodus beckmanni*; A-B same specimen, A. Lateral view of the element, B. Top view of the element; C-D same specimen, C. Lateral view of element, D. Top view of element. Scale bar = 0.2 mm.

5.3 Tentaculitoid

The specimens from the rock surface on sample 19KT12 were photographed and identified by Dr. Shuji Nikko from Hiroshima University.

The suprageneric classification of tentaculitoids is still debated mainly difference in how to defined class, subclass or order. In this study the classification were followed Lardeux (1969), Larsson (1979).

Class TENTACULITOIDEA Ljashenko 1957

Order DACRYOCONARIDA Fisher, 1962

Family NOWAKIIDAE Bouček and Prantl, 1960

Genus *Nowakia* (Gürich, 1896)

***Nowakia* sp.**

(Figure 5.42)

Occurrence: 19KT12.

Remarks: The specimens exhibit a straight conch shape with both transverse rings and longitudinal ribs (difficult to discerned). The initial chamber is difficult to observe but is likely bulbous in shape (Figure 5.42A). When compared to the specimens described by Agematsu et al. (2006a), those in this study appear to belong to *Nowakia*. However, due to the low-quality image and poor preservation, a definitive identification is not possible.

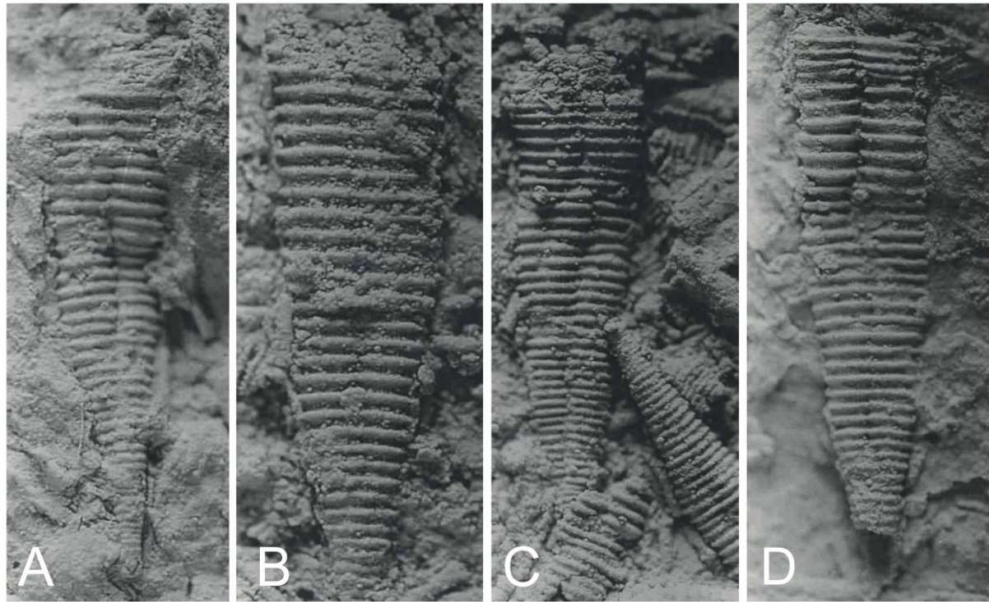


Figure 5.42 A-D *Nowakia* sp. SEM image, 15x magnification.

Family PENEUIIDAE Lardeux, 1969

Genus *Guerichina* Bouček and Prantl, 1961

***Guerichina* sp.**

(Figure 5.43)

Occurrence: 19KT12

Remarks: The specimens exhibit a straight conch with only transverse rings, while the external wall displays annulations composed of smaller rings (Figure 5.43C). Although the low-quality image and poor preservation prevent accurate determination, the characteristic annulations suggest that the specimens belong to *Guerichina*.

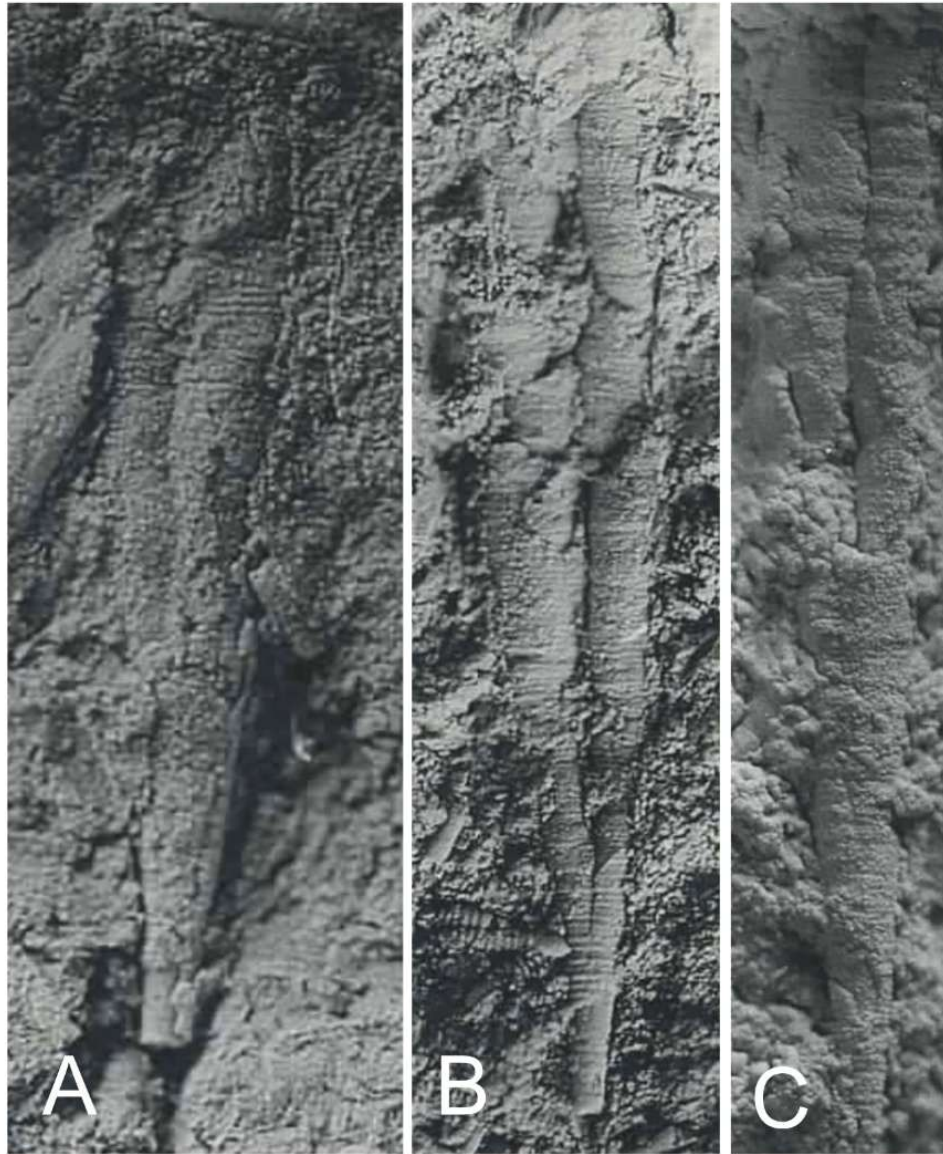


Figure 5.43 A-C *Guerichina* sp. SEM image, 15x magnification.

Family STRIATOSTYLIONIDAE Bouček, 1964

Genus *Striatostyliolina* Bouček and Prantl, 1961

***Striatostyliolina* sp.**

(Figure 5.44)

Occurrence: 19KT12

Remarks: The specimens exhibit a straight conch with a smooth surface and faintly discernible longitudinal ribs, a characteristic feature of *Striatostyliolina*. However, due to the low-quality image and poor preservation, a definitive identification is not possible.



Figure 5.44 *Striatostyliolina* sp. SEM image, 15x magnification.