

Fig. 71. *Anaflemingites hochulii* Brayard and Bucher, 2008. NMNS PM23780, from KC01-13.



Fig. 72. *Anaflemingites hochulii* Brayard and Bucher, 2008, from KC01-13. 1-2, NMNS PM23776. 3-4, NMNS PM23777. 5-6, NMNS PM23778. 7-8, NMNS PM23779.

Family Galfettitidae Brühwiler *et al.*, 2010
Genus *Galfettites* Brayard and Bucher, 2008

Type species: Galfettites simplicitatis Brayard and Bucher, 2008.

Revised diagnosis: Laterally compressed Galfettitidae with flat, parallel flanks and narrow tabulate venter.

Discussion: Brayard and Bucher (2008) described the venter of the type species of this genus, *Galfettites simplicitatis* as narrowly curved to subtabulate. However, the ventral part of their type specimens is poorly preserved. Recently, Brühwiler *et al.* (2012a) studied and illustrated many well-preserved specimens assignable to *Galfettites* from Oman and stated that the taxon's venter is tabulate. Jenks *et al.* (2010) earlier reported that specimens referable to *Galfettites* from Nevada also have a tabulate venter. Therefore, the original diagnosis of the genus with regard to its venter is revised from a "narrowly curved venter" to a "narrow tabulate venter". *Meekoceras wanneri* Welter, 1922, matches well with the revised diagnosis and is herein assigned to *Galfettites*.

Galfettites simplicitatis

Brayard and Bucher, 2008

Figs. 73, 74

? *Meekoceras wanneri* Welter, 1922, p. 129, pl. 164, figs. 17–18, pl. 165, figs. 18–19.

Galfettites simplicitatis Brayard and Bucher, 2008, p. 48, pl. 21, figs. 1–2, text-fig. 43; Brühwiler *et al.*, 2012a, p. 26, pl. 15, figs. 1–4, pl. 16, fig. 1.

Holotype: PIMUZ 26002, figured by Brayard and Bucher (2008, p. 48, pl. 21, fig. 2), from the *Owenites koeneni* beds in Jinya, northwestern Guangxi, South China.

Material examined: One specimen, NMNS PM23781, from a float limestone block at BT02 and two specimens, NMNS PM23782–23783, from BT01-09.

Description: Very evolute, very compressed shell with angular ventral shoulders, and flat parallel flanks for two-thirds of flank,

then gradually converging toward tabulate venter. Umbilicus moderately wide with low, nearly vertical wall and rounded shoulders. Ornamentation consists of low, broad, prorsiradiate ribs visible on outer flank. Suture ceratitic with subphyllid saddles. First lateral saddle equal but narrower than second saddle, and third saddle lower. First lateral lobe deep, wide with many denticulations at base, and second lateral lobe half depth of first lobe.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NMNS PM23783	41.7	15.1	—	—	0.36	—
NMNS PM23781	93.1	37.5	34.0	15.0	0.40	0.44

Discussion: Brühwiler *et al.* (2012a) previously recognized the similarity in shape of "*Meekoceras wanneri* Welter, 1922 from Timor and *G. simplicitatis*, but they hesitated to synonymize them because the suture line of "*M. wanneri* is unknown. However, these similarities in shell morphology and ornamentation provide convincing evidence that the two taxa are almost certainly conspecific.

Occurrence: Described specimens from BT01-09 within the portion of the *Novispathodus* ex gr. *waageni* Zone that includes the *Urdyceras tulongensis* beds (lower Middle Smithian = middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam. This species also occurs in the Middle Smithian in South China (*Owenites koeneni* beds, Brayard and Bucher, 2008) and Oman (*Owenites koeneni* fauna, Brühwiler *et al.*, 2012a).

Genus *Urdyceras* Brayard and Bucher, 2008

Type species: Urdyceras insolitus Brayard and Bucher, 2008.

Urdyceras tulongensis Brühwiler *et al.*, 2010

Fig. 75

Urdyceras tulongensis Brühwiler *et al.*, 2010, p. 416, fig. 10.5–10.11.

Holotype: PIMUZ 27644, figured by Brühwiler *et al.* (2010, p. 416, fig. 10.6), from the *Brayardites compressus* beds (lower Mid-



Fig. 73. *Galfettites simplicitatis* Brayard and Bucher, 2008. 1–2, NMNS PM23781, from a float limestone block at BT02. 3–5, NMNS PM23782, from BT01-09. 6–7, NMNS PM23783, from BT01-09.

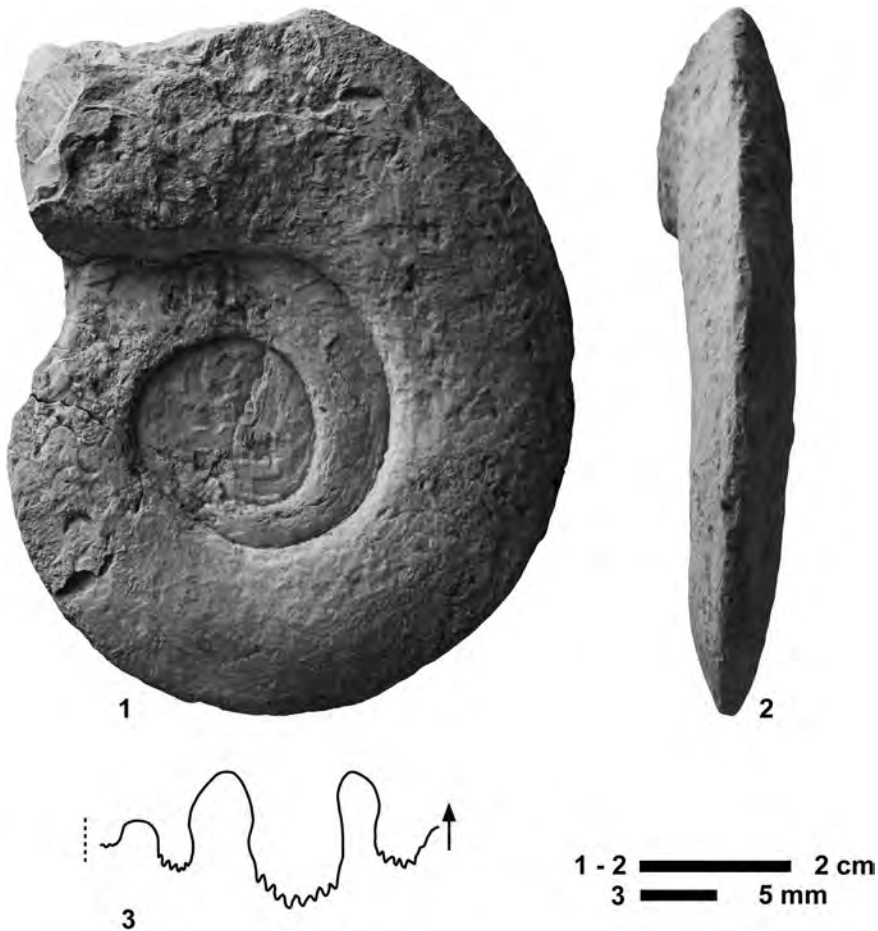


Fig. 74. *Galfettites simplicitatis* Brayard and Bucher, 2008. NMNS PM23781, from BT02-02.

dle Smithian) in Tulong, South Tibet.

Material examined: Four specimens, NMNS PM23785–23788, from BT01-09 and one specimen, NMNS PM23784, from BT02-02.

Description: Moderately evolute, fairly compressed shell with subrectangular whorl section, tabulate venter, angular ventral shoulders, and slightly convex flanks with maximum whorl width near umbilical shoulder. Umbilicus moderately wide with moderately high, nearly vertical wall and rounded shoulders. Ornamentation consists of strong, radial or slightly rursiradiate ribs arising on umbilical shoulder and fading away on ventral should-

er. Suture ceratitic. First lateral saddle lower and narrower than second saddle, and third saddle lower than second saddle. First lateral lobe deep, wide with many denticulations at base, and second lateral lobe half depth of first lobe.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NMNS PM23784	22.0	8.2	8.4	6.0	0.37	0.71
NMNS PM23785	25.7	10.0	8.8	7.6	0.39	0.86
NMNS PM23788	33.4	11.0	13.0	9.8	0.33	0.75
NMNS PM23786	43.0	16.7	15.7	11.9	0.39	0.79
NMNS PM23787	74.0	23.0	34.0	22.0	0.31	0.65

Discussion: The described specimens have stronger radial ribs and a wider umbilicus than the holotype of *Urdoceras tulongensis*, but

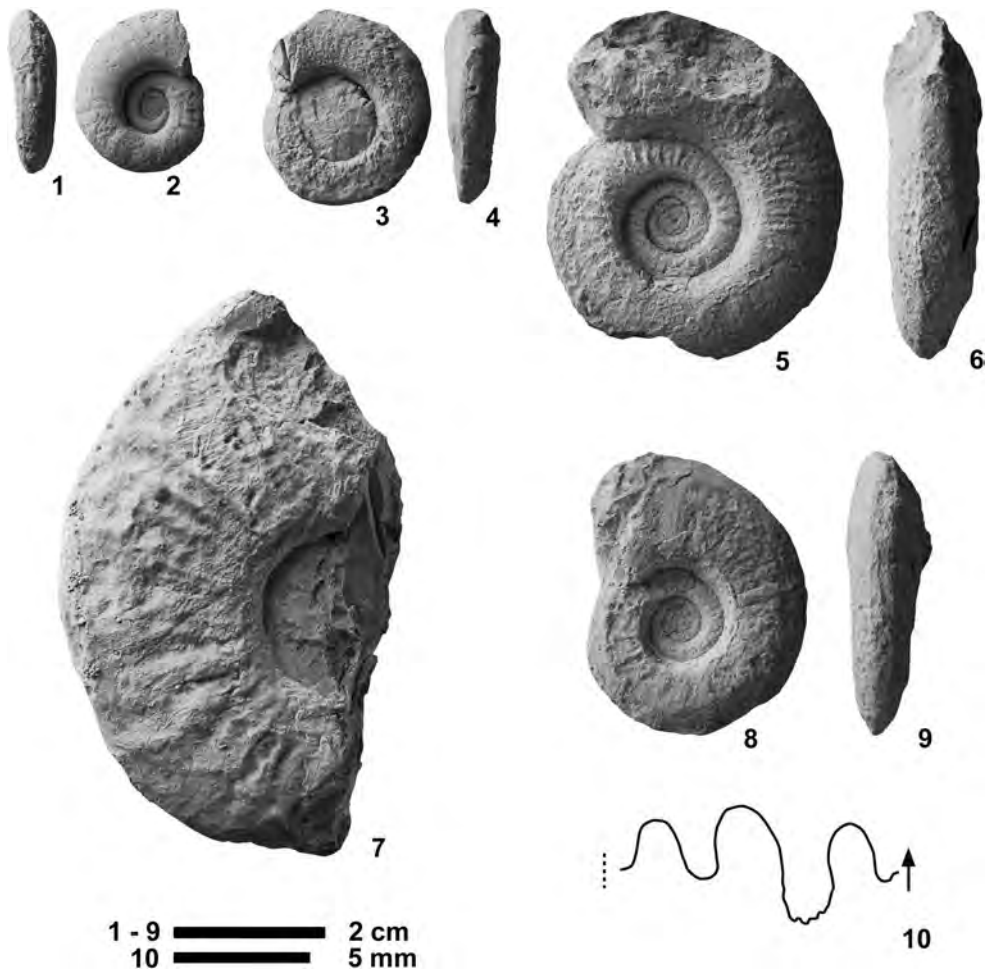


Fig. 75. *Urdyceras tulongensis* Brühwiler *et al.*, 2010. 1–2, NMNS PM23784, from BT02-02. 3–10, from BT01-09. 3–4, NMNS PM23785. 5–6, NMNS PM23786. 7, NMNS PM23787. 8–10, NMNS PM23788.

they are very similar to two of the paratypes (i.e. PIMUZ 27643, 27646; Brühwiler *et al.*, 2010, fig. 10.5, 10.8), which have strong ribs on their inner flanks and a moderately wide umbilicus. Therefore, the described specimens are considered to fit well within the intraspecific variation of *U. tulongensis*.

The shell diameters of the type specimens of *Urdyceras tulongensis* are less than 40 mm. In contrast, NMNS PM23787 is a partial whorl section more than 74 mm in diameter that shares many similarities with *U. tulongensis*, such as a tabulate venter and radial ribs. This evidence suggests that this particular

specimen is probably an adult shell of *U. tulongensis*.

Occurrence: Described specimens from BT01-09 and BT02-02 within the portion of the *Novispathodus* ex gr. *waageni* Zone that includes the *Urdyceras tulongensis* beds (lower Middle Smithian = middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam. This species also occurs at the lower Middle Smithian (*Brayardites compressus* beds) in South Tibet (Brühwiler *et al.*, 2010).

Family Arctoceratidae Arthaber, 1911

Genus *Submeekoceras* Spath, 1934

Type species: *Meekoceras mushbachanum* White, 1879.

***Submeekoceras hsüyüchieni* (Chao, 1959)**

Figs. 76–78

? *Prionolobus ophionus* var. *involutus* Chao, 1959, p. 201, pl. 9, figs. 11–15, text-fig. 11b.

Prionolobus hsüyüchieni Chao, 1959, p. 202, pl. 9, figs. 9–10, text-fig. 11c.

Paranorites ovalis Chao, 1959, p. 217, pl. 9, figs. 16–19, text-fig. 16b.

Paranorites linguisellatus Chao, 1959, p. 218, pl. 10, figs. 1–2, text-fig. 16c.

Paranorites aff. *linguisellatus* Chao, 1959, p. 218, pl. 10, figs. 3–4.

Meekoceras lativentrosus Chao, 1959, p. 309, pl. 38, figs. 15–18, text-fig. 43a.

Meekoceras densistriatum Chao, 1959, p. 310, pl. 38, figs. 1–3, 19, text-fig. 43b.

Meekoceras yukiangense Chao, 1959, p. 311, pl. 39, figs. 1–7, 13, text-fig. 44a.

Meekoceras kaohwaiense Chao, 1959, p. 311, pl. 40, figs. 16–18, text-fig. 44b.

Meekoceras pulchrriforme Chao, 1959, p. 313, pl. 40, figs. 14–15, text-fig. 44c.

Meekoceras (*Submeekoceras*) *subquadratum* Chao, 1959, p. 317, pl. 14, figs. 1–5, pl. 39, figs. 8–9, text-fig. 45c.

Meekoceras (*Submeekoceras*) *quadratum* Chao, 1959, p. 318, pl. 39, figs. 10–11, 22–23.

Meekoceras (*Submeekoceras*) sp. indet. Chao, 1959, p. 319, pl. 40, fig. 20.

Meekoceras (*Submeekoceras*) *lolouense* Chao, 1959, p. 320, pl. 10, figs. 7–8, text-fig. 45d.

Meekoceras (*Submeekoceras*) *longiseptatum* Chao, 1959, p. 321, pl. 10, figs. 5–6, text-fig. 46c.

Arctoceras mushbachanum (White, 1879). Kummel and Erben, 1968, p. 131, pl. 21, figs. 1–2.

Submeekoceras mushbachanum (White, 1879). Brayard and Bucher, 2008, p. 52, pl. 16, fig. 4, pl. 26, figs. 1–9, text-fig. 46; Brühwiler *et al.*, 2012a, p. 30, pl. 17, figs. 1–3.

Holotype: NIGP 12119, figured by Chao (1959, p. 202, pl. 9, figs. 9–10), from the *Flemingites* bed in the Linglo district (Lolou), western Guangxi, South China.

Material examined: Five specimens, NMNS PM23624–23628, from BT01-03, two

specimens, NMNS PM23629–23630, from BT01-09, one specimen, NMNS PM23631, from KC01-01, and three specimens, NMNS PM23632–23634, from float limestone blocks at BT02.

Description: Moderately evolute, very compressed shell with elliptical whorl section, arched venter, indistinct ventral shoulders, and slightly convex flanks with maximum whorl width near mid-flank. Fairly narrow umbilicus with moderately high, vertical wall and rounded shoulders. Ornamentation consists of sinuous growth lines and weak, fold-type ribs. Suture ceratitic. First and second lateral saddles narrowly elongated. First lateral lobe deep, wide with many denticulations at base, and second lateral lobe about two thirds depth of first lobe.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NMNS PM23629	35.4	7.5	16.2	7.2	0.21	0.44
NMNS PM23630	38.6	11.3	16.3	7.7	0.29	0.47
NMNS PM23626	51.0	11.3	23.0	12.5	0.22	0.54
NMNS PM23624	51.5	14.4	21.9	12.5	0.28	0.57
NMNS PM23625	53.9	12.6	22.5	12.1	0.23	0.54
NMNS PM23628	—	17.3	36.0	19.7	—	0.55
NMNS PM23632	70.3	20.3	28.3	13.0	0.29	0.46
NMNS PM23633	77.2	21.1	33.0	18.7	0.27	0.57
NMNS PM23634	—	28.1	40.8	22.6	—	0.55

Discussion: Even though Chao (1959) first assigned this species to *Prionolobus* Waagen, 1895, its shell morphology, which is similar to Arctoceratidae without umbilical tubercles, clearly suggests that it belongs to *Submeekoceras*. This species is very close to type species of the genus, *S. mushbachanum* (White, 1879), but the latter has a more involute shell with a narrower umbilicus. Specimens attributed to *S. mushbachanum* by Brayard and Bucher (2008) from South China are characterized by a more evolute shell with a wider umbilicus than the type specimen of *S. mushbachanum* and other illustrated specimens described by Smith (1932) from western USA. They are herein assigned to *S. hsüyüchieni*. Similar specimens were described as compris-

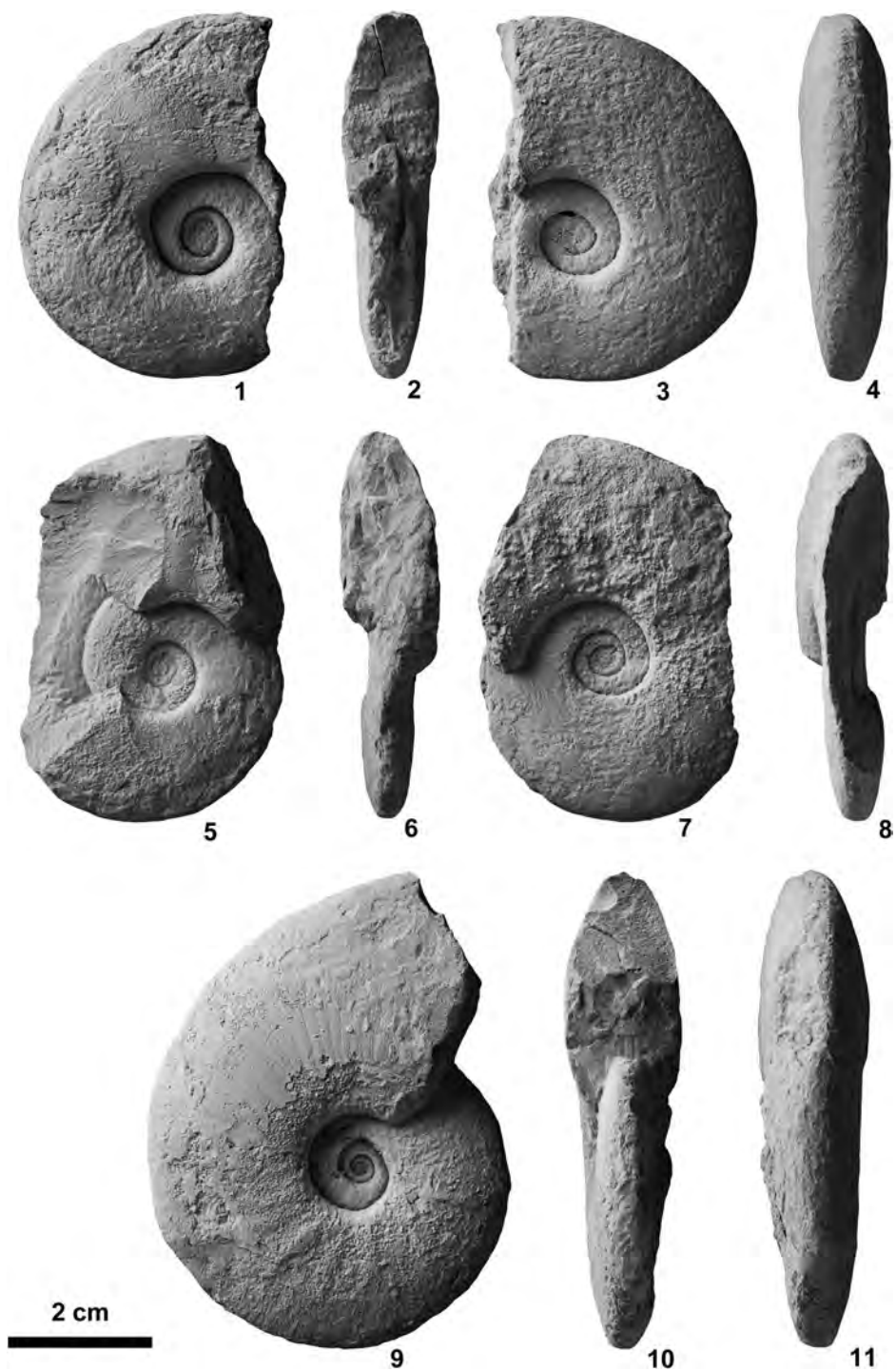


Fig. 76. *Submeekoceras hsüiyüchieni* (Chao, 1959), from BT01-03. 1-4, NMNS PM23624. 5-8, NMNS PM23625. 9-11, NMNS PM23626.

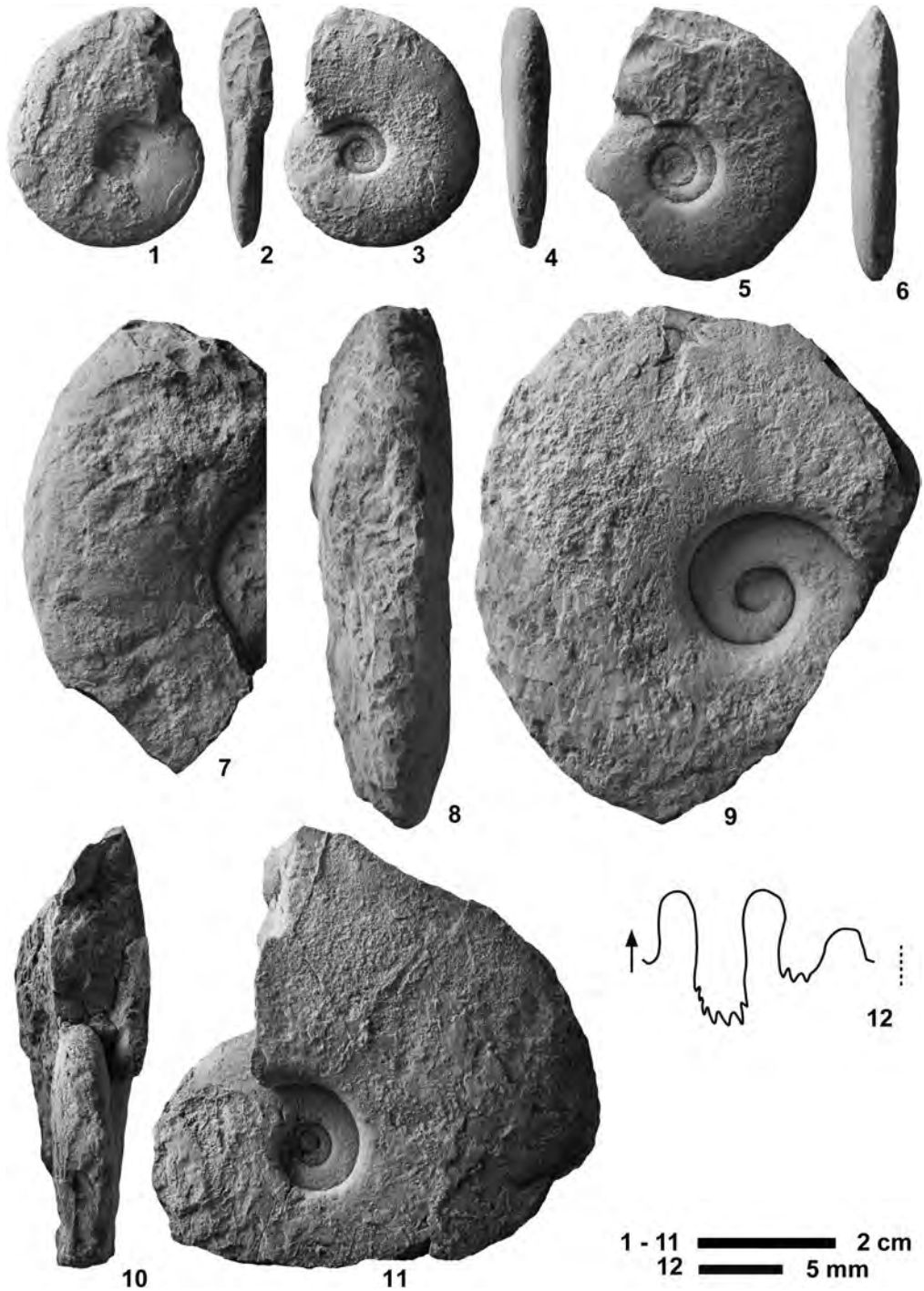


Fig. 77. *Submeekoceras hsüiyüchieni* (Chao, 1959). 1-4, NMNS PM23629, from BT01-09. 5-6, NMNS PM23630, from BT01-09. 7, NMNS PM23627, from BT01-03. 8-9, NMNS PM23628 from BT01-03. 10-12, NMNS PM23631, from KC01-01.

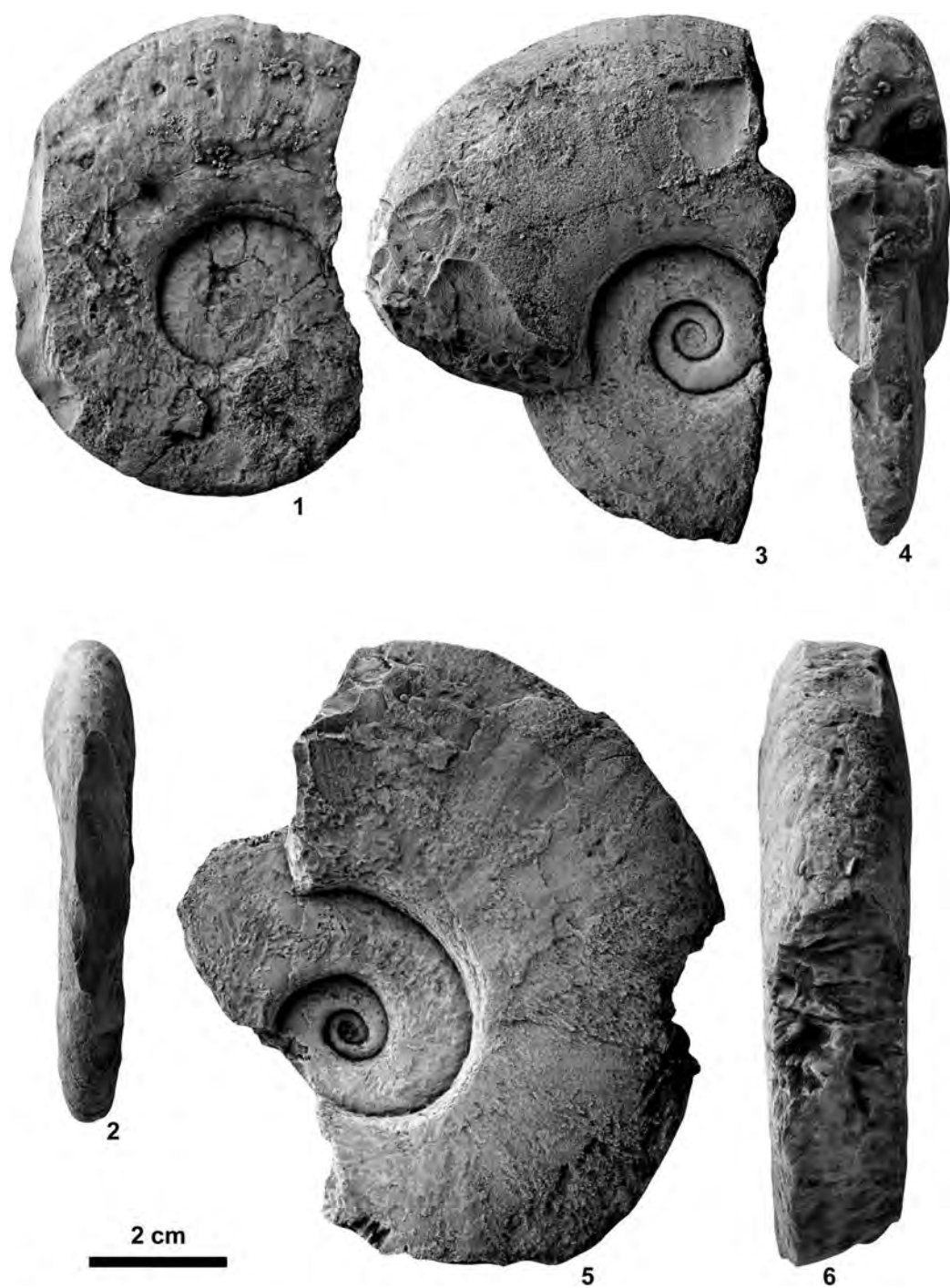


Fig. 78. *SubmEEKOCERAS HSÜYÜCHIENI* (Chao, 1959), from float limestone blocks at BT02. 1–2, NMNS PM23632. 3–4, NMNS PM23633. 5–6, NMNS PM23634.

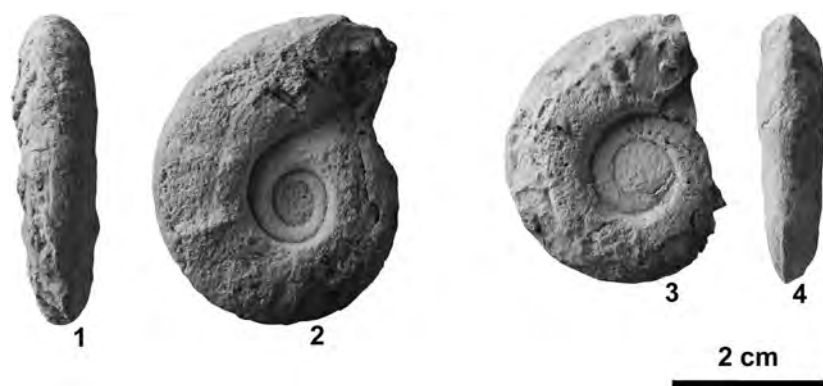


Fig. 79. *Nammalites* sp. indet., from BT02-03. 1–2, NMNS PM23524. 3–4, NMNS PM23525.

ing several different species by Chao (1959, see above synonymy list), but they probably fit within the interspecific variation of a single species because their morphological differences are insignificant. *Prionolobus ophionus* var. *involutus* Chao, 1959 is somewhat similar to *Submeekoceras hsüiyüchieni*, but it is unclear if they are conspecific because the type specimen of the former species is very small (diameter ~30 mm) and its preservation is quite poor.

Occurrence: Described specimens from BT01-03, BT01-09 and KC01-01 within the portion of the *Novispathodus* ex gr. *waageni* Zone that includes the *Flemingites rursiradiatus* beds (lowest Middle Smithian=middle Lower Olenekian) and *Urdoceras tulongensis* beds (lower Middle Smithian=middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam. This species also occurs in the Middle Smithian in South China (*Flemingites rursiradiatus* beds and *Owenites koeneni* beds, Brayard and Bucher, 2008), Afghanistan (Kummel and Erben, 1968), and Oman (*Flemingites rursiradiatus* fauna and *Owenites koeneni* fauna, Brühwiler *et al.*, 2012a).

Genus *Nammalites* Brühwiler *et al.*, 2010

Type species: *Nammalites pilatoides* (Guex, 1978).

Nammalites sp. indet.

Fig. 79

Material examined: Two specimens, NMNS PM23524–23525, from BT02-03.

Description: Moderately evolute, fairly compressed shell with rounded venter, indistinct ventral shoulders, and slightly convex flanks with maximum whorl width near umbilical shoulder. Umbilicus moderately wide with moderately high, nearly vertical wall and rounded shoulders. Ornamentation consists of distant, rursiradiate ribs that develop elongated bullar near umbilicus and fade out toward venter. Suture not well preserved.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NMNS PM23524	40.0	13.4	15.0	11.0	0.34	0.73
NMNS PM23524	34.8	12.5	12.6	9.0	0.36	0.71

Discussion: Even though the present specimens are poorly preserved, their distinctive features enable me to assign them with reasonable confidence to the genus *Nammalites*. They differ from *Nammalites pilatoides* (Guex, 1978) by their wider umbilicus; this feature in combination with their poor preservation precludes a definitive species assignment.

Occurrence: Described specimens from BT02-03 within the portion of the *Novispathodus* ex gr. *waageni* Zone that includes the *Owenites koeneni* beds (Middle Smithian=

middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Family Ussuridae Spath, 1930

Genus *Ussuria* Diener, 1895

Type species: Ussuria schamarae Diener, 1895.

Ussuria kwangsiana Chao, 1959

Fig. 80

Ussuria kwangsiana Chao, 1959, p. 258, pl. 31, figs. 8–10, pl. 8, text-fig. 30a; Brayard and Bucher, 2008, p. 54, pl. 27, figs. 1–3, text-fig. 47.

Ussuria pakungiana Chao, 1959, p. 258, pl. 31, figs. 1–3, pl. 8, text-fig. 30c, d.

Ussuria longilobata Chao, 1959, p. 259, pl. 31, figs. 4–7, pl. 8, text-fig. 30b.

Ussuria lenticularis Vu Khuc, 1984, p. 79, pl. 6, fig. 5, text-fig. 14; Vu Khuc, 1991, p. 140, pl. 47, fig. 4, text-fig. 4–1.

Holotype: NIGP 12321, figured by Chao (1959, p. 258, pl. 31, figs. 8–10), from the Owenitan (middle Smithian) in the Tiengno district (Pakung), western Guangxi, South China.

Material examined: One specimen, NMNS PM23526, from BT02-02 and one specimen, NMNS PM23527, from BT01-09.

Description: Very involute, very compressed oxycone with narrowly rounded venter and gently convex flanks with maximum width near umbilicus. Umbilicus very narrow with high, perpendicular wall and rounded shoulders. Shell surface smooth. Suture sub-ammonitic, with distinctly phylloid saddles and strongly indented lobes.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NMNS PM23527	42.1	3.8	24.5	10.6	0.09	0.43
NMNS PM23526	69.0	4.7	41.2	17.7	0.07	0.43

Discussion: Chao (1959) erected *Ussuria pakungiana* and *U. longilobata* from the same locality as *U. kwangsiana* in South China. They are differentiated from *U. kwangsiana* only by small differences in their suture line, but otherwise are very similar. These two taxa

probably represent juvenile whorls of *U. kwangsiana* and the difference in suture line is interpreted to simply be the result of intraspecific variation or ontogenetic variation. According to Brayard and Bucher (2008), *U. kwangsiana* has a nearly occluded umbilicus. *U. lenticularis* Vu Khuc, 1984 from the Bac Thuy Formation is very similar to the described specimens and probably should be synonymized with *U. kwangsiana*.

Occurrence: Described specimens from BT01-09 and BT02-02 within the portion of the *Novispathodus* ex gr. *waageni* Zone that includes the *Urdoceras tulongensis* beds (lower Middle Smithian = middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam. This species also occurs in the Middle Smithian (*Owenites koeneni* beds) in South China (Brayard and Bucher, 2008).

Genus *Parussuria* Spath, 1930

Type species: Ussuria compressa Hyatt and Smith, 1905.

Parussuria compressa
(Hyatt and Smith, 1905)

Figs. 81, 82

Ussuria compressa Hyatt and Smith, 1905, p. 89, pl. 3, figs. 6–11.

Sturia compressa (Hyatt and Smith, 1905). Smith, 1932, p. 93, pl. 3, figs. 6–11.

Parussuria compressa (Hyatt and Smith, 1905). Spath, 1934, fig. 66c–d; Kummel and Steele, 1962, p. 690, pl. 99, fig. 23, pl. 102, fig. 11; Shevyrev, 1995, p. 37, pl. 4, fig. 6, text-fig. 16; Brayard and Bucher, 2008, p. 56, pl. 12, fig. 17; Brühwiler *et al.*, 2012a, p. 31, pl. 18, figs. 8–14; Brayard *et al.*, 2013, p. 191, fig. 57a–f.

Metussuria spathi Chao, 1959, p. 261, pl. 21, fig. 3, pl. 31, fig. 13.

Parussuria semenovi Zakharov, 1968, p. 59, pl. 5, fig. 4, text-fig. 8e.

Holotype: USNM 75250, figured by Hyatt and Smith (1905, p. 89, pl. 3, figs. 6–7), from the *Meekoceras* beds (middle Smithian) in the Inyo Range, California, western USA.

Material examined: One specimen, NMNS

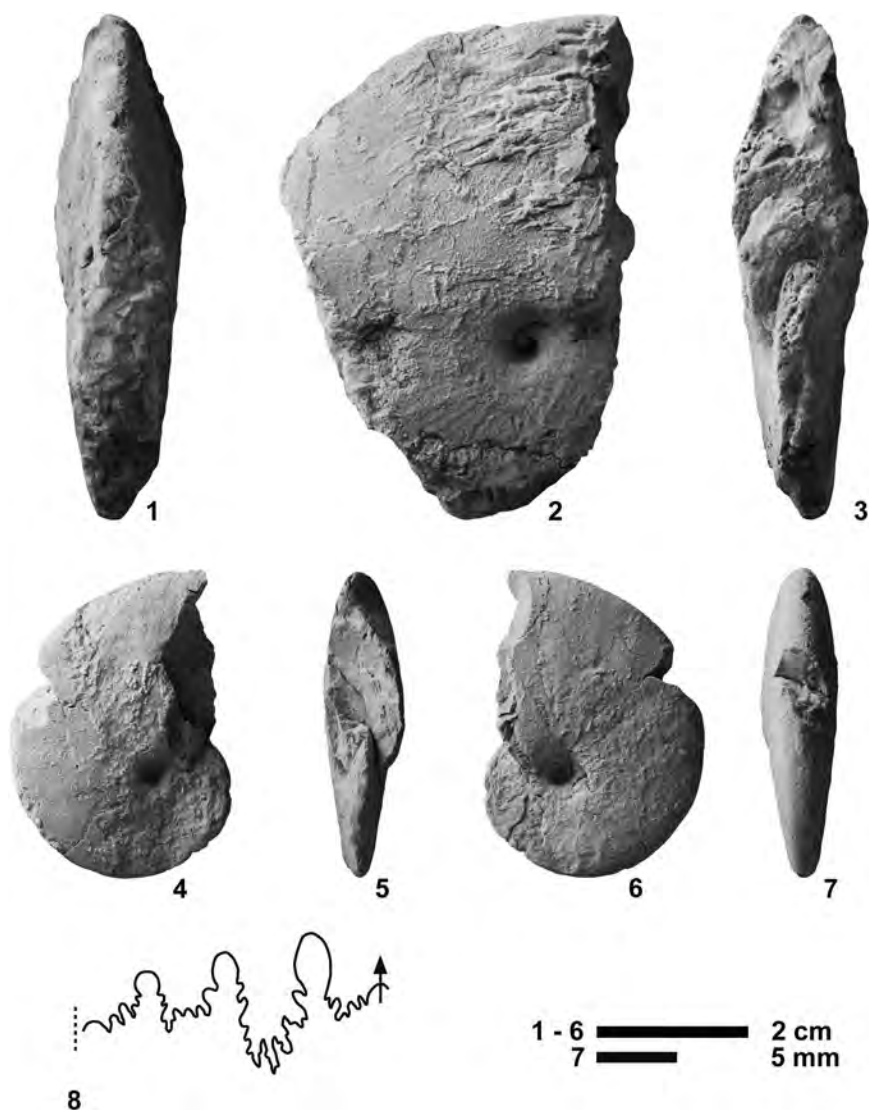


Fig. 80. *Ussuria kwangsiana* Chao, 1959. 1–3, NMNS PM23526, from BT02–02. 4–8, NMNS PM23527, from BT01–09.

PM23528, from BT02–03 and four specimens, NMNS PM23529–23532, from KC01–13.

Description: Very involute, very compressed oxycone with very narrowly rounded venter and gently convex flanks with maximum width near umbilicus. Flanks gradually convergent to venter. Umbilicus occluded with low, oblique wall and rounded shoulders. Shell surface smooth. Suture subammonitic, with deeply divided, phylloid saddles and strongly

indented lobes.

Measurements (mm):

Specimen no.	D	U	H	W	W/H
NMNS PM23529	40.6	0.0	27.1	11.6	0.43
NMNS PM23530	44.6	0.0	29.0	13.2	0.46
NMNS PM23531	—	0.0	35.3	15.0	0.42
NMNS PM23528	72.4	0.0	50.0	18.0	0.36
NMNS PM23532	—	0.0	55.4	18.9	0.34

Discussion: *Metussuria spathi* Chao, 1959 from South China has a subammonitic suture

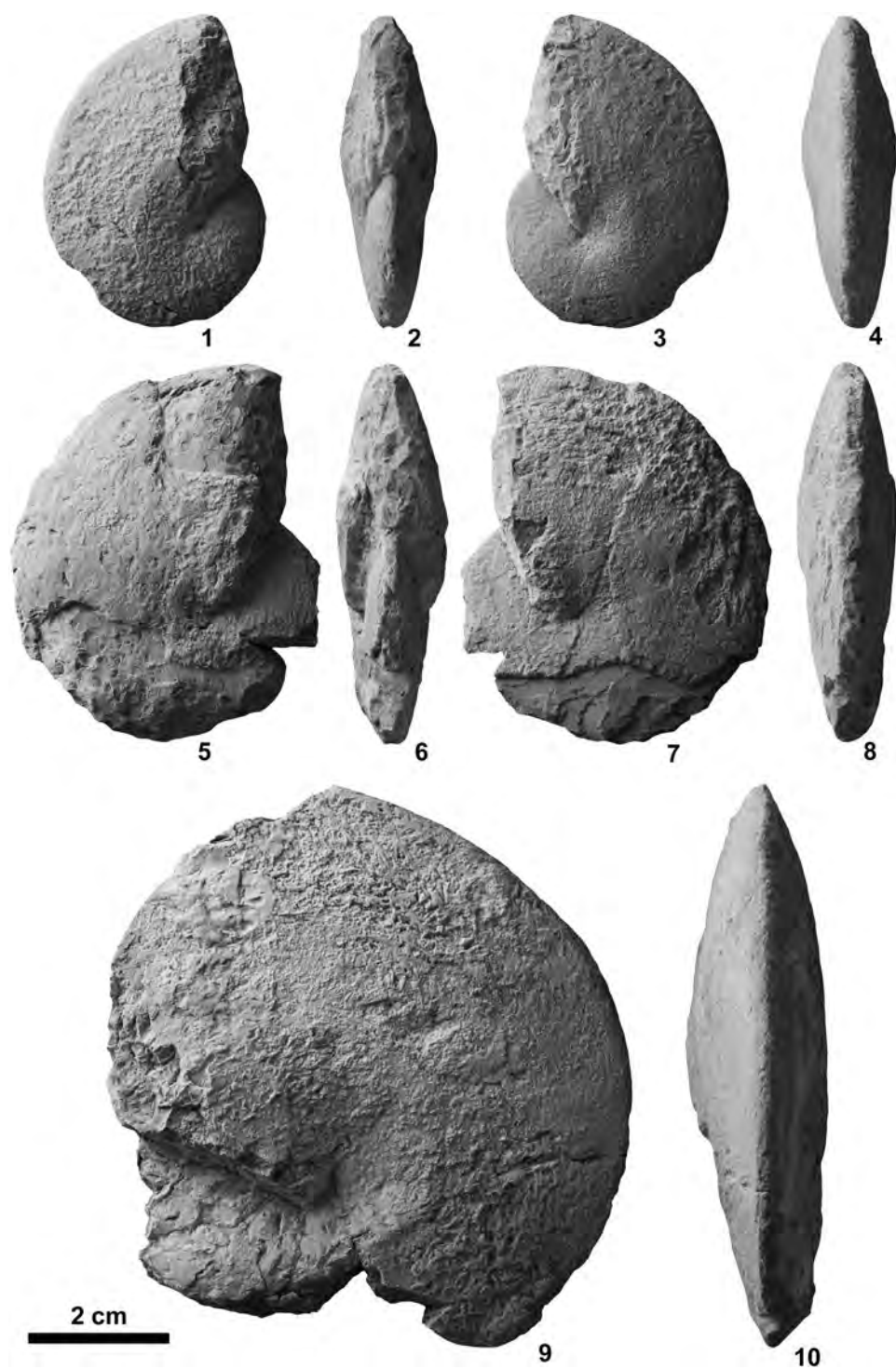


Fig. 81. *Parussuria compressa* (Hyatt and Smith, 1905) from KC01-13. 1–4, NMNS PM23530. 5–8, NMNS PM23531. 9–10, NMNS PM23532.

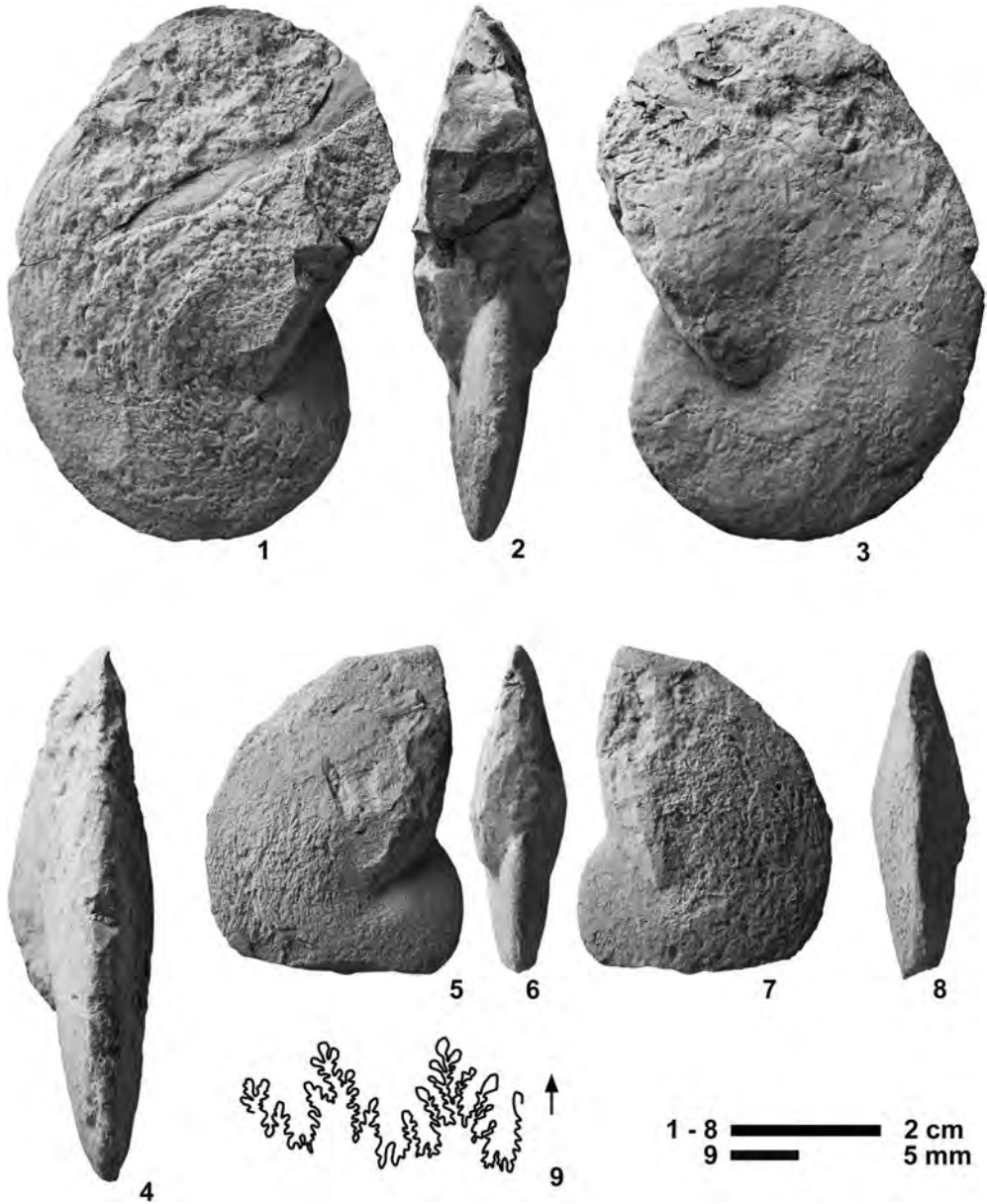


Fig. 82. *Parussuria compressa* (Hyatt and Smith, 1905). 1–4, NMNS PM23528, from BT02-03. 5–9, NMNS PM23529, from KC01-12.

line with deeply divided, phylloid saddles and strongly indented lobes. This evidence clearly suggests that this species should be assigned to *Parussuria*. Furthermore, its shell morphology does not exhibit any significant differences from *Parussuria compressa* and is herein considered as a synonym. *P. semenovi* Zakharov, 1968 from South Primorye, whose suture line and shell morphology is very similar, is also probably conspecific with *P. compressa*.

Occurrence: Described specimens from BT02-03 and KC01-13 within the portion of the *Novispathodus* ex gr. *waageni* Zone that includes the *Leyceras* horizon of the *Owenites koeneni* beds (middle Middle Smithian=middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam. This species also occurs in the Middle Smithian in South China (*Owenites koeneni* beds, Brayard and Bucher, 2008), Oman (*Owenites koeneni* fauna, Brühwiler *et al.*, 2012a), northwestern Caucasus (*Owenites-Dieneroceras* beds, Shevryev, 1995), western USA (*Meekoceras gracilitatis* Zone, Kummel and Steele, 1962; *Owenites* beds, Brayard *et al.*, 2013) and South Primorye (*Owenites koeneni* Zone, Zakharov, 1968).

Family Melagathiceratidae Tozer, 1971

Genus *Jinyaceras* Brayard and Bucher, 2008

Type species: *Jinyaceras bellum* Brayard and Bucher, 2008.

Jinyaceras* cf. *bellum

Brayard and Bucher, 2008

Fig. 83.1–83.15

cf. *Jinyaceras bellum* Brayard and Bucher, 2008, p. 31, pl. 9, figs. 1–19, text-figs. 29.

Material examined: Two specimens, NMNS PM23539–23540, from BT01-03, one specimen, NMNS PM23541, from BT01-09, one specimen, NMNS PM23542, from BT02-02, and one specimen, NMNS PM23543, from a float limestone block at BT02.

Description: Moderately involute, fairly

depressed shell with broadly arched venter, rounded ventral shoulders, and slightly convex flanks gradually converging from umbilical shoulders to venter. Umbilicus fairly narrow with moderately high, nearly vertical wall and rounded shoulders. Ornamentation consists of distant, prorsiradiate constrictions that become weaker on venter. Suture not well preserved.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NMNS PM23542	14.4	3.4	6.0	8.3	0.24	1.38
NMNS PM23543	14.6	4.5	5.7	6.6	0.31	1.16
NMNS PM23541	14.7	3.9	6.4	6.6	0.27	1.03
NMNS PM23539	14.7	4.2	5.7	7.1	0.29	1.25
NMNS PM23540	19.8	4.8	5.5	6.8	0.24	1.23

Discussion: The described specimens are very similar to *Jinyaceras bellum* from South China, but their poor preservation prevents a definitive species assignment. Chao (1959) attributed two new species to *Kashmirites* Diener, 1913, *K. prorsiradiatus* and *K. varians*, and also described two specimens as *K. subarmatus* Diener, 1913, all of which are very close to *J. bellum*. They may be conspecific, but further taxonomic studies are necessary to confirm the synonymy.

Occurrence: Described specimens from BT01-03, BT01-09 and BT02-02 within the portion of the *Novispathodus* ex gr. *waageni* Zone that includes the *Flemingites rursiradiatus* beds (lowest Middle Smithian=middle Lower Olenekian) and *Urdoceras tulongensis* beds (lower Middle Smithian=middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam. *Jinyaceras bellum* occurs in the Middle Smithian in South China (*Flemingites rursiradiatus* beds and *Owenites koeneni* beds, Brayard and Bucher, 2008).

***Jinyaceras*? sp. indet.**

Fig. 83.16–83.19

Material examined: One specimen, NMNS PM23544, from BT02-02 and one specimen, NMNS PM23545, from BT01-09.

Description: Moderately involute shell with equal whorl height and width. Venter

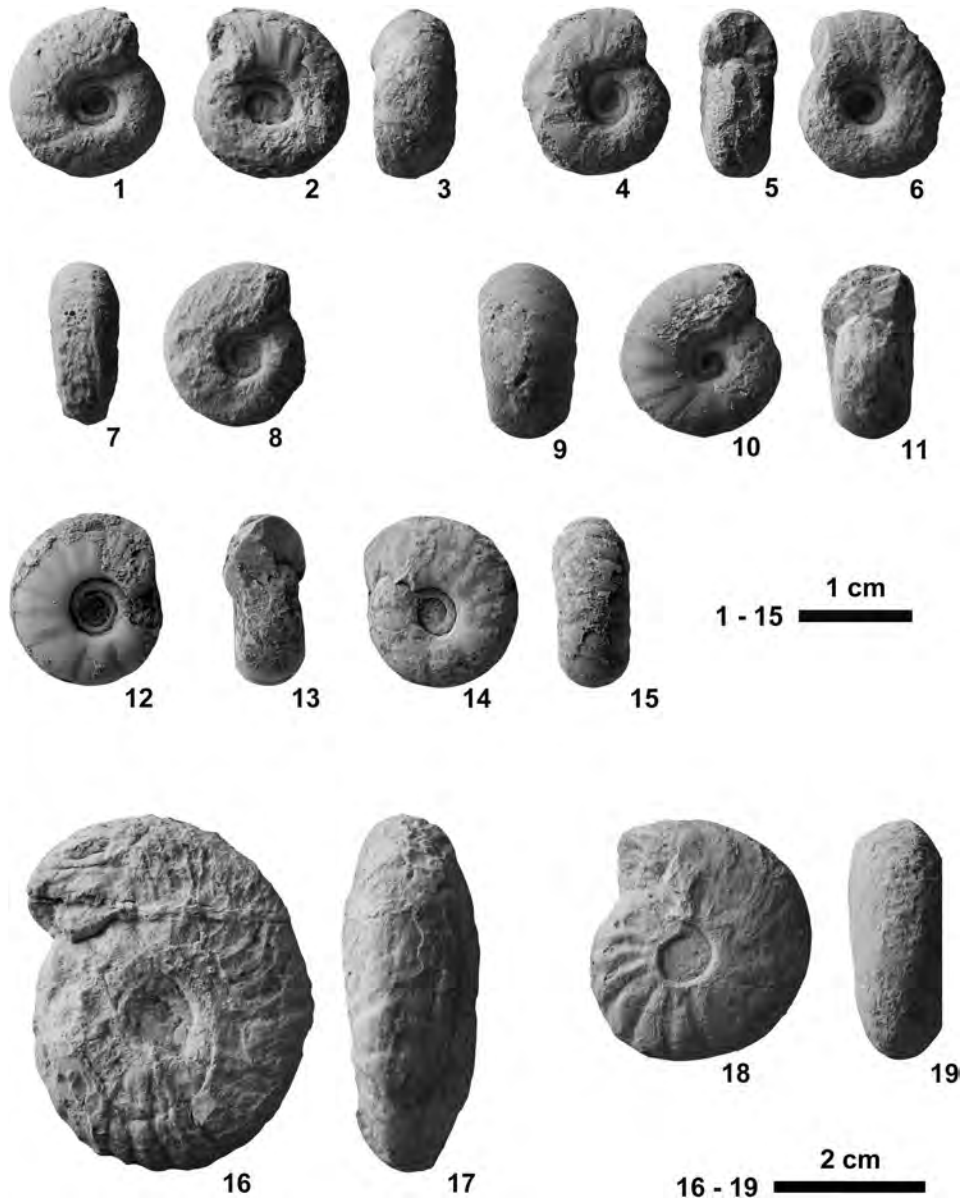


Fig. 83. 1–15, *Jinyaceras cf. bellum* Brayard and Bucher, 2008. 1–3, NMNS PM23539, from BT01-03. 4–6, NMNS PM23540, from BT01-03. 7–8, NMNS PM23541, from BT01-09. 9–11, NMNS PM23542, from BT02-02. 12–15, NMNS PM23543, from a float limestone block at BT02. 16–19, *Jinyaceras?* sp. indet. 16–17, NMNS PM23544, from BT02-02. 18–19, NMNS PM23545, from BT01-09.

broadly arched with rounded shoulders and slightly convex flanks with maximum whorl width near umbilicus. Umbilicus fairly narrow with moderately high, nearly vertical wall and rounded shoulders. Ornamentation consists of distant, prorsiradiate constrictions. Suture not well preserved.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NMNS PM23545	31.8	7.0	14.2	14.5	0.22	1.02
NMNS PM23544	46.0	10.5	20.0	18.0	0.23	0.90

Discussion: The assignment of the described specimens to *Jinyaceras* is uncertain and is based only on the similarity of their morphology with *Jinyaceras*. However, these specimens are larger than specimens assigned to *Jinyaceras* by previous authors (Brayard and Bucher, 2008; Brühwiler *et al.*, 2010, 2012a, 2012c).

Occurrence: Described specimens from BT01-09 and BT02-02 within the portion of the *Novispathodus* ex gr. *waageni* Zone that includes the *Urdyceras tulongensis* beds (lower Middle Smithian=middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Genus *Juvenites* Smith, 1927

Type species: *Juvenites krafftii* Smith, 1927.

Juvenites sinuosus (Kiparisova, 1947)

Fig. 84

Nannites sinuosus Kiparisova, 1947, p. 141, pl. 27, figs. 7–8.

Nannites sinuosus var. *pressula* Kiparisova, 1947, p.141, pl. 27, fig. 6, text-fig. 27.

Juvenites kwangsiensis Chao, 1959, p. 287, pl. 26, figs. 6–8.

Juvenites medius (Diener, 1909). Chao, 1959, p. 288, pl. 25, figs. 11–20.

Juvenites septentrionalis Smith, 1932. Chao, 1959, p. 289, pl. 25, figs. 6–10.

Juvenites orientalis Chao, 1959, p. 290, pl. 26, figs. 3–5.

Juvenites sp. A. Chao, 1959, p. 290, pl. 25, figs. 21–22.

Juvenites sp. B. Chao, 1959, p. 291, pl. 25, figs. 23–27.

Anasibirites simplex Chao, 1959, p. 327, pl. 40, figs. 7–9.

Juvenites sp. Kummel and Sakagami, 1960, p. 8, pl. 1, fig. 2.

Nannites cf. *septentrionalis* (Smith, 1932). Kiparisova, 1961, p. 132, pl. 27, fig. 13.

Nannites aff. *sinuosus* Kiparisova, 1947. Kiparisova, 1961, p. 133, pl. 27, fig. 12, text-fig. 100.

Nannites simplex (Chao, 1959). Zakharov, 1968, p. 117, pl. 22, figs. 3–7.

Juvenites sinuosus (Kiparisova, 1947). Shevryev, 1995, p. 23, pl. 1, fig. 1–2.

Juvenites procurvus Brayard and Bucher, 2008, p. 32, pl. 22, figs. 6–12, text-figs. 30; Brühwiler *et al.*, 2012a, p. 41, pl. 22, figs. 10–11; Brühwiler *et al.*, 2012c, p. 163, fig. 37AK–AP.

Juvenites cf. *thermarum* (Smith, 1927). Brühwiler *et al.*, 2012a, p. 39, pl. 22, figs. 1–9.

Juvenites sp. Brühwiler *et al.*, 2012b, p. 105, fig. 89AN–AX.

Holotype: CGM 43/6259, figured by Kiparisova (1947, p. 141, pl. 27, fig. 8), from the middle Smithian (*Owenites-Dieneroceras* beds) in northwestern Caucasus.

Material examined: One specimen, NMNS PM23533, from KC01-03 and five specimens, NMNS PM23534–23538, from KC01-13.

Description: Fairly involute, very depressed shell with semicircular whorl section and convex flanks gradually converging from abruptly rounded umbilical shoulders to arched venter. Umbilicus moderately wide with moderately high, nearly vertical wall and abruptly rounded shoulders. Ornamentation consists of distant, forward projected constrictions, becoming denser on mature body chamber. Suture not well preserved.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NMNS PM23538	12.8	4.1	4.8	8.4	0.32	1.75
NMNS PM23535	16.0	4.9	6.5	11.3	0.31	1.73
NMNS PM23537	17.0	5.2	6.6	10.5	0.31	1.59
NMNS PM23536	17.7	5.7	6.4	9.5	0.32	1.48
NMNS PM23533	18.2	6.2	6.3	10.3	0.34	1.63
NMNS PM23534	18.8	6.4	7.0	10.4	0.34	1.49

Discussion: Countless specimens referable to the genus *Juvenites* are known not only from eastern Panthalassa (western USA), but also from the Tethys (northwestern Caucasus, Oman, Spiti, the Salt Range, South China) and

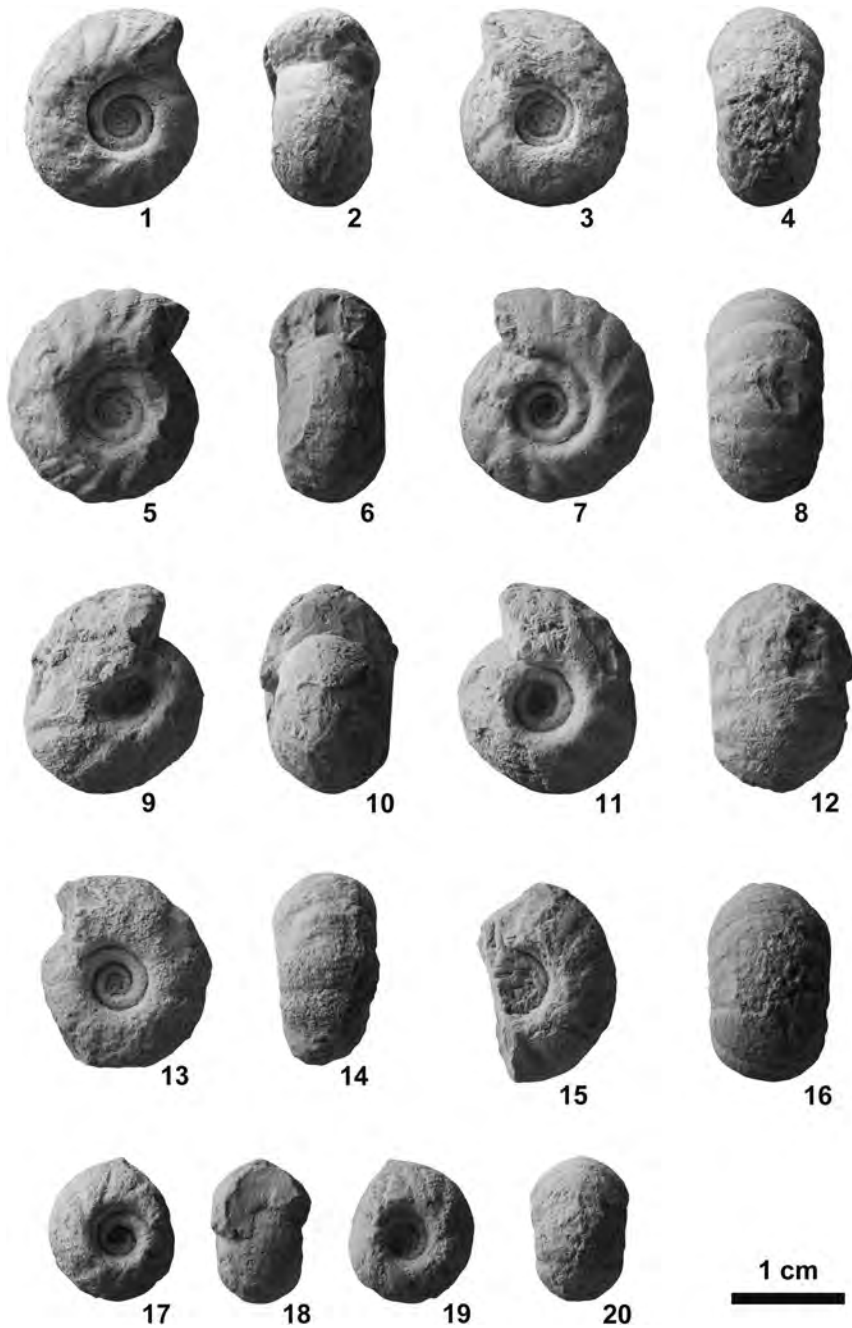


Fig. 84. *Juvenites sinuosus* (Kiparisova, 1947). 1–4, NMNS PM23533, from KC01-03. 5–8, NMNS PM23534, from KC01-13. 9–12, NMNS PM23536, from KC01-13. 13–14, NMNS PM23535, from KC01-13. 15–16, NMNS PM23537, from KC01-13. 17–20, NMNS PM23538, from KC01-13.

western Panthalassa (South Primorye). Many different species have been erected based only on slight differences in shell shape and suture line, but the intraspecific variation of each species is not yet that well understood.

Brayard and Bucher (2008) recently erected *Juvenites procurvus* based on seven specimens from South China ranging from juveniles to mature stages. Some of these specimens are very similar to other species previously described from the Tethys and western Panthalassa. For example, PIMUZ 26010 (Brayard and Bucher, 2008, pl. 22, fig. 8, holotype) is quite similar to the holotype of *J. sinuosus* (Kiparisova, 1947, pl. 27, fig. 8), and PIMUZ 26009 (Brayard and Bucher, 2008, pl. 22, fig. 7) is very close to holotype of *J. kwangsiensis* (Chao, 1959, pl. 26, figs. 6–7). In addition, PIMUZ 26012 (Brayard and Bucher, 2008, pl. 22, fig. 10) is similar to holotype of *J. orientalis* (Chao, 1959, pl. 26, figs. 3–4). These very close similarities strongly suggest that the previously described species from the Tethys and western Panthalassa synonymized above probably fall within the intraspecific or ontogenetic variation *J. sinuosus*.

Occurrence: Described specimens from KC01-03 and KC01-13 within the portion of the *Novispathodus* ex gr. *waageni* Zone that includes the *Leyceceras* horizon of the *Owenites koeneni* beds (middle Middle Smithian=middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam. This species also occurs in the Middle Smithian in South China (*Owenites koeneni* beds, Brayard and Bucher, 2008), Spiti (*Pseudocelites multiplicatus* beds, Brühwiler *et al.*, 2012c), the Salt Range (*Brayardites compressus* beds, Brühwiler *et al.*, 2012b), Oman (*Owenites koeneni* fauna, Brühwiler *et al.*, 2012a), north-western Caucasus (*Owenites-Dieneroceras* beds, Shevyrev, 1995), and South Primorye (*Owenites koeneni* Zone, Zakharov, 1968).

Genus *Paranannites* Hyatt and Smith, 1905

Type species: Paranannites aspenensis Hyatt and Smith, 1905.

***Paranannites sinensis* (Chao, 1959)**

Figs. 85–87

Prospingites sinensis Chao, 1959, p. 297, pl. 25, figs. 1–5, pl. 27, figs. 1–17, text-fig. 40a–c.

Paranannites spathi (Frebold, 1930). Brayard and Bucher, 2008, p. 63, pl. 35, figs. 10–19, text-fig. 55.

Juvenites cf. *spathi* (Frebold, 1930). Brühwiler *et al.* (2012c), p. 161, pl. 37A–O.

Lectotype: Specimen NIGP 12587, figured by Chao (1959, p. 297, pl. 27, figs. 16–17) from the Owenitan (middle Smithian) in the Tientung district (Kaoyunling), western Guangxi, South China, here designated.

Material examined: Three specimens, NMNS PM23564–23566, from KC01-07, one specimen, NMNS PM23567, from KC01-10, seven specimens, NMNS PM23568–23574, from BT02-02, and three specimens, NMNS PM23561–23563, from a float limestone block at BT02.

Description: Fairly involute, fairly depressed shell characterized by subtrigonal whorl section with narrowly rounded to subangular venter and convex flanks gradually converging from umbilical shoulders to venter. Maximum whorl width occurs on umbilical shoulders. Umbilicus fairly narrow with high, vertical wall and abruptly rounded shoulders. Ornamentation consists of variable strength, prorsiradiate constrictions. Suture not well preserved.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NMNS PM23565	19.6	5.2	7.8	11.6	0.27	1.48
NMNS PM23567	26.0	5.7	10.5	—	0.21	—
NMNS PM23563	30.0	5.6	13.4	18.4	0.19	1.37
NMNS PM23569	32.0	6.1	15.0	18.0	0.19	1.20
NMNS PM23570	33.8	5.5	15.7	18.0	0.16	1.15
NMNS PM23561	38.7	7.4	18.9	24.1	0.19	1.28
NMNS PM23571	38.7	8.4	16.0	23.5	0.22	1.47
NMNS PM23562	40.3	8.8	15.0	19.5	0.22	1.30
NMNS PM23573	42.0	10.1	18.5	27.0	0.24	1.46

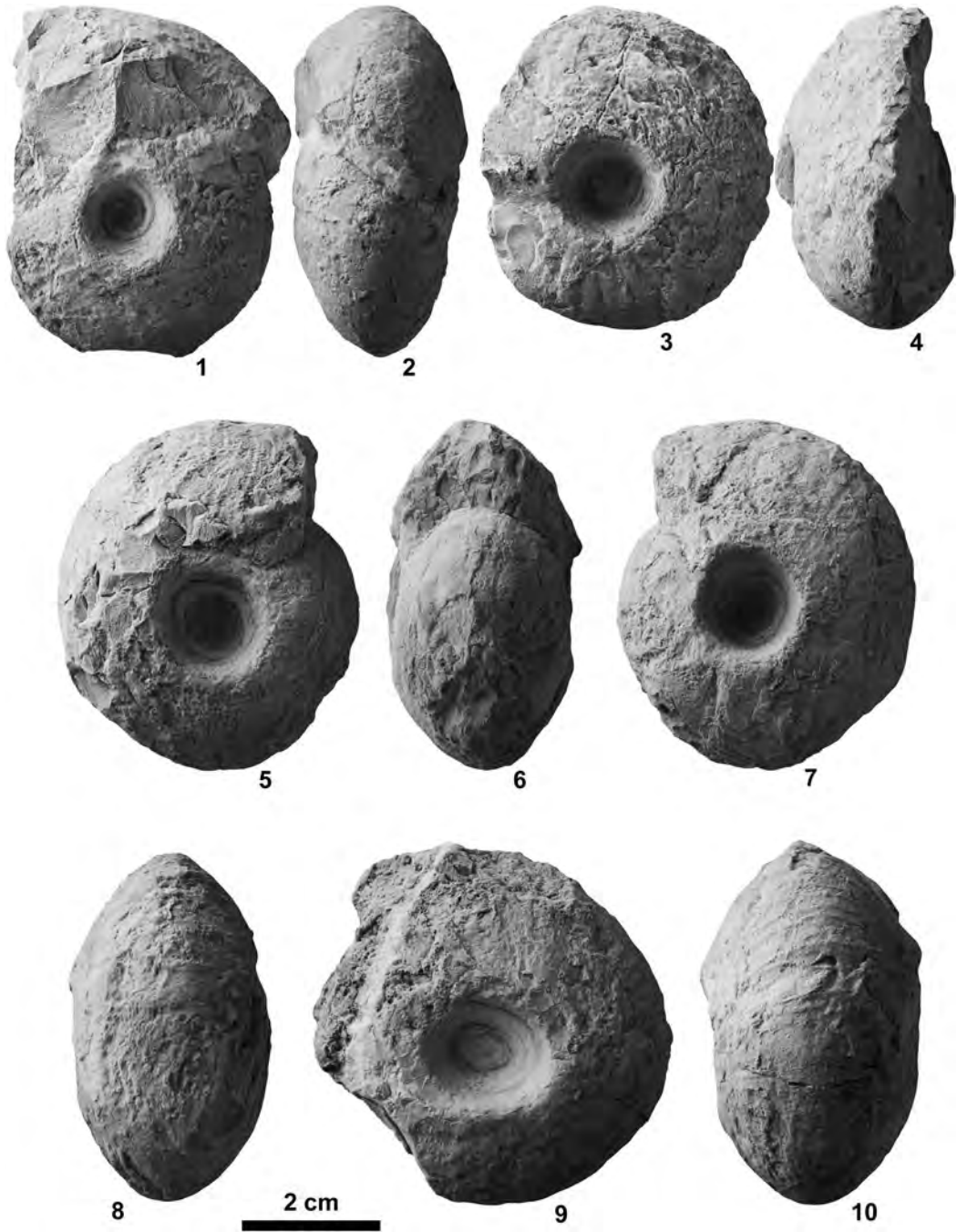


Fig. 85. *Paranannites sinensis* (Chao, 1959) from BT02-02. 1–2, NMNS PM23571. 3–4, NMNS PM23572. 5–7, NMNS PM23573. 8–10, NMNS PM23574.

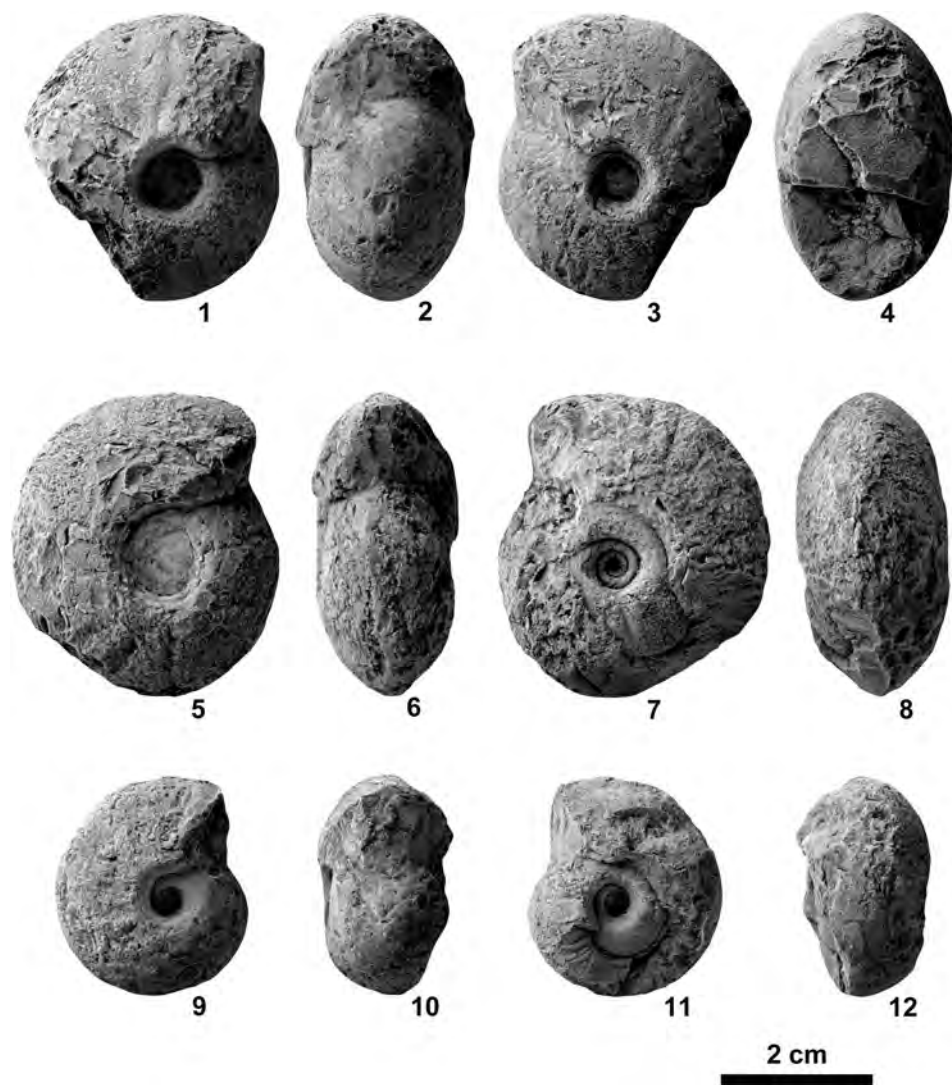


Fig. 86. *Paranannites sinensis* (Chao, 1959) from a float limestone block at BT02. 1–4, NMNS PM23561. 5–8, NMNS PM23562. 9–12, NMNS PM23563.

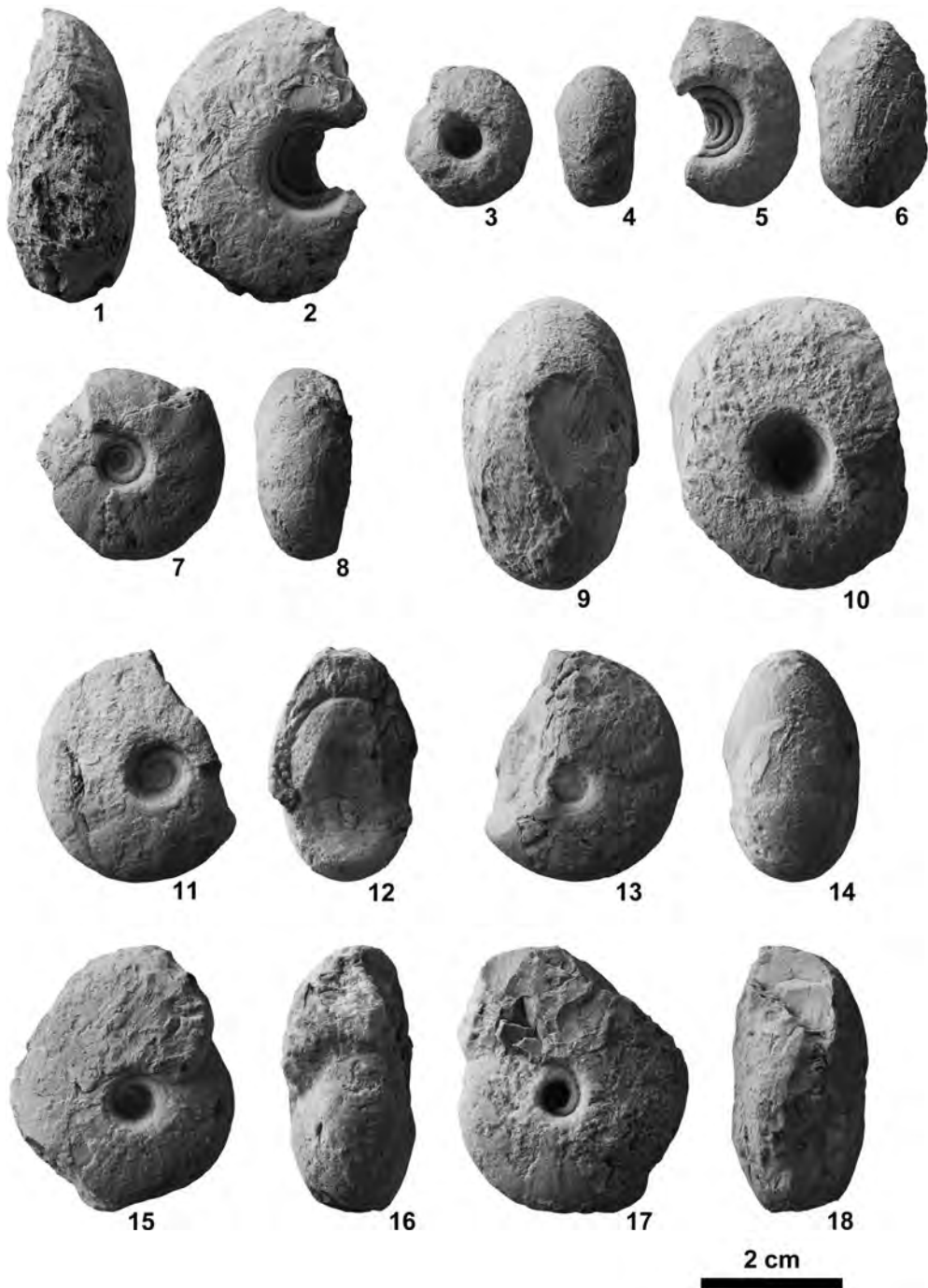


Fig. 87. *Paranannites sinensis* (Chao, 1959). 1–2, NMNS PM23564, from KC01-07. 3–4, NMNS PM23565, from KC01-07. 5–6, NMNS PM23566, from KC01-07. 7–8, NMNS PM23567, from KC01-10. 9–10, NMNS PM23568, from BT02-02. 11–14, NMNS PM23569, from BT02-02. 15–18, NMNS PM23570, from BT02-02.

NMNS PM23572	47.3	9.3	22.5	—	0.20	—
NMNS PM23574	51.0	13.1	18.5	27.6	0.26	1.49

Discussion: *Paranannites sinensis* is very close to *P. spathi* (Frebold, 1930) from the Spathian (Upper Olenekian) of Spitsbergen, but differs by its variable strength constrictions. In contrast, *P. spathi* is ornamented with distant, fine ribs. Specimens described as *P. spathi* from Arctic Canada by Tozer (1961, 1994) and South Tibet by Brühwiler *et al.* (2010) are somewhat similar to *P. sinensis*, but their venters are more rounded. The same observation holds true for specimens from Spiti attributed to *Juvenites cf. spathi* by Brühwiler *et al.* (2012c).

Occurrence: Described specimens from BT02-02, KC01-07 and KC01-10 within the portion of the *Novispathodus ex gr. waageni* Zone that includes the *Urdoceras tulongensis* beds (lower Middle Smithian=middle Lower Olenekian) and the *Leyceras* horizon of *Owenites koeneni* beds (middle Middle Smithian=middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam. This species also occurs in the Middle Smithian (*Owenites koeneni* beds) in South China (Brayard and Bucher, 2008).

***Paranannites involutus* (Chao, 1959)**

Fig. 88.1–88.4

Prosphingites involutus Chao, 1959, p. 297, pl. 28, figs. 1–11, text-fig. 39c.

“*Paranannites*” *ovum* Brayard and Bucher, 2008, p. 65, pl. 34, figs. 4–5.

Holotype: NIGP 12575, figured by Chao (1959, p. 297, pl. 28, fig. 1–2), from the Owenian (middle Smithian) in the Tientung district (Tsoteng), western Guangxi, South China.

Material examined: two specimens, NMNS PM2357–23578, from a float limestone block at PK01.

Description: Involute, very depressed shell with broadly rounded venter and convex flanks gradually converging from umbilical

shoulders to venter. Maximum whorl width occurs on umbilical shoulders. Umbilicus fairly narrow with high, vertical wall and abruptly rounded shoulders. Shell surface smooth. Suture not well preserved.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NMNS PM23578	29.6	6.8	11.4	23.0	0.23	2.02
NMNS PM23577	36.5	6.2	16.3	29.5	0.17	1.81

Discussion: Two specimens (PIMUZ 26090, 26091) described as “*Paranannites*” *ovum* by Brayard and Bucher (2008, pl. 34, figs. 4–5), which are characterized by a more depressed shell than the type specimens, are very similar to *P. involutus* and are probably conspecific.

Occurrence: Described specimens from PK01 within the portion of the *Novispathodus ex gr. waageni* Zone that includes the *Owenites koeneni* beds (middle to upper Middle Smithian=middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam. This species also occurs in the middle Smithian (Owenian) in South China (Chao, 1959).

***Paranannites* sp. indet.**

Fig. 88.5–88.12

Material examined: One specimen, NMNS PM23772, from BT01-09, one specimen, NMNS PM23575, from BT01-11, and one specimen, NMNS PM23576, from a float limestone block at BT02.

Description: Very involute, fairly compressed shell characterized by a subelliptical whorl section with rounded venter and convex flanks gradually converging from umbilical shoulders to venter. Maximum whorl width occurs near umbilical shoulders. Umbilicus narrow with moderately high, vertical wall and abruptly rounded shoulders. Ornamentation consists of weak, forward projected constrictions. Suture not well preserved.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NMNS PM23772	27.0	3.8	13.7	13.3	0.14	0.97

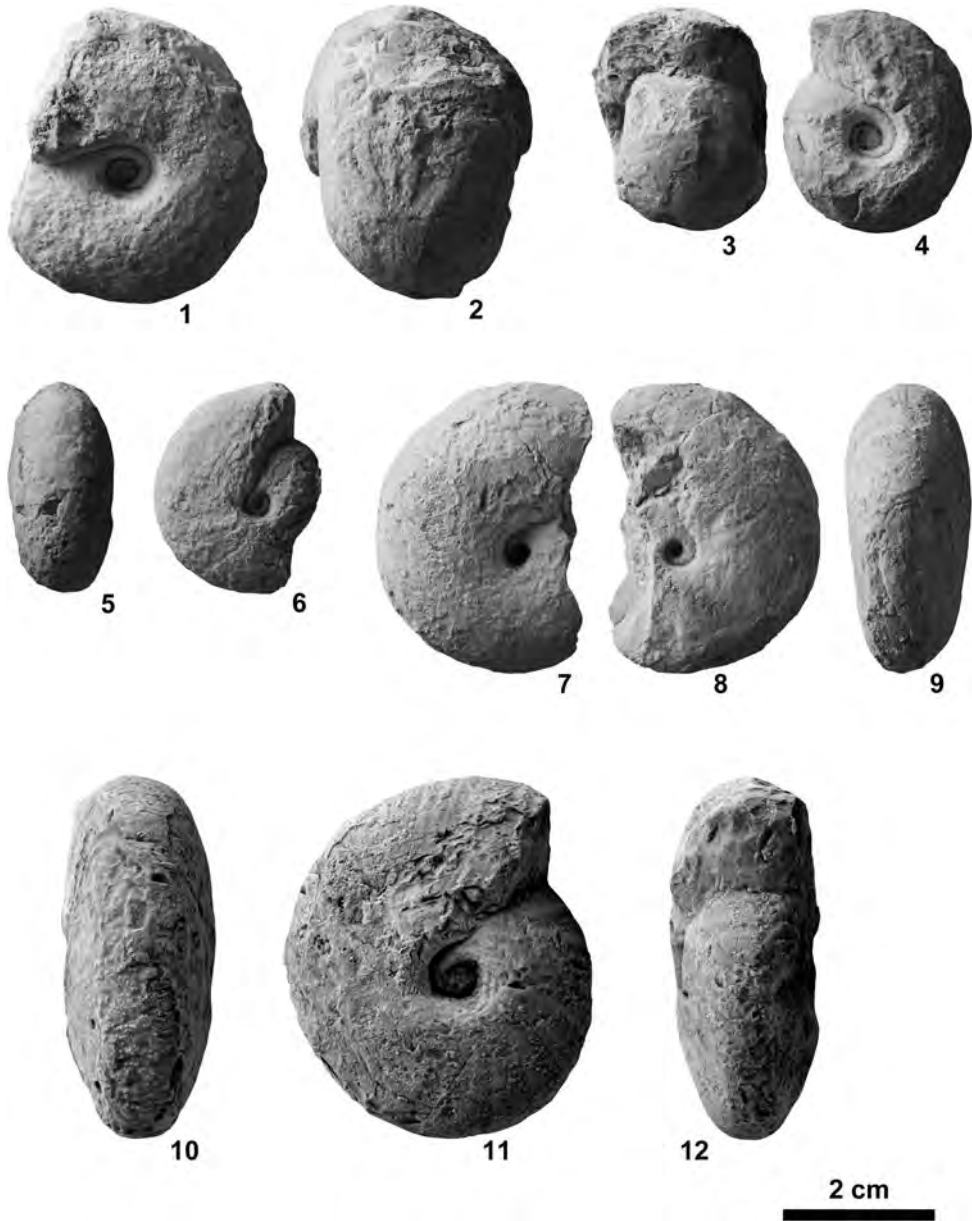


Fig. 88. 1–4, *Paranannites involutus* (Chao, 1959) from PK01. 1–2, NMNS PM23577. 3–4, NMNS PM23578. 5–12, *Paranannites* sp. indet. 5–6, NMNS PM23772, from BT01-09. 7–9, NMNS PM23575, from BT01-11. 10–12, NMNS PM23576, from a float limestone block at BT02.

NMNS PM23575	37.9	4.2	19.0	16.4	0.11	0.86
NMNS PM23576	47.5	7.4	21.7	19.6	0.16	0.90

Discussion: The described specimens are somewhat similar to *Paranannites aspenensis* Hyatt and Smith (1905, p. 81) from western USA in that they exhibit a fairly compressed shell with a narrow umbilicus, but the number of available specimens is insufficient to make a definitive species assignment.

Occurrence: Described specimens from BT01-09 and BT01-11 within the portion of the *Novispathodus* ex gr. *waageni* Zone that includes the *Urdoceras tulongensis* beds (lower Middle Smithian=middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Genus *Owenites* Hyatt and Smith, 1905

Type species: *Owenites koeneni* Hyatt and Smith, 1905.

Owenites koeneni Hyatt and Smith, 1905

Figs. 89–96

- Owenites koeneni* Hyatt and Smith, 1905, p. 83, pl. 10, figs. 1–22; Smith, 1932, p. 100, pl. 10, figs. 1–22; Spath, 1934, p. 185, text-fig. 57a–c; Kummel and Steele, 1962, p. 674, pl. 101, figs. 3–7, text-figs. 9–10; Popov, 1962, p. 44, pl. 6, fig. 6; Kuenzi, 1965, p. 374, pl. 53, figs. 1–6, text-figs. 3d, 6; Hada, 1966, pl. 4, figs. 2–4; Kummel and Erben, 1968, p. 121, pl. 19, figs. 10–15; Zakharov, 1968, p. 94, pl. 18, figs. 1–3, text-figs. 21, 24a–c; Collignon, 1973, p. 139, pl. 4, figs. 2–3; Bando, 1981, p. 158, pl. 17, fig. 7; Shevryev, 1990, p. 118, pl. 1, fig. 5; Shevryev, 1995, p. 51, pl. 5, figs. 1–3; Brayard and Bucher, 2008, p. 67, pl. 36, figs. 1–8, text-fig. 58; Brühwiler *et al.*, 2010, p. 426, fig. 15.9; Brühwiler *et al.*, 2012a, p. 43, pl. 25, figs. 1–6; Brühwiler *et al.*, 2012c, p. 155, fig. 35AH–AJ; Brayard *et al.*, 2013, p. 204, fig. 74a–i.
- Owenites egrediens* Welter, 1922, p. 151, pl. 168, figs. 22–26, text-figs. 14–18; Smith, 1932, p. 100, pl. 52, figs. 6–8; Spath, 1934, p. 186, text-figs. 56, 57d–f.
- Owenites zitteli* Smith, 1932, p. 101, pl. 52, figs. 1–5.
- Owenites* aff. *egrediens* Welter, 1922. Kiparisova, 1947, p. 139, pl. 32, figs. 1–3.
- Kingites shimizui* Sakagami, 1955, p. 138, pl. 2, fig. 2.
- Owenites pakungensis* Chao, 1959, p. 248, pl. 21, figs. 6–8, text-fig. 26a.

- Owenites pakungensis* var. *compressus* Chao, 1959, p. 248, pl. 21, figs. 4–5.
- Owenites costatus* Chao, 1959, p. 249, pl. 22, figs. 10–18, 22–23, text-fig. 26c.
- Owenites costatus* var. *lenticularis* Chao, 1959, p. 249, pl. 22, figs. 7–9, text-fig. 26d.
- Pseudowenites oxynotus* Chao, 1959, p. 252, pl. 23, figs. 1–16, text-fig. 27a–d; Vu Khuc, 1984, p. 82, pl. 7, figs. 3–4; Vu Khuc, 1991, p. 142, pl. 52, figs. 4–5.
- Owenites shimizui* (Sakagami, 1955). Kummel and Sakagami, 1960, p. 6, pl. 5, figs. 5–6.
- Owenites* cf. *koeneni* Hyatt and Smith, 1905. Kummel, 1959, p. 441, figs. 2–4.
- Owenites carinatus* Shevryev, 1968, p. 189, pl. 16, fig. 1; Vu Khuc, 1984, p. 81, pl. 6, figs. 1–4, text-fig. 16; Vu Khuc, 1991, p. 142, pl. 52, figs. 2–3, pl. 53, figs. 1–2, text-fig. 4.4.
- ? *Owenites* cf. *koeneni* Hyatt and Smith, 1905. Nichols and Silberling, 1979, pl. 1, figs. 17–18.

Holotype: USNM 75261, figured by Hyatt and Smith (1905, p. 83, pl. 10, figs. 1–4), from the *Meekoceras* beds (middle Smithian) in Inyo Range, California, western USA.

Material examined: One specimen, NMNS PM23579, from KC01-07, two specimens, NMNS PM23580–23581, from KC01-10, two specimens, NMNS PM23582–23583, from KC01-11, one specimen, twenty one specimens, NMNS PM23603–23623 from KC01-13, NMNS PM23584, from KC02-02, five specimens, NMNS PM23589–23593, from BT01-14, nine specimens, NMNS PM23594–23602, from BT02-03, one specimen, NMNS PM23584, from BT02-04, one specimen, NMNS PM23586, from a float limestone block at BT03, one specimen, NMNS PM23587, from PK01-01, and one specimen, NMNS PM23588, from PK01-02.

Description: During earlier growth stages, very involute, fairly compressed shell characterized by lenticular whorl section with angular venter and convex flanks gradually converging from umbilical shoulders to venter. Maximum whorl width occurs near umbilical shoulders. Umbilicus very narrow with moderately high, oblique wall and rounded shoulders. Ornamentation consists of weak, forward projected folds. As growth proceeds, whorl

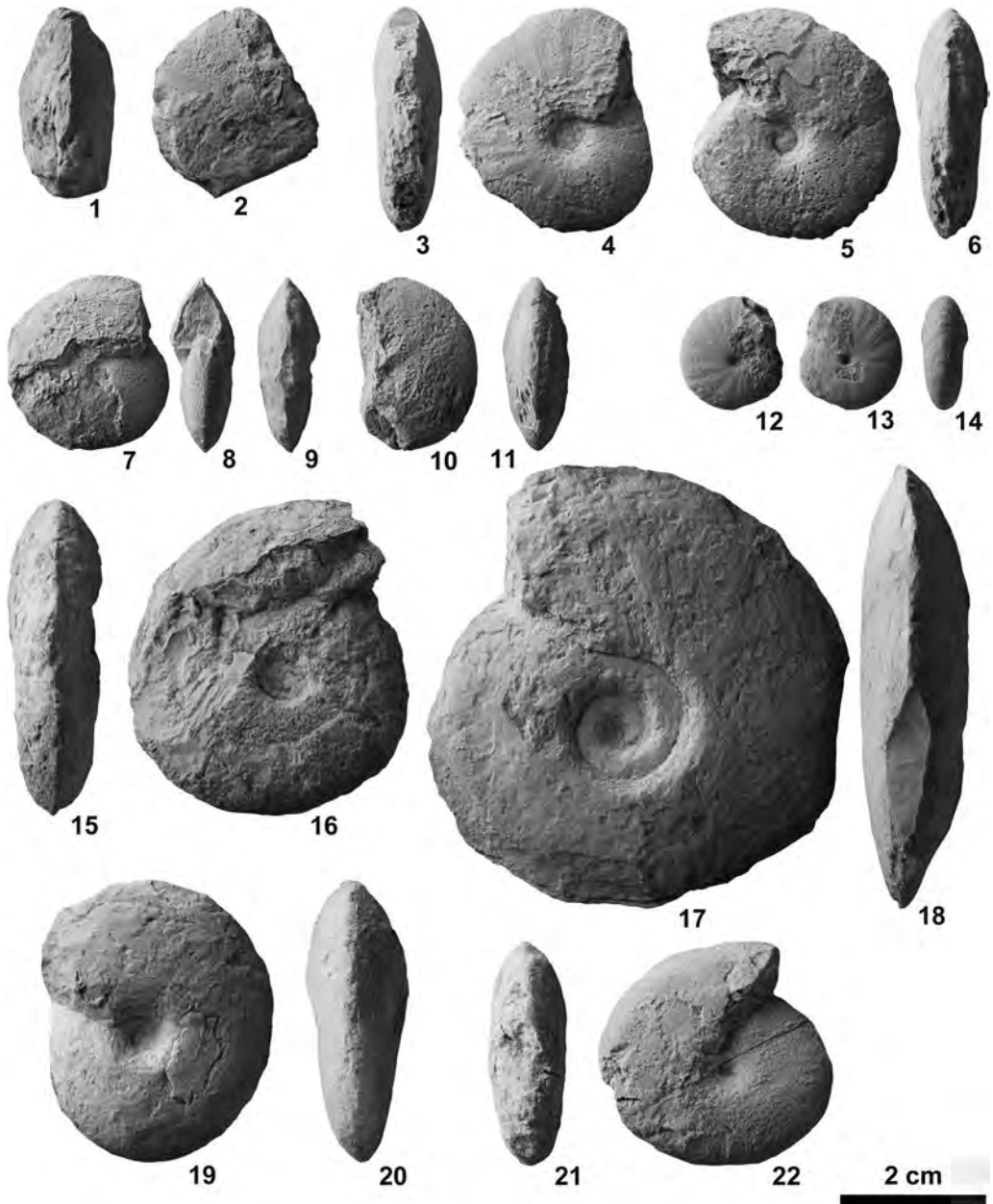


Fig. 89. *Owenites koeneni* Hyatt and Smith, 1905. 1–2, NMNS PM23579, from KC01-07. 3–4, NMNS PM23580, from KC01-10. 5–6, NMNS PM23581, from KC01-10. 7–9, NMNS PM23582, from KC01-11. 10–11, NMNS PM23583, from KC01-13. 12–14, NMNS PM23584, from KC02-02. 15–16, NMNS PM23585, from BT02-04. 17–18, NMNS PM23586, from BT03. 19–20, NMNS PM23587, from PK01-01. 21–22, NMNS PM23588, from PK01-02.

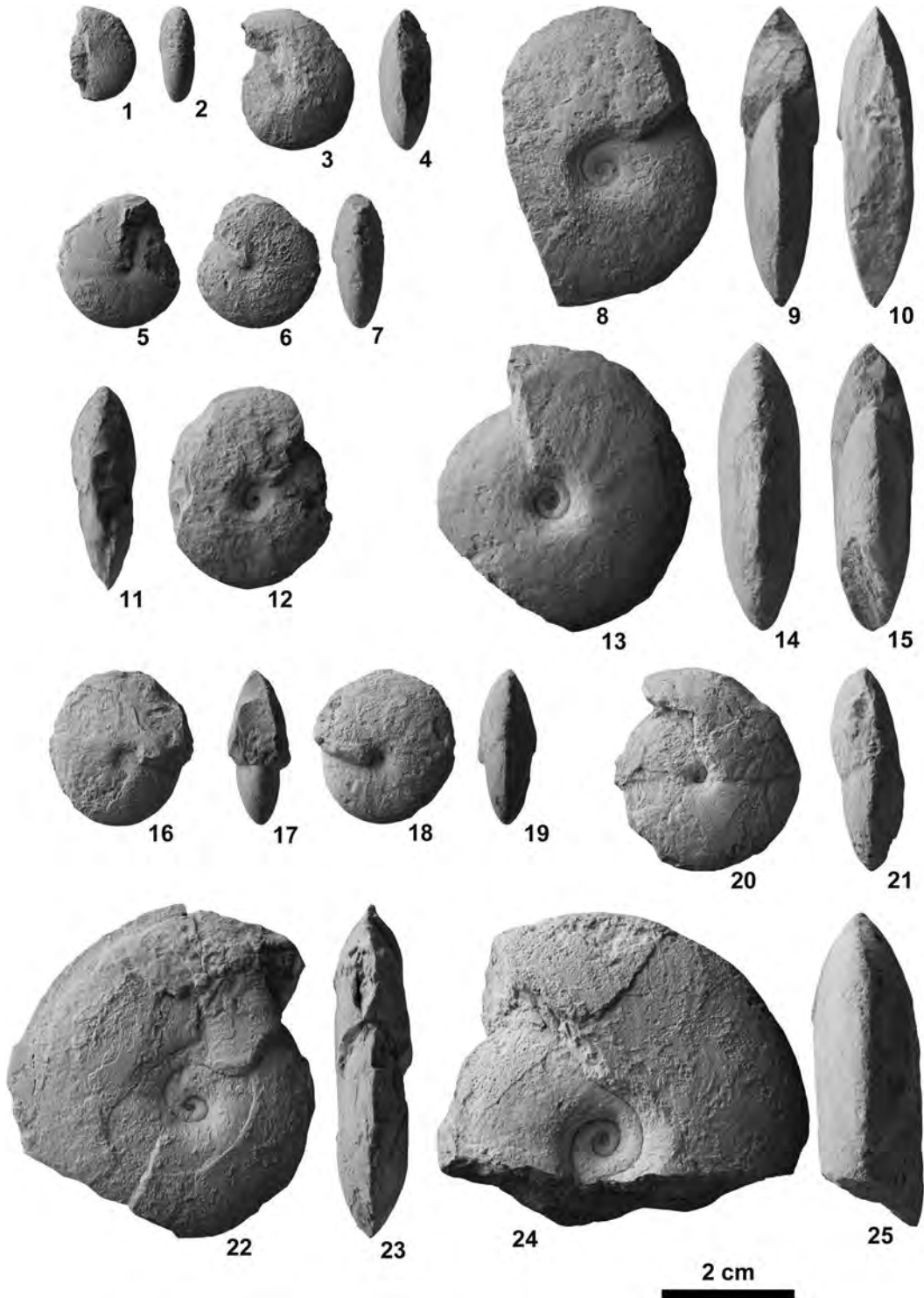


Fig. 90. *Owenites koenei* Hyatt and Smith, 1905, from KC01-13. 1-2, NMNS PM23603. 3-4, NMNS PM23604. 5-7, NMNS PM23605. 8-10, NMNS PM23606. 11-12, NMNS PM23607. 13-15, NMNS PM23608. 16-19, NMNS PM23609. 20-21, NMNS PM23610. 22-23, NMNS PM23611. 24-25, NMNS PM23612.

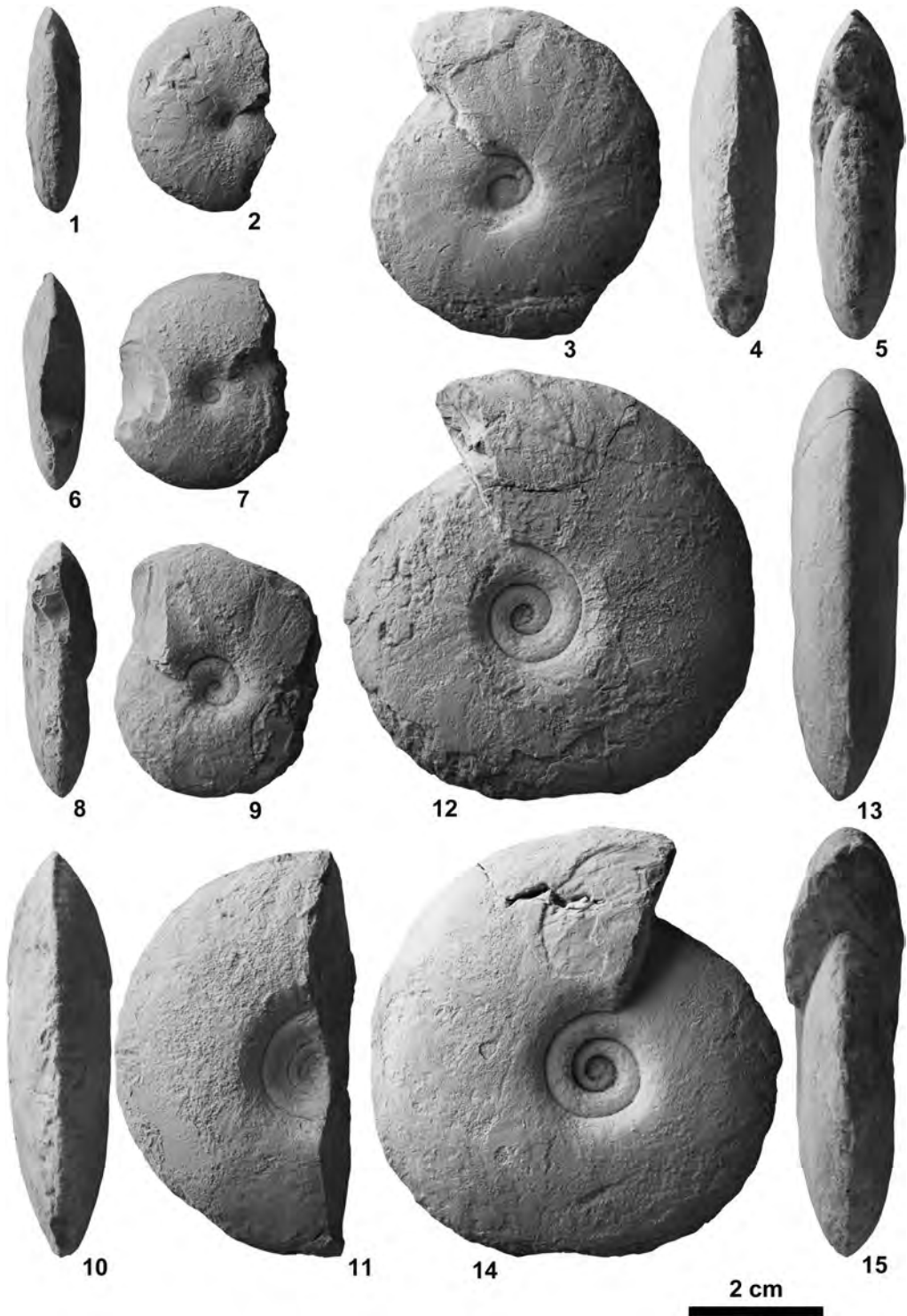


Fig. 91. *Owenites koeneni* Hyatt and Smith, 1905, from KC01-13. 1-2, NMNS PM23613. 3-5, NMNS PM23614. 6-7, NMNS PM23615. 8-9, NMNS PM23616. 10-11, NMNS PM23617. 12-15, NMNS PM23618.

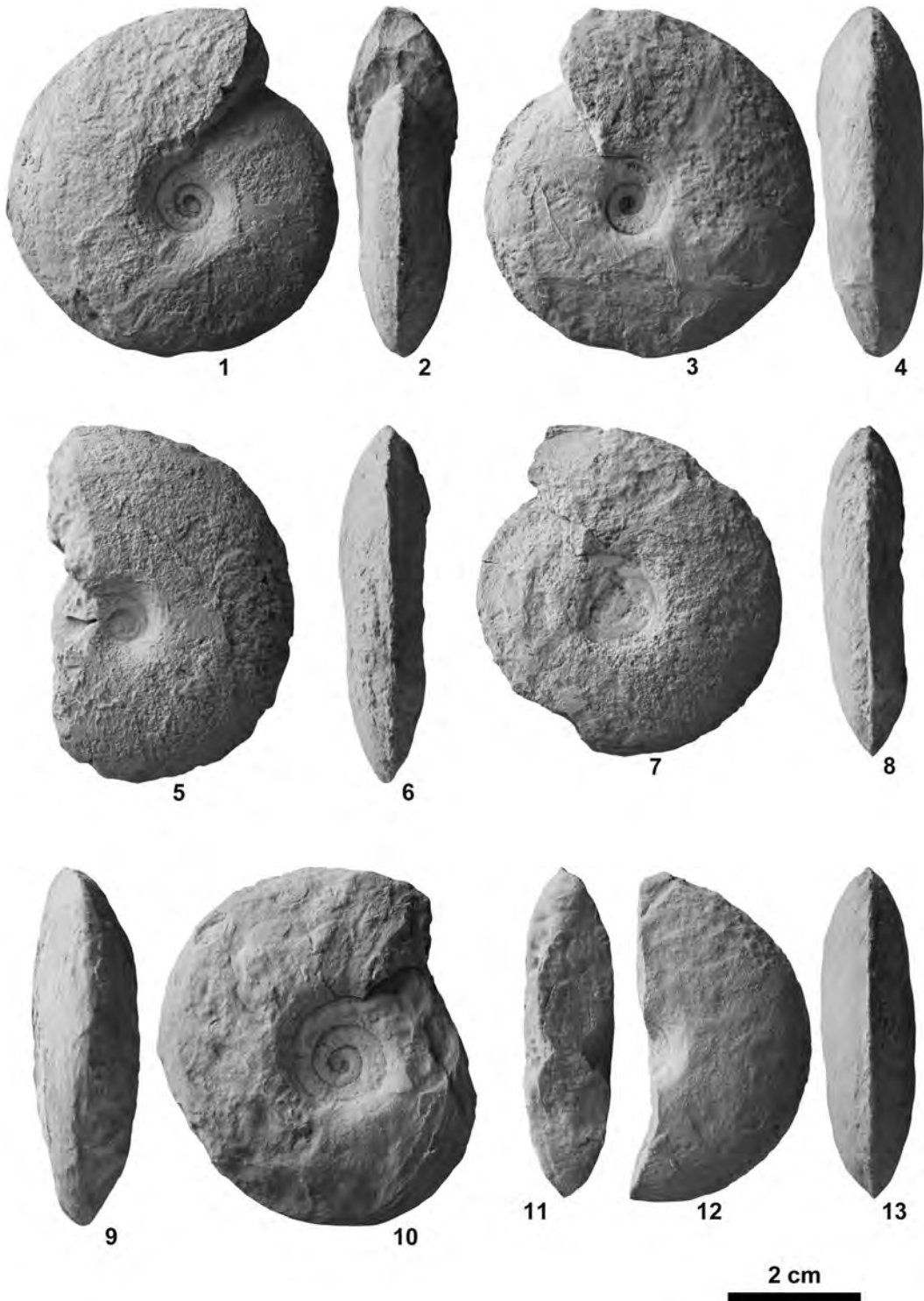


Fig. 92. *Owenites koeneni* Hyatt and Smith, 1905, from KC01-13. 1-4, NMNS PM23619. 5-6, NMNS PM23620. 7-8, NMNS PM23621. 9-10, NMNS PM23622. 11-13, NMNS PM23623.

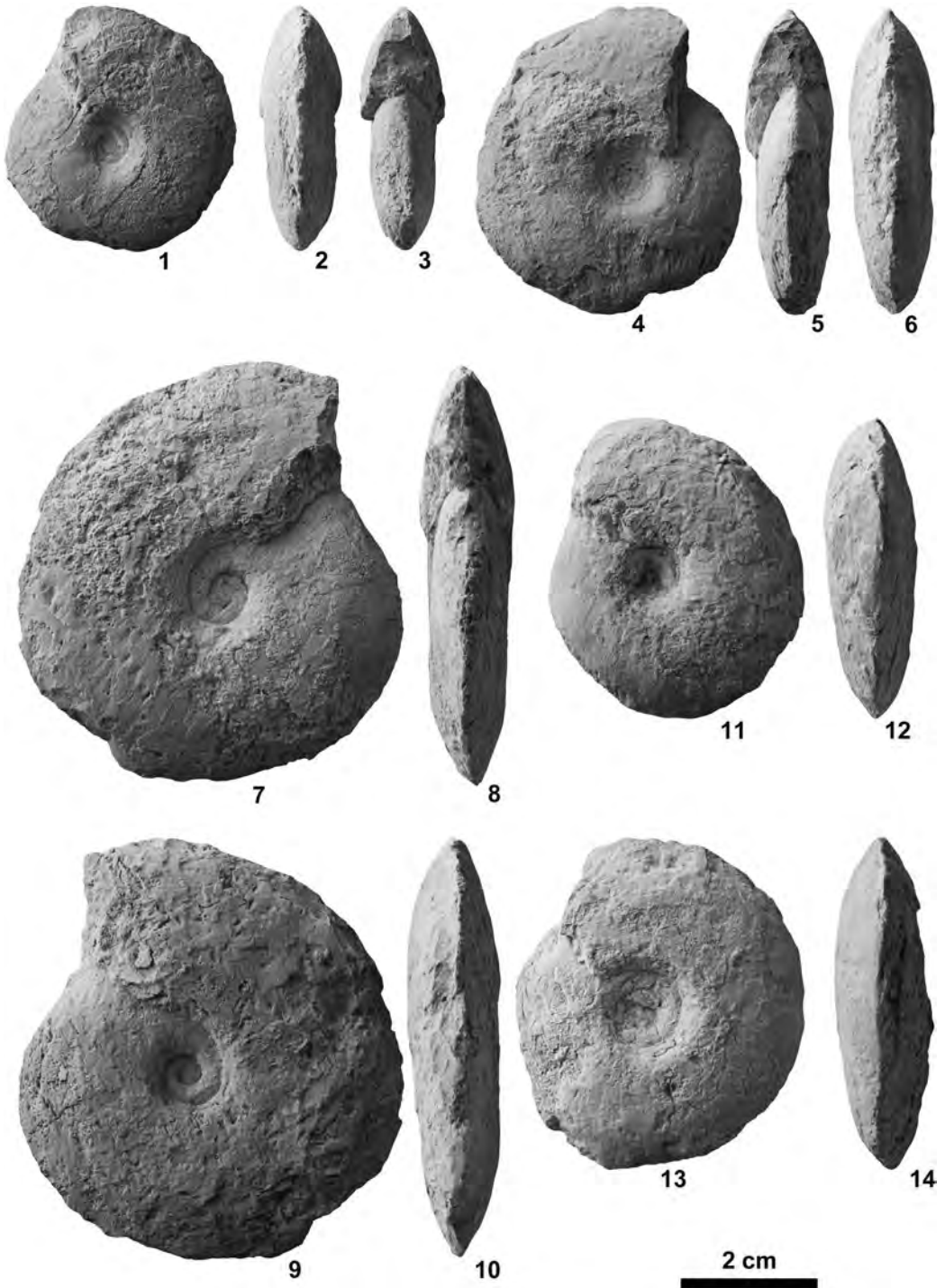


Fig. 93. *Owenites koeneni* Hyatt and Smith, 1905, from BT01-14. 1-3, NMNS PM23589. 4-6, NMNS PM23590. 7-10, NMNS PM23591. 11-12, NMNS PM23592. 13-14, NMNS PM23593.

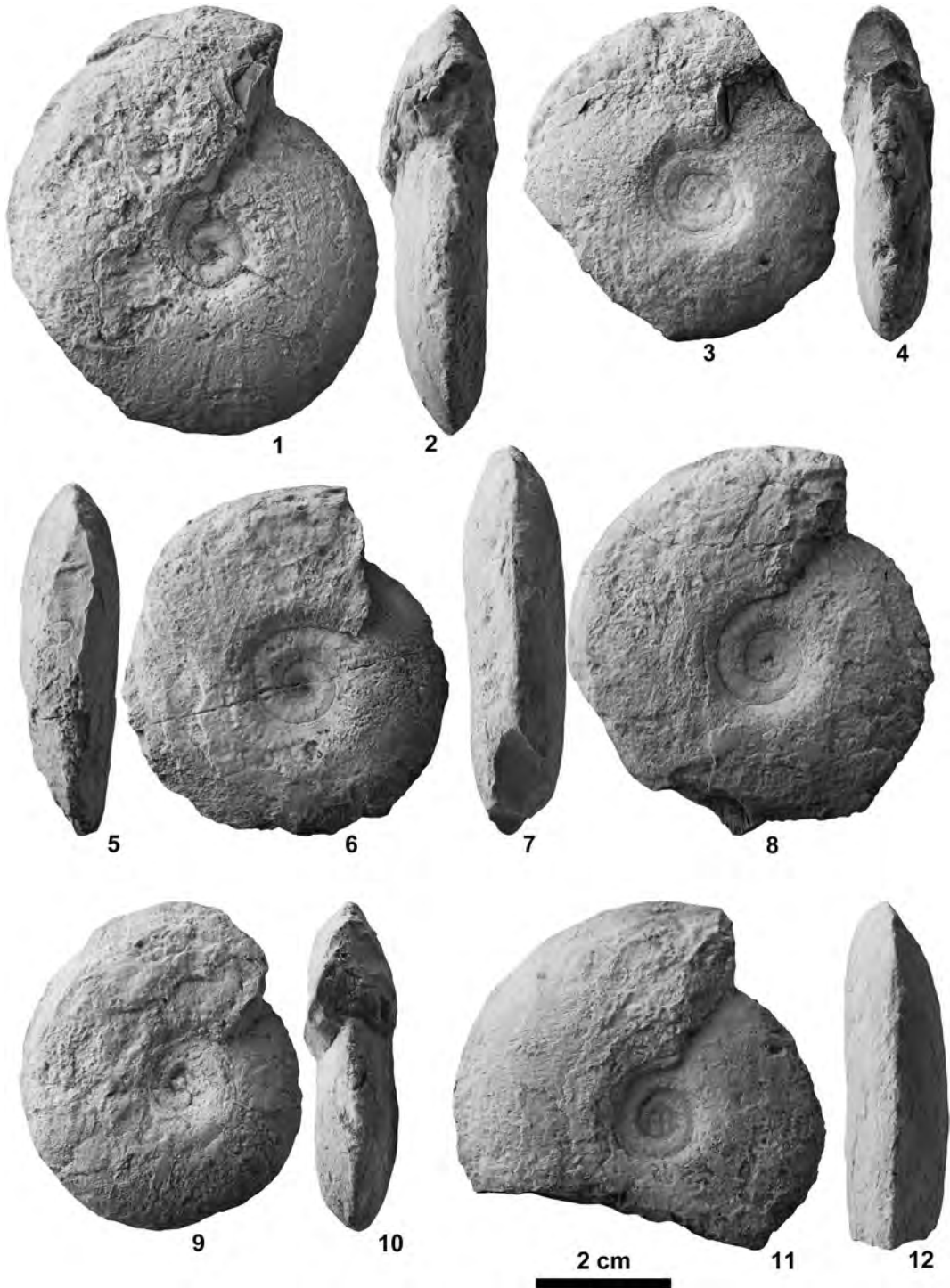


Fig. 94. *Owenites koeneni* Hyatt and Smith, 1905, from BT02-03. 1–2, NMNS PM23594. 3–4, NMNS PM23595. 5–6, NMNS PM23596. 7–8, NMNS PM23597. 9–10, NMNS PM23598. 11–12, NMNS PM23599.

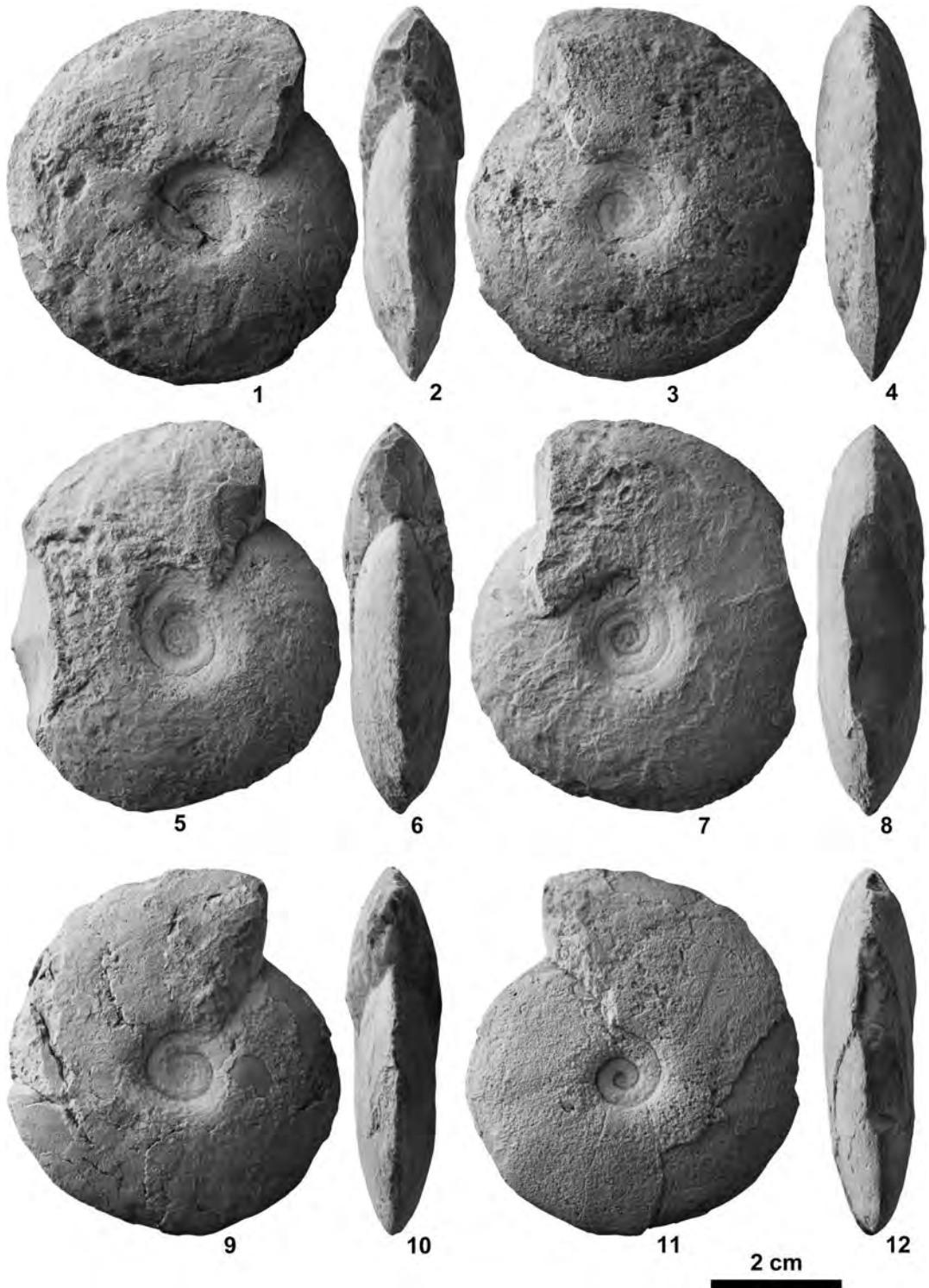
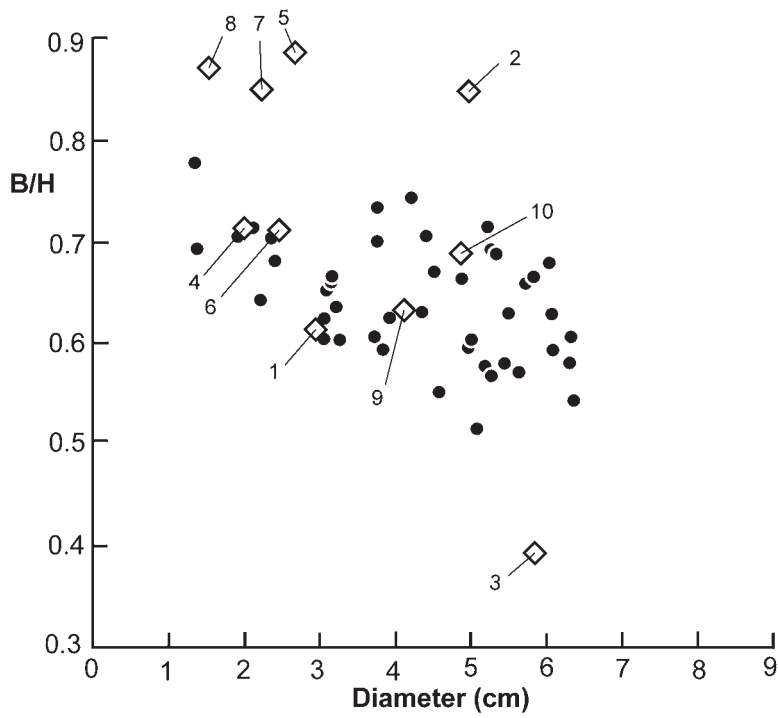
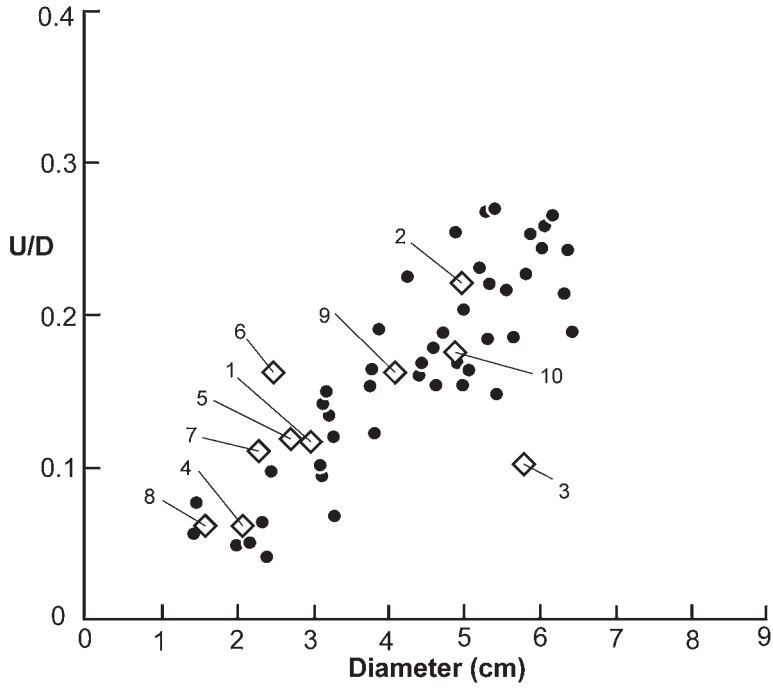


Fig. 95. *Owenites koeneni* Hyatt and Smith, 1905, from BT02-03. 1–4, NMNS PM23600. 5–8, NMNS PM23601. 9–12, NMNS PM23602.



section tends to become more compressed, and umbilical width becomes wider. Suture not well preserved.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NMNS PM23584	14.2	1.1	7.9	5.7	0.08	0.78
NMNS PM23603	14.3	0.8	7.9	5.6	0.06	0.70
NMNS PM23605	19.9	1.0	10.6	7.5	0.05	0.71
NMNS PM23604	21.6	1.1	10.9	7.8	0.05	0.71
NMNS PM23609	23.0	1.5	12.9	8.3	0.07	0.64
NMNS PM23583	24.0	1.0	13.0	9.2	0.04	0.71
NMNS PM23582	24.5	2.4	12.9	8.8	0.10	0.68
NMNS PM23607	31.0	4.5	15.1	9.5	0.15	0.63
NMNS PM23613	31.0	3.1	15.7	9.5	0.10	0.61
NMNS PM23610	31.1	3.0	15.0	10.0	0.10	0.66
NMNS PM23580	31.2	4.5	15.3	10.0	0.14	0.65
NMNS PM23581	32.3	4.4	15.3	10.2	0.14	0.67
NMNS PM23588	32.8	2.2	16.7	10.6	0.07	0.63
NMNS PM23615	32.9	4.0	16.0	9.6	0.12	0.60
NMNS PM23585	37.2	5.7	18.2	11.1	0.15	0.61
NMNS PM23589	37.8	6.3	17.4	12.2	0.17	0.70
NMNS PM23587	38.0	4.7	19.1	14.0	0.12	0.73
NMNS PM23616	38.5	7.4	17.1	10.2	0.19	0.60
NMNS PM23593	42.4	9.7	17.9	13.3	0.23	0.74
NMNS PM23607	43.9	7.1	19.9	12.6	0.16	0.63
NMNS PM23592	44.3	7.4	19.0	13.4	0.17	0.71
NMNS PM23590	45.7	8.2	21.0	13.1	0.18	0.67
NMNS PM23606	46.0	7.0	20.1	11.1	0.15	0.55
NMNS PM23595	49.0	12.4	21.0	14.0	0.25	0.67
NMNS PM23614	49.5	8.4	22.0	13.8	0.17	0.63
NMNS PM23598	50.0	10.2	21.2	12.7	0.20	0.60
NMNS PM23623	50.0	7.8	23.2	14.0	0.16	0.60
NMNS PM23611	50.4	8.3	23.0	11.8	0.16	0.51
NMNS PM23621	52.0	12.1	21.6	12.5	0.23	0.58
NMNS PM23622	52.5	14.2	20.2	14.5	0.27	0.72
NMNS PM23596	53.0	14.3	21.2	14.7	0.27	0.69
NMNS PM23599	53.0	11.8	23.0	13.1	0.22	0.57
NMNS PM23619	53.0	9.9	23.4	16.2	0.19	0.69
NMNS PM23620	54.4	8.1	25.0	14.5	0.15	0.58
NMNS PM23612	55.4	12.9	23.8	15.0	0.23	0.63
NMNS PM23602	56.7	10.5	25.7	14.7	0.19	0.57

NMNS PM23600	58.0	13.2	24.3	16.1	0.23	0.66
NMNS PM23597	58.7	14.8	22.6	15.0	0.25	0.66
NMNS PM23601	60.5	14.8	24.8	16.9	0.24	0.68
NMNS PM23617	60.7	15.8	24.9	15.7	0.26	0.63
NMNS PM23586	61.4	16.2	25.3	15.1	0.26	0.60
NMNS PM23594	63.5	13.6	28.8	17.5	0.21	0.61
NMNS PM23618	63.6	15.4	27.8	16.2	0.24	0.58
NMNS PM23591	64.2	12.1	25.7	14.0	0.19	0.54

Discussion: Morphologically, the described specimens are highly variable and include shell forms ranging from fairly compressed to very compressed with an umbilicus that varies from very narrow to fairly narrow. Shell form ratios (U/D, W/H) of the holotypes of *Owenites koeneni* Hyatt and Smith, 1905, *Kingites shimizui* Sakagami, 1955, *O. pakungensis* Chao, 1959, *O. pakungensis* var. *compressus* Chao, 1959, *O. costatus* Chao, 1959, *O. costatus* var. *lenticularis* Chao, 1959, *Pseudowenites oxynotus* Chao, 1959, and *O. carinatus* Shevryev, 1968 for the most part are included within the variation of the described specimens (Fig. 89). This evidence strongly suggests that these type specimens merely represent the variants of a single species, and hence, they should be synonymized with *O. koeneni*, the first described taxon of these various species.

The holotype of *Owenites zitteli* Smith, 1932 has a more compressed shell with a narrower umbilicus than these specimens, but according to Kummel and Steele (1962), it probably is a more compressed variant of *O. koeneni*. The lectotype of *O. egrediens* Welter, 1922 has a more depressed shell, but otherwise is very similar to *O. koeneni*. It probably represents a more depressed variant of *O. koeneni*. Similar depressed forms are known

← Fig. 96. Scatter diagrams of umbilical diameter/shell diameter (U/D) versus shell diameter (D) and whorl width/whorl height (W/H) versus shell diameter (D) for *Owenites koeneni* Hyatt and Smith, 1905 from the Bac Thuy Formation, northeastern Vietnam (black circles) and ten selected type specimens referable to *Owenites*. Numbered squares correspond as follows. 1: *Owenites koeneni* (holotype), 2: *O. egrediens* Welter, 1922 (lectotype), 3: *O. zitteli* Smith, 1932 (holotype), 4: *Kingites shimizui* Sakagami, 1955 (holotype), 5: *O. pakungensis* Chao, 1959 (holotype), 6: *O. pakungensis* var. *compressus* Chao, 1959 (holotype), 7: *O. costatus* Chao, 1959 (holotype), 8: *O. costatus* var. *lenticularis* Chao, 1959 (holotype), 9: *Pseudowenites oxynotus* Chao, 1959 (holotype), 10: *O. carinatus* Shevryev, 1968 (holotype). Most of the type specimen shell form ratios fit well within those of the specimens from the Bac Thuy Formation.

from Tulong (Brühwiler *et al.*, 2010) and Oman (Brühwiler *et al.*, 2012a) and they too, have been assigned to *O. koeneni*. Nichols and Silberling (1979) described a specimen as *Owenites cf. koeneni* from South-central Alaska, but their generic assignment is questionable because its ventral view is not shown.

Occurrence: Described specimens from KC01-07, KC01-10, KC01-11, KC01-13, KC02-02, BT01-14, BT02-03, BT02-04, BT03, PK01-01 and PK01-02 within the portion of the *Novispathodus* ex gr. *waageni* Zone that includes the *Leyeceras* and *Guodunites* horizons of the *Owenites koeneni* beds (middle to upper Middle Smithian = middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam. This species also occurs in the Middle Smithian in South China (*Owenites koeneni* beds, Brayard and Bucher, 2008; Chao, 1959), Malaya (Hada, 1966), Timor (Welter, 1922), South Tibet (*Pseudoceltites multiplicatus* beds and *Nyalamites angustecostatus* beds, Brühwiler *et al.*, 2010), Spiti (*Nyalamites angustecostatus* beds, Brühwiler *et al.*, 2012c), Kashmir (*Owenites-Kashmirites* Zone, Bando, 1981), Afganistan (Kummel and Erben, 1968; Collignon, 1973), Oman (*Owenites koeneni* fauna, Brühwiler *et al.*, 2012a), northwestern Caucasus (Shevyrev, 1968, 1990, 1995), New Zealand (Kummel, 1959), Japan (Kummel and Sakagami, 1960), South Primorye (*Owenites koeneni* Zone, Zakharov, 1968), and western USA (*Meekoceras gracilitatis* Zone, Kummel and Steele, 1962, Kuenzi, 1965; *Owenites* beds, Brayard *et al.*, 2013).

Superfamily Sageceratoidea Hyatt, 1884

Family Aspenitidae Spath, 1934

Genus *Aspenites* Hyatt and Smith, 1905

Type species: *Aspenites acutus* Hyatt and Smith, 1905.

Aspenites acutus Hyatt and Smith, 1905

Fig. 97

- Aspenites acutus* Hyatt and Smith, 1905, p. 96, pl. 2, figs. 9–13, pl. 3, figs. 1–5; Smith, 1932, p. 86, pl. 2, figs. 9–13, pl. 3, figs. 1–5, pl. 30, figs. 1–26, pl. 60, figs. 4–6; Chao, 1959, p. 269, pl. 35, figs. 12–18, 23, text-figs. 34a; Kummel and Steele, 1962, p. 692, pl. 99, figs. 16–17; Nichols and Silberling, 1979, pl. 1, figs. 12–14; Brayard and Bucher, 2008, p. 77, pl. 42, figs. 1–9, text-fig. 67; Brühwiler *et al.*, 2010, p. 429, fig. 16.12, 16.13; Brühwiler *et al.*, 2012a, p. 48, pl. 26, figs. 1–2; Brühwiler *et al.*, 2012c, p. 166, fig. 41A–M; Brayard *et al.*, 2013, p. 212, fig. 81a–j.
- Aspenites laevis* Welter, 1922, p. 99, pl. 155, figs. 4–5; Smith, 1932, p. 86, pl. 28, figs. 28–33; Chao, 1959, p. 270, pl. 35, figs. 9–11, text-fig. 34b.
- Aspenites obtusus* Smith, 1932, p. 86, pl. 31, figs. 8–10.
- Hemiaspenites obtusus* (Smith, 1932). Kummel and Steele, 1962, p. 666, pl. 99, fig. 18.
- Aspenites cf. acutus* Hyatt and Smith, 1905. Nichols and Silberling, 1979, pl. 1, figs. 15–16.

Holotype: USNM 75249, figured by Hyatt and Smith (1905, p. 96, pl. 3, figs. 1–2), from the *Meekoceras* beds (middle Smithian) in the Inyo Range, California, western USA.

Material examined: One specimen, NMNS PM23635, from BT01-09 and one specimen, NMNS PM23636, from KC01-13.

Description: Very involute, very compressed oxycone with acutely keeled venter and slightly convex flanks with maximum width at mid-flank. Umbilicus occluded. Shell surface smooth or ornamented with radial folds. Suture ceratitic with many adventitious elements.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NMNS PM23636	30.7	0.0	18.8	5.6	0.0	0.18
NMNS PM23635	48.8	0.0	30.0	—	0.0	—

Discussion: *Aspenites laevis* Welter, 1922 and *A. obtusus* Smith, 1932 were synonymized with *A. acutus* by Brayard and Bucher (2008, p. 77), and we agree with their interpretation. *Hedenstroemia acuta* Kraft and Diner, 1909 from Spiti is somewhat similar to *A. acutus*, but differs by its suture line, which has lateral lobes with many denticulations at the base and wide lateral saddles.

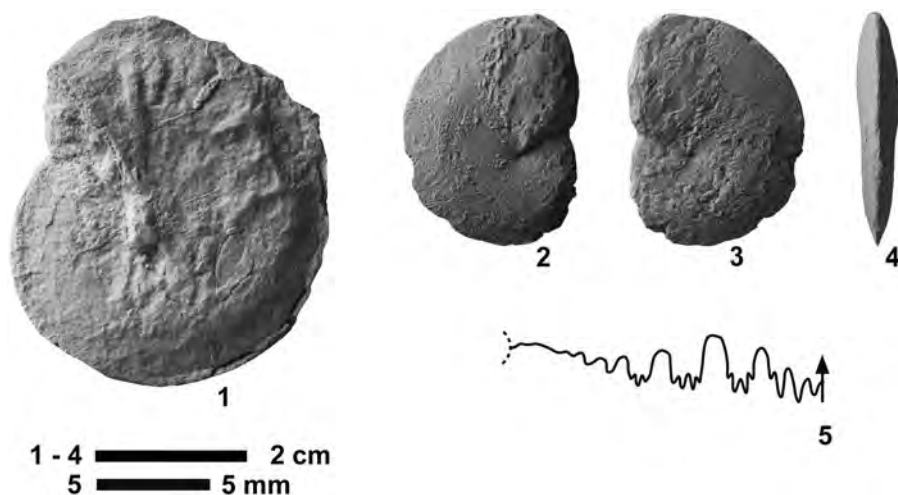


Fig. 97. *Aspenites acutus* Hyatt and Smith, 1905. 1, NMNS PM23635, from BT01-09. 2–5, NMNS PM23636, from KC01-13.

Occurrence: Described specimens from BT01-09 and KC01-03 within the portion of the *Novispathodus* ex gr. *waageni* Zone that includes the *Urdyceras tulongensis* beds (lower Middle Smithian=middle Lower Olenekian) and *Leyeceras* horizon of the *Owenites koeneni* beds (middle Middle Smithian=middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam. This species also occurs in the Middle Smithian in South China (*Flemingites rursiradiatus* beds and *Owenites koeneni* beds, Brayard and Bucher, 2008), Timor (Welter, 1922), South Tibet (*Brayardites compressus* beds, Brühwiler *et al.*, 2010), Spiti (*Brayardites compressus* beds, Brühwiler *et al.*, 2012c), Oman (*Rohilites omanensis* fauna, *Nammalites pilatoides* fauna, and *Owenites koeneni* fauna, Brühwiler *et al.*, 2012a), South-central Alaska (Nichols and Silberling, 1979) and western USA (*Meekoceras gracilitatis* Zone, Kummel and Steele, 1962; *Owenites* beds, Brayard *et al.*, 2013).

Family Hedenstroemiidae Hyatt, 1884
Genus *Pseudosageceras* Diener, 1895

Type species: *Pseudosageceras* sp. indet. Diener, 1895.

Pseudosageceras multilobatum

Noetling, 1905a

Figs. 98, 99

Pseudosageceras sp. indet. Diener, 1895, p. 28, pl. 1, fig. 8.

Pseudosageceras multilobatum Noetling, 1905a, p. 181, pls. 19–27; Noetling, 1905b, pl. 23, fig. 4, pl. 25, fig. 1, pl. 26, fig. 3; Krafft and Diener, 1909, p. 145, pl. 21, fig. 5; Welter, 1922, p. 94, fig. 3; Smith, 1932, p. 87, pl. 4, figs. 1–3, pl. 5, figs. 1–6, pl. 25, figs. 7–16, pl. 60, fig. 32, pl. 63, figs. 1–6; Collignon, 1933, p. 56, pl. 11, fig. 2; Spath, 1934, p. 54, text-fig. 6a; Kiparisova, 1947, p. 127, pl. 25, figs. 3–4; Chao, 1959, p. 183, pl. 1, figs. 9, 12; Kummel, 1966, p. 388, pl. 1, figs. 11–12; Hada, 1966, pl. 4, fig. 6; Kummel and Erben, 1968, p. 112, pl. 19, fig. 9; Shevryev, 1968, p. 79, pl. 1, figs. 1–2; Collignon, 1973, p. 5, pl. 1, fig. 1; Weitschat and Lehmann, 1978, p. 75, pl. 10, fig. 2; Vu Khuc, 1984, p. 26, pl. 1, fig. 1, text-fig. 1; Pakistani-Japanese Research Group, 1985, pl. 12, figs. 5–7; Vu Khuc, 1991, p. 119, pl. 45, figs. 5–6, text-fig. 2.2; Tozer, 1994, p. 83, pl. 18, fig. 1, text-fig. 17; Brayard and Bucher, 2008, p. 70, pl. 37, figs. 1–5; Shigeta and Zakharov, in Shigeta *et al.*, 2009, p. 140, figs. 129–130; Brühwiler *et al.*, 2010, p. 429, fig. 16.14; Brühwiler *et al.*, 2012a, p. 47, pl. 26, fig. 4; Brühwiler *et al.*, 2012c, p. 109, fig. 95A–N; Brayard *et al.*, 2013, p. 208, fig. 77a–f.

non *Pseudosageceras multilobatum* Noetling, 1905a. Kummel and Steele, 1962, p. 701, pl. 102, figs. 1–2.

Lectotype: Designated by Spath (1934, p.

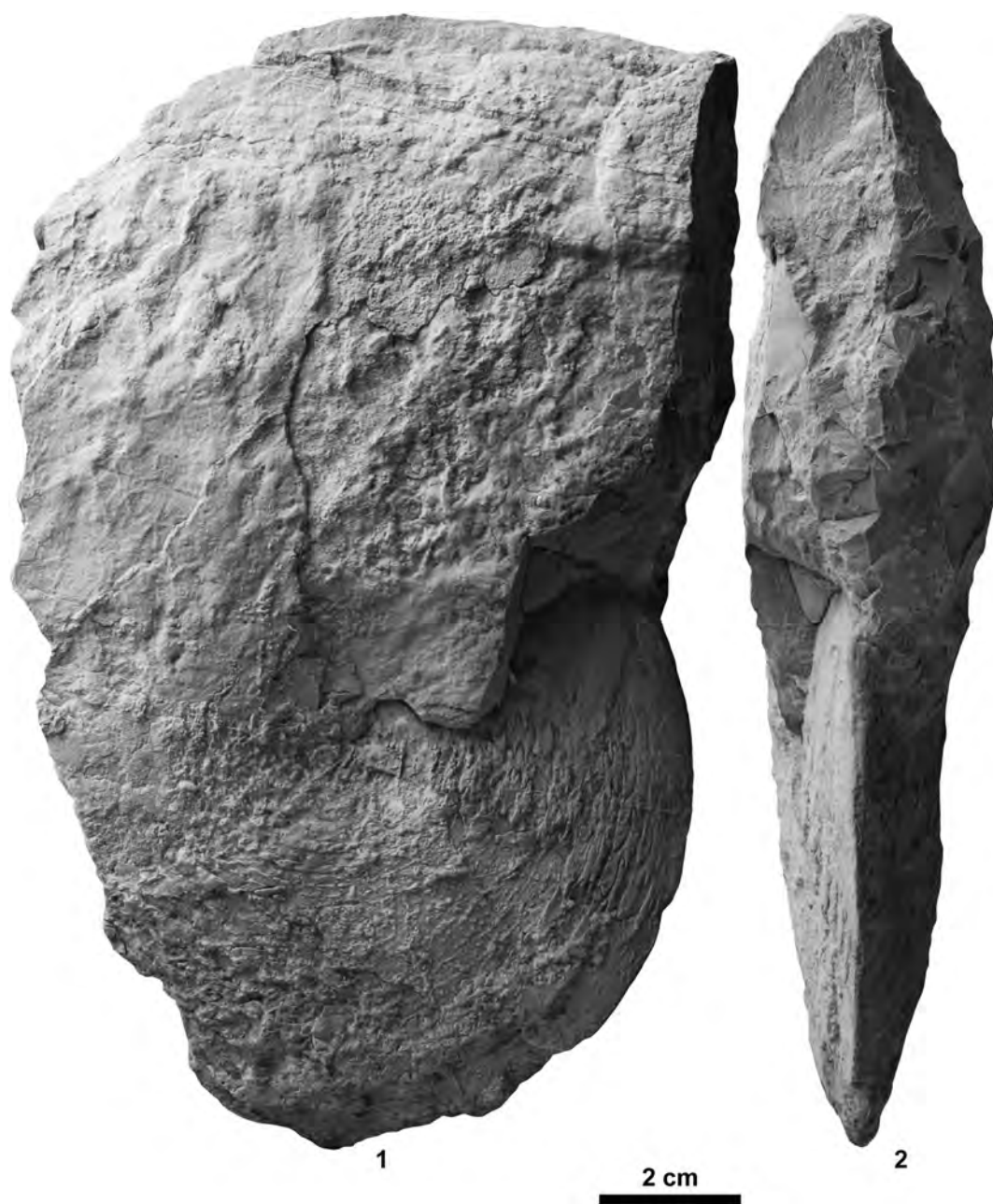


Fig. 98. *Pseudosageceras multilobatum* Noetling, 1905, from BT02-02. 1–2, NMNS PM23638.

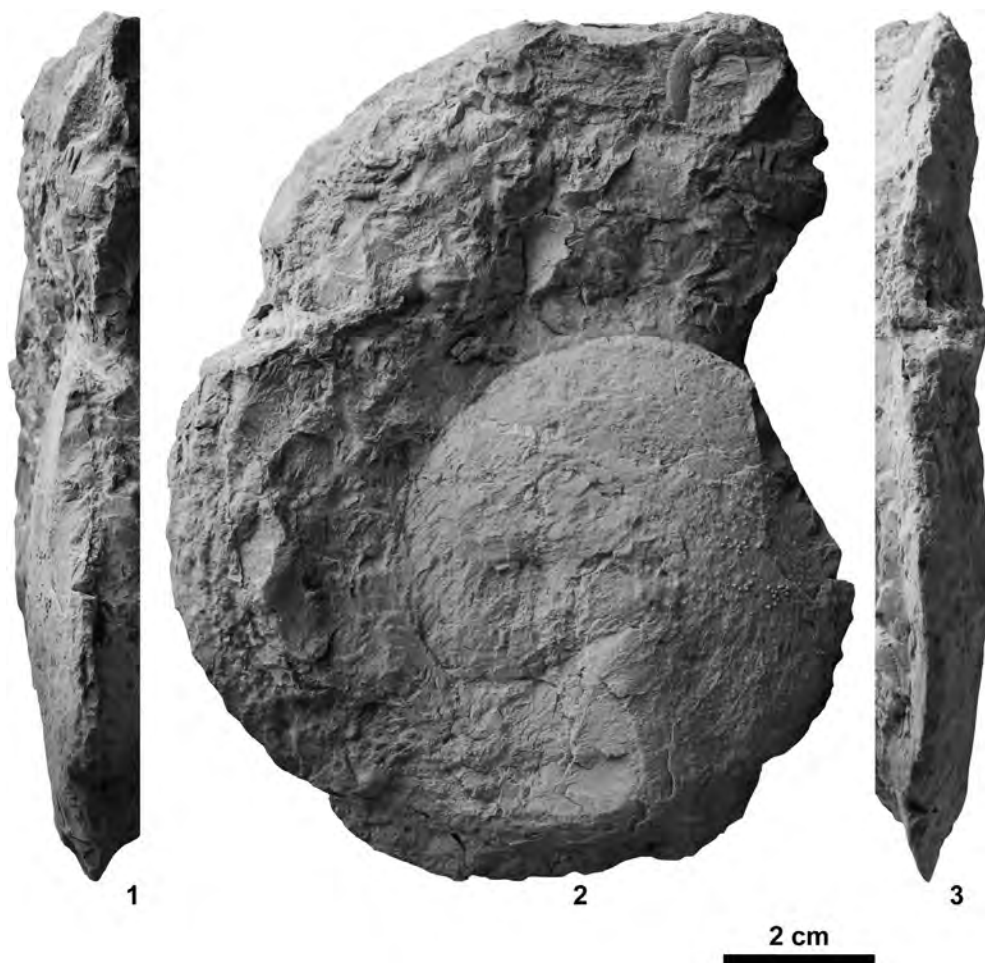


Fig. 99. *Pseudosageceras multilobatum* Noetling, 1905, from BT01-14. 1–3, NMNS PM23637.

54), is original of Noetling (1905a, p. 181, pl. 19, fig. 1, pl. 24, fig. 12) from the Ceratite Marls of the Salt Range, Pakistan.

Material examined: One specimen, NMNS PM23637, from BT01-14 and one specimen, NMNS PM23638, from BT02-02.

Description: Very involute, very compressed oxycone with very narrow, bicarinate venter and weakly convex flanks, gently convergent from occluded umbilicus to venter. Shell surface smooth. Suture ceratitic with many adventitious elements.

Discussion: The specimen described as *Pseudosageceras multilobatum* by Kummel and Steele (1962, pl. 102, figs. 1–2) from Ne-

vada is characterized by an acutely keeled venter and wider lobes and saddles than *Pseudosageceras*. It probably should be assigned to *Aspenites*. As earlier reported by Shigeta and Zakharov (in Shigeta *et al.*, 2009), the specimen described as *Pseudosageceras* sp. by Diener (1895) from South Primorye is only a partial phragmocone, but it displays the same shell shape and suture as *P. multilobatum*, and thus, is probably conspecific.

Occurrence: Described specimens from BT02-02 and BT01-14 within the portion of the *Novispathodus* ex gr. *waageni* Zone that includes the *Urdoceras tulongensis* beds (lower Middle Smithian = middle Lower Ole-

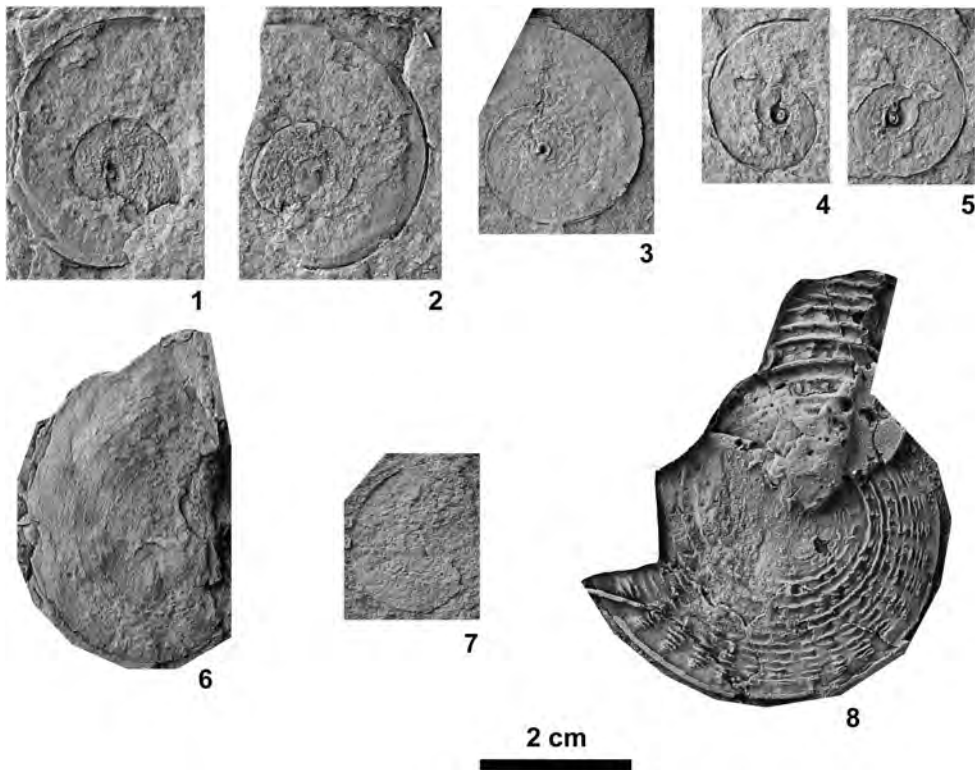


Fig. 100. *Pseudosageceras* sp. indet. 1–6, from KC02-11. 1–2, NMNS PM23648. 3, NMNS PM23649 (rubber cast of outer mold). 4–5, NMNS PM23650. 6, NMNS PM23651. 7, NMNS PM23760, from KC02-13. 8, NMNS PM23652 (rubber cast of outer mold), from KC02-15.

nekian) and the *Leyceras* horizon of the *Owenites koeneni* beds (middle Middle Smithian=middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam. This taxon, which is probably the most cosmopolitan species of the Early Triassic, occurs in the Smithian in South China (Chao, 1959; Brayard and Bucher, 2008), Malaya (Hada, 1966), Timor (Welter, 1922), South Tibet (Brühwiler *et al.*, 2010), Spiti (Krafft and Diener, 1909), Afganistan (Kummel and Erben, 1968; Collignon, 1973), Salt Range (Kummel, 1966; Brühwiler *et al.*, 2012b), Madagascar (Collignon, 1933), Oman (Brühwiler *et al.*, 2012a), northwestern Caucasus (Shevyrev, 1968), South Primorye (Kiparisova, 1961), western USA (Hyatt and Smith, 1905, Smith, 1932, Brayard *et al.*, 2013), Arctic Canada (Tozer, 1994) and Spitsbergen (Weitschat and Leh-

ann, 1978).

Pseudosageceras sp. indet.

Fig. 100

Material examined: Four specimens, NMNS PM23648–23651, from KC02-11, one specimen, NMNS PM23760, from KC02-13 and one specimen, NMNS PM23652, from KC02-15.

Description: Very involute, very compressed shell with very narrow, bicarinate venter. Umbilicus occluded. Suture ceratitic with many adventitious elements.

Discussion: The described specimens are very similar to *Pseudosageceras multilobatum* Noetling, 1905, but a definitive assignment is not possible because of their poor preservation.

Occurrence: Described specimen from KC02-11 within the portion of the *Novispathodus pingdingshanensis* Zone represented by the *Tirolites* cf. *cassianus* beds (lowest Lower Spathian=lowest Upper Olenekian), those from KC02-13 and KC02-15 within the portion of the *Triassospathodus symmetricus* Zone represented by the *Tirolites* cf. *cassianus* beds (lowest Lower Spathian=lowest Upper Olenekian) and *Tirolites* sp. nov. beds (Lower Spathian=lower Upper Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Superfamily Dinaritoidea Mojsisovics, 1882

Family Tirolitidae Mojsisovics, 1882

Genus *Tirolites* Mojsisovics, 1879

Type species: *Tirolites idrianus* Hauer, 1865.

Tirolites* cf. *cassianus (Quenstedt, 1849)

Fig. 101

cf. *Ceratites cassianus* Quenstedt, 1849, p. 231, pl. 18, fig. 11.

cf. *Tirolites spinosus* Mojsisovics, 1882, p. 70, pl. 2, fig. 2.

cf. *Tirolites darwini* Mojsisovics, 1882. Kittl, 1903, p. 60, pl. 11, figs. 1–2.

cf. *Tirolites spinosior* Kittl, 1903, p. 62, pl. 11, fig. 5.

cf. *Tirolites toulai* Kittl, 1903, p. 64, pl. 11, fig. 11.

Material examined: Four specimens, NMNS PM23662–23665, from KC02-11, two specimens, NMNS PM23762–23763, from KC02-12, and two specimens, NMNS PM23765–23766, from KC02-13.

Description: Very evolute, very compressed shell with arched venter, rounded ventral shoulders, and slightly convex flanks. Umbilicus fairly wide with moderately high, gently inclined wall. Ornamentation consists of spiny tubercles on ventrolateral shoulders as well as strong radial ribs on early to middle growth stages. Ribs decrease in strength and become much finer, while ventrolateral tubercles exhibit attenuation in strength and finally disappear on mature body chamber. Suture not preserved.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NMNS PM23662	39.2	16.2	14.0	—	0.41	—
NMNS PM23665	57.0	24.0	21.5	—	0.42	—
NMNS PM23663	59.0	26.5	20.8	—	0.43	—
NMNS PM23664	89.0	37.0	32.0	—	0.42	—

Discussion: Even though the present specimens are significantly deformed and crushed, their distinctive ornamentation and shell shape enable me to identify them with reasonable confidence as *Tirolites cassianus*. Specimen NMNS PM23664 is very close to specimens described as *T. spinosus* by Mojsisovics (1882, pl. 2, fig. 2), *T. darwini* Mojsisovics, 1882 by Kittl (1903, pl. 11, figs. 1–2), *T. spinosior* by Kittl (1903, pl. 11, fig. 5), and *T. toulai* by Kittl (1903, pl. 11, fig. 11). These species were synonymized with *T. cassianus* by Kummel (1969).

Occurrence: Described specimens from KC02-11 within the portion of the *Novispathodus pingdingshanensis* Zone represented by the *Tirolites* cf. *cassianus* beds (lowest Lower Spathian=lowest Upper Olenekian), and those of KC02-12 and KC02-13 within the portion of the *Triassospathodus symmetricus* Zone represented by the *Tirolites* cf. *cassianus* beds (lowest Lower Spathian=lowest Upper Olenekian) in the Bac Thuy Formation, northeastern Vietnam. *Tirolites cassianus* occurs in the lowest Lower Spathian in the Alps (Werfen Formation), Dalmatia and associated regions (Mojsisovics, 1882; Kittl, 1903; Krystyn, 1974; Posenato, 1992), and Mangyshlak (Shevyrev, 1968).

***Tirolites* sp. nov.**

Figs. 102–113

Material examined: Seven specimens, NMNS PM23666–23672, from KC02-14, twenty specimens, NMNS PM23673–23690, 23768–23769, from KC02-15, two specimens, NMNS PM23770–23771, from KC02-16, four specimens, NMNS PM23695–23698, from KC02-18, two specimens, NMNS PM23691–

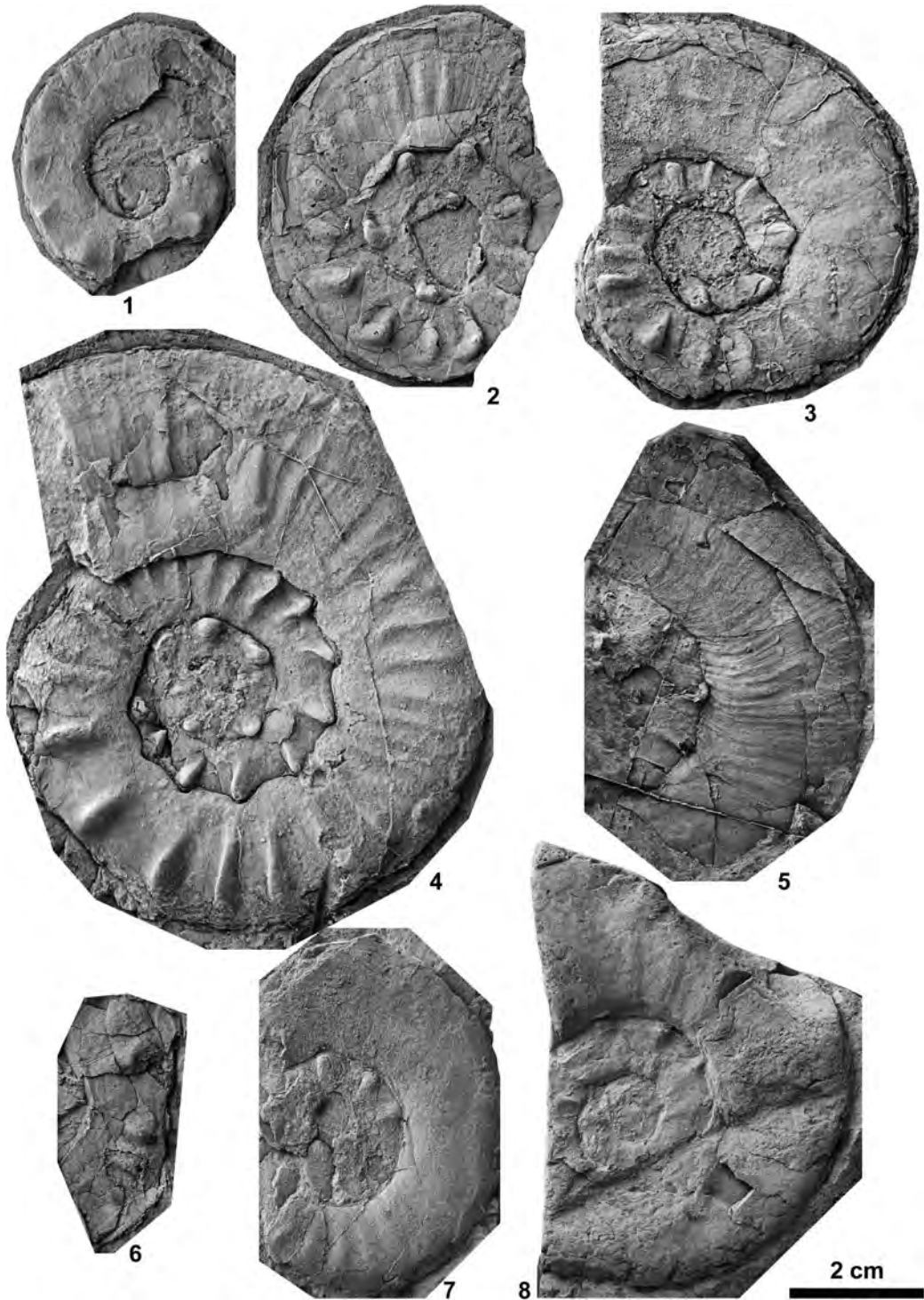


Fig. 101. *Tirolites cf. cassianus* (Quenstedt, 1849). 1–4, from KC02-11. 1, NMNS PM23662. 2, NMNS PM23665 (rubber cast of outer mold). 3, NMNS PM23663. 4, NMNS PM23664. 5–6, from KC02-12. 5, NMNS PM23762 (rubber cast of outer mold). 6, NMNS PN23763 (rubber cast of outer mold). 7–8, from KC02-13. 7, NMNS PM23765. 8, NMNS PM23766.

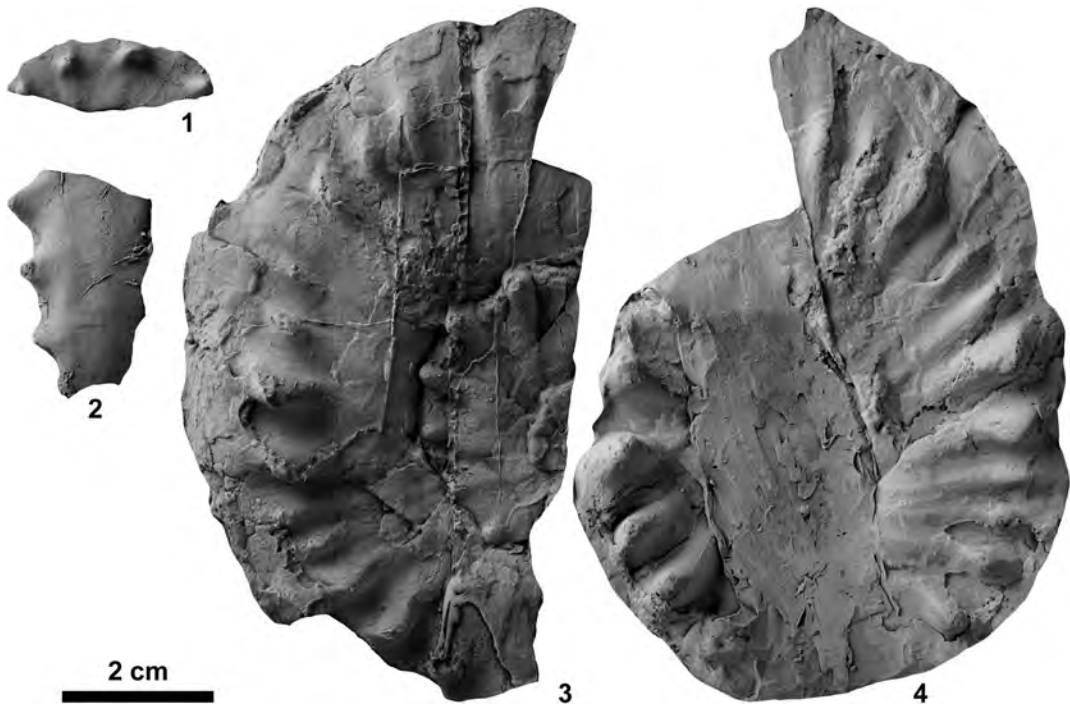


Fig. 102. *Tirolites* sp. nov. 1–4, from NT01-10. 1, NMNS PM23764. 2, NMNS PM23693. 3–4, NMNS PM23694 (rubber casts of outer molds).

23692, from BT02-06, and three specimens, NMNS PM23693–23694, 23764, from NT01-10.

Description: Fairly evolute, very compressed shell with rectangular whorl section, broadly rounded or nearly tabulate venter, rounded ventral shoulders, and slightly convex flanks with maximum whorl width near ventral shoulder. Umbilicus moderately wide with moderately high, gently inclined wall. Ornamentation consists of large, spiny tubercles on ventrolateral shoulders as well as variable strength, slightly sinuous, prorsiradiate ribs that arise on or slightly above umbilical shoulder and culminate in the large tubercles on the ventral shoulder. Ribs and ventrolateral tubercles abruptly disappear on mature body chamber, but weaker tubercles may rarely re-occur. Suture not preserved.

Measurements (mm):

Specimen no. D U H W U/D W/H

NMNS PM23678	62.4	21.0	25.0	—	0.34	—
NMNS PM23668	65.0	20.5	25.0	—	0.32	—
NMNS PM23666	72.0	24.0	28.0	—	0.33	—
NMNS PM23676	72.5	24.0	30.5	—	0.33	—
NMNS PM23679	74.0	23.5	28.0	—	0.32	—
NMNS PM23770	74.0	25.6	29.0	—	0.35	—
NMNS PM23684	75.5	25.6	30.0	—	0.34	—
NMNS PM23695	76.0	25.0	27.0	—	0.33	—
NMNS PM23670	78.0	25.0	31.5	—	0.32	—
NMNS PM23683	79.0	26.3	31.7	—	0.33	—
NMNS PM23771	79.0	28.0	—	—	0.35	—
NMNS PM23685	80.5	27.0	32.0	—	0.34	—
NMNS PM23769	82.5	31.0	30.0	—	0.38	—
NMNS PM23677	84.0	26.4	34.0	—	0.31	—
NMNS PM23768	87.0	31.0	31.0	—	0.36	—
NMNS PM23687	90.5	30.4	35.5	—	0.34	—

Discussion: The described specimens differ from *Tirolites cassianus* (Quenstedt, 1849) by their more involute shell, narrower umbilicus and nearly smooth mature body chamber, and they likely represent a new species. However, we hesitate to propose a new specific

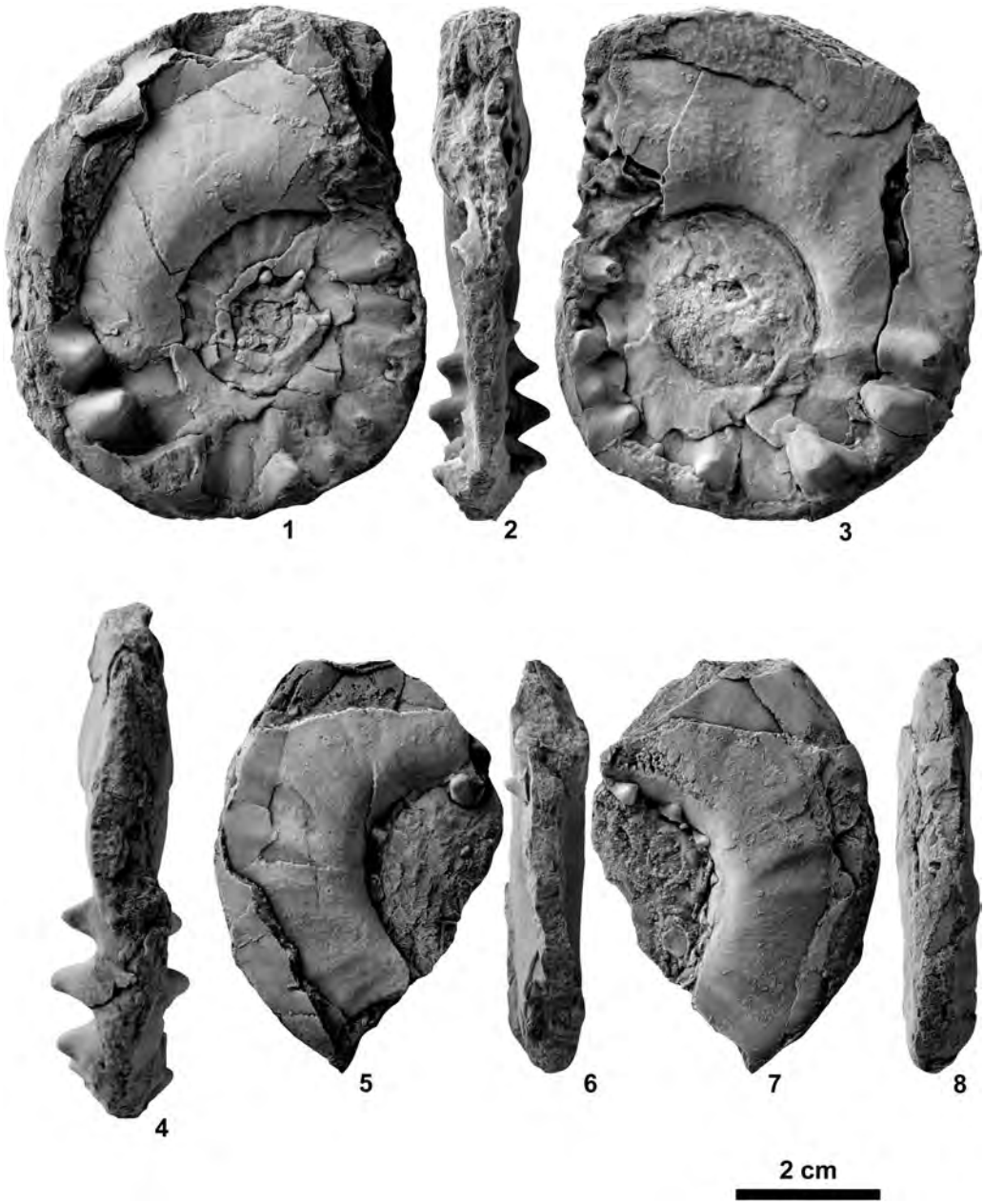


Fig. 103. *Tirolites* sp. nov., from KC02-14. 1–4, NMNS PM23666. 5–8, NMNS PM23667.



Fig. 104. *Tirolites* sp. nov., from KC02-14. 1-4, NMNS PM23668. 5, NMNS PM23669.

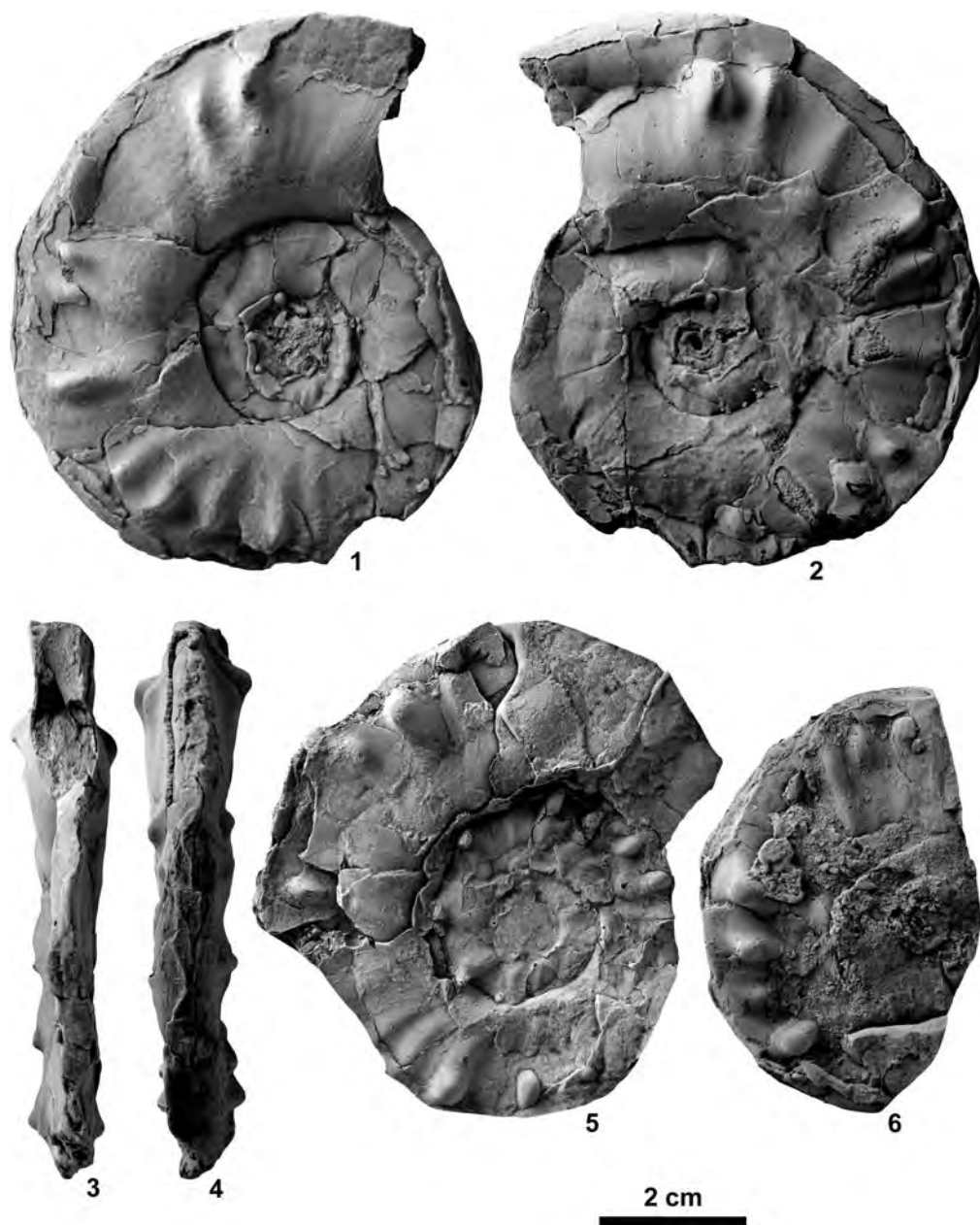


Fig. 105. *Tirolites* sp. nov., from KC02-4. 1–4, NMNS PM23670. 5, NMNS PM23671 (rubber cast of outer mold). 6, NMNS PM23672 (rubber cast of outer mold).

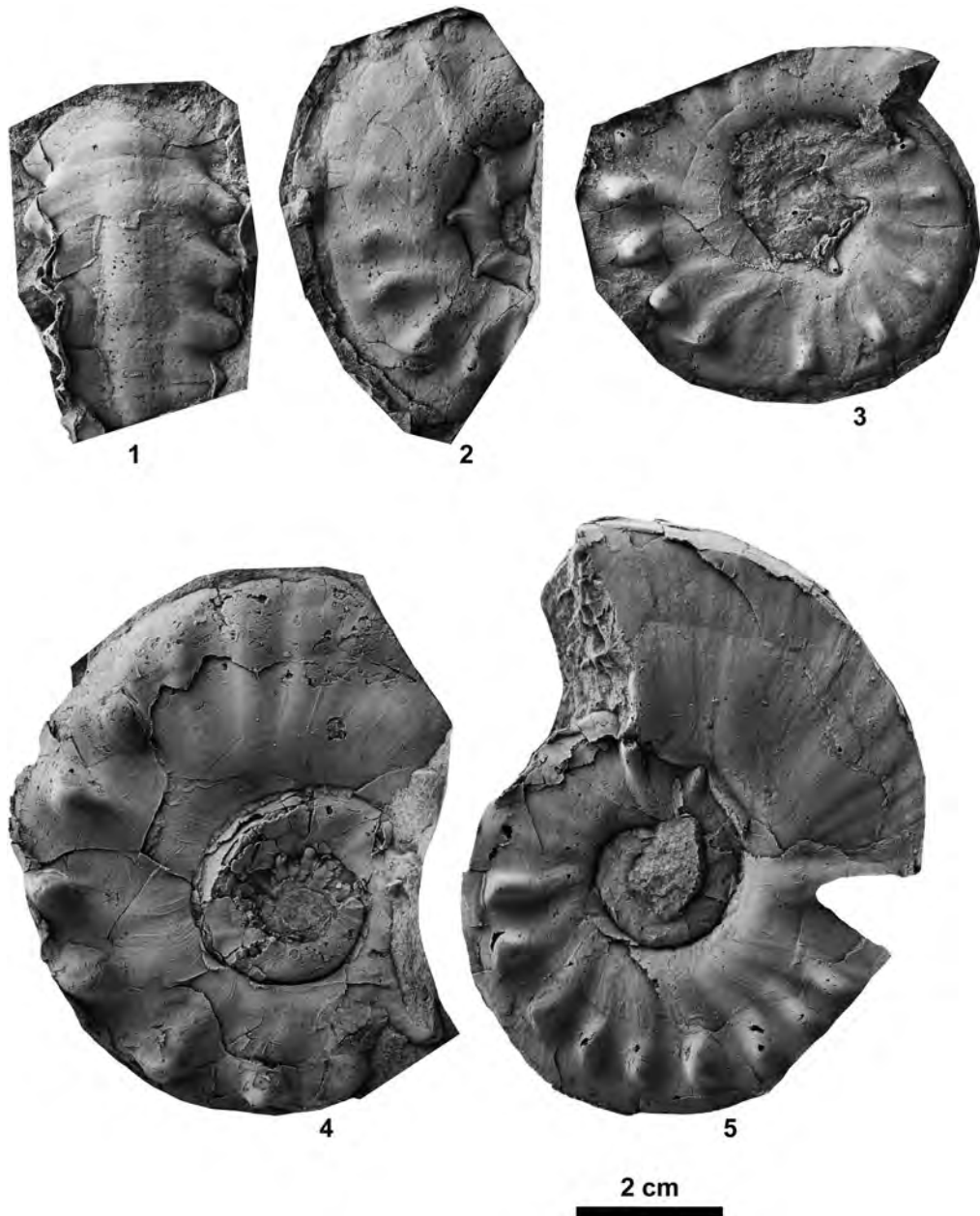


Fig. 106. *Tirolites* sp. nov., from KC02-15. 1, NMNS PM23673. 2, NMNS PM23674. 3, NMNS PM23675. 4, NMNS PM23676. 5, NMNS PM23677. All specimens are rubber casts of the outer molds.



Fig. 107. *Tirolites* sp. nov., from KC02-15. 1, NMNS PM23678. 2, NMNS PM23679. 3, NMNS PM23680. 4, NMNS PM23681.

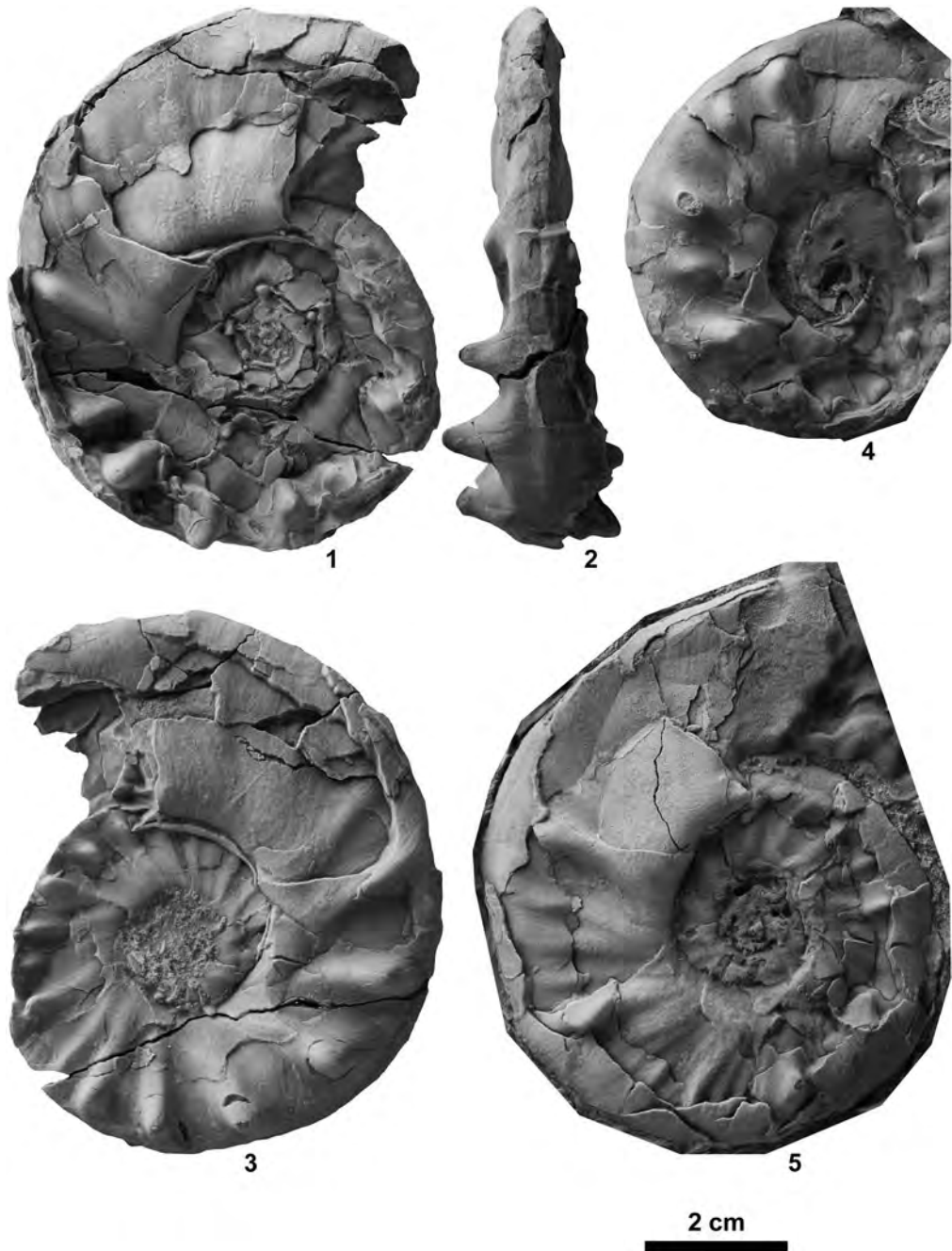


Fig. 108. *Trolites* sp. nov., from KC02-15. 1-3, NMNS PM23684. 4, NMNS PM23682. 5, NMNS PM23683.

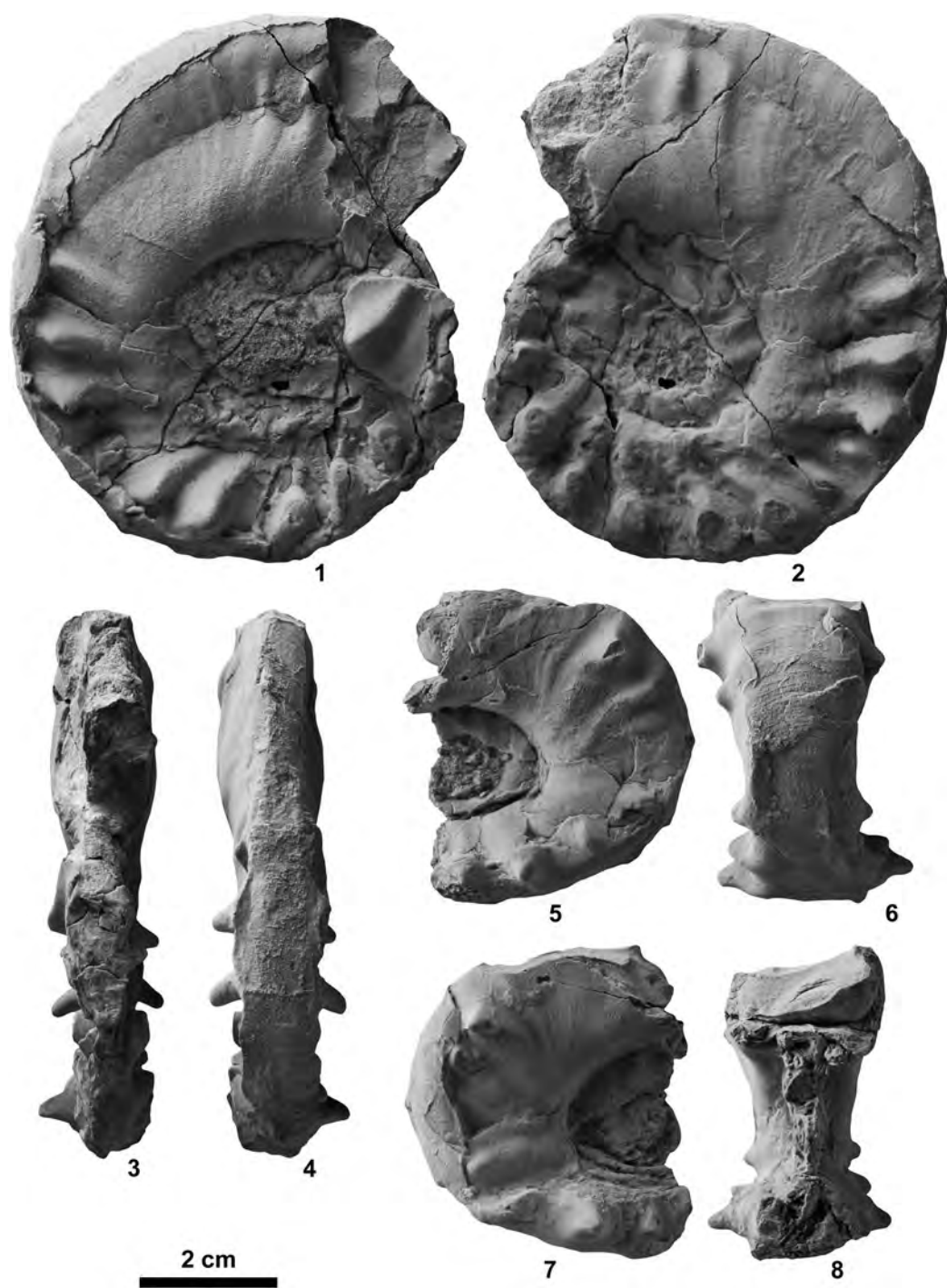


Fig. 109. *Tirolites* sp. nov., from KC02-15. 1–4, NMNS PM23685. 5–8, NMNS PM23686.

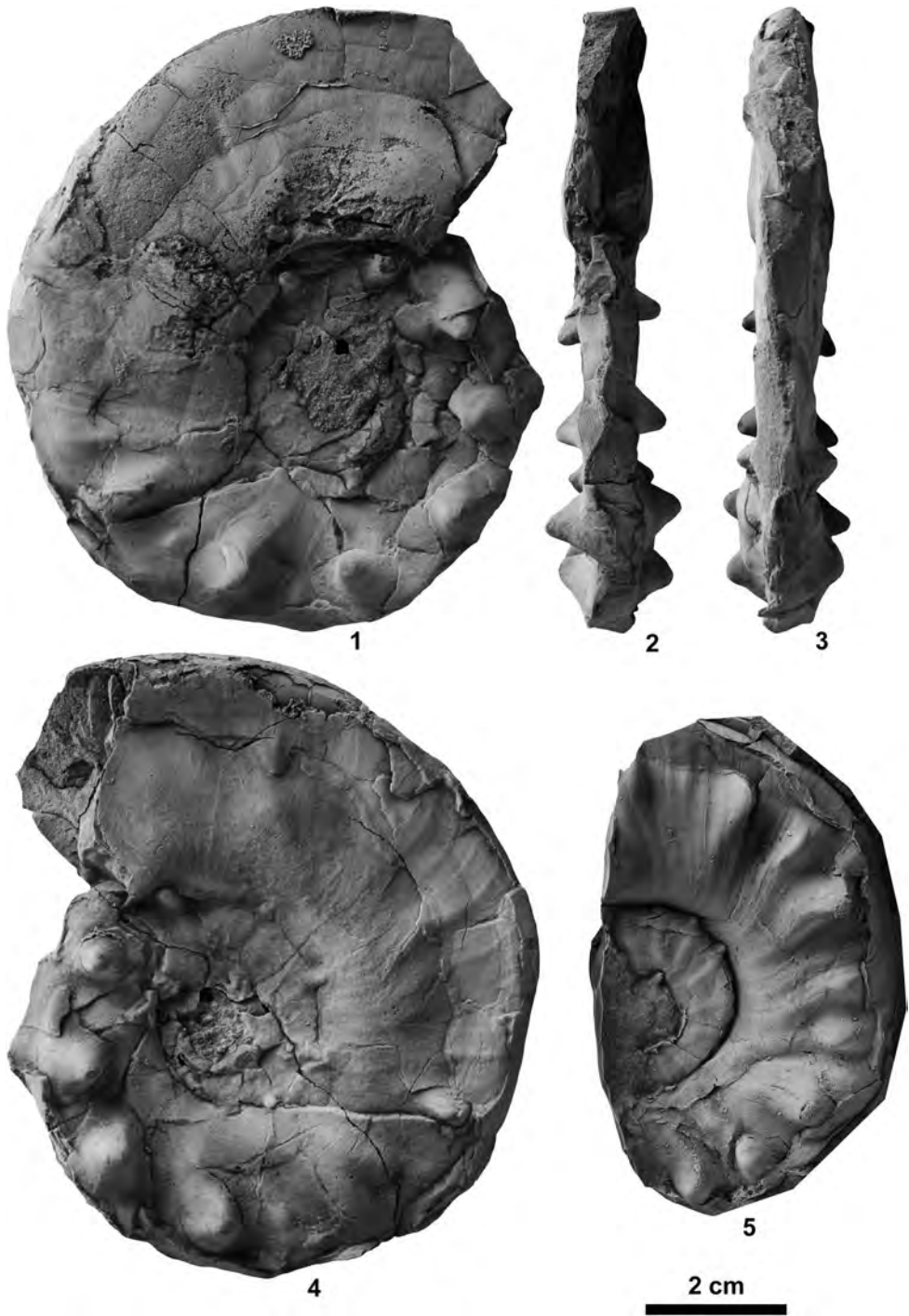


Fig. 110. *Tirolites* sp. nov., from KC02-15. 1–4, NMNS PM23687. 5, NMNS PM23688 (rubber cast of outer mold).



Fig. 111. *Tirolites* sp. nov., from KC02-15. 1–4, NMNS PM23690. 5, NMNS PM23689 (rubber cast of outer mold).

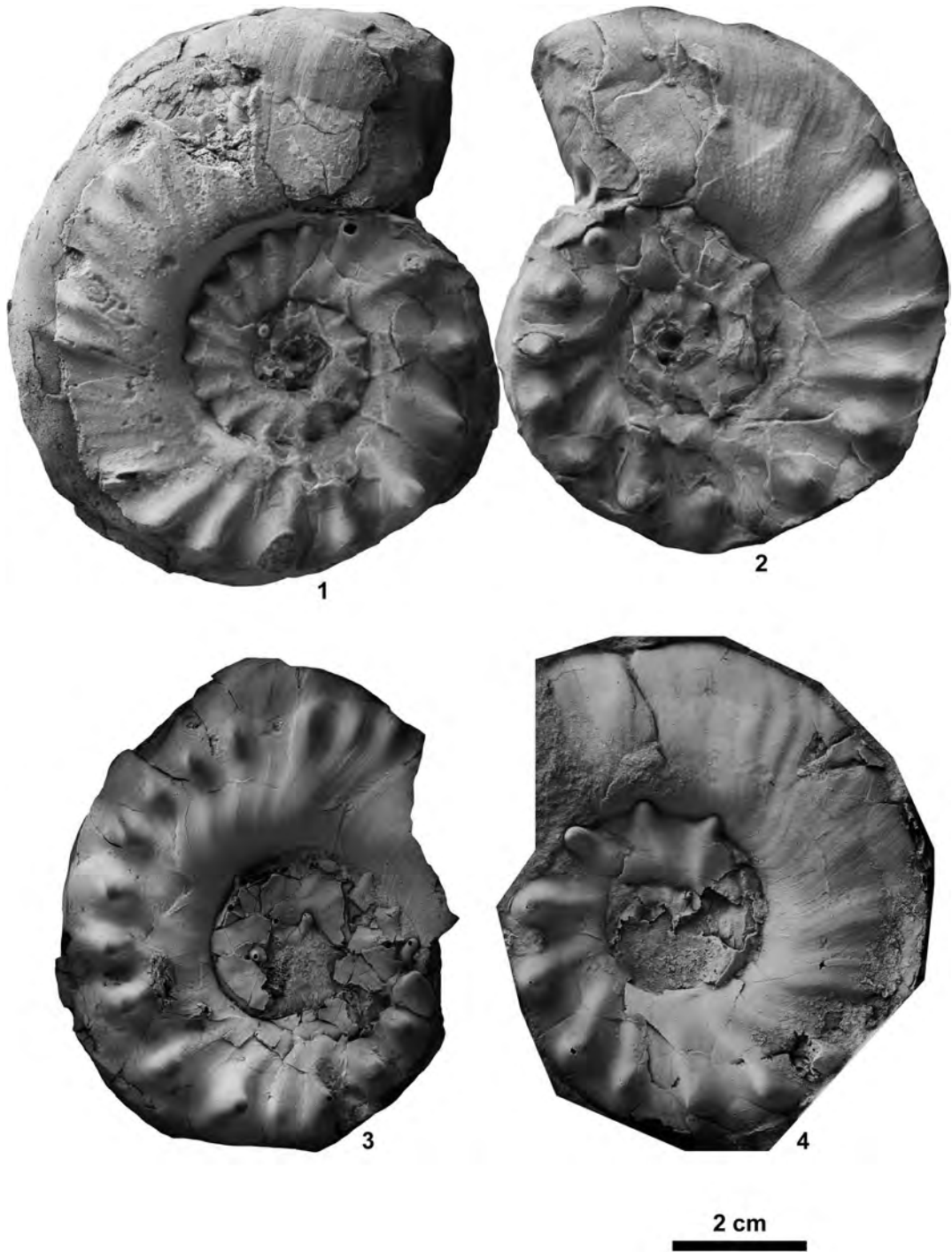


Fig. 112. *Tirolites* sp. nov. 1–2, from KC02-15. 1, NMNS PM23768. 2, NMNS PM23769. 3–4, from KC02-16. 3, NMNS PM23770 (rubber cast of outer mold). 4, NMNS PM23771 (rubber cast of outer mold).

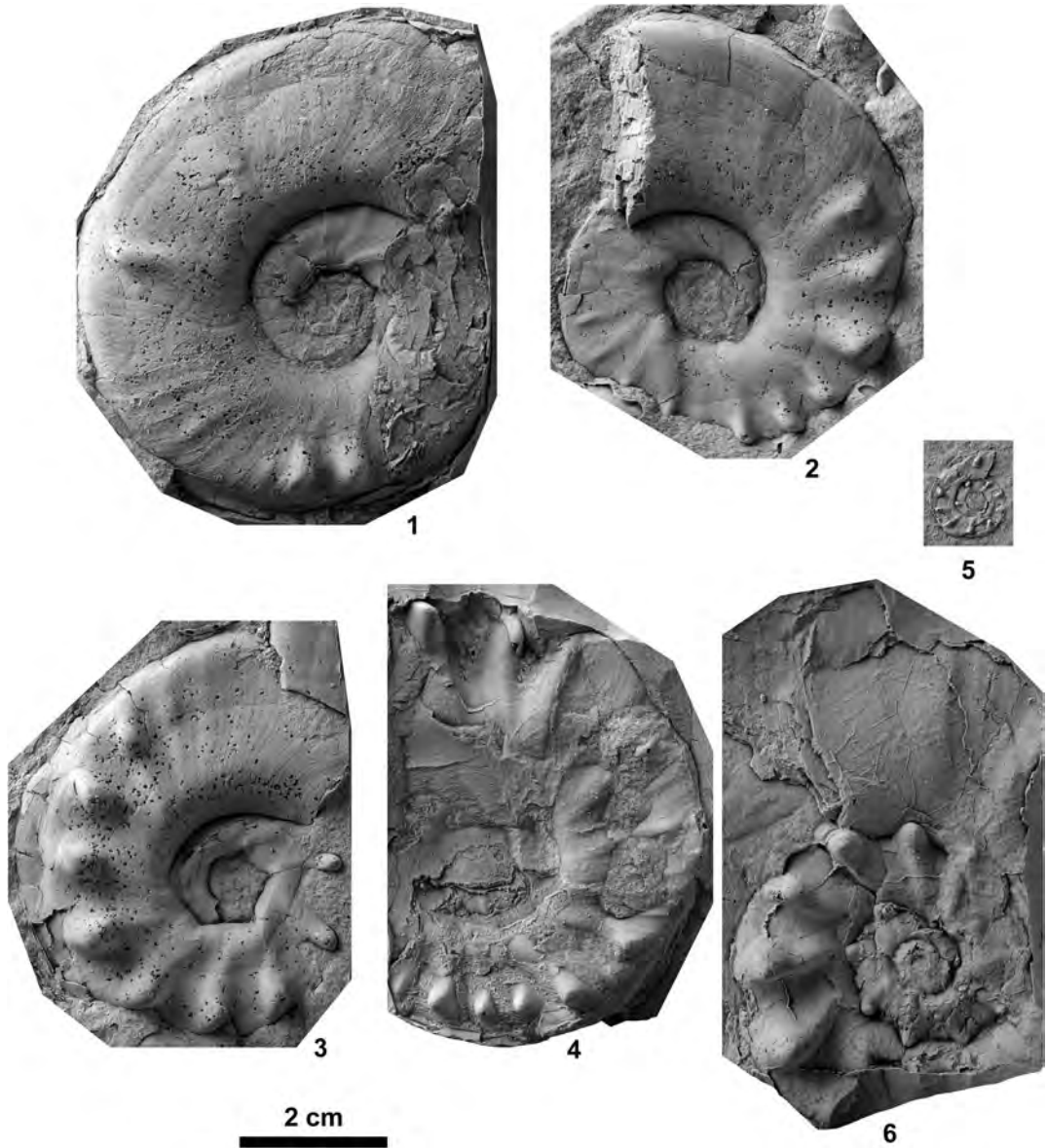


Fig. 113. *Tirolites* sp. nov. 1–4, from KC02-18. 1, NMNS PM23695. 2, NMNS PM23696. 3, NMNS PM23697. 4, NMNS PM23698. 5–6, from BT02-06. 5, NMNS PM23692. 6, NMNS PM23691. All specimens are rubber casts of outer molds.

name because the specimens are poorly preserved and the suture line is unknown.

Occurrence: Described specimens from KC02-14, KC02-15 and KC02-16 within the portion of the *Triassospathodus symmetricus* Zone represented by the *Tirolites* sp. nov. beds (Lower Spathian=lower Upper Olenekian), and those from BT02-06, KC02-18 and NT01-10 within the *Tirolites* sp. nov. beds (Lower Spathian=lower Upper Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Family Columbitidae Spath, 1934

Genus *Columbites* Hyatt and Smith, 1905

Type species: *Columbites parisianus* Hyatt and Smith, 1905.

***Columbites* sp. indet.**

Fig. 114

Material examined: Six specimens, NMNS PM23699–23704, from KC02-14, four specimens, NMNS PM23705–23708, from KC02-15, one specimen, NMNS PM23709, from KC02-18, two specimens, NMNS PM23710–23711, from BT02-06, one specimen, NMNS PM23712, from BR01-08, three specimens, NMNS PM23713–23715, from NT01-10, one specimen, NMNS PM23716, from NT01-11, and one specimen, NMNS PM23716, from NT01-12.

Description: Very evolute, fairly depressed shell with quadratic whorl section, broadly rounded venter, rounded ventral shoulders, and slightly convex flanks. Umbilicus wide with moderately high, gently inclined wall. Ornamentation consists of strong radial ribs that arise on umbilical shoulder and project forward prominently on outer flanks, thus creating impression of tubercles and sinus on ventral shoulders. Ribs continue across venter adorally and are associated with parallel and deep, but variable strength constrictions. Suture not preserved.

Discussion: The described specimens are more or less laterally crushed – they may sim-

ply be juvenile forms of an undetermined species of *Columbites*. Although they appear to be somewhat similar to *Columbites parisianus* Hyatt and Smith, 1905, their poor preservation precludes a definitive species assignment.

Occurrence: Described specimens from KC02-14 and KC02-15 within the portion of the *Triassospathodus symmetricus* Zone represented by the *Tirolites* sp. nov. beds (Lower Spathian=lower Upper Olenekian), and those from KC02-18, BT02-06, BR01-08, NT01-10, NT01-11 and NT01-12 within the *Tirolites* sp. nov. beds (Lower Spathian=lower Upper Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Genus *Yvesgalleticeras* Guex *et al.*, 2005

Type species: *Preflorianites montpelierensis* Kummel, 1969.

***Yvesgalleticeras*? sp. indet.**

Fig. 115

Material examined: Five specimens, NMNS PM23718–23722, from BT02-06, one specimen, NMNS PM23723, from BT02-07, one specimen, NMNS PM23724, from BT02-08, one specimen, NMNS PM23725, from KC02-15, and one specimen, NMNS PM23726, from KC02-18.

Description: Very evolute, fairly compressed shell with elliptical whorl section, rounded venter, rounded ventral shoulders, and slightly convex flanks with maximum whorl width near mid-flank. Umbilicus wide with low, gently inclined wall. Ornamentation consists of radial to slightly concave ribs. Suture not preserved.

Discussion: The assignment of the specimens to *Yvesgalleticeras* is uncertain because of their poor preservation and lack of suture lines, and is based only on the similarity of their morphology with *Yvesgalleticeras*. In particular, they are somewhat similar to inner whorls of *Yvesgalleticeras montpelierense* (Kummel, 1969) from western USA (Guex *et*

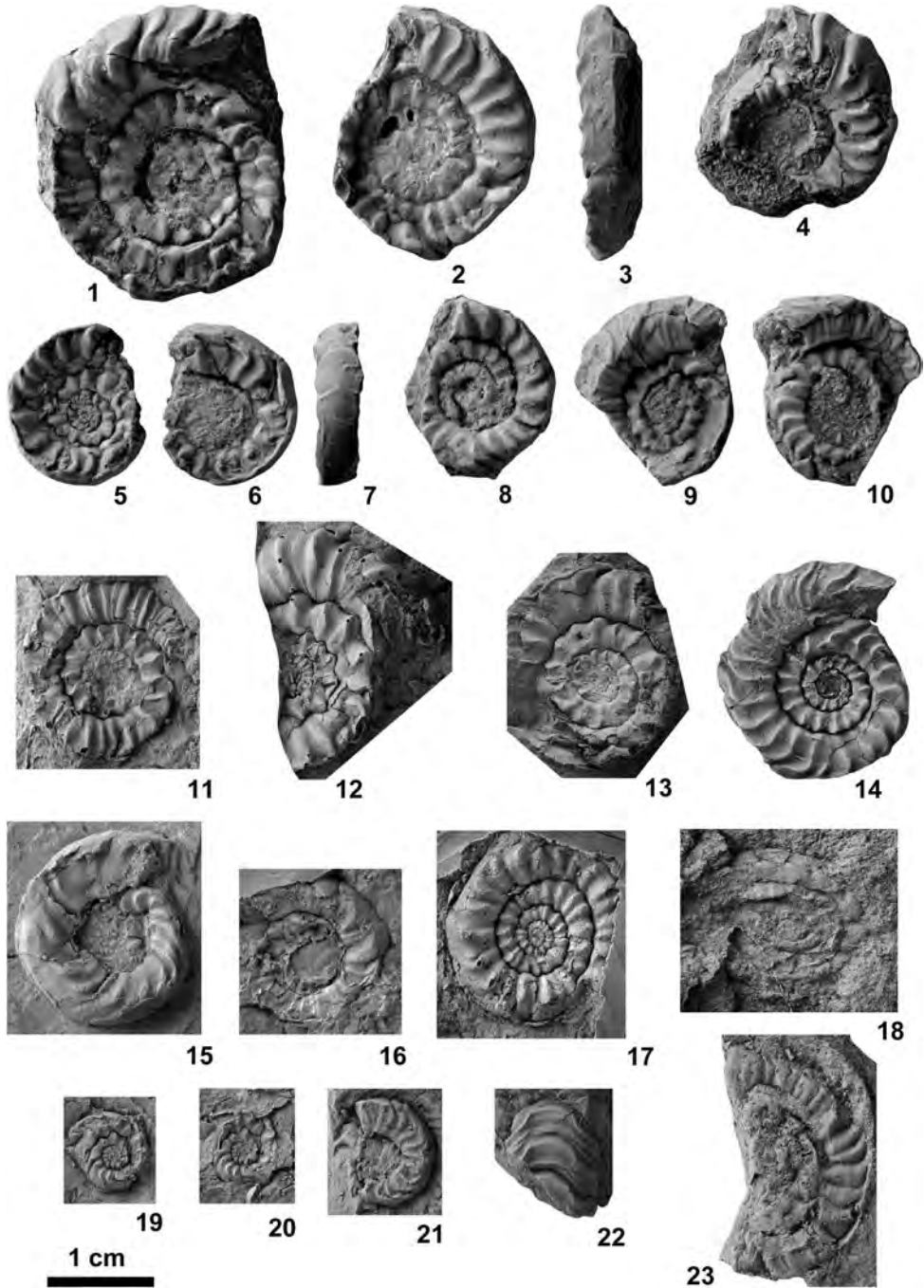


Fig. 114. *Columbites* sp. indet. 1–10, from KC02-14. 1, NMNS PM23699. 2–3, NMNS PM23700. 4, NMNS PM23701. 5–7, NMNS PM23702. 8, NMNS PM23703. 9–10, NMNS PM23704. 11–13, rubber casts of outer molds from KC02-15. 11, NMNS PM23705. 12, NMNS PM23706. 13, NMNS PM23707. 14, NMNS PM23708, from KC02-14. 15, NMNS PM23709, from KC02-18. 16–17, rubber casts of outer molds from BT02-06. 16, NMNS PM23710. 17, NMNS PM23711. 18, NMNS PM23712 (rubber cast of outer mold), from BR01-08. 19–21, from NT01-10. 19, NMNS PM23713. 20, NMNS PM23714 (rubber cast of outer mold). 21, NMNS PM23715. 22, NMNS PM23716, from NT01-11. 23, NMNS PM23717, from NT01-12.

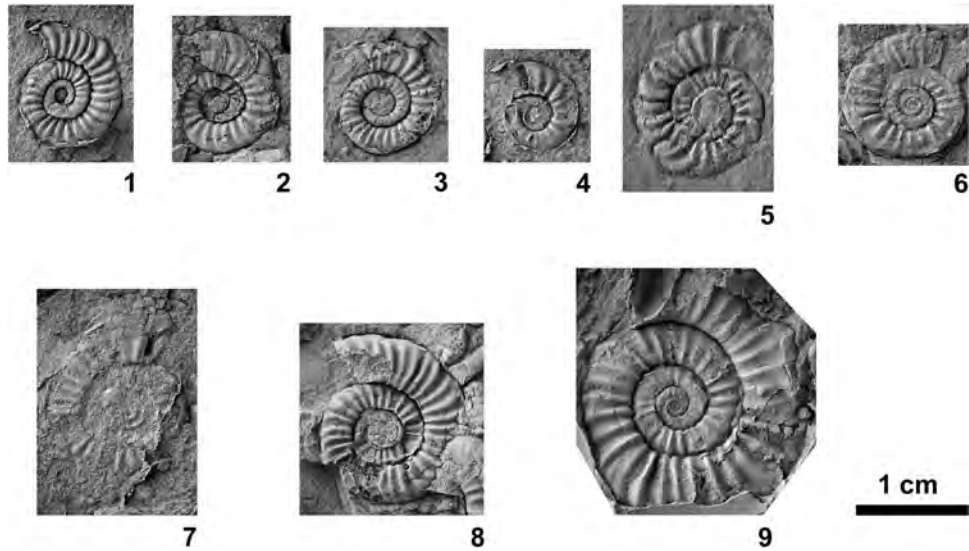


Fig. 115. *Yvesgalleticeras?* sp. indet. 1–5, from BT02-06. 1, NMNS PM23718. 2, NMNS PM23719. 3, NMNS PM23720. 4, NMNS PM23721. 5, NMNS PM23722. 6, NMNS PM23723, from BT02-07. 7, NMNS PM23724, from BT02-08. 8, NMNS PM23725, from KC02-15. 9, NMNS PM23726, from KC02-18. All specimens except for NMNS PM23725 are rubber casts of outer molds.

al., 2010).

Occurrence: Described specimens from KC02-15 within the portion of the *Triassospathodus symmetricus* Zone represented by the *Tirolites* sp. nov. beds (Lower Spathian=lower Upper Olenekian), and those from KC02-18, BT02-06, BT02-07 and BT02-08 within the *Tirolites* sp. nov. beds (Lower Spathian=lower Upper Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Superfamily Megaphyllitoidea Mojsisovics,
1896

Family Procarnitidae Chao, 1959

Genus *Procarnites* Arthaber, 1911

Type species: *Parapopanoceras kokeni*
Arthaber, 1908.

Procarnites? sp. indet.

Fig. 116

Material examined: Three specimens,
NMNS PM23653–23655, from KC02-14.

Description: Fairly involute, very com-

pressed shell with subelliptical whorl section, narrow rounded venter, indistinct ventral shoulders, and slightly convex flanks with maximum whorl width at mid-flank. Umbilicus fairly narrow with moderately high, vertical wall and abruptly rounded shoulders. Ornamentation consists of sigmoidal growth lines strongly projected forwards on outer flank and low, weak folds. Suture ceratitic with subphyllloid saddles. First lateral saddle lower than second saddle, and third saddle only slightly lower than second saddle. First lateral lobe deep, wide with many denticulations at base, and second lateral lobe narrower and shallower than first lobe.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NMNS PM23654	40.9	9.7	17.7	9.2	0.34	0.52

Discussion: The assignment of the specimens to *Procarnites* is uncertain because of their poor preservation and is based only the similarity of their shell morphology and suture line with *Procarnites*. They are somewhat similar to specimen (IPUW 1911-4-11) de-

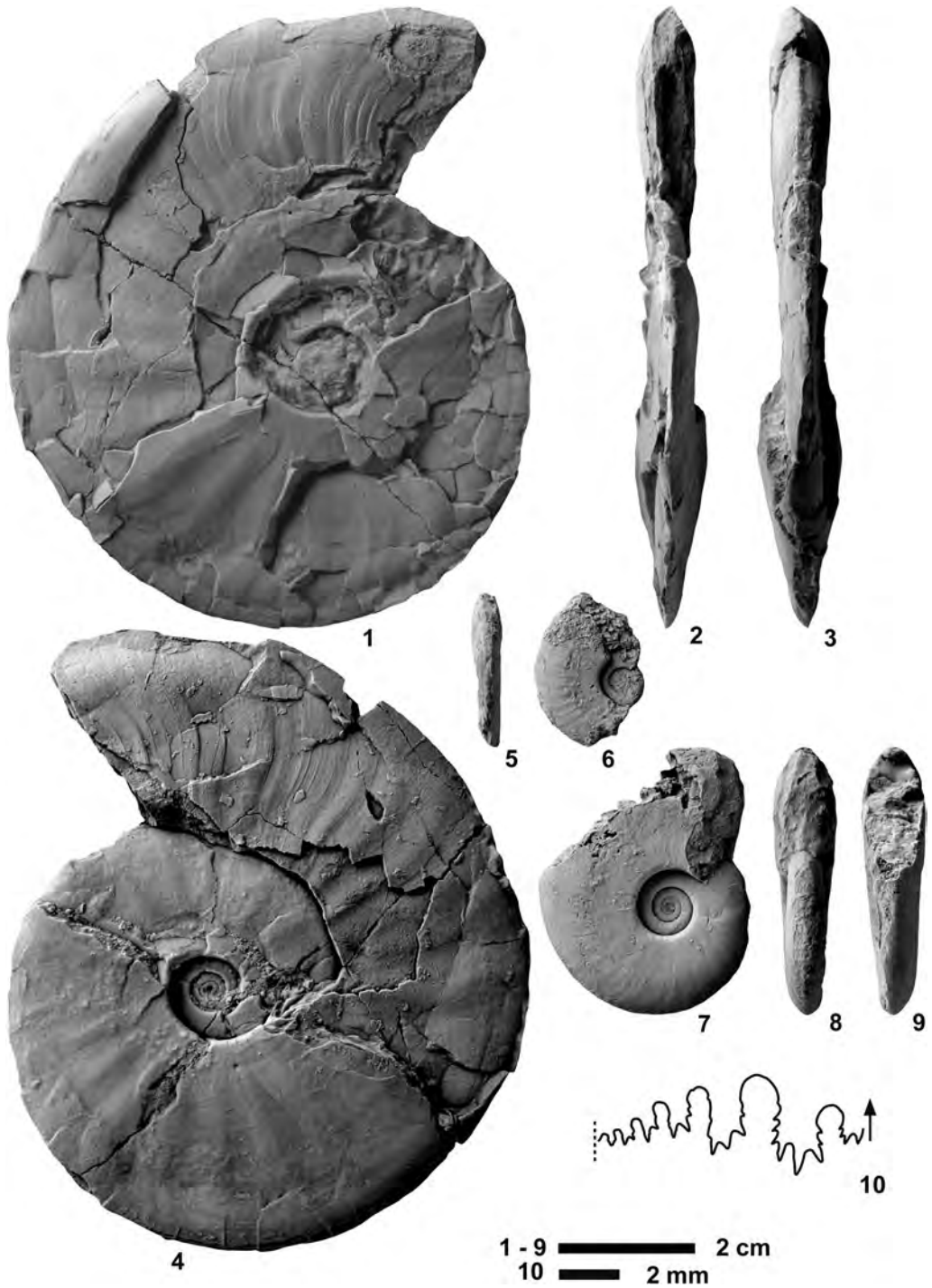


Fig. 116. *Procarnites?* sp. indet., from KC02-14. 1-4, NMNS PM23653. 5-6, NMNS PM23654. 7-10, NMNS PM23655.

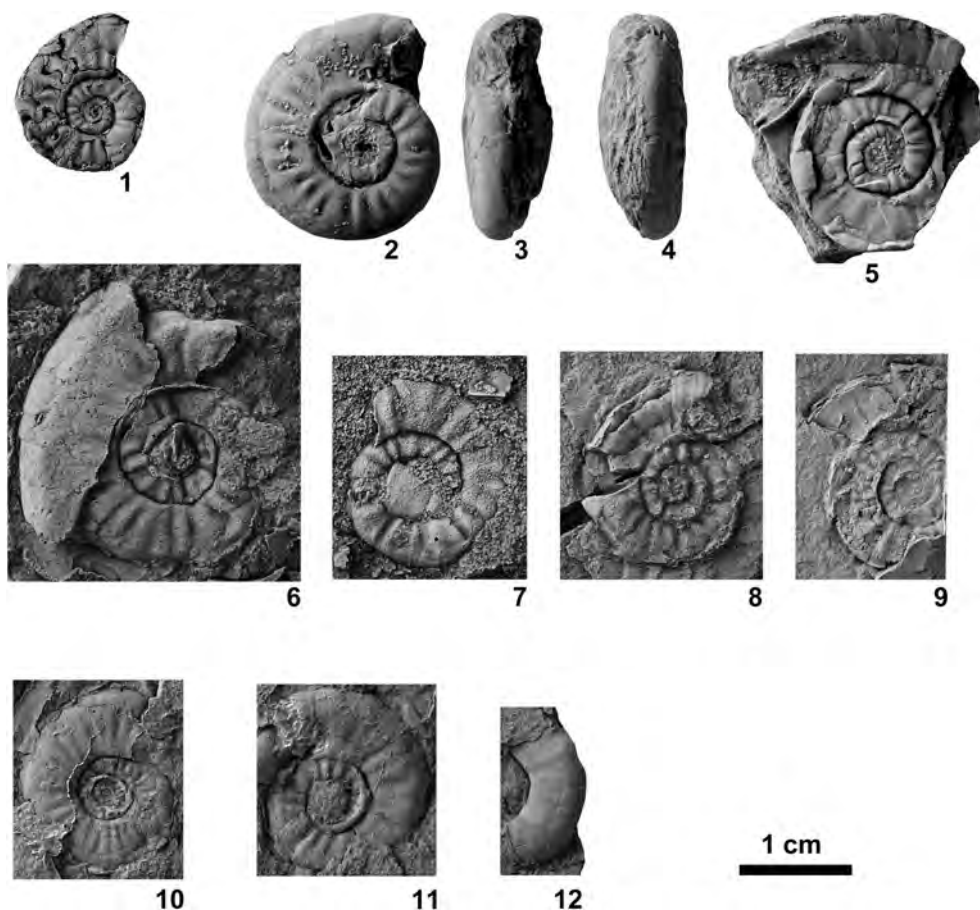


Fig. 117. *Eodanubites?* sp. indet. 1–5, from KC02-14. 1, NMNS PM23727 (rubber cast of outer mold). 2–4, NMNS PM23728. 5, NMNS PM23729. 6–7, from KC02-15. 6, NMNS PM23730 (rubber cast of outer mold). 7, NMNS PM23731 (rubber cast of outer mold). 8, NMNS PM23732, from KC02-19. 9, NMNS PM23733 (rubber cast of outer mold), from BT02-08. 10–12, from NT01-08. 10, NMNS PM23734 (rubber cast of outer mold). 11, NMNS PM23735 (rubber cast of outer mold). 12, NMNS PM23736.

scribed as *Procarnites kokeni* (Arthaber, 1908) by Arthaber (1911, pl. 18, fig. 5) in that it has a slender shell form.

Occurrence: Described specimen from KC02-14 within the portion of the *Triassospathodus symmetricus* Zone represented by the *Tirolites* sp. nov. beds (Lower Spathian = lower Upper Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Superfamily Ceratitaceae Mojsisovics, 1879
Family Danubitidae Spath, 1951
Genus *Eodanubites* Wang, 1978

Type species: *Eodanubites xinyuanensis* Wang, 1978.

Eodanubites? sp. indet.

Figs. 117, 118

Material examined: Three specimens, NMNS PM23727–23729, from KC02-14, two specimens, NMNS PM23730–23731, from KC02-15, one specimen, NMNS PM23732,

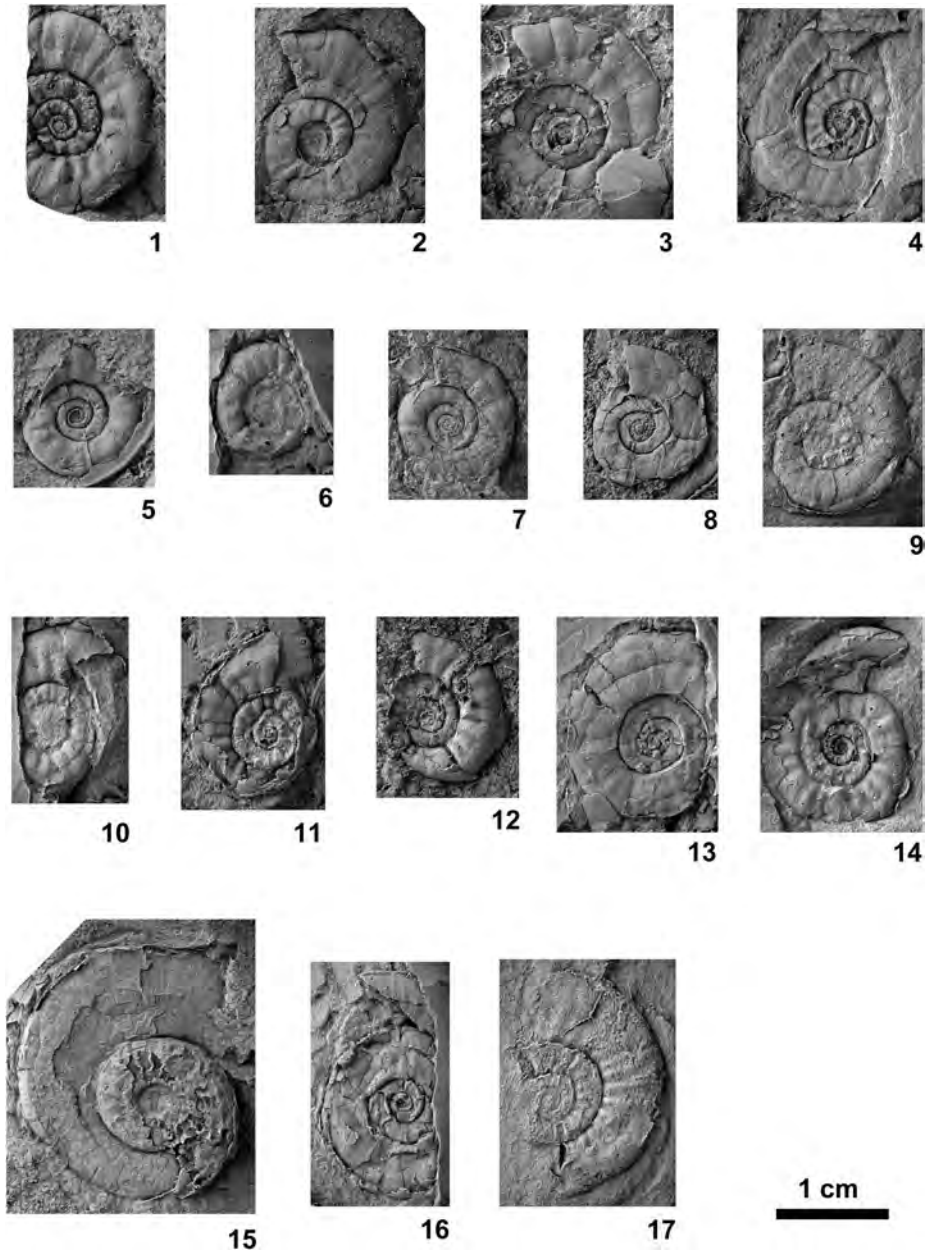


Fig. 118. *Eodanubites?* sp. indet., from BT02-06. 1, NMNS PM23737. 2, NMNS PM23738. 3, NMNS PM23739. 4, NMNS PM23740. 5, NMNS PM23741. 6, NMNS PM23742. 7, NMNS PM23743. 8, NMNS PM23744. 9, NMNS PM23745. 10, NMNS PM23746. 11, NMNS PM23747. 12, NMNS PM23748. 13, NMNS PM23749. 14, NMNS PM23750. 15, NMNS PM23751. 16, NMNS PM23752. 17, NMNS PM23753. All specimens are rubber casts of outer molds.

from KC02-19, seventeen specimens, NMNS PM23737–23753, from BT02-06, one specimen, NMNS PM23733, from BT02-08, and three specimens, NMNS PM23734–23736, from NT01-10.

Description: Fairly evolute, fairly compressed shell with elliptical whorl section, rounded venter, rounded ventral shoulders, and slightly convex flanks with maximum whorl width near mid-flank. Umbilicus fairly wide with low, vertical wall and rounded shoulders. Ornamentation consists of strong, radial or slightly rursiradiate rounded ribs arising on umbilical shoulder, becoming most prominent at mid-flank and weakening at ventral shoulder. Suture not preserved.

Discussion: Assignment of the specimens to *Eodanubites* is uncertain because of their poor preservation and lack of suture lines, and is based only on the similarity of their morphology with *Eodanubites*. They are somewhat similar to *Eodanubites (Dumitricaceras) judae* (Guex *et al.*, 2005) from western USA (Guex *et al.*, 2010).

Occurrence: Described specimens from KC02-14 and KC02-15 within the portion of the *Triassospathodus symmetricus* Zone represented by the *Tirolites* sp. nov. beds (Lower Spathian=lower Upper Olenekian), and those from KC02-19, BT02-06, BT02-08 and NT01-10 within the *Tirolites* sp. nov. beds (Lower Spathian=lower Upper Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Order Phylloceratida Zittel, 1884

Superfamily Ussuritoidea Hyatt, 1900

Family Palaeophyllitidae Popov, in Luppov
and Drushchits, 1958

Genus *Goudemandites* Brühwiler *et al.*, 2012a

Type species: *Goudemandites sinensis*
Brühwiler *et al.*, 2012a.

Goudemandites langsonensis

Shigeta and Nguyen sp. nov.

Fig. 119

Eophyllites sp. nov. Tong *et al.*, 2004, p. 201, pl. 2, figs. 16–17.

Type specimen: Holotype, NMNS PM23639, consists of the phragmocone and most of the body chamber, which begins at a diameter of about 60 mm and occupies nearly two-thirds of the outer whorl. Specimen was collected from KC02-14.

Diagnosis: Moderately evolute *Goudemandites* with subtrapezoidal whorl section, ornamented with slightly biconcave, fine lirae and very weak, radial plications.

Etymology: Named after Lang Son City, northeastern Vietnam.

Description: Moderately evolute, fairly compressed shell with subtrapezoidal whorl section, broadly rounded venter, rounded ventral shoulders, and slightly convex flanks with maximum whorl width near umbilical shoulder. Umbilicus moderately wide with moderately high, vertical wall and rounded shoulders. Ornamentation consists of very weak, radial plications, as well as slightly biconcave, fine lirae. Suture ceratitic with subphylloid saddles. First lateral saddle nearly equal to second saddle, and third saddle even lower. First lateral lobe deep, wide with many denticulations at base, and second lateral lobe about two thirds depth of first lobe.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NMNS PM23639	60.0	18.9	26.5	22.7	0.32	0.86

Comparison: *Goudemandites langsonensis* sp. nov. is close to *G. sinensis* Brühwiler *et al.*, 2012a from the Middle Smithian in South China and Oman, but differs by its subtrapezoidal whorl section and ornamentation consisting of very weak, radial plications. Specimens described as *Eophyllites* sp. nov. by Tong *et al.* (2004, pl. 2, figs. 16) from the *Columbites-Tirolites* Zone in East China are very similar to *G. langsonensis* and are probably

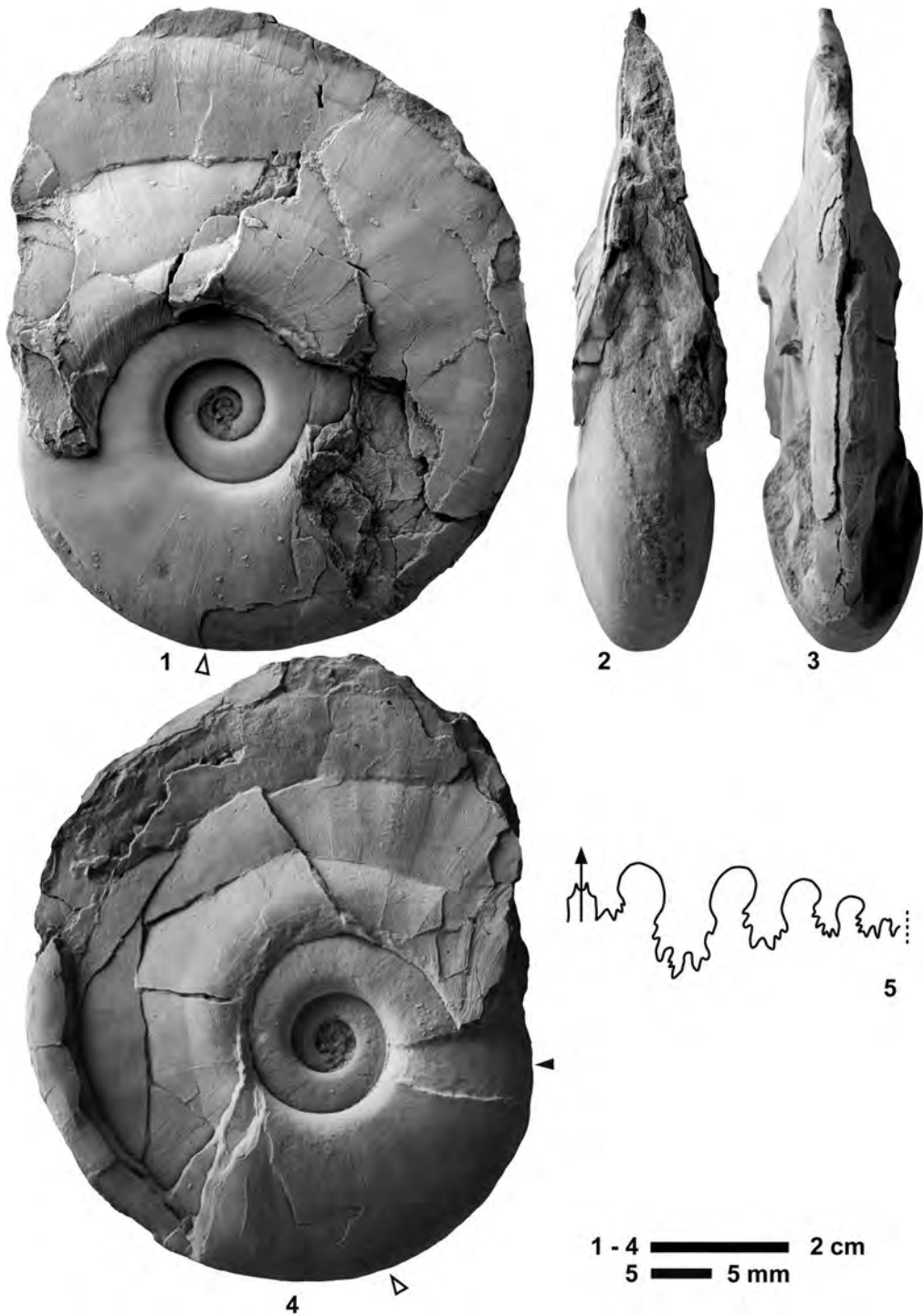


Fig. 119. *Gaudemandites langsonensis* Shigeta and Nguyen sp. nov., from KC02-14. 1-5, NMNS PM23639, holotype. White arrows indicate shell breakage. Suture line drawn at position indicated by black arrow.

conspecific.

Remarks: A major sub-lethal shell break and repair scar are visible on the shell of the holotype. Its outer flank and ventral portion were severely damaged and nearly one-sixth of the outer whorl was lost.

Occurrence: Described specimen from KC02-14 within the portion of the *Triassospathodus symmetricus* Zone represented by the *Tirolites* sp. nov. beds (Lower Spathian=lower Upper Olenekian) in the Bac Thuy Formation, northeastern Vietnam. This species also occurs in the Lower Spathian (*Columbites-Tirolites* Zone in Tong *et al.*, 2004) in East China.

Incertae sedis

Genus gen. indet. A

Fig. 120.1–120.3

Material examined: One specimen, NMNS PM23754, from BT02-04.

Description: Moderately evolute, fairly compressed shell with elliptical whorl section, arched venter, rounded ventral shoulders, and slightly convex flanks with maximum whorl width near mid-flank. Umbilicus fairly narrow with moderately high, vertical wall and rounded shoulders. Ornamentation consists of sigmoidal ribs, more pronounced near venter. Suture not visible.

Occurrence: Described specimen from BT02-04 within the portion of the *Novispathodus* ex gr. *waageni* Zone that includes the *Leyeceras* horizon of the *Owenites koeneni* beds (middle Middle Smithian=middle lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Genus gen. indet. B

Fig. 120.4–120.5

Material examined: One specimen, NMNS PM23755, from BT01-09.

Description: Very evolute, very compressed shell with narrow tabulate venter, rounded ventral shoulders, and convex flanks

with maximum whorl width near mid-flank. Umbilicus fairly wide with moderately high, oblique wall and rounded shoulders. Shell surface smooth. Suture not visible.

Occurrence: Described specimens from BT01-09 within the portion of the *Novispathodus* ex gr. *waageni* Zone that includes the *Urdyceras tulongensis* beds (lower Middle Smithian=middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Genus gen. indet. C

Fig. 121.1–121.2

Material examined: One specimen, NMNS PM23756, from KC01-10.

Description: Involute, fairly compressed shell with tabulate or subtabulate venter, angular ventral shoulders, and slightly convex flanks with maximum whorl width near mid-flank. Umbilicus narrow. Ornamentation consists of dense, concave, fine and projected ribs. Suture not visible.

Occurrence: Described specimen from KC01-10 within the portion of the *Novispathodus* ex gr. *waageni* Zone that includes the *Leyeceras* horizon of the *Owenites koeneni* beds (middle Middle Smithian=middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Genus gen. indet. D

Fig. 121.3–121.4

Material examined: One specimen, NMNS PM23757, from NT01-10.

Description: Fairly evolute, very compressed shell with subelliptical whorl section, arched venter, rounded ventral shoulders, and flat, subparallel flanks. Umbilicus moderately wide with moderately high, oblique wall. Ornamentation consists of dense, sigmoidal fine ribs strongly projected forwards on outer flank. Suture not preserved.

Occurrence: Described specimen from NT01-10 within the *Tirolites* sp. nov. beds (Lower Spathian=lower Upper Olenekian) in



Fig. 120. 1–3, Genus gen. indet. A, NMNS PM23754, from BT02-04. 4–5, Genus gen. indet. B, NMNS PM23755, from BT01-09.

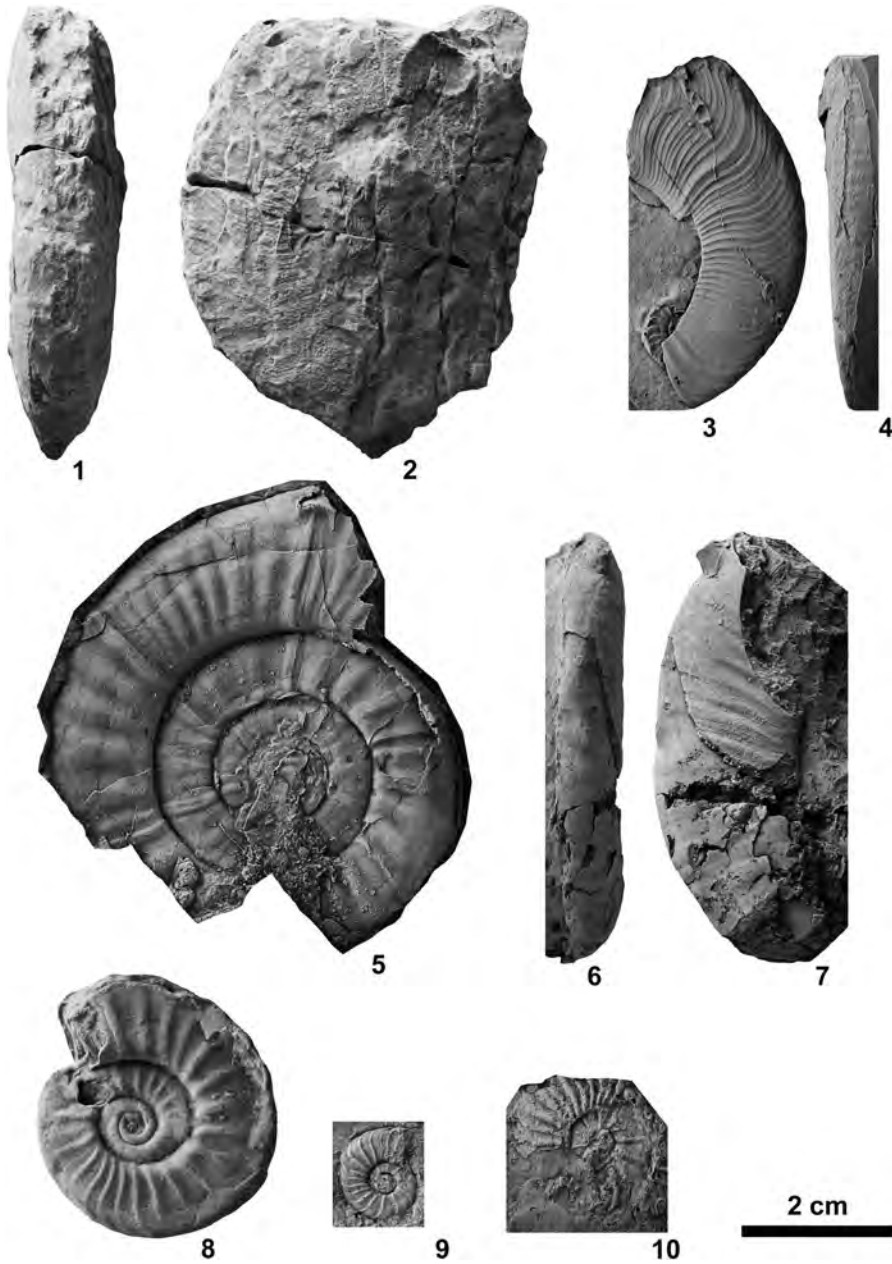


Fig. 121. 1–2, Genus gen. indet. C, NMNS PM23756, from KC01-10. 3–4, Genus gen. indet. D, NMNS PM23757 (rubber cast of outer mold), from NT01-10. 5–7, Genus gen. indet. E. 5, NMNS PM23758 (rubber cast of outer mold), from KC02-15. 6–7, NMNS PM23759, from KC02-14. 8–10, Genus gen. indet. F. 8, NMNS PM23767, from KC02-16. 9, NMNS PM23646 (rubber cast of outer mold), from a float mudstone block at KC02. 10, NMNS PM23647 (rubber cast of outer mold), from a float mudstone block at KC02.

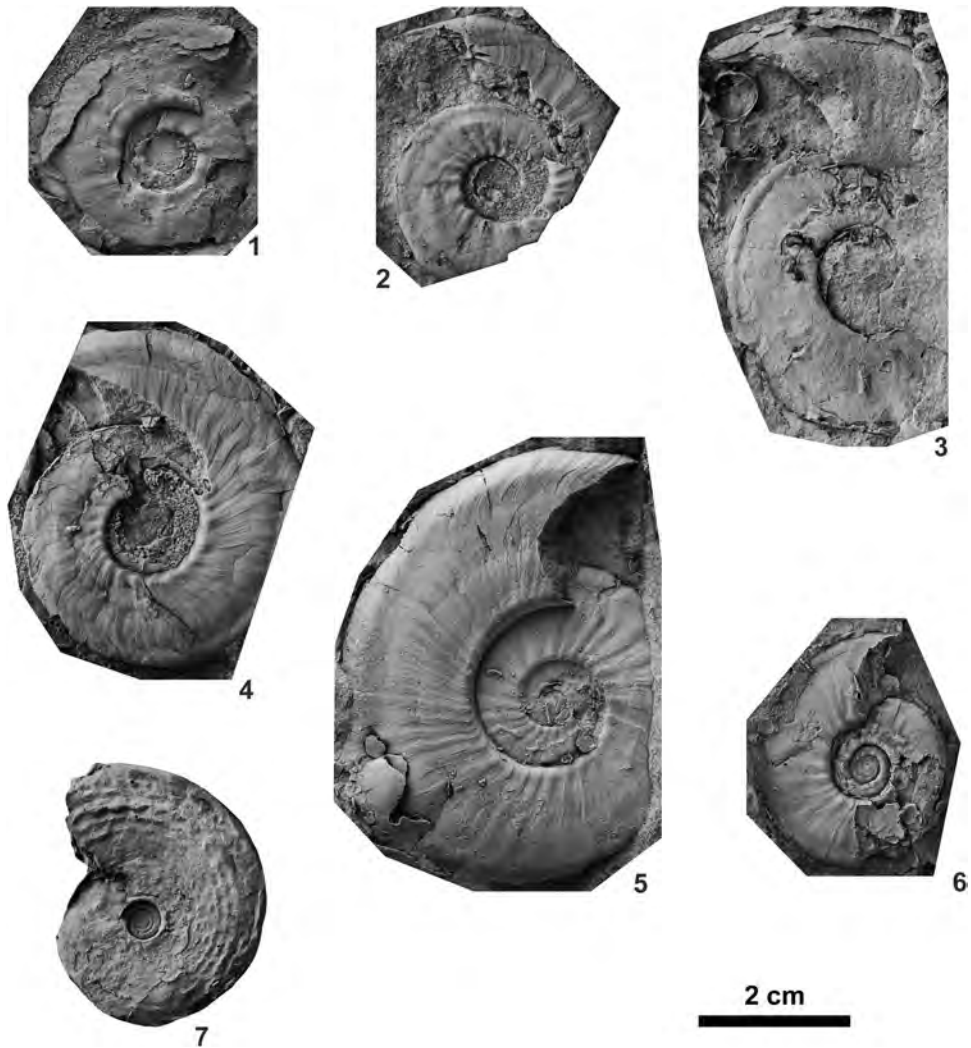


Fig. 122. 1–6, Genus gen. indet. G, from KC02-14. 1, NMNS PM23656. 2, NMNS PM23657. 3, NMNS PM23658. 4, NMNS PM23659. 5, NMNS PM23660. 6, NMNS PM23661. All specimens are rubber casts of outer molds. 7, Genus gen. indet. H, NMNS PM23789 (rubber cast of outer mold), from KC02-16.

the Bac Thuy Formation, northeastern Vietnam.

Genus gen. indet. E

Fig. 121.5–121.7

Material examined: One specimen, NMNS PM23759, from KC02-14 and one specimen, NMNS PM23758, from KC02-15.

Description: Very evolute, very compressed shell with elliptical whorl section,

arched venter, rounded ventral shoulders, and slightly convex flanks with maximum whorl width near mid-flank. Umbilicus wide with low, vertical wall and rounded shoulders. Ornamentation consists of periodic major ribs with parabolic nodes on ventrolateral margin and radial rounded ribs, arising on umbilical shoulder, becoming most prominent at mid-flank and weakening at ventral shoulder. Suture not preserved.

Occurrence: Described specimen from

KC02-14 and KC02-15 within the portion of the *Triassospathodus symmetricus* Zone represented by the *Tirolites* sp. beds (Lower Spathian=lower Upper Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Genus gen. indet. F

Fig. 121.8–121.10

Material examined: Two specimens, NMNS PM23646–23647, from float mudstone blocks in KC02 and one specimen, NMNS PM23767, from KC02-16.

Description: Moderately evolute, very compressed shell with slightly convex flanks with maximum whorl width near mid-flank. Umbilicus moderately wide with low, vertical wall and rounded shoulders. Ornamentation consists of strong, sigmoidal ribs. Suture not preserved.

Occurrence: Described specimens from KC02-16 within the portion of the *Triassospathodus symmetricus* Zone represented by the *Tirolites* sp. nov. beds (Lower Spathian=lower Upper Olenekian), and those from float mudstone blocks probably derived from the mudstone within the *Tirolites* sp. nov. beds (Lower Spathian=lower Upper Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Genus gen. indet. G

Fig. 122.1–122.6

Material examined: Six specimens, NMNS PM23656–23661, from KC02-15.

Description: Fairly evolute, very compressed shell with subelliptical whorl section, arched venter, rounded ventral shoulders, and flat, subparallel flanks. Umbilicus moderately wide with moderately high, vertical wall and abruptly rounded shoulders. Ornamentation consists of sigmoidal growth lines that form umbilical bullae and rib-like plications, becoming strongly projected forwards on outer flank. Suture not preserved.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NMNS PM23657	24.6	8.2	9.6	—	0.33	—
NMNS PM23656	32.0	11.8	12.5	—	0.37	—
NMNS PM23661	33.0	11.3	11.8	—	0.34	—
NMNS PM23659	45.0	14.5	19.2	—	0.32	—
NMNS PM23660	57.0	21.0	20.2	—	0.37	—

Occurrence: Described specimen from KC02-15 within the portion of the *Triassospathodus symmetricus* Zone represented by the *Tirolites* sp. nov. beds (Lower Spathian=lower Upper Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Genus gen. indet. H

Fig. 122.7

Material examined: One specimen, NMNS PM23789, from KC02-16.

Description: Very involute, very compressed shell with narrow rounded venter, rounded ventral shoulders, and slightly convex flanks with maximum whorl width near mid-flank. Umbilicus narrow with low, vertical wall and abruptly rounded shoulders. Suture with probably subphyllid saddles partly visible.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NMNS PM23789	35.0	5.0	18.6	—	0.14	—

Occurrence: Described specimen from KC02-16 within the portion of the *Triassospathodus symmetricus* Zone represented by the *Tirolites* sp. nov. beds (Lower Spathian=lower Upper Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Gastropods (by A. Kaim, A. Nützel and T. Maekawa)

Systematic descriptions basically follow the classification by Bouchet *et al.* (2005). Morphological terms are those used in the Treatise on Invertebrate Paleontology (Cox, 1960) and the glossary of malacological terms by Arnold (1965).

The present material consists entirely of small specimens (smaller 1 mm) and repre-

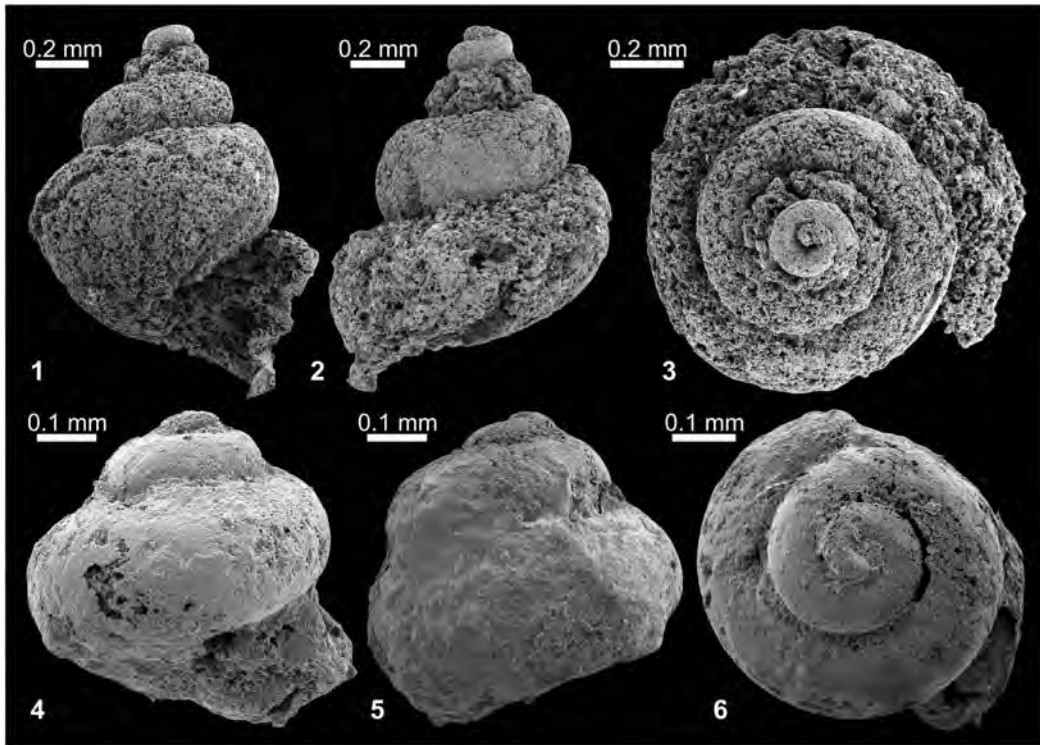


Fig. 123. Gastropods from the lowest Middle Smithian. 1–3, unidentified caenogastropod, NMNS PM23849, from BT01-04. 4–6, ?*Atorcula* sp. indet., NMNS PM23848, from BT02-01.

sents protoconchs and/or early juveniles. The specimens are silicified and most are internal moulds so that the ornament is rarely preserved. For these reasons, open nomenclature must be used and all generic assignments are tentative. However, it is possible to characterize various different forms.

Institution abbreviation: NMNS=National Museum of Nature and Science, Tsukuba

Class Gastropoda Cuvier, 1795
 Order Vetigastropoda Salvini-Plawen, 1980
 Superfamily Trochonematoidea von Zittel, 1895
 Family Lophospiridae Wenz, 1938
 Genus *Worthenia* de Koninck, 1883

Type species: *Turbo tabulatus* Conrad, 1835.

Worthenia? sp. indet.

Fig. 124.1–124.6

Material examined: One juvenile specimen, NMNS PM23800, from BT01-06 and one specimen, NMNS PM23801, from KC01-04.

Description: Shell from sample BT01-06 (Fig. 124.1–124.3) relatively well preserved consisting of 3.5 round convex turbiniform whorls with deep sutures and covered with granular micro-ornament. Small umbilicus present. Aperture circular. Demarcation between larval shell and teleoconch not visible. Selenizone not yet developed.

Discussion: This shell is most likely a juvenile of a *Worthenia*-like gastropod. Bandel (2009) argues that the Triassic species of *Worthenia* should be classified as *Pseudochizogonium* Kutassy, 1937 (with the Late Tri-

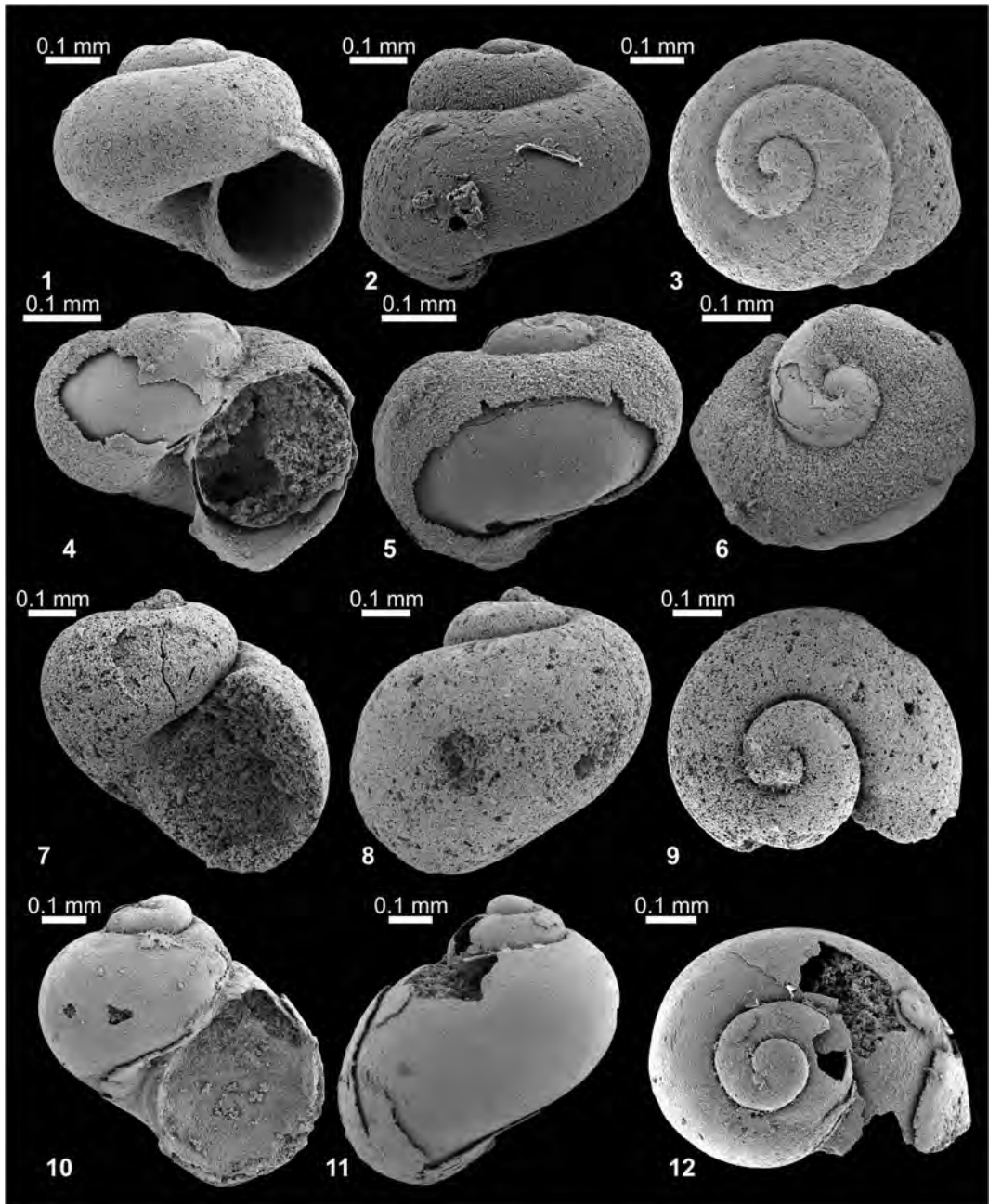


Fig. 124. Gastropods from the lower Middle Smithian. 1–6, *Worthenia?* sp. indet. 1–3, NMNS PM23800, from BT01-06. 4–6, NMNS PM23801, from KC01-04. 7–12, *Naticopsis* sp. indet. A. 7–9, NMNS PM23812, from BT01-06. 10–12, NMNS PM23813, from BT01-07.

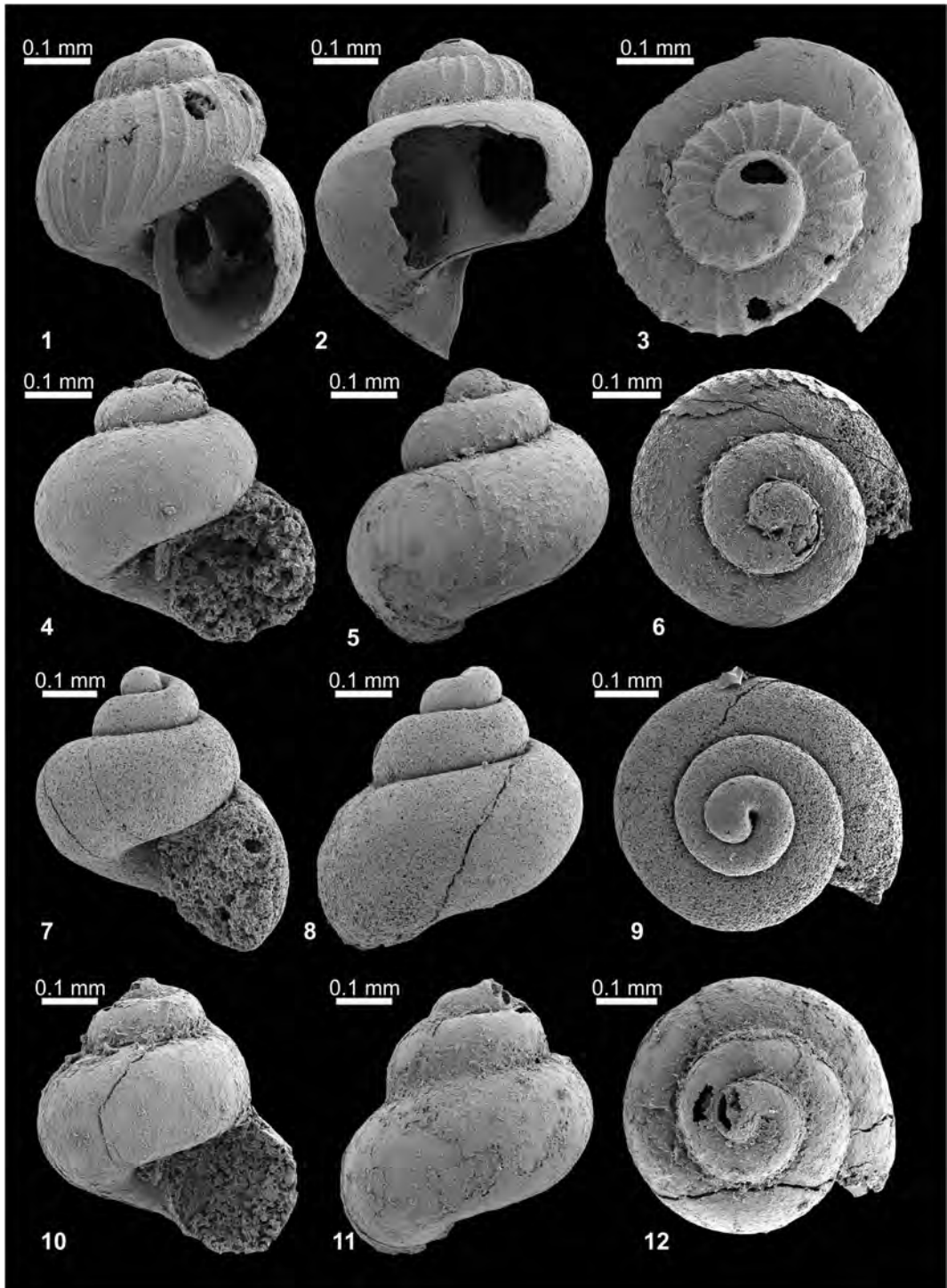


Fig. 125. Gastropods from the lower Middle Smithian. *Atorcula* sp. indet. 1–3, NMNS PM23840, from KC01-04. 4–6, NMNS PM23834, from BT01-07. 7–9, NMNS PM23835, from BT01-07. 10–12, NMNS PM23836, from BT01-07.

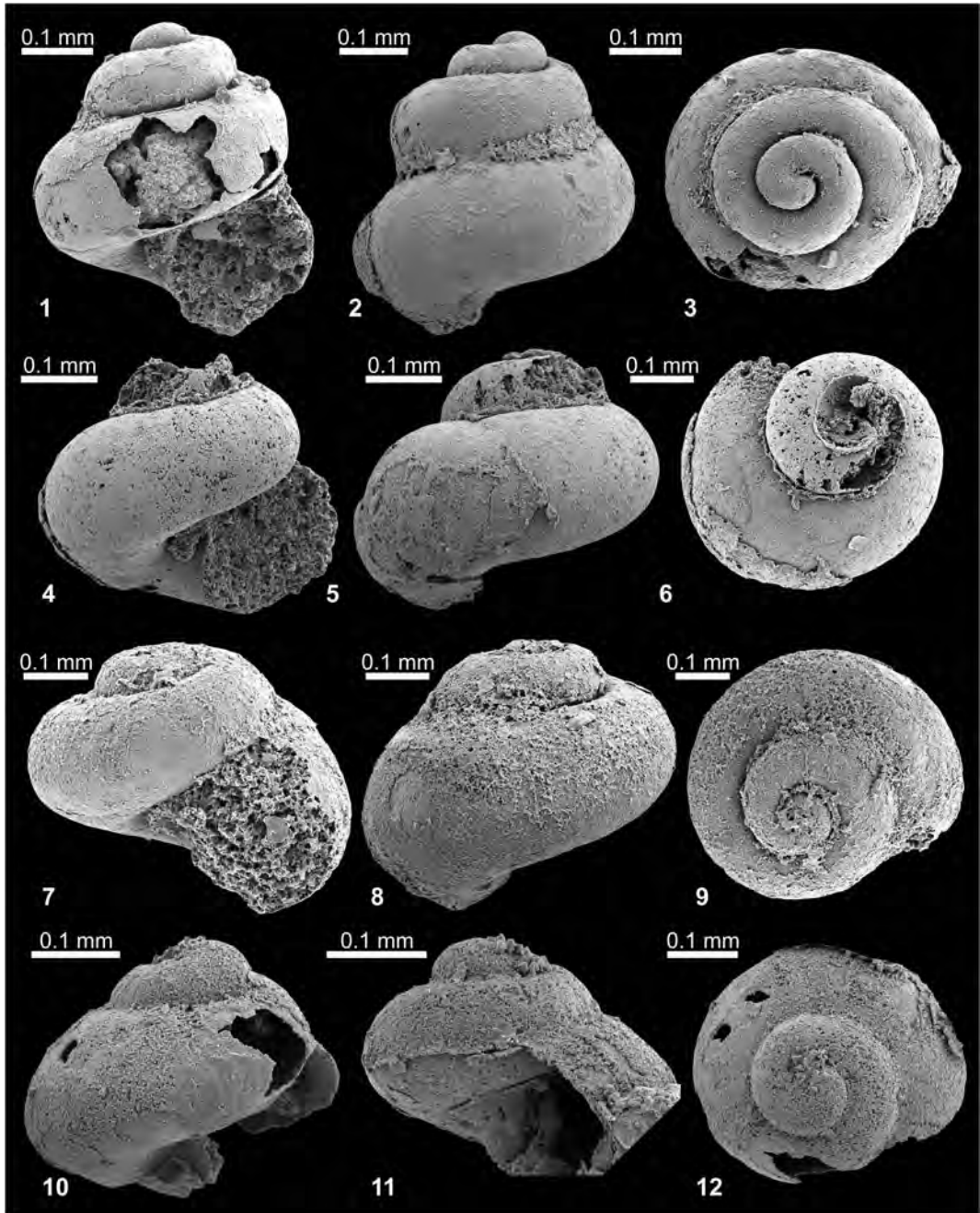


Fig. 126. Gastropods from the lower Middle Smithian. *Atorcula* sp. indet. 1–3, NMNS PM23837, from BT01-07. 4–6, NMNS PM23838, from BT01-07. 7–9, NMNS PM23839, from BT01-07. 10–12, NMNS PM23841, from KC01-04.

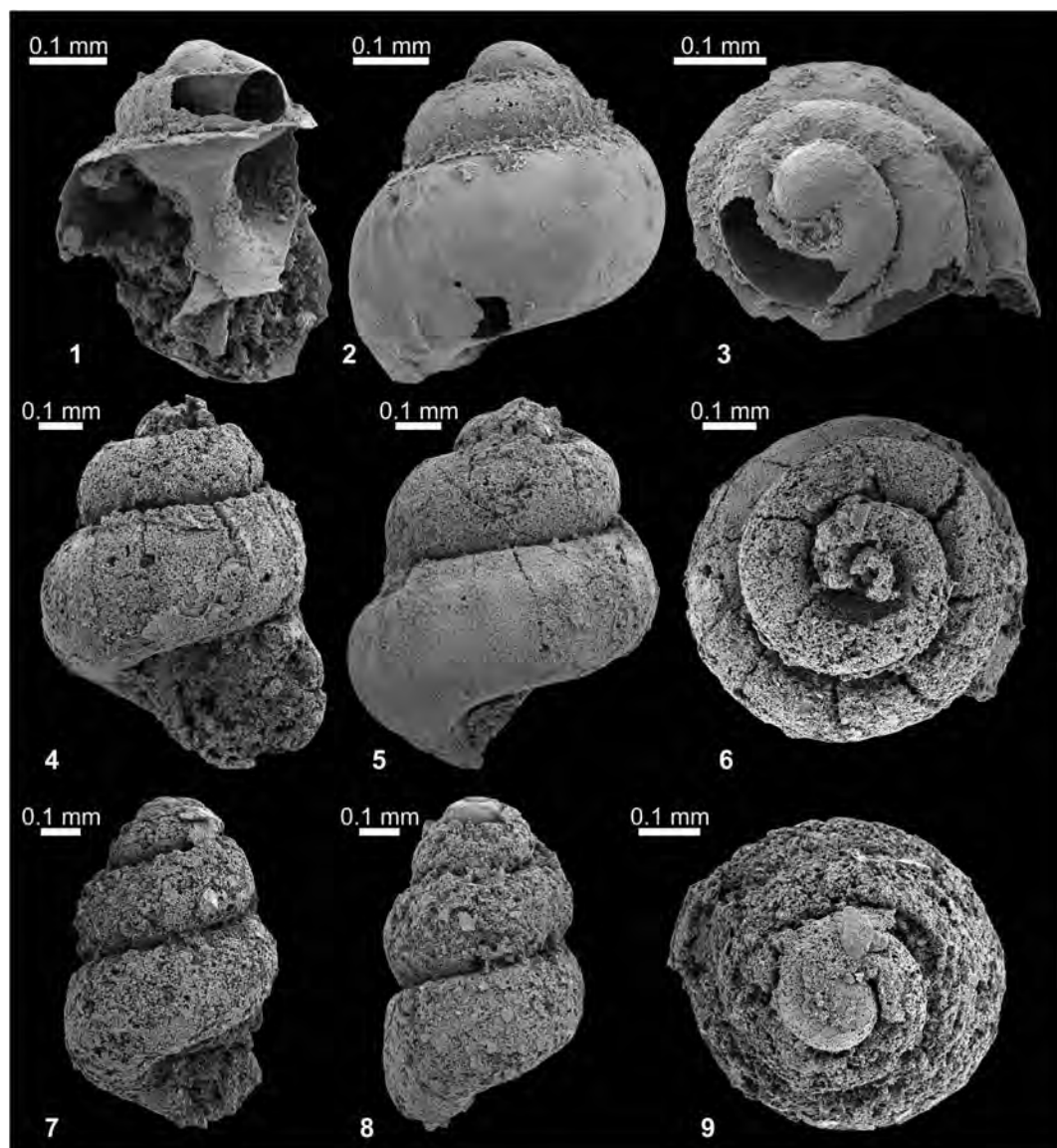


Fig. 127. Gastropods from the lower Middle Smithian. 1–6, *Atorcula* sp. indet. 1–3, NMNS PM23842, from KC01-04. 4–6, NMNS PM23843, from BT01-06. 7–9, unidentified caenogastropod, NMNS PM23850, from BT01-06.

assic type species *Pseudoschizogonium turriculatum* Kutassy, 1937) rather than *Worthenia* (having the Carboniferous type species). The problem of *Pseudoschizogonium* vs. *Worthenia* needs further research in our opinion as some Triassic species (including our specimens from Vietnam) are more reminiscent of the Carboniferous type species of *Worthenia* than the Late Triassic type species of *Pseudoschizogonium*. The Early Triassic species of *Worthenia* were previously reported from Utah, USA (Batten and Stokes, 1986), Oman (Wheeley and Twitchett, 2005), and South Primorye, Russia (Kaim, 2009). Some additional reports from Greenland (Spath, 1930, 1935) and China (Pan, 1982; Zhan, 1995) require review. Unpublished micrographs of early whorls of *Worthenia* from the Smithian Sinbad Limestone closely resemble the present specimens from Vietnam. In these species, the slit develops late during ontogeny.

Occurrence: Described specimen collected from BT01-06 and KC01-04 within the *Novispathodus* ex gr. *waageni* Zone in the Bac Thuy Formation, northeastern Vietnam. BT01-06 is located between the *Flemingites rursiradiatus* beds (lowest Middle Smithian = middle Lower Olenekian) and the *Urdoceras tulongensis* beds (lower Middle Smithian = middle Lower Olenekian). KC01-04 is located beneath the *Owenites koeneni* beds (middle Middle Smithian = middle Lower Olenekian).

Superfamily Trochoidea Rafinesque, 1815

Family Turbinidae Rafinesque, 1815

Subfamily Anomphalinae Wenz, 1938

Genus *Anomphalus* Meek and Worthen, 1867

Type species: *Anomphalus rotulus* Meek and Worthen, 1867.

Anomphalus? sp. indet.

Figs. 128.4–128.12, 134

Material examined: One specimen, NMNS PM23802, from BT01-15, two specimens, NMNS PM23803–23804, from KC02-02, five

specimens, NMNS PM23805–23809, from KC02-03, and one specimen, NMNS PM23810, from KC02-10.

Description: All available specimens juveniles of about two whorls or less. Shells low-spired, rotelliform with convex whorls. Shell surface smooth. Initial whorl orthostrophic. Protoconch/teleoconch demarcation not visible. Umbilicus well developed. Aperture circular.

Discussion: The shells under consideration are poorly preserved juveniles of rather simple morphology. The low rotelliform shells with orthostrophic protoconch are characteristic for small vetigastropods of turbinid affinity. Such shells in the Paleozoic and Triassic (see e.g., Haas, 1953; Bandel, 1993; Nützel and Nakazawa, 2012) are classified in the family Anomphalidae (here downranked to subfamily). We follow this identification in preliminarily classifying our shells from Vietnam as *Anomphalus*? sp. indet.

Occurrence: Described specimens from BT01-15, KC02-02 and KC02-03 within the *Novispathodus* ex gr. *waageni* Zone that includes the *Leyeceras* and the *Guodunites* horizons of the *Owenites koeneni* beds (middle to upper Middle Smithian = middle Lower Olenekian), and those from KC02–10 within the portion of the *Novispathodus pingdingshanensis* Zone represented by the *Xenoceltites varicosatus* beds (Upper Smithian = upper Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Order Neritimorpha Koken, 1896

Superfamily Neritoidea Rafinesque, 1815

Family Naticopsidae Waagen, 1880

Genus *Abrekopsis* Kaim, 2009

Type species: *Naticopsis (Naticopsis) depressispirus* Batten and Stokes, 1986.

Abrekopsis? sp. indet.

Fig. 128.13–128.15

Material examined: One specimen, NMNS

PM23811, from BT02-03.

Description: Juvenile neritoid shell with flattened upper whorl surface and whorls embracing above periphery. Shell surface densely covered with fine orthoclinal lirae probably reflecting some selective erosional feature of external shell layer. Aperture drop-shaped. Small umbilicus present.

Discussion: The shell resembles *Abrekopsis depressispirus* (Batten and Stokes, 1986) from the Early Triassic of Russia (Kaim, 2009) and the United States (Batten and Stokes, 1986), however, it is juvenile and poorly preserved; the diagnostic protoconch is also preserved and it may actually belong also to some other neritoid gastropod. The suture is reduced in the earliest whorls and this may indicate that this neritimorph resorbed the inner shell walls as is typical for modern Neritidae.

Occurrence: Described specimen from BT02-03 within the portion of the *Novispathodus* ex gr. *waageni* Zone represented by the *Leyceras* horizon of the *Owenites koeneni* beds (middle Middle Smithian=middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Genus *Naticopsis* McCoy, 1844

Type species: *Naticopsis phillipsii* McCoy, 1844.

Naticopsis sp. indet. A

Figs. 124.7–124.12, 130.7–130.12, 131, 132.1–132.3, 135.1–135.3

Material examined: One specimen, NMNS PM23812, from BT01-06, one specimen, NMNS PM23813, from BT01-07, two specimens, NMNS PM23814–23815, from BT01-15, four specimens, NMNS PM23816–23819, from BT02-03, one specimen, NMNS PM23820, from KC01-12, and one specimen, NMNS PM23821, from KC02-10.

Description: Juvenile relatively high-spired naticopsid shell with shallow but sharply incised suture and bulbous initial whorl.

Aperture drop-shaped.

Discussion: The shells under considerations are similar to *Naticopsis utahensis* Batten and Stokes, 1986 from Early Triassic of Utah (Batten and Stokes, 1986). Similar species have also been reported from the Early Triassic of China (Kaim *et al.*, 2010) and Pakistan (Kaim *et al.*, 2013), however, the juvenile nature of our material discourages us from attributing the *Naticopsis* sp. indet. A to any formally named species.

Occurrence: Described specimens collected from BT01-06, BT01-07, BT01-15, BT02-03 and KC01-12 within the *Novispathodus* ex gr. *waageni* Zone in the Bac Thuy Formation, northeastern Vietnam. BT01-06 and BT01-07 are located between the *Flemingites rursiradatus* beds (lowest Middle Smithian=middle Lower Olenekian) and the *Urdoceras tulongensis* beds (lower Middle Smithian=middle Lower Olenekian). BT01-15, BT02-03 and KC01-12 are located the *Leyceras* horizon of the *Owenites koeneni* beds (middle Middle Smithian=middle Lower Olenekian), and those from KC02-10 within the portion of the *Novispathodus pingdingshanensis* Zone represented by the *Xenoceltites variocostatus* beds (Upper Smithian=upper Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Naticopsis sp. indet. B

Figs. 129, 130.1–130.5

Material examined: Five specimens, NMNS PM23822–23826, from BT02-03, three specimens, NMNS PM23827–23829, from BT01-14, and one specimen, NMNS PM23830, from KC01-13.

Description: Juvenile relatively low-spired naticopsid shell with slightly flattened upper whorl surface and shallow but sharply incised suture and bulbous initial whorl. Aperture rectangular with rounded corners.

Discussion: *Naticopsis* sp. indet. B differs from *Naticopsis* sp. indet. A in having polygo-

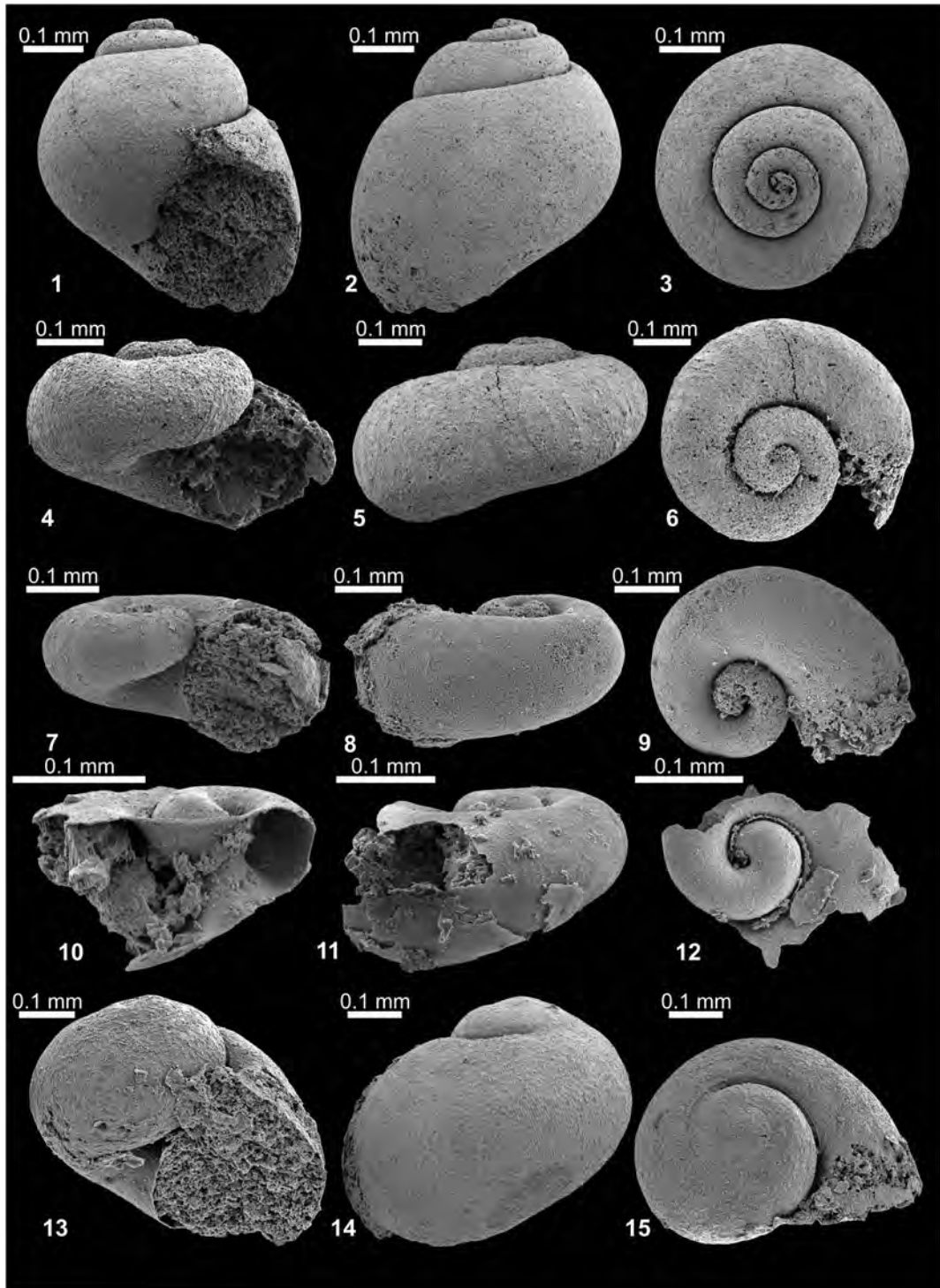


Fig. 128. Gastropods from the middle to upper Middle Smithian. 1–3, *Strobeus* sp. indet., NMNS PM23831, from BT01-15. 4–12, *Anomphalus?* sp. indet. 4–6, NMNS PM23802, from BT01-15. 7–9, NMNS PM23803, from KC02-02. 10–12, NMNS PM23804, from KC02-02. 13–15, *Abrekopsis?* sp. indet., NMNS PM23811, from BT02-03.

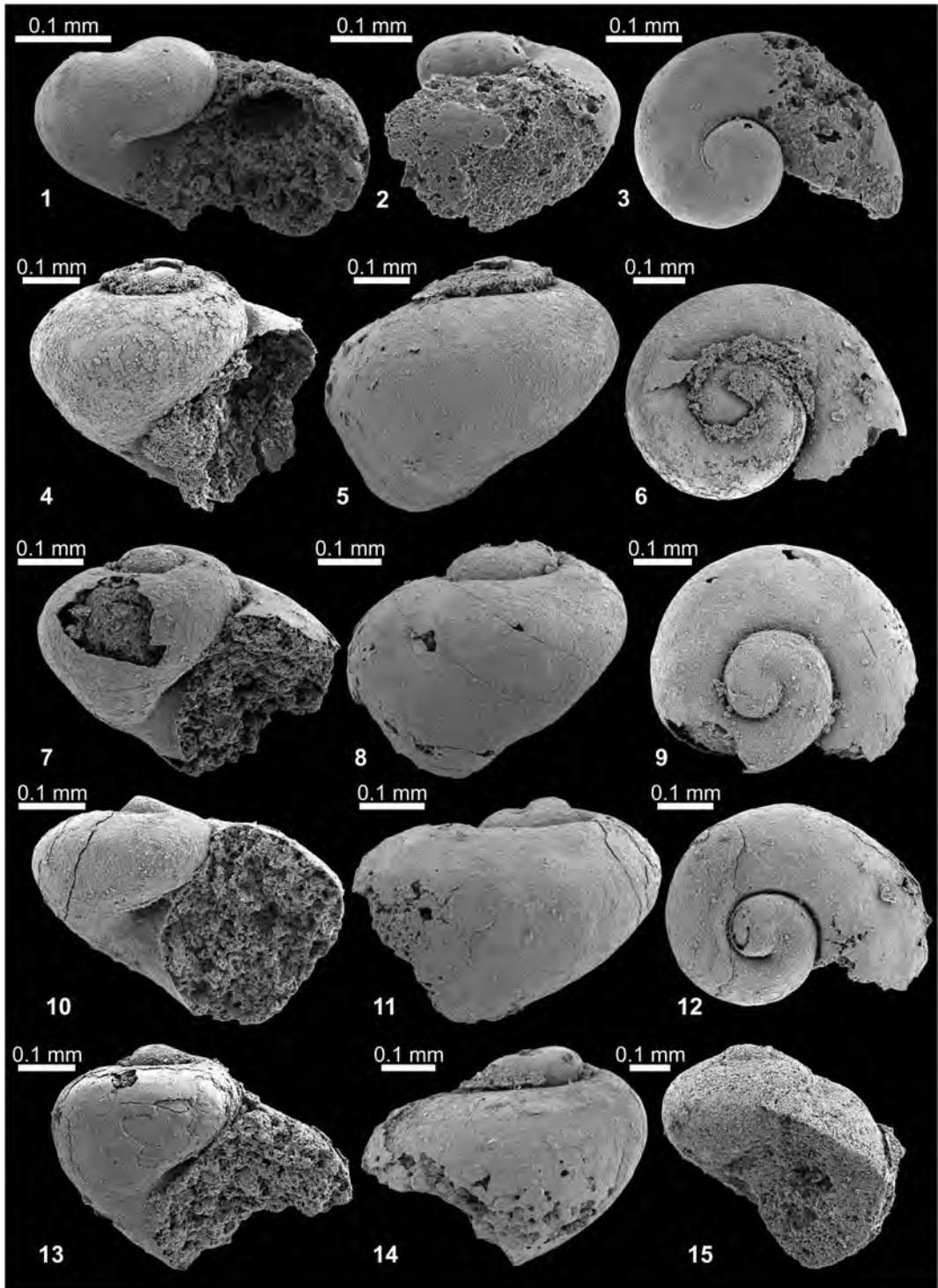


Fig. 129. Gastropods from the middle to upper Middle Smithian. *Naticopsis* sp. indet. B. 1–3, NMNS PM23830, from KC01-13. 4–6, NMNS PM23822, from BT02-03. 7–9, NMNS PM23823, from BT02-03. 10–12, NMNS PM23824, from BT02-03. 13–14, NMNS PM23827, from BT01-14. 15, NMNS PM23828, from BT01-14.

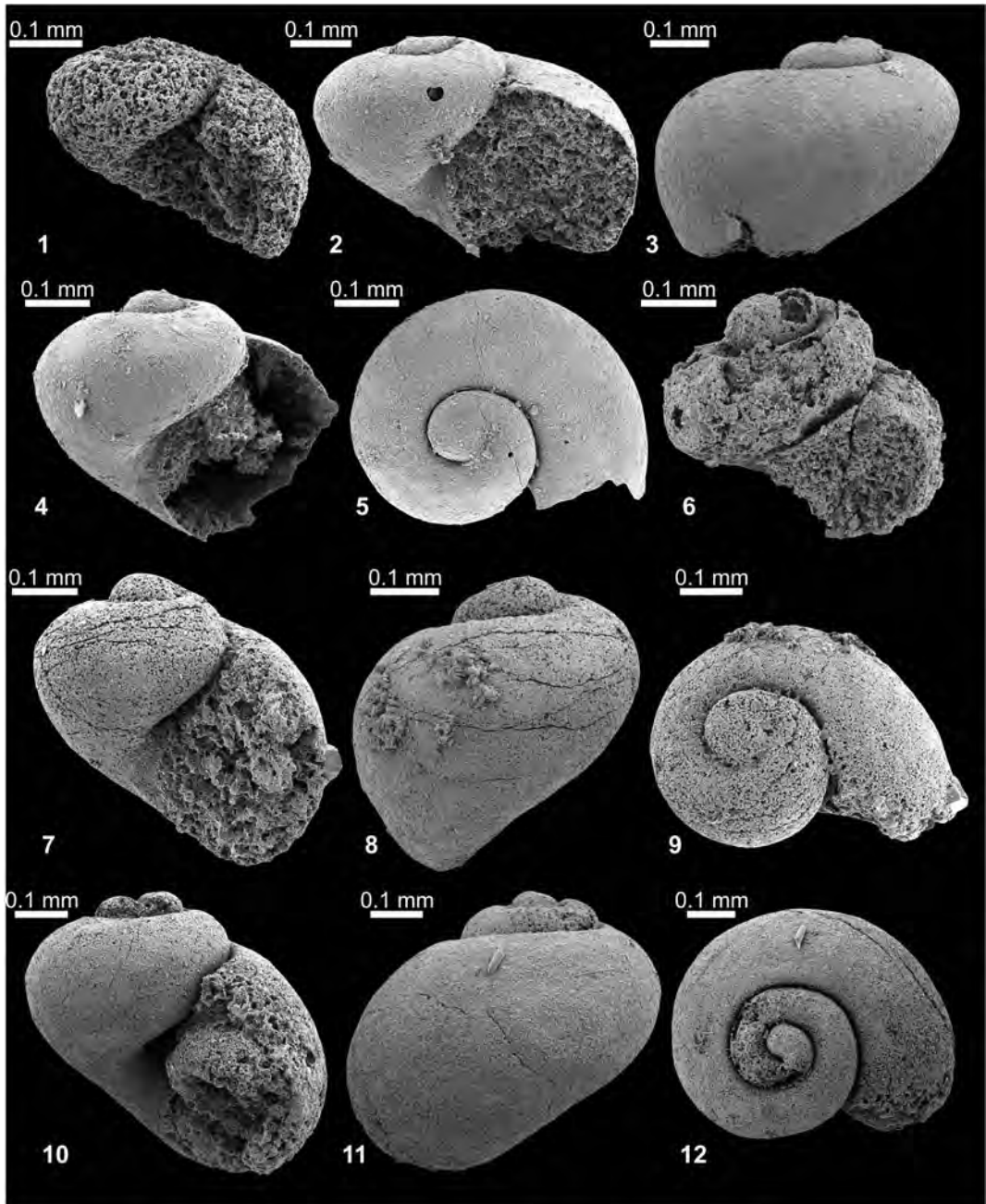


Fig. 130. Gastropods from the middle to upper Middle Smithian. 1–5, *Naticopsis* sp. indet. B. 1, NMNS PM23829, from BT01-14. 2–3, NMNS PM23825, from BT02-03. 4–5, NMNS PM23826, from BT02-03. 6, unidentified gastropod, NMNS PM23851, from KC01-12. 7–12, *Naticopsis* sp. indet. A. 7–9, NMNS PM23814, from BT01-15. 10–12, NMNS PM23815, from BT01-15.

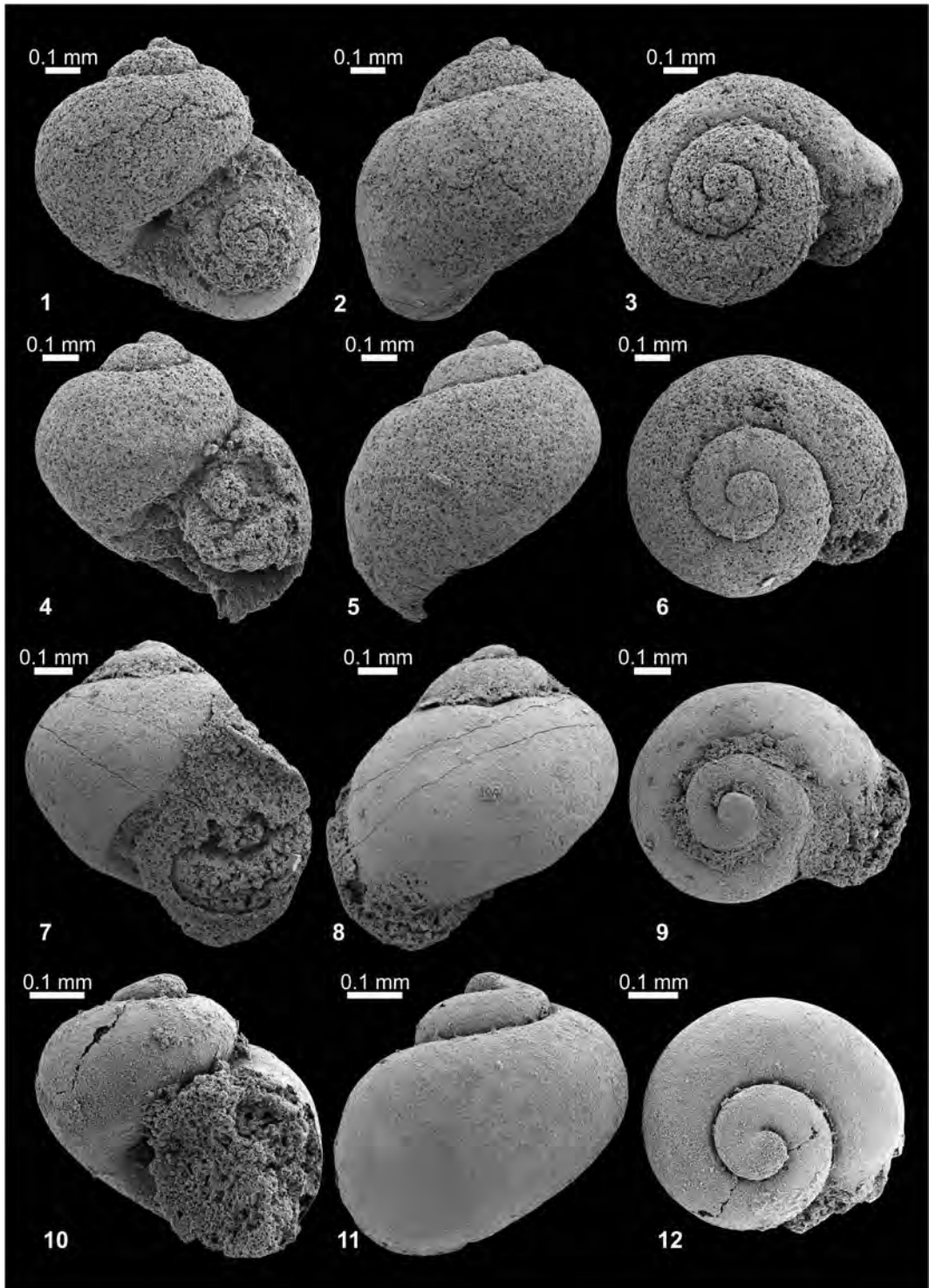


Fig. 131. Gastropods from the upper Middle Smithian. *Naticopsis* sp. indet. A, from BT02-03. 1–3, NMNS PM23816. 4–6, NMNS PM23817. 7–9, NMNS PM23818. 10–12, NMNS PM23819.

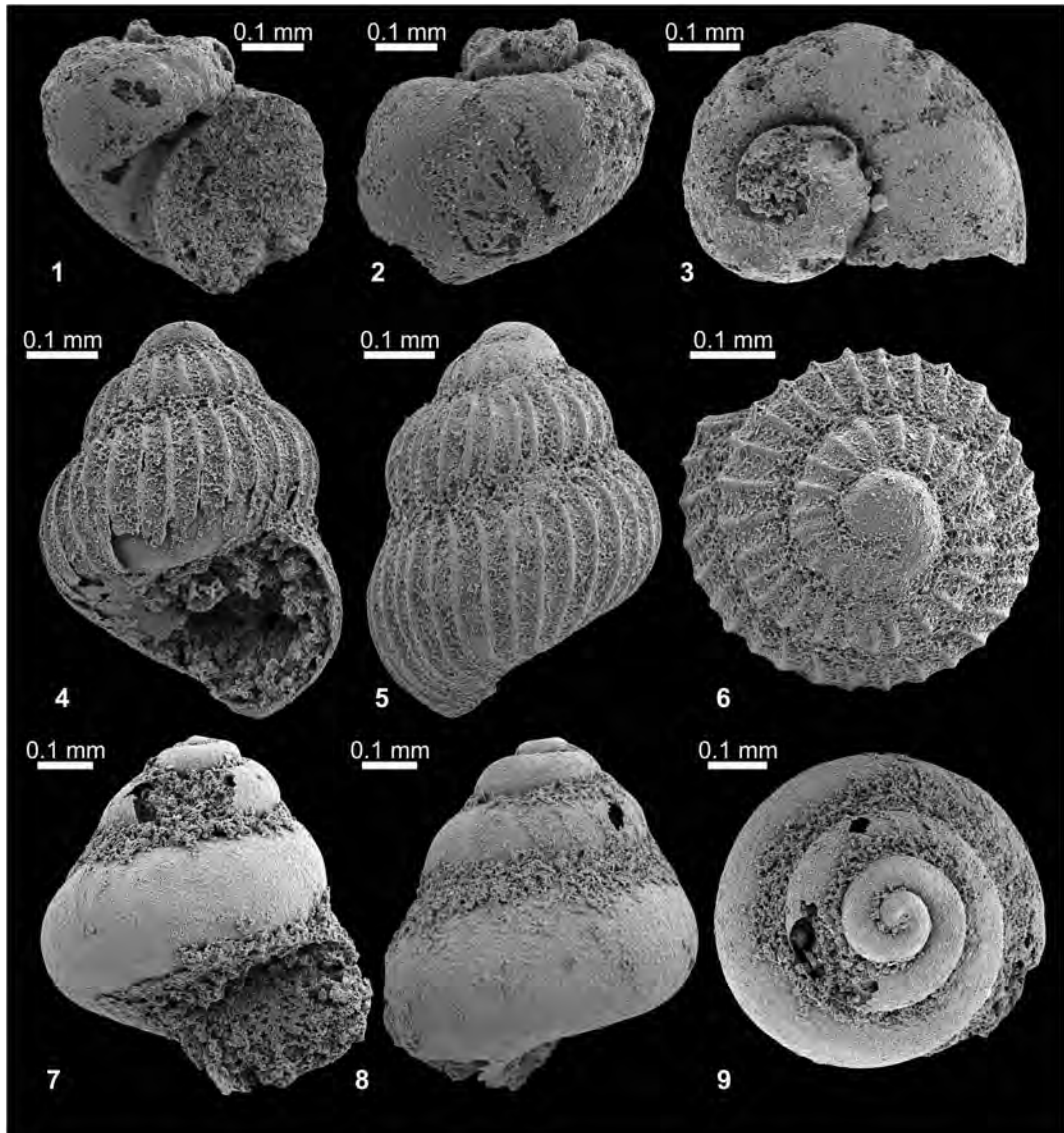


Fig. 132. Gastropods from the middle to upper Middle Smithian. 1–3, *Naticopsis* sp. indet. A, NMNS PM23820, from KC01-12. 4–9, *Ampezzopleura* sp. indet., from BT02-03. 4–6, NMNS PM23832. 7–9, NMNS PM23833.

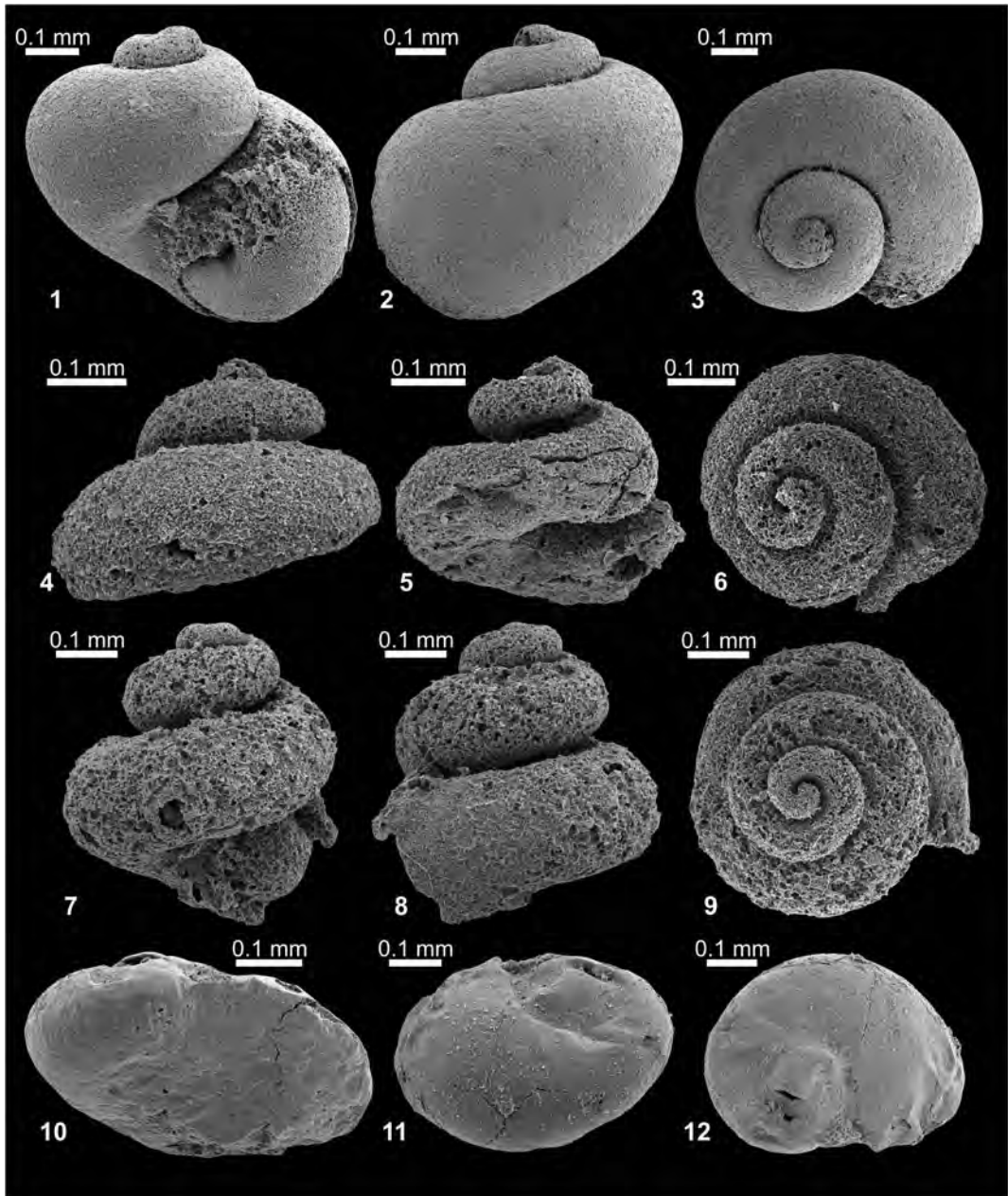
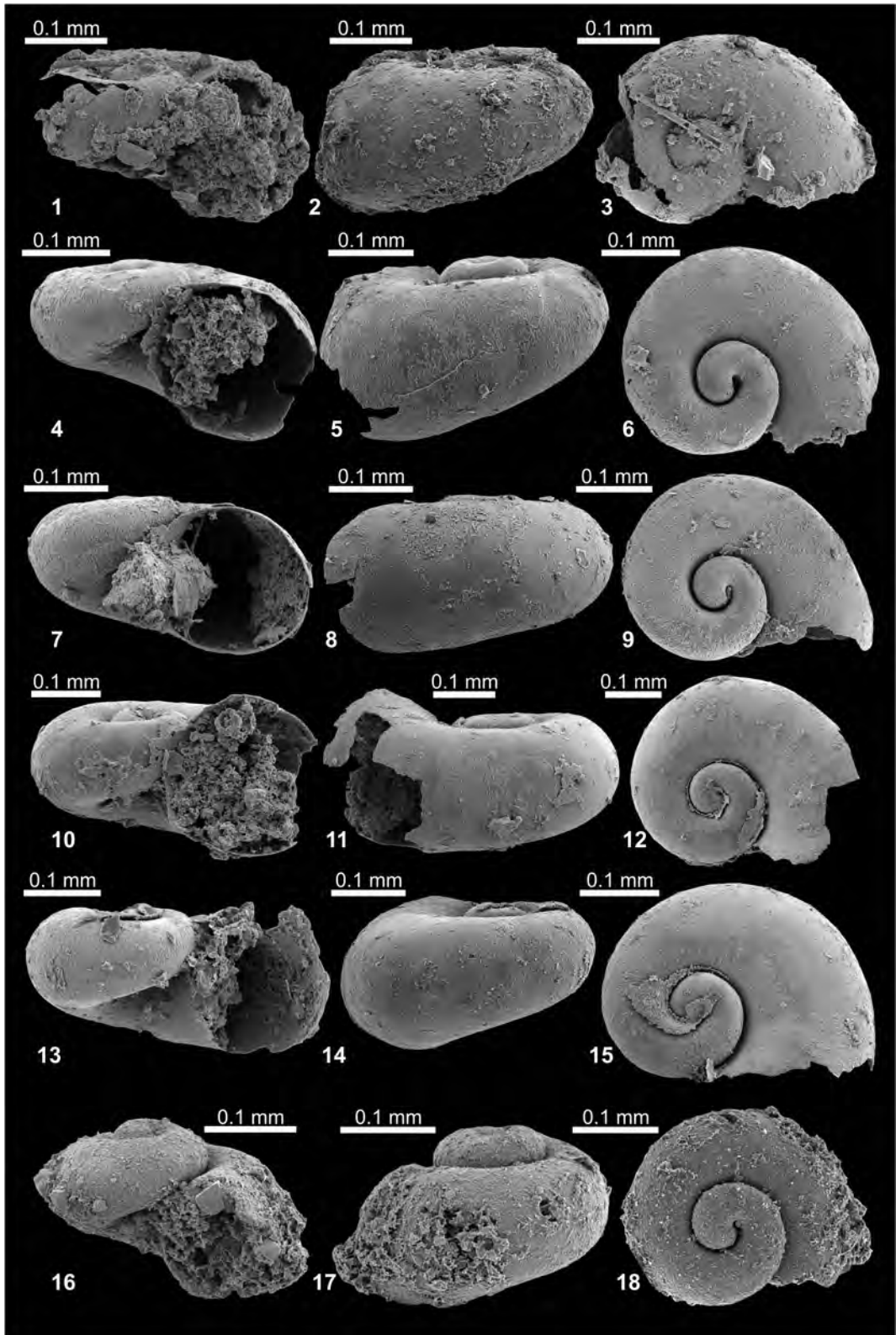


Fig. 133. Gastropods from the middle Middle Smithian. 1–3, *Atorcula* sp. indet., NMNS PM23844, from BT01-15. 4–9, unidentified caenogastropods, from KC01-13. 4–6, NMNS PM23852. 7–9, NMNS PM23853. 10–12, unidentified ?gastropod, NMNS PM23854, from KC01-13.

Fig. 134. Gastropods from the upper Middle and Upper Smithian. *Anomphalus?* sp. indet. 1–15, from KC02-03, 1–3, NMNS PM23805. 4–6, NMNS PM23806. 7–9, NMNS PM23807. 10–12, NMNS PM23808. 13–15, NMNS PM23809. 16–18, NMNS PM23810, from KC02-10.



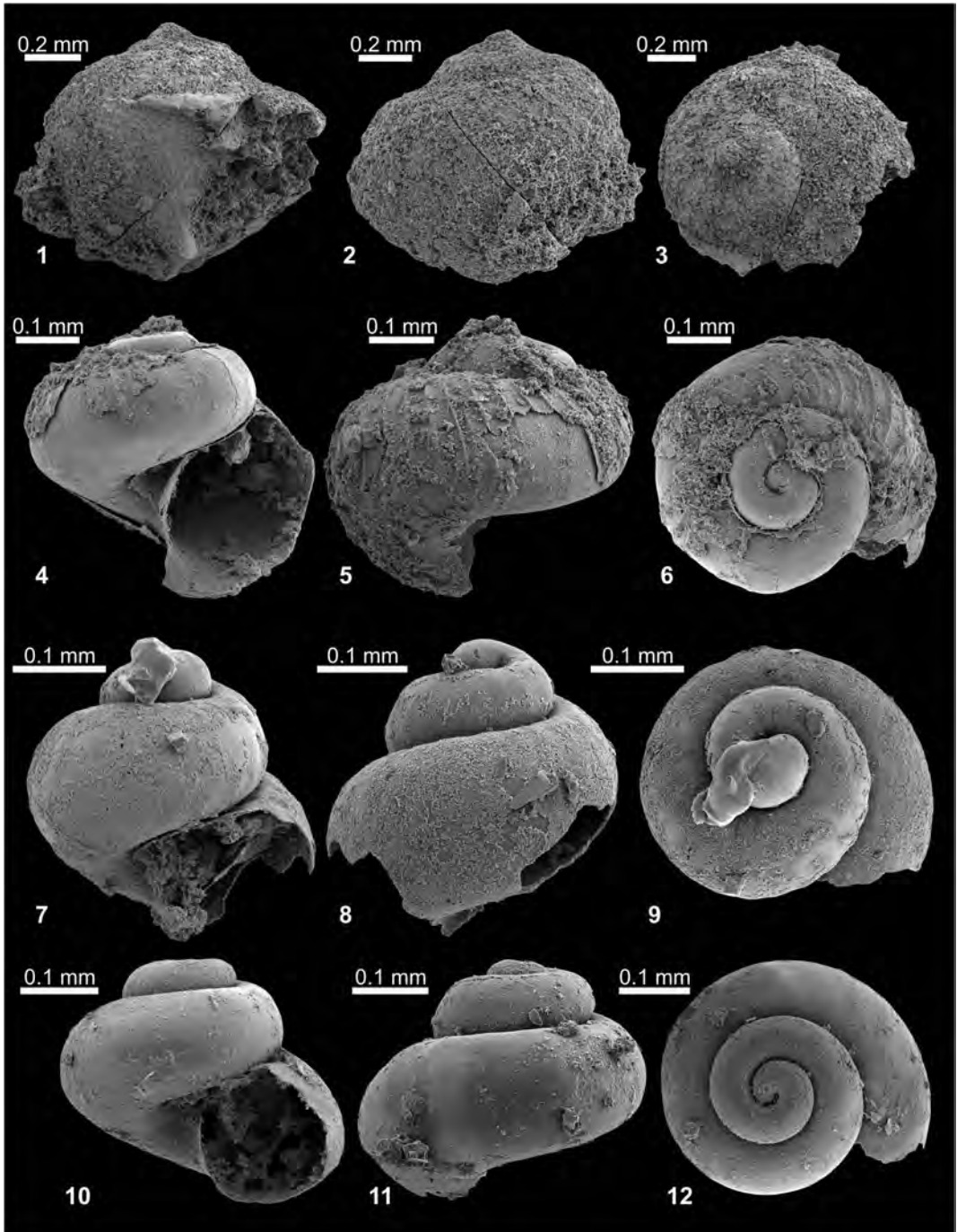


Fig. 135. Gastropods from the upper Middle and Upper Smithian. 1–3, *Naticopsis* sp. indet. A, NMNS PM23821, from KC02-10. 4–12, *Atorcula* sp. indet., from KC02-03. 4–6, NMNS PM23845. 7–9, NMNS PM23846. 10–12, NMNS PM23847.

nal aperture rather than drop-shaped, more flattened upper whorl surface, and a lower shell profile. The gross shell morphology of *Naticopsis* sp. indet. B is similar to *Abrekopsis depressispirus* (Batten and Stokes, 1986) but the initial whorl is bulbous (naticopsid) and not flattened as in *Abrekopsis* (see Kaim, 2009). All shells are early juveniles and we refrain from identifying them to a species level.

Occurrence: Described specimens from BT01-14, BT02-03 and KC01-13 within the portion of the *Novispathodus* ex gr. *waageni* Zone represented by the *Leyceras* horizon of the *Owenites koeneni* beds (middle Middle Smithian=middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Order Caenogastropoda Cox, 1960
 Superfamily Acteoninoidea Cossmann, 1895
 Family Soleniscidae Knight, 1931
 Genus *Strobeus* de Koninck, 1881

Type species: *Strobeus ventricosus* de Koninck, 1881.

Strobeus sp. indet.

Fig. 128.1–128.3

Material examined: One specimen, NMNS PM23831, from BT01-15.

Description: Shell of globular fusiform shape with 3.5 juvenile whorls preserved. Initial whorl corroded. Demarcation between protoconch and teleoconch not discernible. Shell surface smooth. Suture moderately impressed, flanks evenly convex with no shoulder or ramp. No clear demarcation between flank and base. Growth lines not discernible.

Discussion: The shell under consideration is similar to early whorls of *Strobeus pakistansis* Kaim, Nützel, Hautmann, and Bucher, 2013 from the Smithian of Pakistan (Kaim *et al.*, 2013) though we refrain from including the shells from Vietnam to the latter species because of its juvenile nature. Other Early Triassic *Strobeus* are known from the Smithian of Utah (Batten and Stokes, 1986; Nützel, 2005),

Dienerian of Russia (Kaim, 2009), and from Griesbachian of Oman (Wheley and Twitchett, 2005).

Occurrence: Described specimen from BT01-15 within the portion of the *Novispathodus* ex gr. *waageni* Zone within or above the *Owenites koeneni* beds (middle Middle Smithian=middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Superfamily Zygopleuroidea Wenz, 1938
 Family Zygopleuridae Wenz, 1938
 Subfamily Ampezzopleurinae Nützel, 1998
 Genus *Ampezzopleura* Bandel, 1991

Type species: *Ampezzopleura tenuis* Bandel, 1991.

Ampezzopleura sp. indet.

Fig. 132.4–132.9.

Material examined: Two specimens, NMNS PM23832–23833, from BT02-03.

Description: Protoconch 1 smooth, slightly bulbous, and composed of about one whorl. Protoconch 2 composed of 2.5 whorls ornamented by 30 axial ribs per whorl; axial ribs straight opisthocline to slightly sigmoidal, continuous from suture to suture. Teleoconch not present, either not developed or not preserved.

Discussion: The specimen NMNS PM23832 is a well preserved larval shell of *Ampezzopleura*. The specimen NMNS PM23833 is classified to *Ampezzopleura* only conditionally as its external surface is eroded away and the identification is based solely on gross shell morphology. We refrain from putting any species name on the larval shell alone. A single species of this genus was identified from the Early Triassic, *Ampezzopleura rugosa* (Batten and Stokes, 1986) has been reported from the Smithian of Utah, United States (Nützel and Schulbert, 2005).

Occurrence: Described specimen from BT02-03 within the portion of the *Novispathodus* ex gr. *waageni* Zone represented by the

Leyceceras horizon of the *Owenites koeneni* beds (middle Middle Smithian = middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Family Protorculidae Bandel 1991

Genus *Atorcula* Nützel, 1998

Type species: Melania canalifera zu Münster, 1841 sensu Kittl, 1894.

Atorcula sp. indet.

Figs. 123.4–123.6, 125, 126, 127.1–127.6, 133.1–133.3, 135.4–135.12

Material examined: Six specimens, NMNS PM23834–23839, from BT01-07, three specimens, NMNS PM23840–23842, from KC01-04, one specimen, NMNS PM23843, from BT01-06, one specimen, NMNS PM23844, from BT01-15, three specimens, NMNS PM23845–23847, from KC02-03, and one specimen, NMNS PM23848, from BT02-01.

Description: Protoconch 1 smooth and composed of about one whorl. Protoconch 2 composed of about 1.5–2 whorls ornamented by about 30 axial ribs; axial ribs opisthocyrt, slightly more incurved in abapical shell portion, and continuous from suture to suture. Teleoconch smooth, whorls convex and sutures deeply incised. Aperture circular.

Discussion: *Atorcula* unites protorculid gastropods characterised by an axially-ribbed protoconch followed by smooth high-spined shells; the present taxon differs from the type species in being relatively low and in having convex whorls and incised suture. Most of the shells from Vietnam, which we attributed to this genus have the outermost ornamented shell layer eroded away. Nevertheless, in a number of specimens the protoconch ornamentation is partially or wholly preserved (e.g., Figs. 125.1–125.6, 126.5, 135.4–135.6).

Occurrence: Described specimens from BT01-06, BT01-07, BT01-15, BT02-01, KC01-04 and KC02-03 within the *Novispath-*

odus ex gr. *waageni* Zone in the Bac Thuy Formation, northeastern Vietnam. BT02-01 is represented by the *Flemingites rursiradiatus* beds (lowest Middle Smithian = middle Lower Olenekian). BT01-06 and BT01-07 are located between the *Flemingites rursiradiatus* beds and the *Urduyceras tulongensis* beds (lower Middle Smithian = middle Lower Olenekian). KC01-04 is located beneath the *Owenites koeneni* beds (middle Middle Smithian = middle Lower Olenekian). BT01-15 is represented by the *Leyceceras* horizon of the *Owenites koeneni* beds. KC02-03 is located above the *Guodunites* horizon of the *Owenites koeneni* beds. *Atorcula* is known from the Late Triassic (Nützel 1998); it also resembles some *Omphaloptycha* species from the Early Triassic which have been reported from Utah (Batten and Stokes, 1986) and Russia (Kaim, 2009).

Bivalves (by T. Komatsu, H. T. Dang and T. C. Dinh)

Systematic descriptions basically follow the classification established by Newell (1938) and Moore (1969).

Abbreviations for shell dimensions: RV = right valve; LV = left valve; H = shell height; L = shell length; T = shell thickness.

Institution abbreviations: KMSP = Faculty of Science, Kumamoto University.

Class Bivalvia Linné, 1758

Order Pterioida Newell, 1965

Superfamily Posidonioidea Frech, 1909

Family Posidoniidae Frech, 1909

Genus *Bositra* de Gregorio, 1886

Type species: Posidonia ornati Quenstedt, 1856.

Remarks: Emended diagnoses of *Posidonia* Bronn, 1828 and *Bositra* were described by Waller and Stanley (2005). According to Waller and Stanley (2005), the characteristics of the right anterior auricle and byssal sinus of

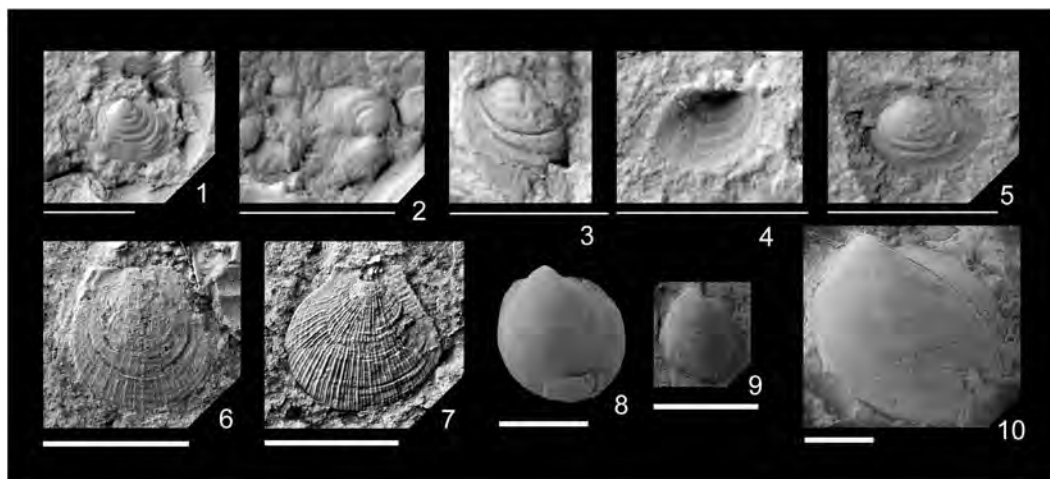


Fig. 136. 1–4, *Bositra limbata* (Guo, 1985). 1, KMSp-5131, from KC02-15, external cast of left valve. 2, KMSp-5132, from NT01-12, external cast of articulated valves. 3, KMSp-5133, from NT01-07, external cast of incomplete left valve. 4, KMSp-5134, from KC02-14, internal cast of left valve. 5, *Bositra* sp. indet, KMSp-5135, from KC02-03, external cast of left valve. 6–7, *Leptochondria bittneri* (Kiparisova, 1938) from KC02-14. 6, KMSp-5136, external cast of left valve. 7, KMSp-5137, external cast of left valve. 8–10, *Crittendenia langsonensis* Komatsu and Dang, 2013. 8, KMSp-5117 (paratype), from KC02-08, left valve. 9, KMSp-5120, from NT01-04, left valve. 10, KMSp-5119 (holotype), from NT01-09, left valve. Thick scale bars indicate 1 cm. Thin scale bars 5 mm.

Posidonia are more in line with placement near the Pterineidae rather than the Pterinoplectinidae. *Bositra* has a single adductor muscle scar and an alivincular ligament. In contrast, *Posidonia* is characterized by a duplivincular ligament system and anisomyarian adductor musculature. The Triassic “*Posidonia*” is placed in *Bositra* and is common in early Mesozoic offshore sediments (Waller and Stanley, 2005).

***Bositra limbata* (Guo, 1985)**

Fig. 136.1–136.4

Posidonia limbata Guo, 1985, pl. 15, figs. 1, 2.

Types: Type specimens figured by Guo (1985, pl. 15, figs. 1, 2) from the Middle Triassic Baifeng Formation, Jiuzhai, Funing, Yunnan, South China.

Material examined: Disarticulated left valves and articulated valves (KMSp-5131–5134) collected from dark gray and greenish gray laminated mudstones and marls in NT01 and KC02. KMSp-5131 and 5134 are moder-

ately well preserved.

Description: Shell small for genus, equi-valve, suborbicular to transversely oval in outline, shell length greater than shell height; test very thin; moderately convex valves, dorsal margin short and straight, ventral margins rounded, umbo not prominent but inflated, situated slightly anterior to the middle, auricles lacking; shell surface (except for umbonal area) covered with broad concentric ribs, fine lamellae and undulations; umbonal area covered with coarse concentric folds and undulations; byssal notch lacking; ligament and adductor muscle impressions unknown.

Measurements (in mm):

Specimen no.	H	L	T	Remarks
KMSp-5131	3.2	4.0	—	LV
KMSp-5134	1.9+	2.3	—	LV

Discussion: *Bositra limbata* has been described as *Posidonia limbata* from the Middle Triassic Baifeng Formation, Jiuzhai, Funing, Yunnan, South China (Guo, 1985). Guo (1985) described the umbonal area and ornamentation of this species in detail, reporting

that the early stage of the shell is much more inflated than the surrounding tissue, which is like “a gypsy-hat margin”. Fine broad concentric lamellae are rarely found on the fold.

In Vietnam, “*Posidonia*”, are commonly reported from the Middle Triassic (Vu Khuc *et al.*, 1991), although almost all species of these Triassic “*Posidonia*” probably belonged to *Bositra*. These Middle Triassic Vietnamese “*Posidonia*” are ornamented by many clear concentric ribs and have never been reported from the Lower Triassic.

Occurrence: Described specimens from NT01-07 and KC02-09 within the *Novispathodus pingdingshanensis* Zone represented by the *Xenoceltites variocostatus* beds (upper Smithian=upper Lower Olenekian), and those from BR01-06 between the *Xenoceltites variocostatus* beds and *Tirolites* sp. nov. beds (lower Spathian=lower Upper Olenekian), and those from KC02-14 and KC02-15 within the *Triassospathodus symmetricus* Zone represented by the *Tirolites* sp. nov. beds, and those from NT01-11, NT01-12 and BR01-08 within the *Tirolites* sp. nov. beds in the Bac Thuy Formation, northeastern Vietnam. They co-occur with *Crittendenia australasiatica*, *Crittendenia langsonensis*, *Leptochondria bittneri*, and “*Pseudomonotis*” *himaica*. This species also occurs in the Middle Triassic Baifeng Formation, Yunnan, South China (Guo, 1985).

***Bositra* sp. indet.**

Fig. 136.5

Material examined: Poorly preserved disarticulated left valve (KMSP-5135) collected from greenish gray laminated mudstone.

Description: Shell small and suborbicular to elongately ovate; shell length greater than shell height; test very thin; moderately convex valve; dorsal margin short and straight; ventral margins rounded; umbo not prominent but inflated, situated a little anterior to middle; auricles lacking; shell surface covered with fine weak concentric ribs and undulations; umbo-

nal area smooth; byssal notch lacking; ligament and adductor muscle impressions unknown.

Measurements (in mm):

Specimen no.	H	L	T	Remarks
KMSP-5135	2.0	3.0	—	LV

Discussion: This species is characterized by an elongately ovate shell ornamented with weak concentric ribs. In contrast, *B. limbata* is suborbicular to transversely oval in outline and is characterized by broad concentric ribs.

Occurrence: Described specimen from KC02-03 within the portion of the *Novispathodus* ex gr. *waageni* Zone above the *Guodunites* horizon of the *Owenites koeneni* beds (upper Middle Smithian=middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Order Pterioida Newell, 1965

Superfamily Pterinopectinacea Newell, 1938

Family Pterinopectinidae Newell, 1938

Subfamily Claraiinae Gavrillova, 1996

Genus *Crittendenia* Newell and Boyd, 1995

Type species: *Crittendenia kummeli* Newell and Boyd, 1995.

Crittendenia australasiatica

(Krumbeck, 1924)

Fig. 137

Pseudomonotis australasiatica Krumbeck, 1924, pl. 8, figs. 8–10.

Pseudomonotis subconvexa Krumbeck, 1924, pl. 8, fig. 12a, b.

Claraia australasiatica (Krumbeck, 1924). Kiparisova, 1938, pl. 3, figs. 8, 9a, b, 10.

Crittendenia australasiatica (Krumbeck, 1924). Komatsu and Dang, 2013, figs. 4.1–4.18, 4.24, 4.26–4.28.

Types: Type specimens sketched by Krumbeck (1924, pl. 8, figs. 8–10) from the Lower Triassic, Timor, Indonesia.

Material examined: Abundant well-preserved left valves and several right valves collected from calcareous nodules and limestone beds (KMSP-5100–5115, 5122–5124). Over-

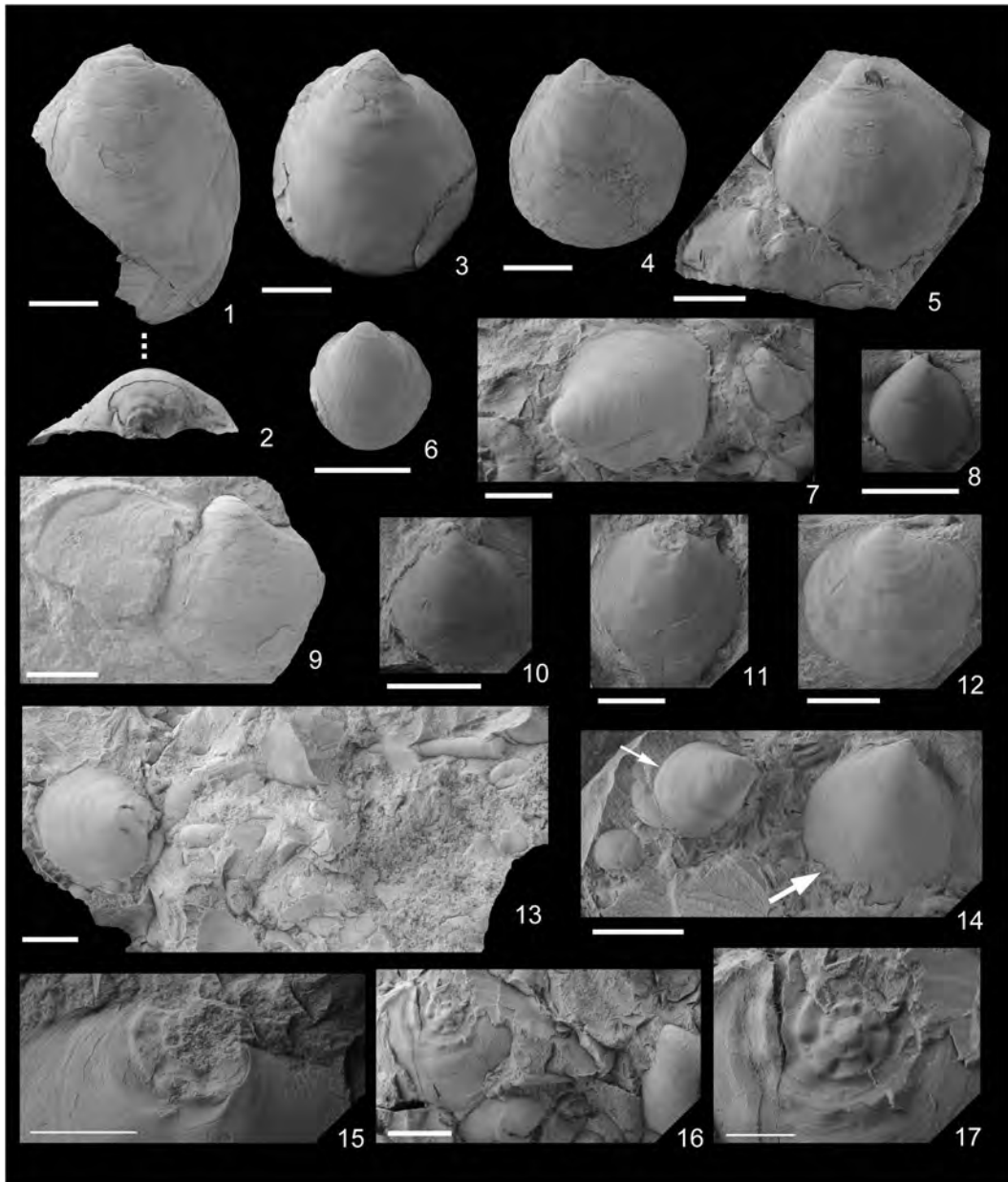


Fig. 137. *Crittendenia australasiatica* (Krumbeck, 1924). 1, KMSp-5110, from NT01-09, external view of left valve. 2, Dorsal view of KMSp-5110, umbonal showing imprint of ammonoid (*Xenocelites variocostatus* Brayard and Bucher, 2008). 3, KMSp-5111, from NT01-09, left valve. 4, KMSp-5101, from NT01-09, left valve. 5, KMSp-5126 (left valve) and KMSp-5122 (right valve), from KC02-08, KMSp-5122 (lower) showing irregular attachment cicatrix on right valve. 6, KMSp-5105, from NT01-04, left valve. 7, KMSp-5127, from NT01-04, left valve. 8, KMSp-5128, from BR01-04, left valve. 9, KMSp-5116, from NT01-07, right and left valves, showing anterior auricle of right valve. 10, KMSp-5129, from KC02-06, left valve. 11, KMSp-5123, from NT01-04, right valve. 12, KMSp-5114, from NT01-05, right valve. 13, KMSp-5113, from NT02-04, modes of occurrence of *C. australasiatica* and ammonoid shells. 14, *Crittendenia langsonensis* Komatsu and Dang, 2013 (small arrow), KMSp-5125, and *C. australasiatica* (large arrow), KMSp-5108, from NT01-07, left valves. 15, KMSp-5123, umbonal area showing imprint of ammonoid (*X. variocostatus*) umbilicus on right valve. 16, KMSp-5124, from NT01-07, modes of occurrence of *C. australasiatica* and ammonoid shells. 17, KMSp-5124, umbonal area showing imprint of ammonoid (*X. variocostatus*) umbilicus on right valve. Thick scale bars indicate 1 cm. Thin scale bars 5 mm.

lapping solitary right and left valves found in a calcareous nodule (KMSP-5116; Fig. 137.9).

Description: Shell moderate in size for genus, inequivalve, orbicular or suborbicular in outline; length and height of shells subequal, or height slightly greater than length; test very thin; hinge line straight and moderately long for genus; strongly convex left valve, orthocline; anterior wing small without sinus, posterior wing also small and indistinguishable; ventral margins rounded, umbo protruded above hinge line, situated mostly central; umbonal angle about 90 to 120 degrees; shell surface of left valve moderately smooth except for very weak concentric growthlines, irregularly faint radial threads, and ribs occasionally showing growth stop; slightly inflated right valve ornamented with irregularly, very weak radials and growthlines, posterior wing not differentiated, anterior auricle small for genus, surface of auricle smooth, narrow and moderately deep byssal notch conspicuous; dorsal area of right valve and umbonal area of left valve occasionally imprinted by the reflecting substrate, for example, an ammonoid umbilicus.

Measurements (in mm):

Specimen no.	H	L	T	Remarks
KMSP-5100	33.1	34.4	11.8	LV
KMSP-5101	28.9	31.2	8.8	LV
KMSP-5102	26.1	26.2	8.5	LV
KMSP-5111	29.1	32.0	9.5	LV
KMSP-5113	22.4	20.7	3.7	RV
KMSP-5114	23.6	22.1	4.4	RV
KMSP-5128	12.1+	11.2	3.1	LV

Discussion: *Crittendenia australasiatica* has been described as *Pseudomonotis australasiatica* on the basis of the left valve from the Lower Triassic Timor, Indonesia (Krumbeck, 1924). Komatsu *et al.* (2013) recently reported some well-preserved right and left valves of this species from NT01-03 to NT01-07 within the *Xenoceltites variocostatus* beds in the Bac Thuy Formation; they described right valves and juveniles of this species in detail.

The described specimens show an impor-

tant diagnostic characteristic for the genus. Small attachment imprints are clearly marked on the umbonal area of the left valve and near the byssal notch of the right valve (Fig. 137.15–137.17). Some of the imprints of the attachments are coiled impressions of ammonoid umbilicus of *Xenoceltites variocostatus* (Fig. 137.2, 137.15–137.17). Newell and Boyd (1995) described *Crittendenia kummeli* specimens characterized by a coiled negative impression of an ammonoid umbilicus from the *Meekoceras* zone of the Thaynes Formation, northeast Nevada, USA.

Occurrence: Described specimens from KC02-06, KC02-07 and BR01-01 to BR01-04, below the *Xenoceltites variocostatus* beds (Upper Smithian=upper Lower Olenekian), and those from BT02-05, KC02-10, KC02-11, NT01-01 to NT01-07, NT01-09 and BR01-05 within the *Novispathodus pingdingshanensis* Zone that includes the *Xenoceltites variocostatus* beds and *Tirolites cf. cassianus* beds, and those from KC02-12 to KC02-17 within the *Triassospathodus symmetricus* Zone that includes the *Tirolites cf. cassianus* beds (lowest Lower Spathian=lowest Upper Olenekian) and *Tirolites sp. nov.* beds (Lower Spathian=lower Upper Olenekian), and those from BR01-06 and BR01-07 between the *Xenoceltites variocostatus* beds and *Tirolites sp. nov.* beds, and those from BT02-07, BT02-08, KC02-18, NT01-10 to NT01-12, and BR01-08 within the *Tirolites sp. nov.* beds in the Bac Thuy Formation, northeastern Vietnam. This species also occurs in the Lower Triassic in Timor, Indonesia (Krumbeck, 1924) and the upper Smithian to lower Spathian on Russky Island, South Primorye, Russia (Kiparisova, 1938).

***Crittendenia langsonensis* Komatsu and Dang, 2013**

Figs. 136.8–136.10, 137.14

Crittendenia langsonensis Komatsu and Dang, 2013, figs. 4.19–4.24, 10.

Holotype: Holotype KMSP-5119, figured by Komatsu and Dang (2013, fig. 4.21) from NT01-06 within the *Xenoceltites variocostatus* beds in the Bac Thuy Formation.

Material examined: Holotype (KMSP-5119), paratypes (KMSP-5117, 5118, 5120) from NT01-04, 07, and 09, and one specimen from KC02-08.

Descriptions: Shells of average size for genus, inequivalve and inequilateral, prosocline, suborbicular in outline, slightly longer than high; test very thin; surface ornamented with growth lines and irregularly faint threads and radials occasionally representing growth stop; hinge line moderately long and straight; left valve inflated, strongly prosogyrous umbo protruded above hinge line, situated about 1/3 to 2/5 of the way from the anterior margin; umbonal angle about 95 to 105 degrees; obtuse anterior left wing very small without sinus; posterior left wing inconspicuous, ventral margins rounded; right valve gently convex, non-protruded umbo; right spatulate small anterior auricle ornamented with fine clear ribs parallel to the anterior auricle end; byssal sinus; hinge unknown.

Measurements (in mm):

Specimen no.	H	L	T	Remarks
KMSP-5119	27.5+	28.6	7.8	LV (Holotype)
KMSP-5117	12.7	13.5	5.0	LV (Paratype)
KMSP-5120	8.9	9.6	3.5	LV (Paratype)
KMSP-5125	12.1	10.9	4.9	LV

Discussion: *Crittendenia langsonensis* is characterized as a prosocline species and is ornamented with faint radial threads on the left valve. Prosocline species are not common in this genus. Olenekian (upper Smithian?/Spethian) *C. nammalensis* (Nakazawa, 1996) characterized as typical prosocline shells described by Waterhouse (2000) are reported from the Langpo Member, Gungdang Formation, Manang, Nepal and the Sungjar Formation, the Salt Range, Pakistan. However, only poorly preserved *C. nammalensis* are figured and sketched by Waterhouse (2000).

Occurrence: Described specimens from

KC02-08 and NT01-05 to NT01-09 within the portion of the *Novispathodus pingdingshanensis* Zone represented by the *Xenoceltites variocostatus* beds (Upper Smithian=upper Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Superfamily Pseudomonotoidea Newell, 1938
Family Leptochondriidae Newell and Boyd, 1995
Genus *Leptochondria* Bittner, 1891

Type species: *Pecten (Leptochondria) aeolicus* Bittner, 1891.

Leptochondria bittneri (Kiparisova, 1938)

Fig. 136.6–136.7

Pseudomonotis cf. *multiformis* Bittner, 1899, p.10, pl. 2, figs. 11–14.

Pecten (Velopecten) bittneri Kiparisova, 1938, p. 289, pl. 4, figs. 5–9, 11, 13.

Holotype: Right valve, figured by Kiparisova (1938, p. 289, pl. 4, fig. 13), from the Lower Triassic, Russky Island, South Primor'ye, Russia.

Material examined: Disarticulated left valves collected from dark gray and greenish gray laminated shales (KMSP-5136, 5137). Almost all specimens moderately well preserved.

Description: Left valve moderate in size for genus, suborbicular in outline, moderately inflated; test very thin; dorsal margin short and straight, ventral margins well rounded, umbo slightly projecting above dorsal margin, situated central; anterior and posterior auricles right-angled to obtuse, indistinctly delimited from disk; shell surface ornamented with fine radial ribs and concentric lamellae, close-set radial ribs, intercalating in two or three ranks; about 15 to 20 first-order ribs slightly prominent, weaker ribs separated by first-order ribs, first- and second-order ribs rarely bifurcated; concentric fine lamellae irregularly spaced on marginal ventral surface; hinge and internal structures unknown, right valve not collected.

Measurements (mm):

Specimen no.	H	L	T	Remarks
KMSP-5136	8.1	8.0	—	LV
KMSP-5137	10.7	11.1	—	LV

Discussion: The ornamentations of *Leptochondria bittneri* are more or less variable. According to Kiparisova (1938, pl. 4, figs. 5–9, 11, 13), the shell surface is irregularly covered by concentric lamellae and very fine concentric ribs. Furthermore, the number, sequence, and strength of the radial ribs are quite variable. In addition, third-order radial ribs and concentric erect lamellae are not found on some Russian specimens (e.g. fig. 9, pl. 4 in Kiparisova, 1938). Vietnamese specimens are similar to specimens of Kiparisova (1938, pl. 4, figs. 5–7).

Leptochondria bittneri resembles *L. minima* (Kiparisova, 1938) described from the Induan Lazurnaya Formation and Induan to Olenekian (Smithian) Zhitkov Formation by Kiparisova (1938). *L. minima* is also characterized by variable shell ornamentations. However, the primary ribs of *L. bittneri* are much stronger than those of *L. minima* (Kumagae and Nakazawa, 2009). In addition, *L. bittneri* is distinguished from *L. minima*, which is characterized by very fine numerous radial ribs.

Leptochondria cf. *bittneri* reported from the Lower Triassic Daye Formation, Guizhou, South China, by Gu (1976) and the Guizhou Bureau of Geology and Mineral Resources (1987) is very similar to *L. bittneri*. However, we cannot confirm, because the umbonal area of the specimen figured by Gu (1976, pl. 29, fig. 4) is poorly preserved.

Occurrence: Described specimens from NT01-07 to NT01-09 within the *Novispathodus pingdingshanensis* Zone represented by the *Xenoceltites variocostatus* beds (upper Smithian=upper Lower Olenekian), and those from KC02-14 within the *Triassospathodus symmetricus* Zone represented by the *Tirolites* sp. nov. beds (Lower Spathian=lower Upper Olenekian), and those from BR01-07 between the *Xenoceltites variocostatus* beds and *Tirolites* sp. nov. beds in the Bac Thuy Formation,

northeastern Vietnam. This species also occurs in the Lower Triassic Tobizin Formation in South Primorye, Russia (Bittner, 1899; Kiparisova, 1938).

Conodonts (by T. Maekawa and H. Igo)

Terminology for the orientation of elements has largely been modified by intensive analysis of multielement reconstruction of conodont animals (e.g., Purnell *et al.*, 2000). All specimens described herein are discrete P elements; hence, the orientation terms proposed by Orchard (1995, 2005) are utilized, and the supergeneric classification proposed by Orchard (2005, 2007a) and Sweet (1988) has also been adopted.

Institution abbreviation: MPC=Micro-paleontology Collection, National Museum of Nature and Science, Tsukuba.

Order Ozarkodinida Dzik, 1976
 Superfamily Gondolelloidea (Lindström, 1970)
 Family Gondolellidae Lindström, 1970
 Subfamily Mullerinae Orchard, 2005
 Genus *Conservatella* Orchard, 2005

Type species: *Ctenognathus conservativa* Müller, 1956.

Conservatella conservativa (Müller, 1956)

Figs. 138–140, 141.1–141.6

Ctenognathus conservativa Müller, 1956, p. 821, pl. 95, fig. 25.

Neospathodus conservativa (Müller, 1956). Buryi, 1979, p. 50, pl. 9, fig. 1.

Neospathodus conservativus (Müller, 1956). Sweet *et al.*, 1971, pl. 1, fig. 10; Solien, 1979, p. 303, pl. 3, figs. 5–6.

multielement apparatuses, *Conservatella* aff. *conservativa* (Müller, 1956). Orchard, 2005, p. 81, text-fig. 7.

Conservatella conservativa (Müller, 1956). Orchard, 2008, p. 402, figs. 8.20–8.21.

Material examined: Three specimens, MPC25067–25069, from BT01-03, two specimens, MPC25070, 25071, from BT01-04, one specimen, MPC25072, from BT01-06, four specimens, MPC25073–25076 from BT01-07,

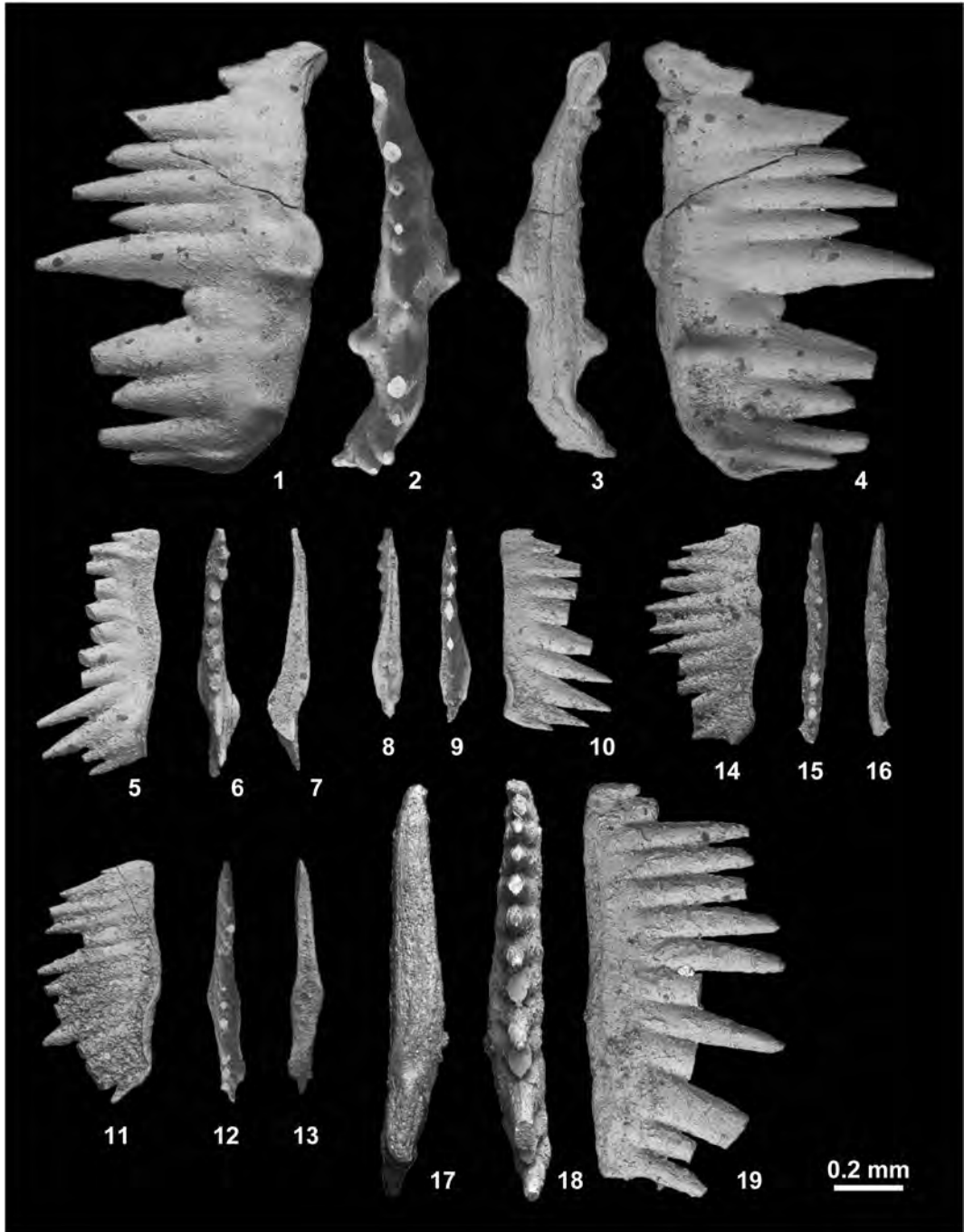


Fig. 138. *Conservatella conservativa* (Müller, 1956). 1–4, MPC25067, from BT01-03. 5–7, MPC25068, from BT01-03. 8–10, MPC25069, from BT01-03. 11–13, MPC25070, from BT01-04. 14–16, MPC25071, from BT01-04. 17–19, MPC25072, from BT01-06.

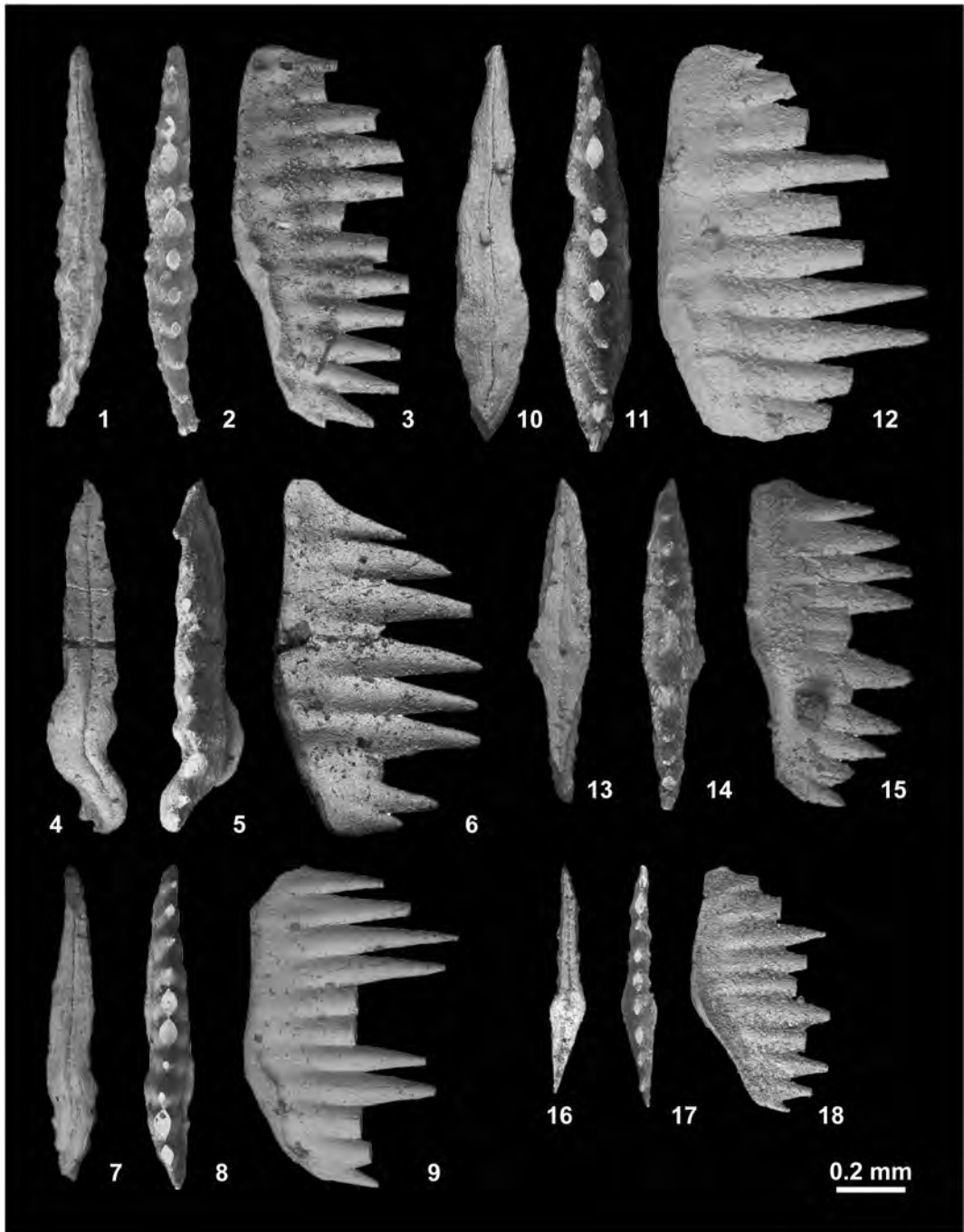


Fig. 139. *Conservatella conservativa* (Müller, 1956). 1–3, MPC25073, from BT01-07. 4–6, MPC25074, from BT01-07. 7–9, MPC25075, from BT01-07. 10–12, MPC25076, from BT01-07. 13–15, MPC25077, from BT01-10. 16–18, MPC25078, from BT01-10.

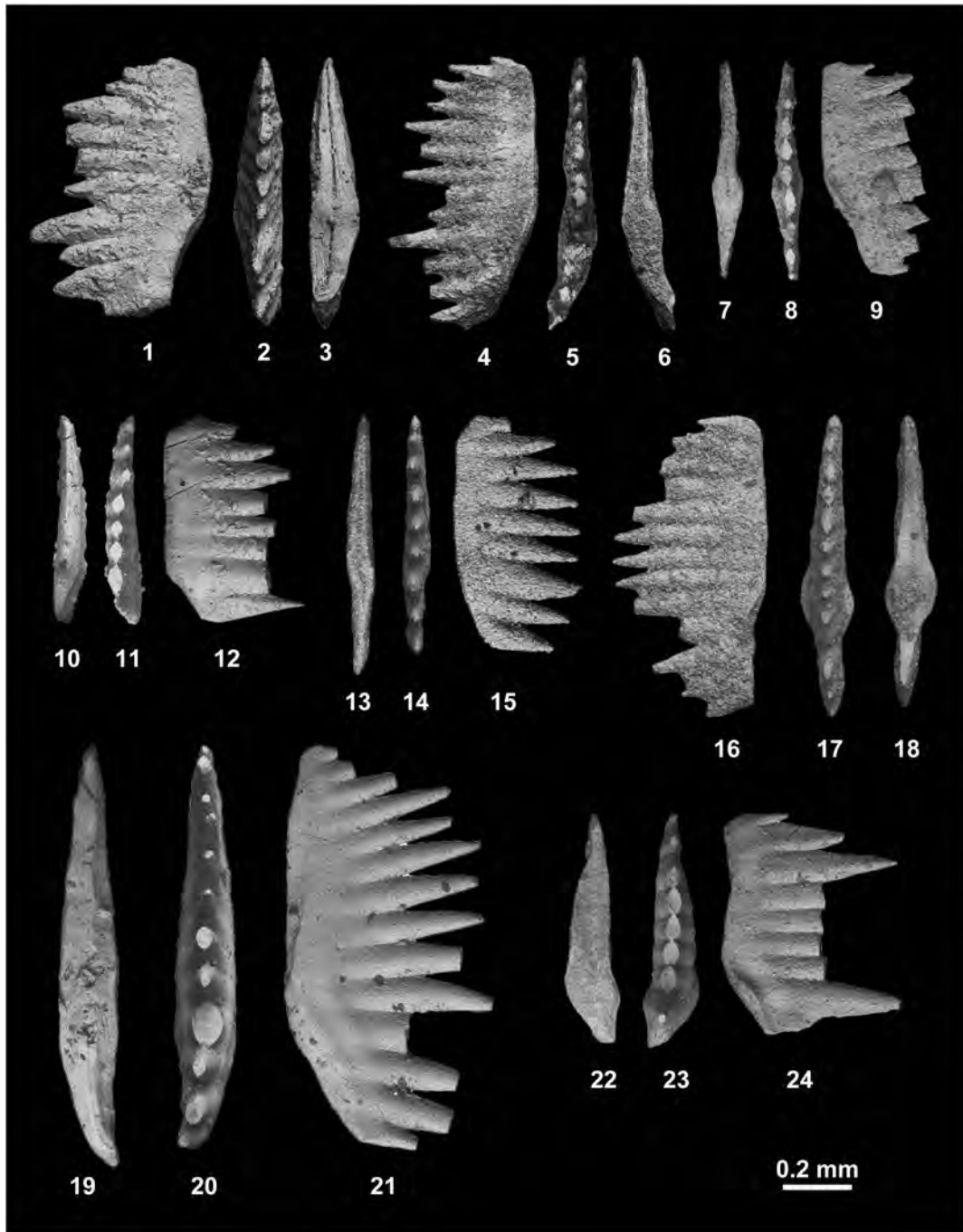


Fig. 140. *Conservatella conservativa* (Müller, 1956). 1–3, MPC25079, from BT01-10. 4–6, MPC25080, from BT01-10. 7–9, MPC25081, from BT01-12. 10–12, MPC25082, from BT01-14. 13–15, MPC25083, from BT02-01. 16–18, MPC25084, from BT02-01. 19–21, MPC25085, from BT02-02. 22–24, MPC25086, from BT02-02.

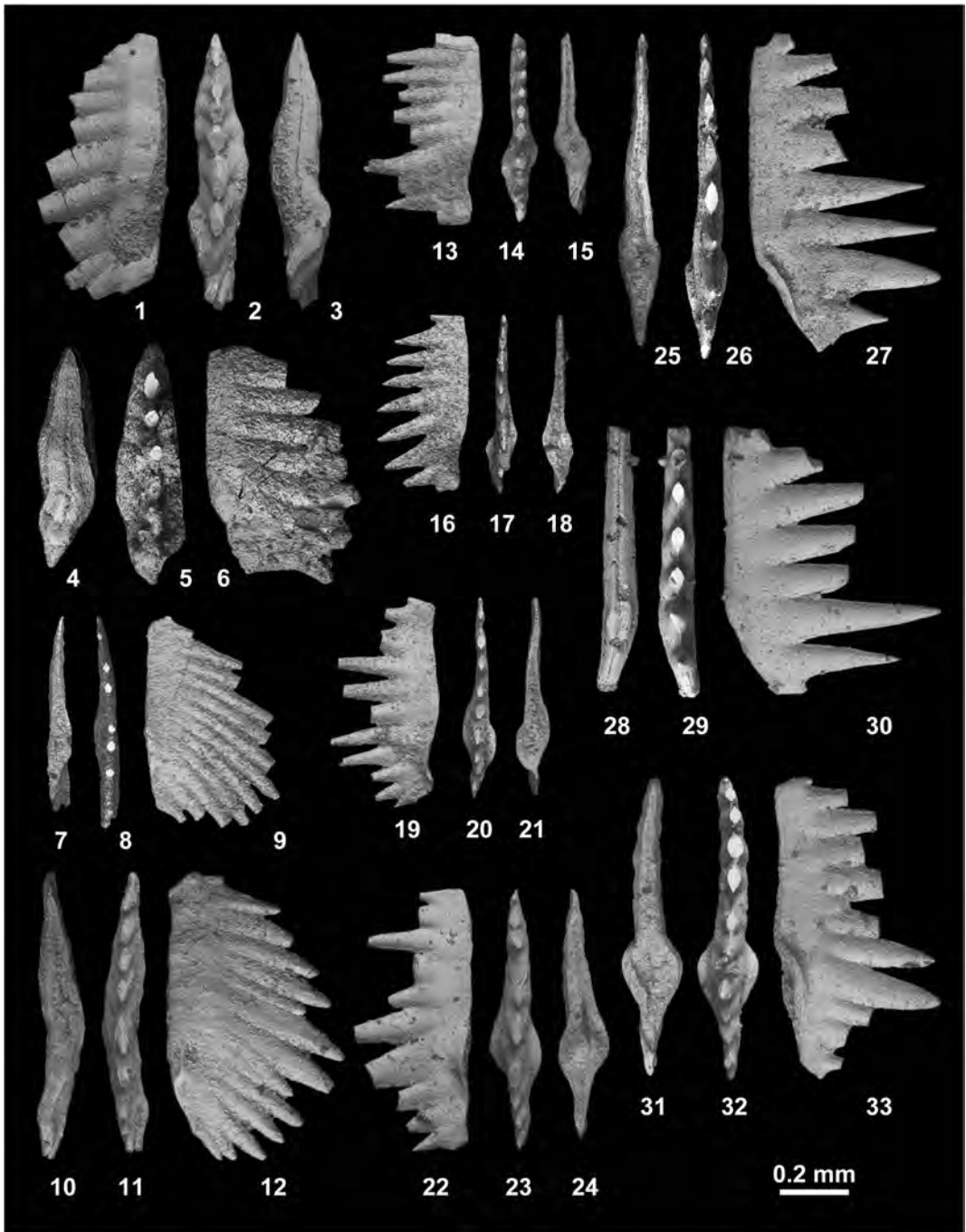


Fig. 141. 1–6, *Conservatella conservativa* (Müller, 1956). 1–3, MPC25087, from BT02-02. 4–6, MPC25088, from BT03-01. 7–12, *Conservatella* sp. indet. A. 7–9, MPC25089, from BT01-03. 10–12, MPC25090, from BT01-04. 13–33, *Discretella discreta* (Müller, 1956). 13–15, MPC25091, from BT01-03. 16–18, MPC25092, from BT01-03. 19–21, MPC25093, from BT01-03. 22–24, MPC25094, from BT01-04. 25–27, MPC25095, from BT01-06. 28–30, MPC25096, from BT01-06. 31–33, MPC25097, from BT01-06.

four specimens, MPC25077–25080, from BT01-10, one specimen, MPC25081, from BT01-12, one specimen, MPC25082, from BT01-14, two specimens, MPC25083, 25084, from BT02-01, three specimens, MPC25085–25087, from BT02-02, and one specimen, MPC25088, from BT03-01.

Description: Laterally compressed, rectangular or rhombic segminate elements 0.59–1.26 mm in length, average 0.85 mm; 0.31–0.85 mm in height, average 0.49 mm; length to height ratio 1.2–2.2, average 1.7 for twenty-two specimens. Pointed spine-like denticles vary in number from 7 to 14, average 11, straight or slightly reclined posteriorly, discrete in upper two-thirds, fused in lower one-third. Basal margin straight or slightly upturned in anterior and upturned 5–40 degrees, average 18 degrees at middle to one-third posterior margin. Triangular, non-expanded, flat or slightly convex basal cavity posteriorly extended. Anterior groove continues to posterior end. Some elements curved left or right side posteriorly.

Remarks: The Bac Thuy Formation includes many well preserved specimens of *Conservatella conservativa* (Müller, 1956) that exhibit denticles and a groove at different growth stages. The length of the denticule and the upturned position of the basal part of the element are variable, but they share some common features including slightly fused denticles and a non-expanded and non-concave basal cavity, features that are recognized only in this species. Smaller specimens (MPC25068–25071, 25078, etc.), in contrast to larger ones with typical form (MPC25067, 25072–25076, etc.), are probably juveniles, and have fused short denticles. These features are different from juvenile specimens of *Discretella discreta* (Müller, 1956), whose denticles are more discrete and fewer in number.

Occurrence: Described specimens from BT01-03, BT01-04, BT01-06, BT01-07, BT01-10, BT01-12, BT01-14, BT02-01, BT02-02 and BT03-01 within the portion of

the *Novispathodus* ex gr. *waageni* Zone that includes the *Flemingites rursiradiatus* beds (lowest Middle Smithian=middle Lower Olenekian), *Urdoceras tulongensis* beds (lower Middle Smithian=middle Lower Olenekian) and *Leyceras* horizon of the *Owenites koenei* beds (middle Middle Smithian=middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam. This species also occurs in the Middle Smithian in Nevada (*Meekoceras* beds, Müller, 1956; Sweet *et al.*, 1971), Utah (*Furnishius* Zone to *Parachirognathus* Zone, Solien, 1979), South Primorye, Russia (*Parachirognathus-Furnishius* Zone, Buryi, 1979), Jabra Safra, Oman (Orchard, 2005), and Canadian Arctic (*Euflemingites romunderi* Zone, Orchard, 2008).

Conservatella sp. indet. A

Fig. 141.7–141.12

Material examined: One specimen, MPC25089, from BT01-03, and one specimen, MPC25090, from BT01-04.

Description: Two laterally compressed segminate elements 0.61–0.84 mm in length; 0.39–0.52 mm in height; length to height ratio 1.6. Strongly reclined and fused denticles total 13 and 14 in number. Cusp situated at middle to posterior part with two posterior small denticles. Basal margin straight in anterior and slightly upturned in posterior. Non-expanded basal cavity extended posteriorly. Anterior shallow groove extends to basal pit.

Remarks: The laterally compressed element with fused denticles suggests that the described specimens belong to the genus *Conservatella*. However, their extremely reclined and fused denticles are different from those of the type species of the genus, *C. conservativa* (Müller, 1956). They probably represent an unknown species of *Conservatella*.

Occurrence: Described specimens from BT01-03 and BT01-04 within the portion of the *Novispathodus* ex gr. *waageni* Zone represented by the *Flemingites rursiradiatus* beds

(lowest Middle Smithian=middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam.

Genus *Discretella* Orchard, 2005

Type species: Ctenognathus discreta Müller, 1956.

Discretella discreta (Müller, 1956)

Figs. 141.13–141.33, 142–145, 146.1–146.30

Ctenognathus discreta Müller, 1956, p. 821, pl. 95, fig. 28.
Neospathodus conservativus (Müller, 1956). Koike, 1982, p. 36, pl. 6, figs. 12–14.
Neospathodus discretus (Müller, 1956). Tian *et al.*, 1983, p. 376, pl. 95, fig. 1.
Neospathodus aff. *crisagalli* (Huckriede, 1958). Bui, 1989, p. 404, pl. 30, fig. 1.
 multielement apparatuses, *Discretella* sp. A, Orchard, 2005, p. 83, text-fig. 8.
Discretella discreta (Müller, 1956). Orchard, 2008, p. 402, figs. 8.18–8.19; Beranek *et al.*, 2010, figs. 6.18, 6.19.

Material examined: Three specimens, MPC25091–25093, from BT01-03, one specimen, MPC25094, from BT01-04, three specimens, MPC25095–25097, from BT01-06, four specimens, MPC25098–25101, from BT01-07, five specimens, MPC25102–25106, from BT01-10, one specimen, MPC25107, from BT01-12, two specimens, MPC25108, 25109, from BT01-14, seven specimens, MPC25110–25116, from BT02-01, four specimens, MPC25117–25120 from BT02-02, one specimen, MPC25121, from BT02-03, two specimens, MPC25122, 25123, from BT03-01, one specimen, MPC25124, from KC01-01, three specimens, MPC25125–25127, from KC01-04, two specimens, MPC25128, 25129, from KC01-05, four specimens, MPC25130–25133, from KC01-11, four specimens, MPC25134–25137, from KC01-12, two specimens, MPC25138, 25139, from KC01-13, one specimen, MPC25140, from KC02-02, and two specimens, MPC25141, 25142, from PK01-02.

Description: Long and slender segminate elements 0.35–1.36 mm in length, average

0.77 mm; 0.27–0.72 mm in height, average 0.42 mm; length to height ratio 1.1–2.4, average 1.7 for fifty-two specimens. General profile of element rectangular, highest point situated at posterior one-third to posterior margin. Lower margin of element almost straight to slightly undulated and posterior part upturned in some specimens. Discrete denticles vary in number from 4 to 13, average 8, sub-erect or reclined posteriorly. Cusp situated above basal cavity and bears one to three small denticles at posterior end. Sub-rounded and posteriorly elongated basal cavity with a thin pit. Anterior groove continues to posterior end.

Remarks: The Bac Thuy Formation includes many well preserved specimens of *Discretella discreta* (Müller, 1956), and two morphotypes (A and B) are also recognized. Morphotype A (MPC25097, 25101, 25103, etc.) is characterized by a higher cusp with two or three small posterior denticles and a rounded basal cavity. The posterior part of the lower margin is downturned. Morphotype A is identical to the typical form of *D. discreta* described by Müller (1956) from Nevada. Morphotype B (MPC25095, 25096, 25100, etc.) can be distinguished by its triangular larger denticle and upturned posterior margin.

Occurrence: Described specimens from BT01-03, BT01-04, BT01-06, BT01-07, BT01-10, BT01-12, BT01-14, BT02-01, BT02-02, BT02-03, BT03-01, KC01-01, KC01-04, KC01-05, KC01-11, KC01-12, KC01-13, KC02-02 and PK01-02 within the portion of the *Novispathodus* ex gr. *waageni* Zone that includes the *Flemingites rursiradialis* beds (lowest Middle Smithian=middle Lower Olenekian), *Urdoceras tulongensis* beds (lower Middle Smithian=middle Lower Olenekian) and *Owenites koeneni* beds (middle Middle Smithian=middle Lower Olenekian) in the Bac Thuy Formation, northeastern Vietnam. This species also occurs in the Middle Smithian in Nevada (*Meekoceras* beds, Müller, 1956), Gunong Keriang, West Malaysia (Koike, 1982), Tibet (Tian *et al.*,

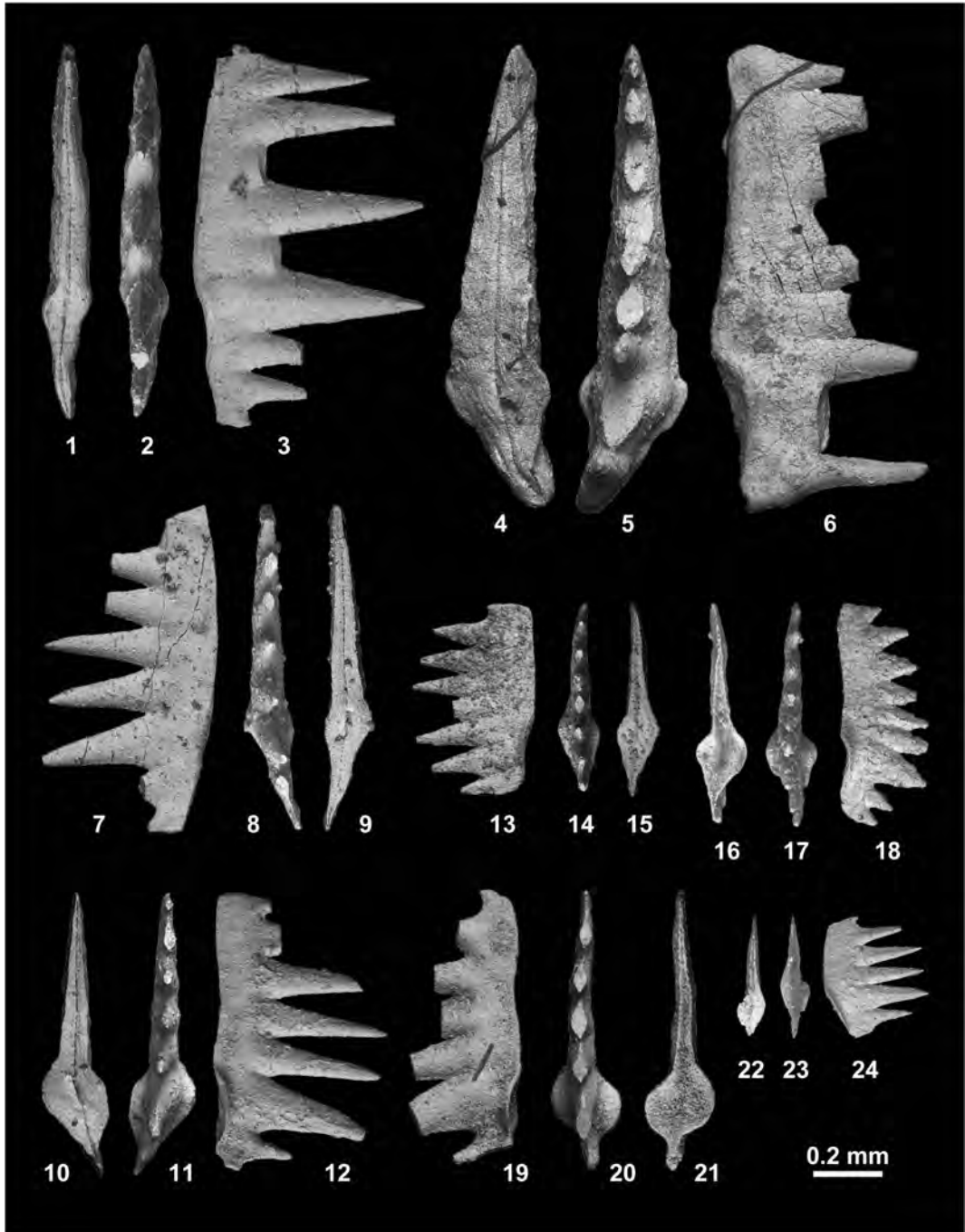


Fig. 142. *Discretella discreta* (Müller, 1956). 1–3, MPC25098, from BT01-07. 4–6, MPC25099, from BT01-07. 7–9, MPC25100, from BT01-07. 10–12, MPC25101, from BT01-07. 13–15, MPC25102, from BT01-10. 16–18, MPC25103, from BT01-10. 19–21, MPC25104, from BT01-10. 22–24, MPC25105, from BT01-10.

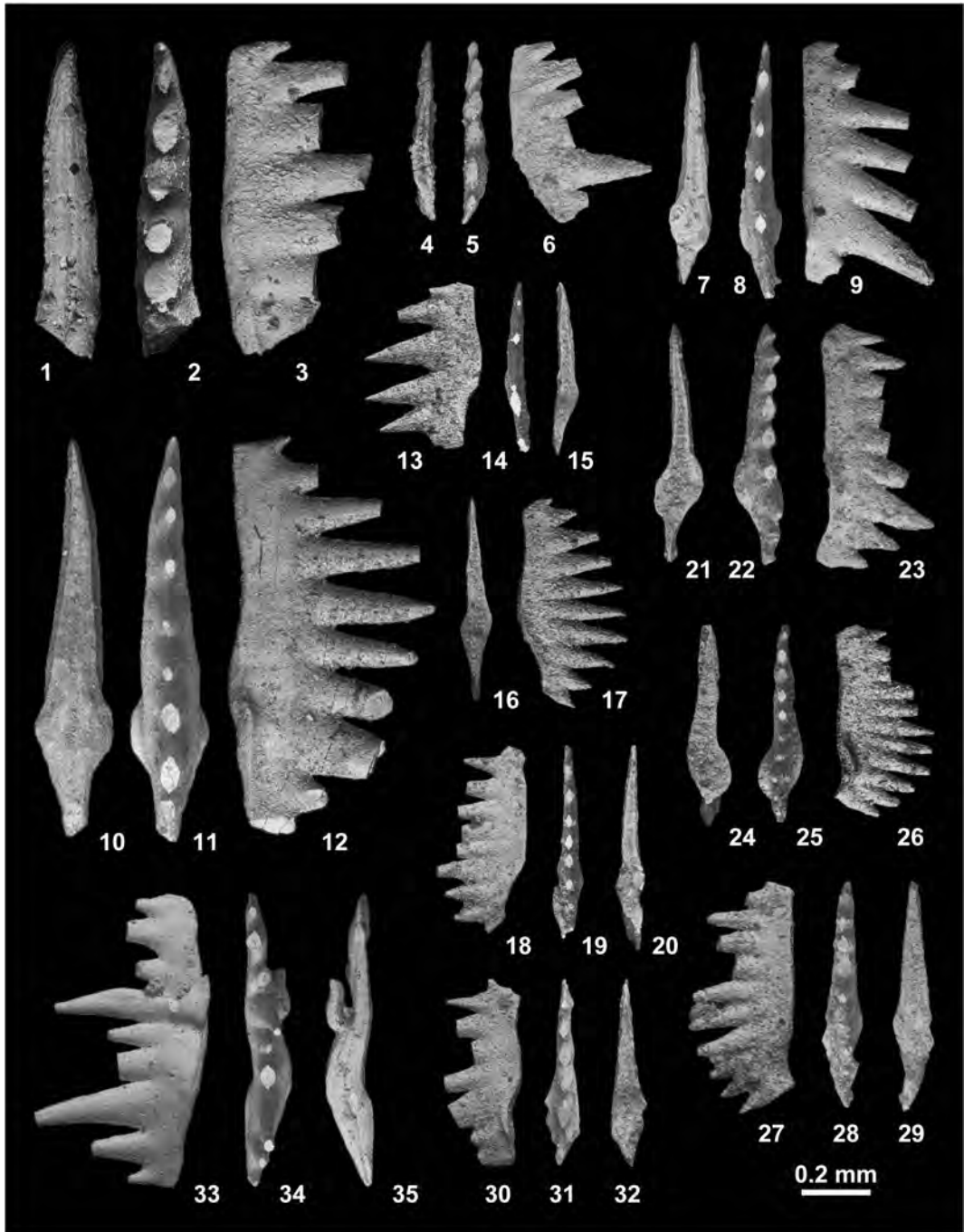


Fig. 143. *Discretella discreta* (Müller, 1956). 1–3, MPC25106, from BT01-10. 4–6, MPC25107, from BT01-12. 7–9, MPC25108, from BT01-14. 10–12, MPC25109, from BT01-14. 13–15, MPC25110, from BT02-01. 16–17, MPC25111, from BT02-01. 18–20, MPC25112, from BT02-01. 21–23, MPC25113, from BT02-01. 24–26, MPC25114, from BT02-01. 27–29, MPC25115, from BT02-01. 30–32, MPC25116, from BT02-01. 33–35, MPC25117, from BT02-02.

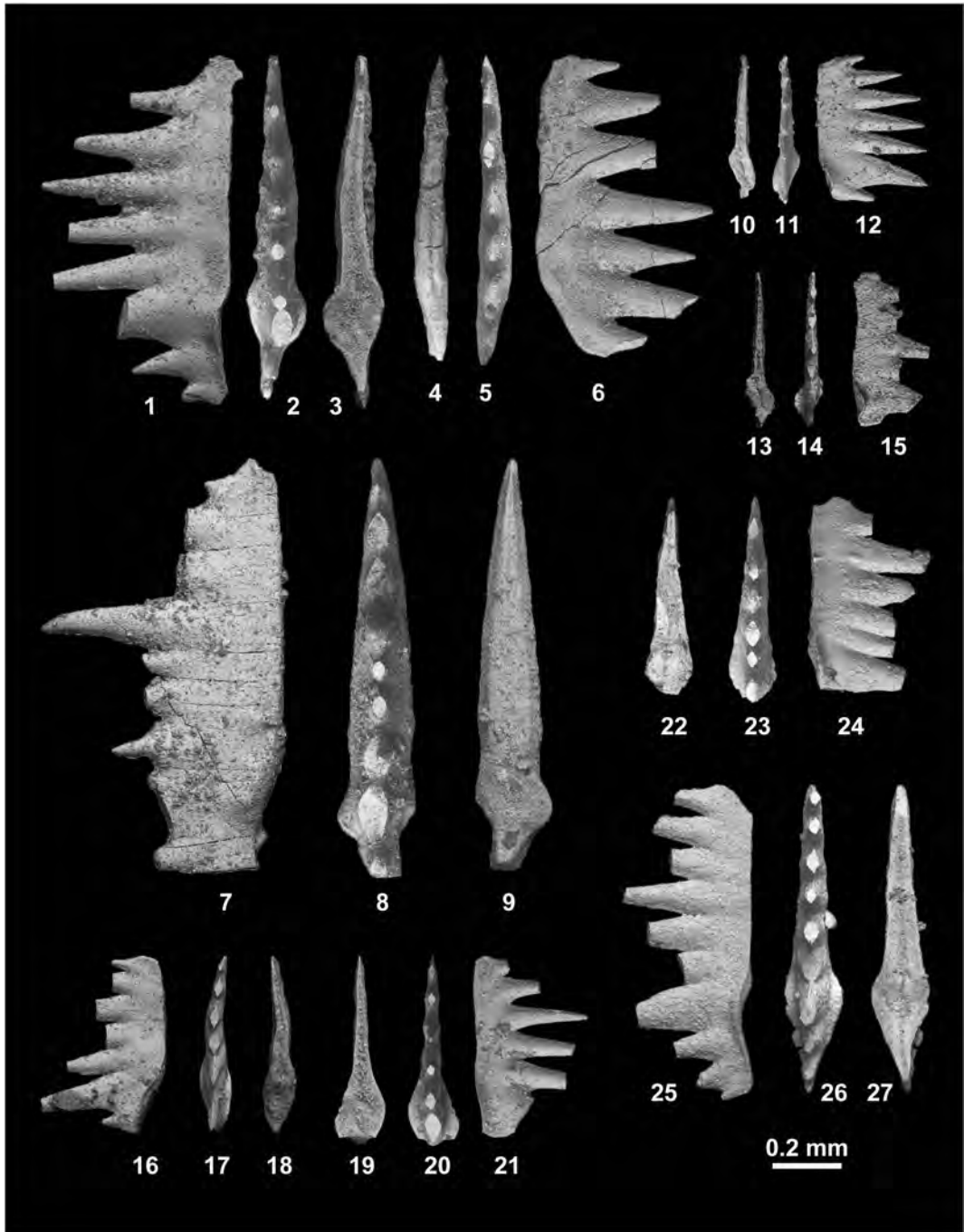


Fig. 144. *Discretella discreta* (Müller, 1956). 1–3, MPC25118, from BT02-02. 4–6, MPC25119, from BT02-02. 7–9, MPC25120, from BT02-02. 10–12, MPC25121, from BT02-03. 13–15, MPC25122, from BT03-01. 16–18, MPC25123, from BT03-01. 19–21, MPC25124, from KC01-01. 22–24, MPC25125, from KC01-04. 25–27, MPC25126, from KC01-04.

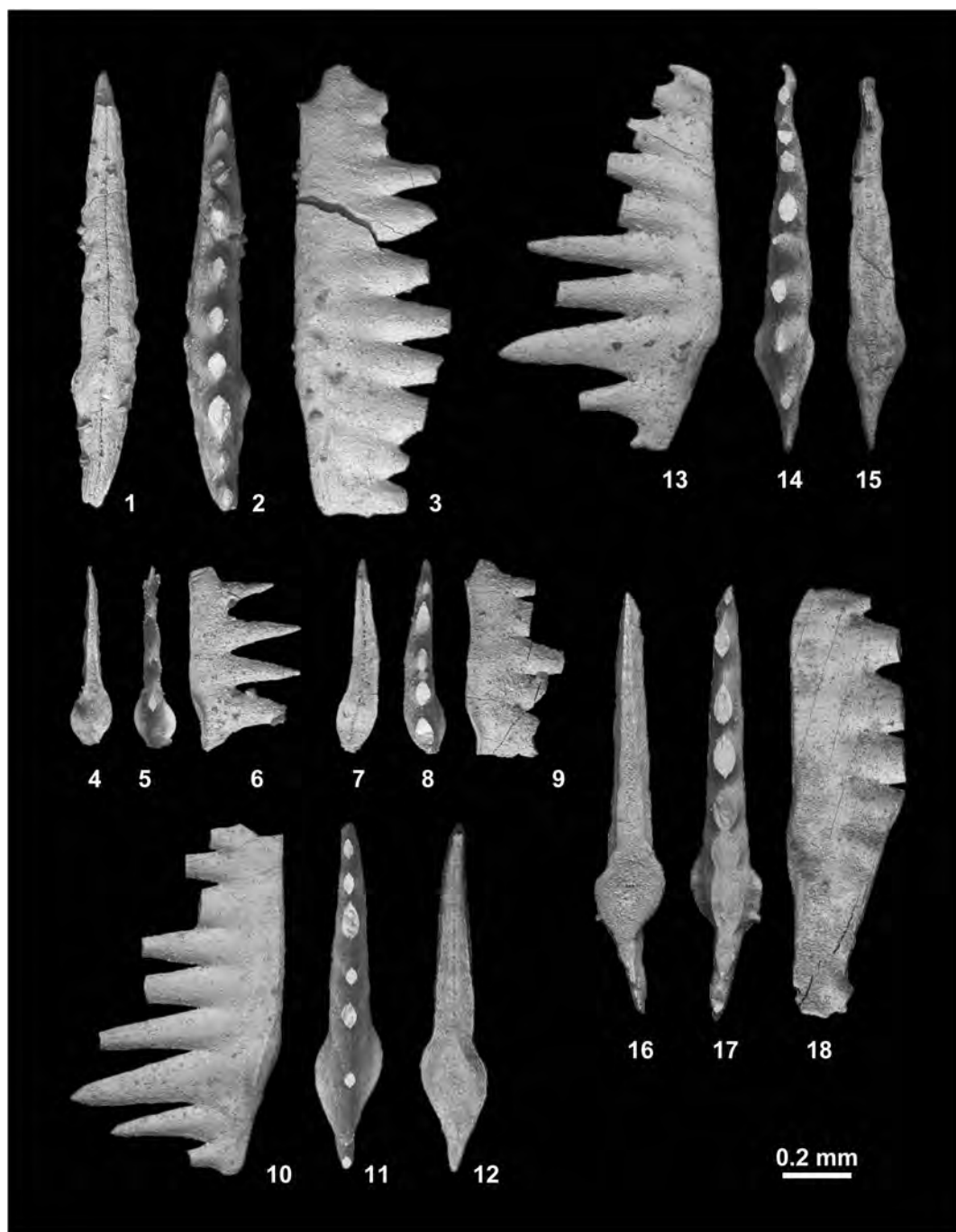


Fig. 145. *Discretella discreta* (Müller, 1956). 1–3, MPC25127, from KC01-04. 4–6, MPC25128, from KC01-05. 7–9, MPC25129, from KC01-05. 10–12, MPC25130, from KC01-11. 13–15, MPC25131, from KC01-11. 16–18, MPC25132, from KC01-11.