

Systematic Paleontology

Cephalopods (by Y. Shigeta and Y. D. Zakharov)

Systematic descriptions basically follow the classification established by Sweet (1964) for orthocerids, Kummel (1964) for nautilids, and Tozer (1981, 1994) for ceratitids. Morphological terms are those used in the Treatise on Invertebrate Paleontology (Moore, 1957, 1964). Quantifiers used to describe the size and shape of ammonoid shells replicate that proposed by Matsumoto (1954, p. 246) and modified by Haggart (1989, Table 8.1).

Abbreviations for shell dimensions: D=shell diameter; U=umbilical diameter; H=whorl height; W=whorl width.

Institution abbreviations: NSM=National Museum of Nature and Science, Tokyo; CGM=Central Research Geological Prospecting Museum (CNIGR Museum), St. Petersburg; DVGI=Far Eastern Geological Institute, Vladivostok; GSC=Geological Survey of Canada, Ottawa; GSI=Geological Survey of India, Kolkata.

Class Cephalopoda Leach, 1817

Order Orthocerida Kuhn, 1940

Superfamily Orthoceratoidea M'Coy, 1844

Family Orthoceratidae M'Coy, 1844

Genus *Trematoceras* Eichwald, 1851

Type species: *Orthoceras elegans* Münster, 1841.

Trematoceras subcampanile

(Kiparisova, 1954)

Fig. 27

Orthoceras sp. indet. ex aff. *campanile* Mojsisovics. Diener, 1895, p. 10, pl. 4, fig. 5.

Orthoceras subcampabile Kiparisova, 1954, p. 20, pl. 11, figs. 1, 2.

Trematoceras subcampanile (Kiparisova). Kiparisova, 1961, p. 14, pl. 1, figs. 1, 2.

Holotype: CGM 596, figured by Diener (1895, p. 10, pl. 4, fig. 5), from the Lower

Triassic (Olenekian) of Paris Bay, Russian Island, in South Primorye, Russia.

Material examined: Three specimens, NSM PM23100–23102, from AB1022.

Description: Moderately expanding orthoconic shell with 4–5 degree adoral angle of expansion and circular whorl cross-section. Juvenile shell ornamented with network lirae consisting of fine longitudinal ridges and fine transverse lirae, while larger shells exhibit fine transverse lirae. Centrally located siphuncle with cylindrical connecting ring, and short, orthochoanitic septal neck. Suture simple and straight. Cameral deposits not observed.

Occurrence: Described specimens from AB1022 within the *Clypeoceras timorensis* Zone (early Early Olenekian=early Smithian) in the main part of the Zhitkov Formation, Abrek Bay area, South Primorye. This species occurs abundantly in Olenekian deposits at many localities in South Primorye (Kiparisova, 1961)

Discussion: *Trematoceras subcampanile* (Kiparisova, 1954) is morphologically very close to *T. campanile* (Mojsisovics, 1882, p. 291), *T. vulgare* Schastlivtceva, (1981, p. 77), *T. ciarum* Schastlivtceva, (1986, p. 125) and *T. boreale* Schastlivtceva, (1986, p. 125), but differs in that its juvenile shell is ornamented with network lirae. It differs from *T. mangishlakense* Schastlivtceva, (1981, p. 79) and *T. insperatum* Schastlivtceva, (1988, p. 67) by its smaller angle of shell expansion.

Order Nautilida Agassiz, 1847

Superfamily Trigonoceratoidea Hyatt, 1884

Family Grypoceratidae Hyatt, 1900

Genus *Gyronautilus* Zakharov and

Shigeta, 2000

Type species: *Syringoceras praeevolutum* Kiparisova, 1961.

Discussion: *Gyronautilus* was placed within the family Grypoceratidae because of its flattened venter and its suture, which displays distinct ventral and lateral lobes (Zakharov &



Fig. 27. *Trematoceras subcampanile* Kiparisova, 1954 from AB1022. 1, NSM PM23100, $\times 1.0$. 2, NSM PM23101, $\times 1.0$. 3, NSM PM23102, $\times 2.0$.

Shigeta, 2000). Shimansky (1962) recognized four subfamilies within the family Grypoceratidae: Domatoceratinae, Grypoceratinae, Syringonautilinae and Clymenonautilinae. Zakharov and Shigeta (2000) proposed an additional subfamily Gyronautilinae, and placed *Gyronautilus* in it.

Gyronautilus popovi Shigeta and Zakharov
sp. nov.

Figs. 28, 29

Type specimens: Holotype, NSM PM23104,

from AB1008; paratype, NSM PM23103, from AB1008.

Diagnosis: *Gyronautilus* with evolute inner whorls and gyroconic outer whorls.

Etymology: Named for Alexander M. Popov, who collected the specimens.

Description: Gyroconic shell characterized by evolute inner whorls, subquadratic to subtrapezoidal whorl section, broadly rounded to subtabulate venter, rounded ventral shoulders, fairly concave dorsum and nearly parallel to slightly convex flanks with maximum whorl width just above umbilical shoulder. Umbili-

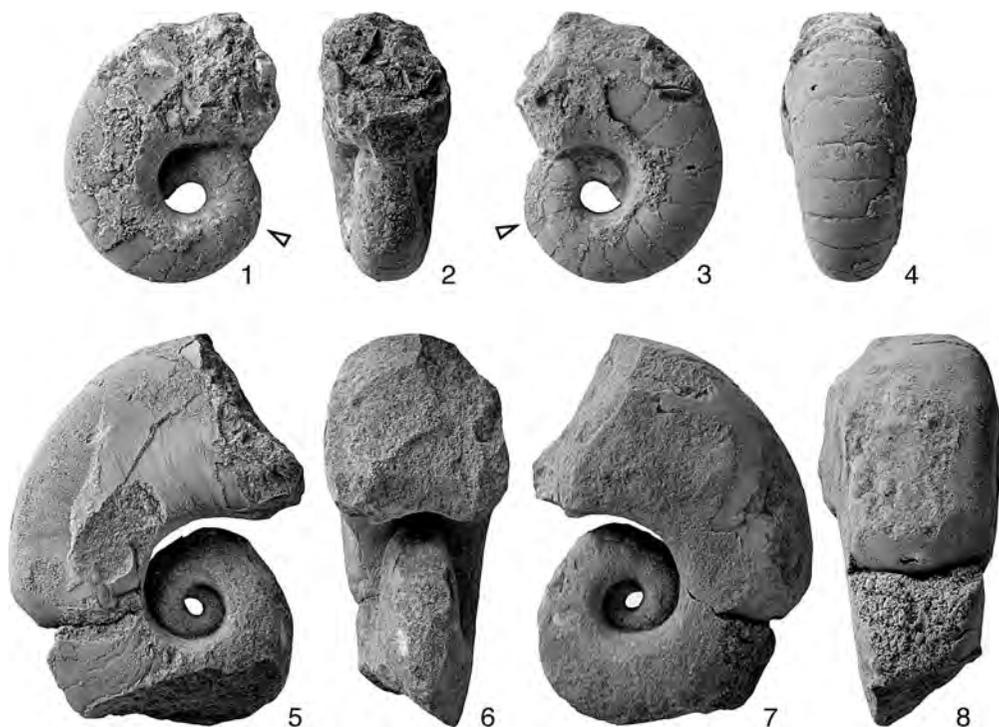


Fig. 28. *Gyronautilus popovi* Shigeta and Zakharov sp. nov. from AB1008. 1–4, NSM PM23103, paratype, $\times 2.0$. 5–8, NSM PM23104, holotype, $\times 1.0$. White arrows indicate position of the embryonic constriction.

cus exhibits moderately high, vertical wall with rounded shoulders and fairly small (2–3 mm) umbilical perforation. Embryonic shell 7.5 mm in length and consists of one half whorl. Body chamber length unknown. Siphuncle located at two thirds of whorl height. Ornamentation consists of sinuous growth lines with deep, U-shaped hyponomic sinus on venter. Suture simple with shallow ventral lobe and shallow, wide lateral lobe.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23104	52.0	14.7	23.3	23.3	0.28	1.00
NSM PM23103	17.4	4.8	8.4	8.0	0.28	0.95

Occurrence: Described specimens from AB1008 within the *Lytophicerus* sp. Zone (Early Induan=Griesbachian) in the middle part of the Lazurnaya Bay Formation, Abrek Bay area, South Primorye.

Discussion: *Gyronautilus popovi* sp. nov. differs from *Gy. praevolutus* (Kiparisova,

1961, p. 25) by its evolute inner whorls, but both species probably belong to the same evolutionary lineage.

Among the previously described Early Induan (Griesbachian) species, *Gy. popovi* sp. nov. more closely resembles *Nautilus quadrangulus* var. *brahmanicus* Griesbach (1880, p. 104) (assigned to *Grypoceras* Hyatt, 1883 by Kummel in 1953a) from the Himalayan area, in terms of whorl cross-section, siphuncle position, ornamentation and suture line. *Gy. popovi* sp. nov. is somewhat similar to *Nautilus brahmanicus* var. *hexagonalis* Diener (1897, p. 11) from the Early Induan (Griesbachian) of the Himalayan area, but differs in whorl cross-section. It seems best to consider *Gy. popovi* sp. nov. to be an offshoot of a species of the early Induan genus *Grypoceras*, such as *Gr. brahmanicum*.



Fig. 29. Suture line of *Gyronautilus popovi* Shigeta and Zakharov sp. nov., NSM PM23104, holotype, from AB1008, at H=17 mm.

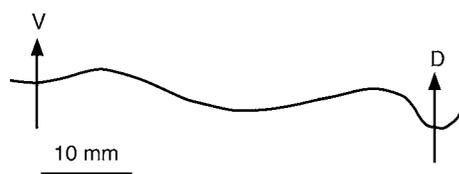


Fig. 30. Suture line of *Gyronautilus praevolutus* (Kiparisova, 1961), NSM PM23105, from AB1010, at H=33 mm. V: venter, D: dorsum.

Gyronautilus praevolutus (Kiparisova, 1961)

Figs. 30–35

Syringoceras praevolutum Kiparisova, 1961, p. 25, pl. 4, fig. 2, text-fig. 26.

Gyronautilus praevolutus (Kiparisova). Zakharov and Shigeta, 2000, p. 232, figs. 2–4.

Holotype: CGM 12/5504, figured by Kiparisova (1961, p. 25, pl. 4, fig. 2), from the Lower Triassic (Olenekian?) in the Abrek Bay area in South Primorye, Russia.

Material examined: Three specimens, NSM PM16132, 23105, 23106, from AB1010.

Description: Gyroconic shell distinguished by subquadratic whorl section, broadly rounded to subtabulate venter, rounded ventral shoulders, slightly concave dorsum and nearly parallel to slightly convex flanks. Umbilicus characterized by moderately high, subvertical wall with rounded shoulders and small (4–6 mm) umbilical perforation. Embryonic shell 11.3 mm in length, exogastrically curved and consists of one half whorl. Body chamber represents about 130° in spiral length. Ornamentation consists of sinuous growth lines with deep, U-shaped hyponomic sinus on venter. Siphuncle located near venter at one fifth of whorl height. Suture simple with shallow ventral lobe, shallow, wide lateral lobe and deep dorsal lobe.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM16132	92.6	31.5	41.5	37.1	0.34	0.89
NSM PM23106	135.0	48.0	54.0	55.0	0.36	1.02
NSM PM23105	–	30.0	35.5	30.3	–	0.85

Occurrence: Described specimens from

AB1010 within the *Gyronites subdharmus* Zone (late Early Induan=late Griesbachian) in the upper part of the Lazurnaya Bay Formation, Abrek Bay area, South Primorye.

Discussion: *Gyronautilus praevolutus* (Kiparisova, 1961) differs from *Gy. popovi* sp. nov. in that its shell is gyroconic throughout ontogeny.

Kiparisova (1961) proposed *Syringoceras praevolutum* on the basis of a single small specimen (Fig. 31.1–31.3) collected in 1948 by N. K. Trifonov from the Lower Triassic (Olenekian?) in the Abrek Bay area. Although the exact locality and horizon of the specimen were not documented, Zakharov and Shigeta (2000) later found a large specimen, NSM PM16132 (Fig. 35), at the type locality, which they identified as *S. praevolutum*. They carefully described its shell features throughout ontogeny, and proposed *Gyronautilus* as a new genus of Grypoceratidae. They collected the specimen from a horizon represented by AB1010 in the Lazurnaya Bay Formation, and interpreted its occurrence as Early Olenekian, based on previous biostratigraphical work by Zakharov and Popov (1999). However, the horizon of AB1010 is now correlated with the late Early Induan (late Griesbachian).

Genus *Xiaohenautilus* Xu, 1988

Type species: *Xiaohenautilus sinensis* Xu, 1988.



Fig. 31. *Gyronautilus praevolutus* (Kiparisova, 1961). 1–3, CGM 12/5504, holotype, $\times 1.0$. 4–7, NSM PM23105, from AB1010, $\times 1.0$.

Fig. 32. *Gyronautilus praevolutus* (Kiparisova, 1961), NSM PM23106, from AB1010. 1–9, $\times 2.0$. 10–12, $\times 1.0$. White arrows indicate position of the embryonic constriction. →



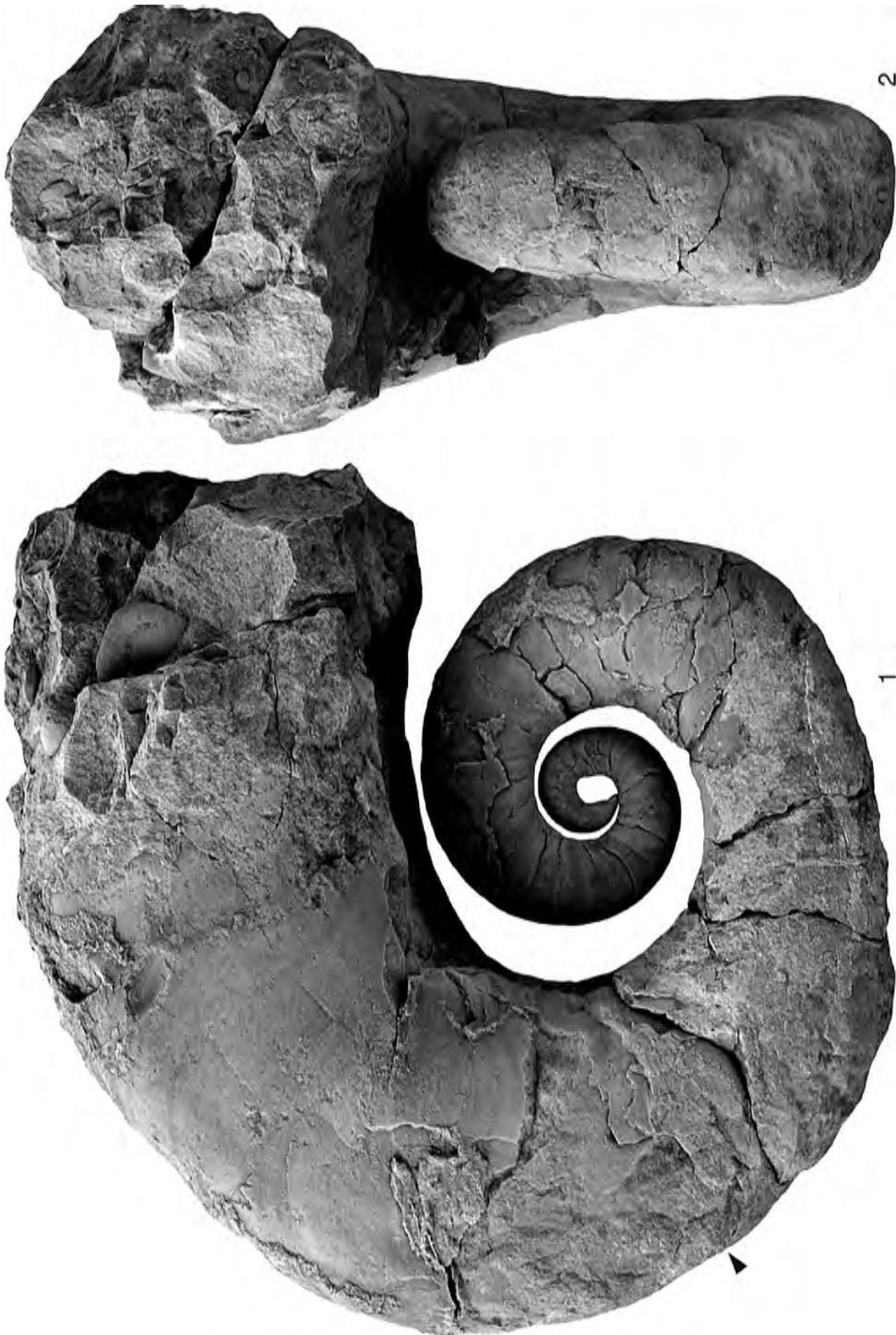


Fig. 33. *Gyronautilus praeevolatus* (Kiparisova, 1961). 1–2, NSM PM23106, from AB1010, $\times 1.0$. Black arrow indicates position of last preserved septum.



Fig. 34. *Gyronautilus praeevolutus* (Kiparisova, 1961). 1–2, NSM PM23106, from AB1010, $\times 1.0$. Black arrow indicates position of last preserved septum.

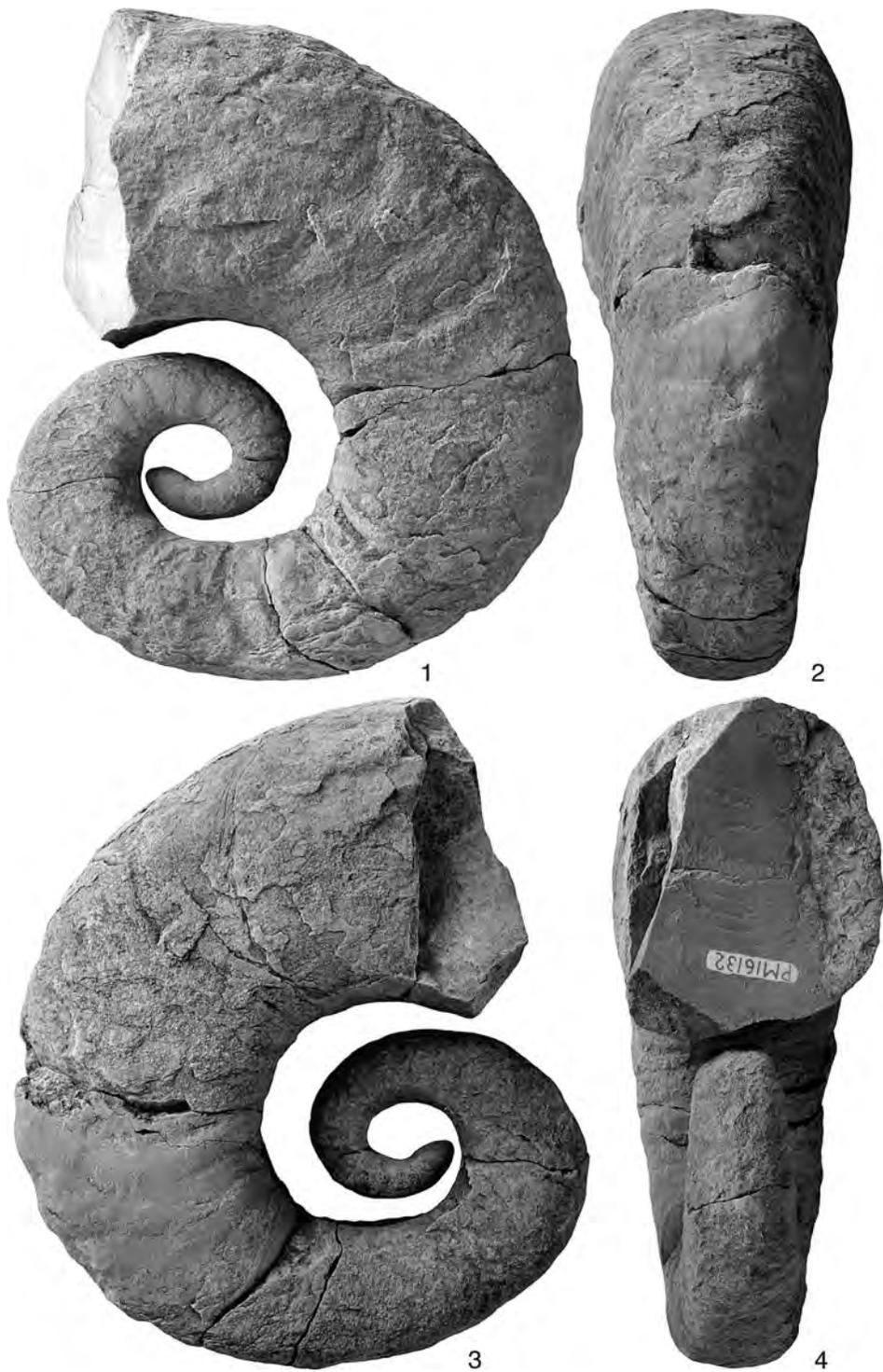


Fig. 35. *Gyronautilus praevolutus* (Kiparisova, 1961). 1–4, NSM PM16132, from AB1010, $\times 1.0$.

Xiaohenautilus abrekensis Shigeta and
Zakharov sp. nov.

Figs. 36–42

Type specimens: Holotype, NSM PM23110, from AB1011; paratypes, thirteen specimens, NSM PM23107–23109, 23111–23120, from AB1011.

Diagnosis: Moderately evolute *Xiaohenautilus* with a subquadratic to subtrapezoidal whorl section and delicate network lirae.

Etymology: Named after Abrek Bay (Strelok Strait) in South Primorye.

Description: Moderately evolute, thickly discoidal shell with subquadratic to subtrapezoidal whorl section, broadly rounded venter, rounded ventral shoulders and nearly parallel flanks with maximum whorl width just above umbilical shoulder. Umbilicus characterized by moderately high, vertical wall with rounded shoulders and fairly small (2–4 mm) umbilical perforation. Embryonic shell about 8 mm in length and consists of one half whorl. Body chamber represents about 130° in spiral length. Shell ornamented with delicate network lirae consisting of very fine spiral lirae as well as fine, sinuous growth lines with deep, U-shaped hyponomic sinus on venter. Siphuncle located near venter at one fifth of whorl height. Suture simple with shallow ventral lobe and shallow, wide lateral lobe. Attachment scars, visible on flanks in front of last septum, exhibit a tongue-shaped outline (Fig. 37.5).

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23110*	47.0	11.4	24.3	19.8	0.24	0.81
NSM PM23107	61.7	16.8	30.7	25.4	0.27	0.83
NSM PM23108	8.3	–	4.4	4.3	–	0.98
NSM PM23109	49.7	13.0	23.6	18.1	0.26	0.82
NSM PM23111	60.8	14.7	30.6	25.8	0.24	0.84
NSM PM23112	65.4	17.7	29.8	25.0	0.27	0.84
NSM PM23113	50.7	13.0	25.6	–	0.26	–
NSM PM23114	54.2	13.1	26.4	23.8	0.24	0.90
NSM PM23115	61.2	15.0	29.5	24.0	0.25	0.81
NSM PM23116	66.5	16.8	32.0	27.2	0.25	0.85
NSM PM23117	77.6	17.9	40.0	33.5	0.23	0.84
NSM PM23118	65.0	15.8	32.2	26.5	0.24	0.82

* Measurements taken at last septum.

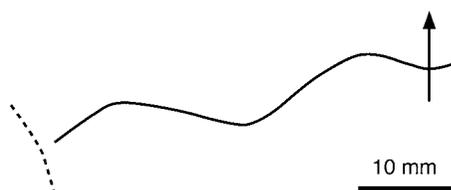


Fig. 36. Suture line of *Xiaohenautilus abrekensis* Shigeta and Zakharov sp. nov., NSM PM23111, paratype, from AB1011, at H=26 mm.

Occurrence: Described specimens from AB1011, within the *Gyronites subdharmus* Zone (late Early Induan=late Griesbachian) in the upper part of the Lazurnaya Bay Formation, Abrek Bay area, South Primorye.

Discussion: *Xiaohenautilus abrekensis* sp. nov. can be easily distinguished from *X. sinensis* Xu (1988, p. 439) by its more evolute coiling, and from *X. huananensis* Xu (1988, p. 439) by its subquadratic to subtrapezoidal whorl section.

This species bears some resemblance to *Gyronautilus praevolutus* (Kiparisova, 1961) in its near-ventral siphuncle position and whorl cross-section. Other early Induan Gypoceratids, such as *Gypoceras brahmanicum* (Griesbach, 1880) and *Gy. popovi* sp. nov., have a sub-central siphuncle position. If siphuncle position is considered to be diagnostic in regard to phylogenetic relationships, then *X. abrekensis* sp. nov. would likely be an offshoot of *Gy. praevolutus*.

An attachment scar observed on a specimen of *X. abrekensis* sp. nov. (NSM PM23107, Fig. 37.5) is equivalent to the mantle myoadhesive band, which is the anterior edge of the bean-shaped attachment area of the cephalic retractor muscle in recent *Nautilus* Linné, 1758 (Mutvei *et al.*, 1993; Doguzhaeva & Mutvei, 1996; Mutvei & Doguzhaeva, 1997; Isaji *et al.*, 2002). The cephalic retractor muscles, representing the most massive muscles in *Nautilus*, serve to retract the body and assist in locomotion. Because the tongue-shaped outline of the attachment scar closely resembles that

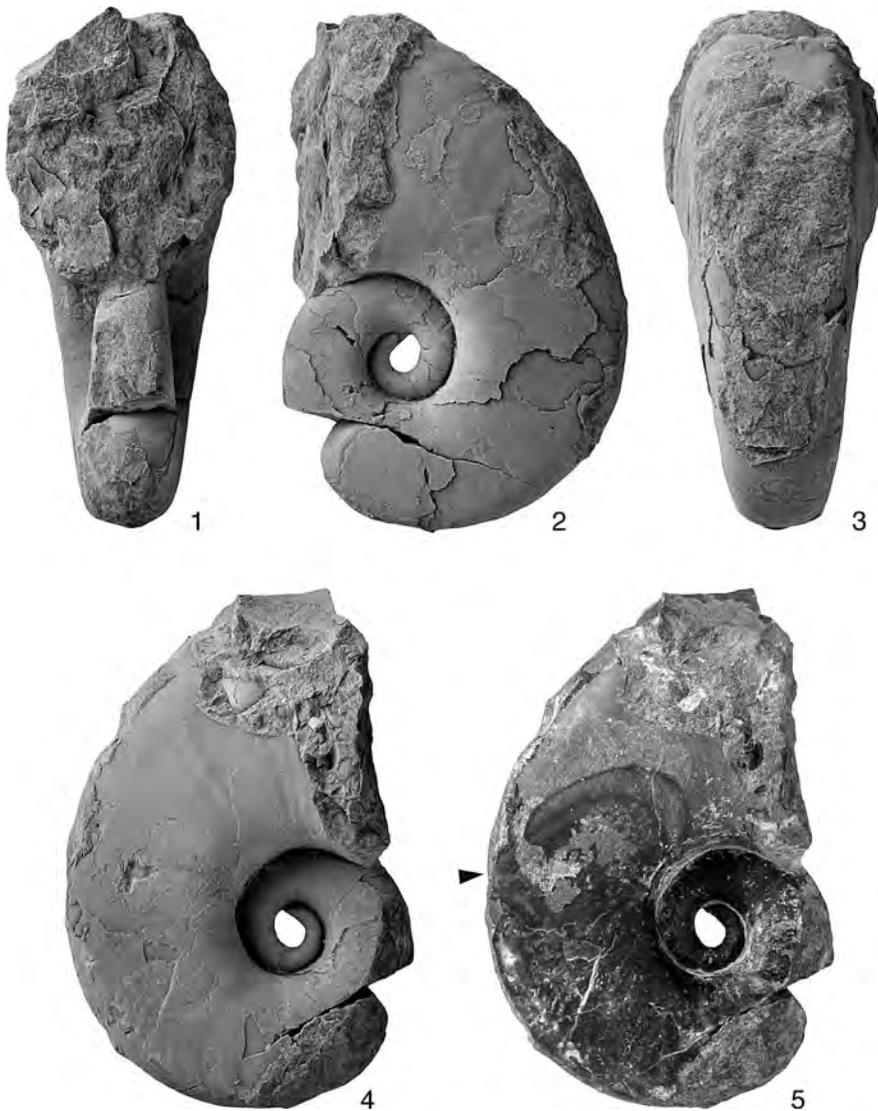
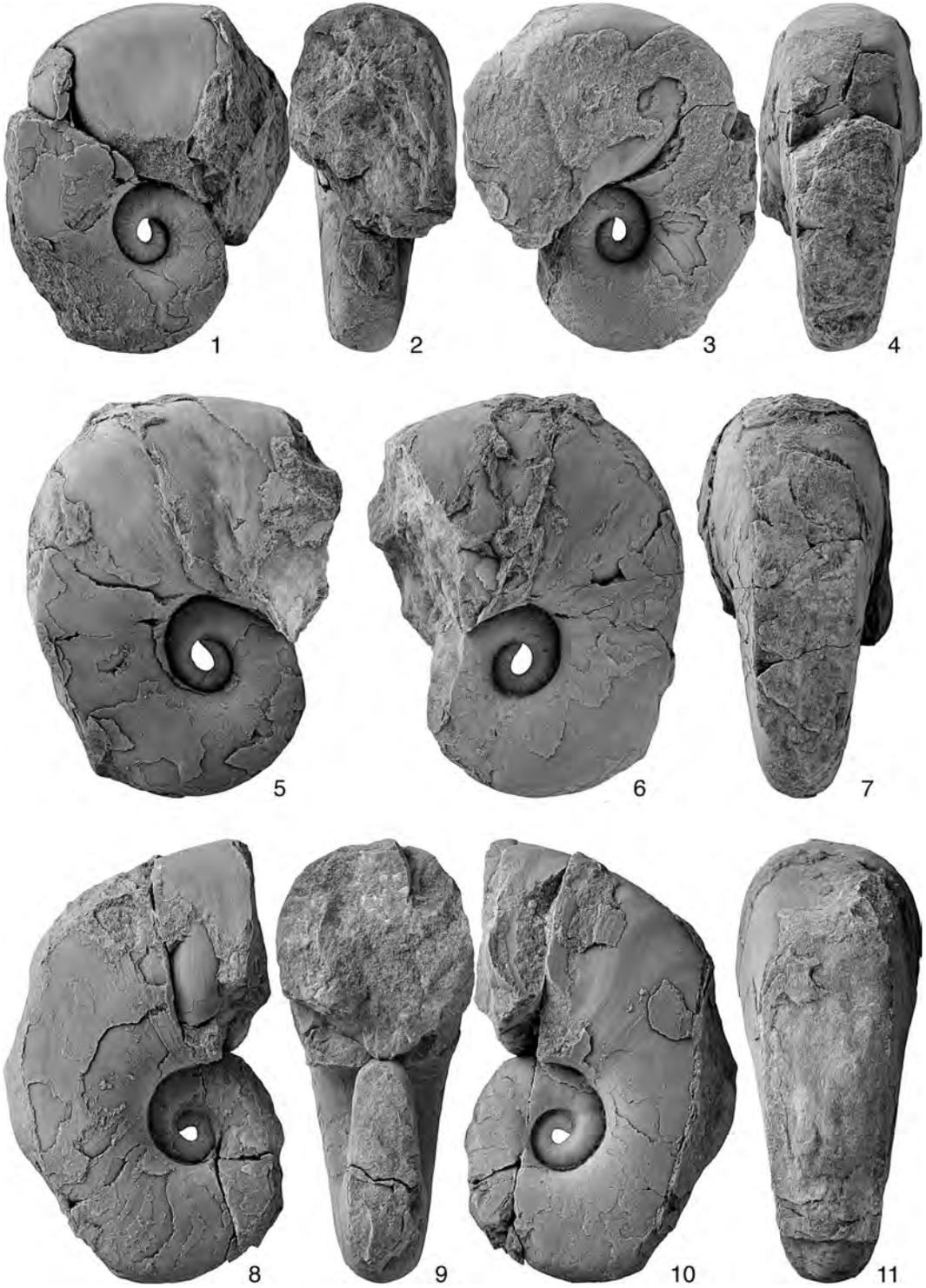


Fig. 37. *Xiaohenautilus abrekensis* Shigeta and Zakharov sp. nov. 1–5, NSM PM23107, paratype, from AB1011, $\times 1.0$. Black arrow indicates position of last preserved septum.

Fig. 38. *Xiaohenautilus abrekensis* Shigeta and Zakharov sp. nov. from AB1011. 1–4, NSM PM23114, paratype, $\times 1.0$. 5–7, NSM PM23115, paratype, $\times 1.0$. 8–11, NSM PM23116, paratype, $\times 1.0$.



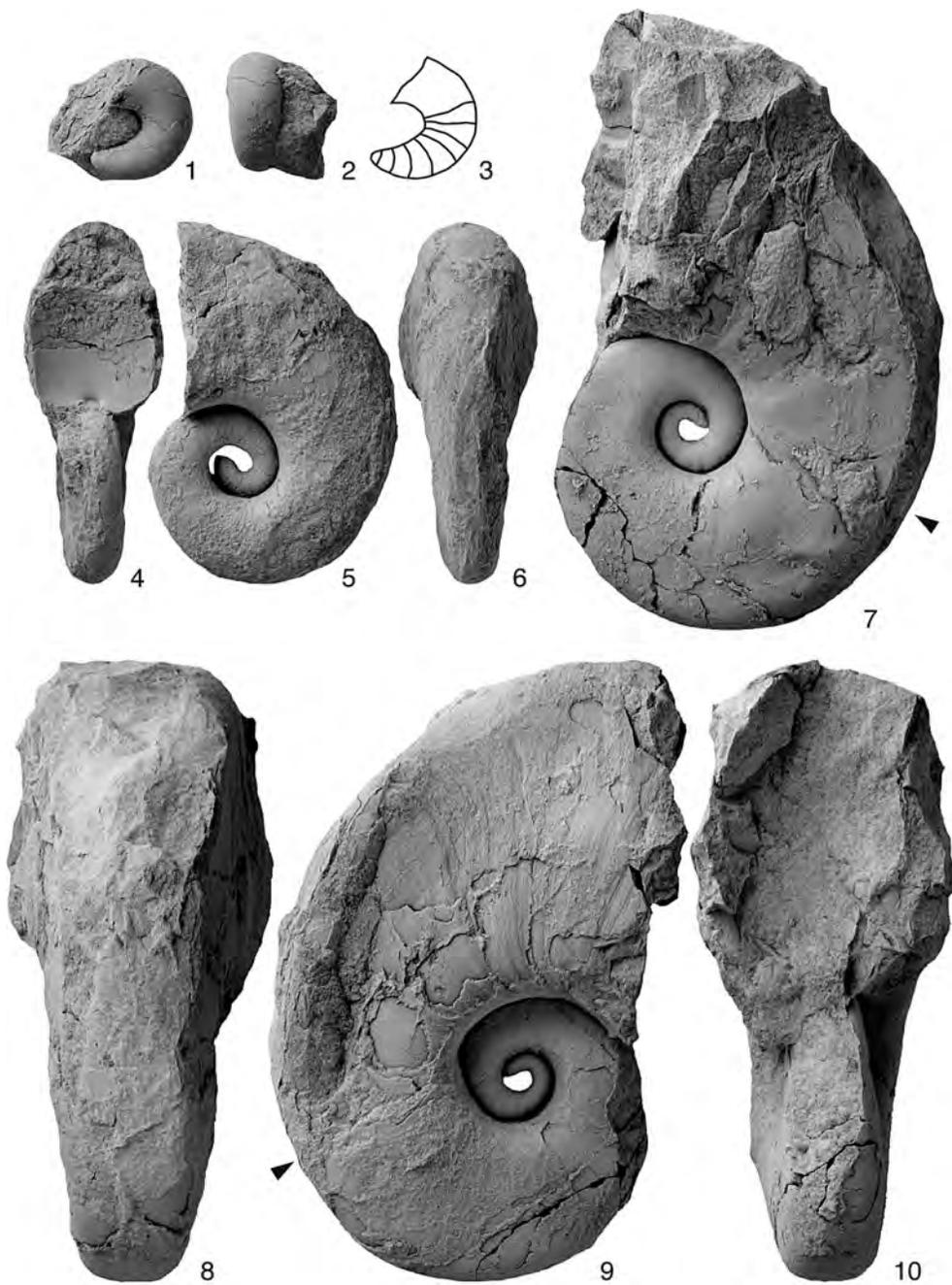


Fig. 39. *Xiaohenautilus abrekensis* Shigeta and Zakharov sp. nov. from AB1011. 1–3, NSM PM23108, paratype, $\times 2.0$. 4–6, NSM PM23109, paratype, $\times 1.0$. 7–10, NSM PM23110, holotype, $\times 1.0$. Black arrows indicate position of last preserved septum.



Fig. 40. *Xiaohenautilus abrekensis* Shigeta and Zakharov sp. nov. from AB1011. 1–4, NSM PM23117, paratype, $\times 1.0$. 5–6, NSM PM23118, paratype, $\times 1.0$. Black arrows indicate position of last preserved septum.

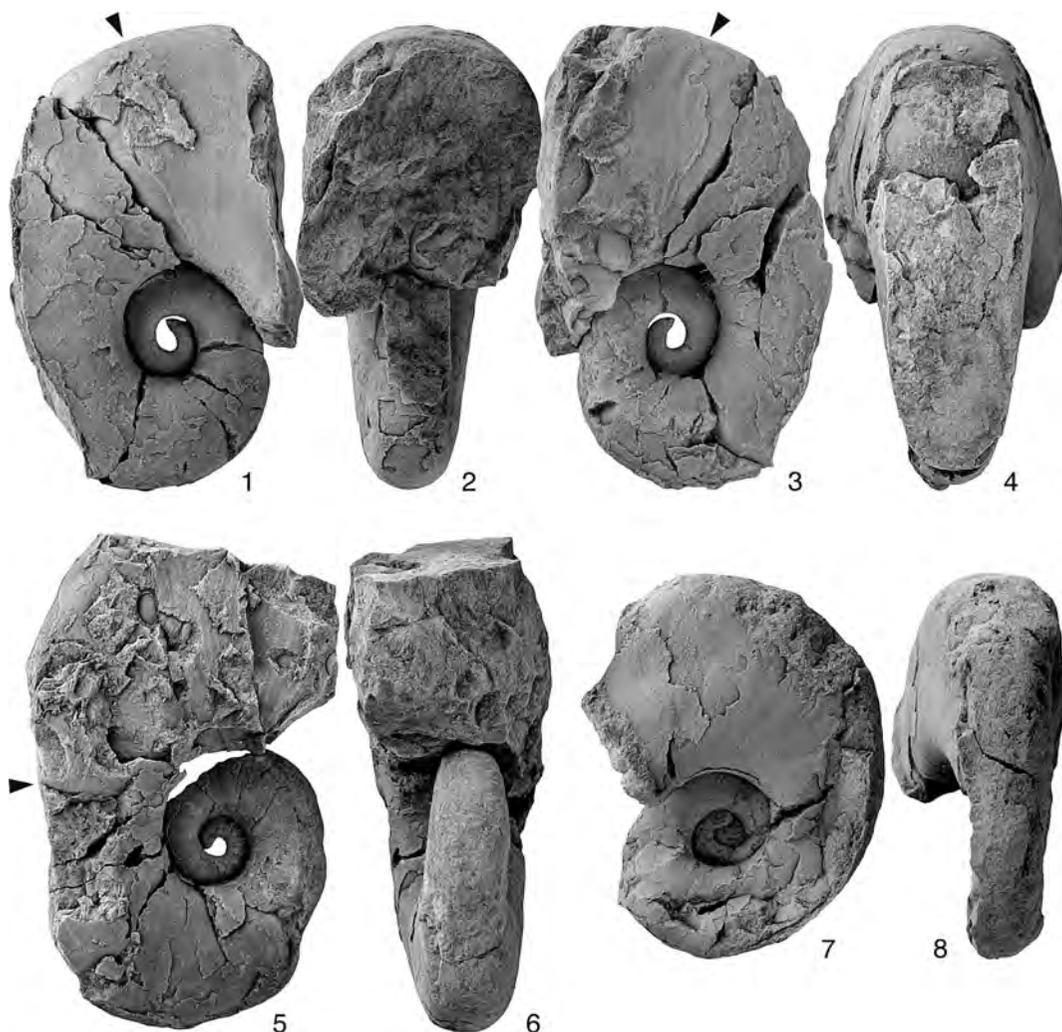


Fig. 41. *Xiaohenautilus abrekensis* Shigeta and Zakharov sp. nov. from AB1011. 1–4, NSM PM23111, paratype, $\times 1.0$. 5–6, NSM PM23112, paratype, $\times 1.0$. 7–8, NSM PM23113, paratype, $\times 1.0$. Black arrows indicate position of last preserved septum.

of *Nautilus*, the soft part morphology of *X. abrekensis* sp. nov. was probably similar. Similar attachment scars have also been reported on the Middle Triassic nautiloid *Germanonautilus* Mojsisovics, 1902 (Klug & Lehmkuhl, 2004).

Genus *Menuthionutilus* Collignon, 1933

Type species: Nautilus (Menuthionutilus) keislingeri Collignon, 1933.

Discussion: Kummel (1953a, b) pointed out

that the shell shape and suture of *Menuthionutilus* clearly place it in the Grypoceratidae, and that it displays close affinities with the Late Paleozoic *Domatoceras* Hyatt, 1891 and Triassic *Grypoceras* Hyatt, 1883. Shimansky (1962) included the genus in the subfamily Domatoceratinae. However, its delicate network lirae ornamentation and marginal siphuncle position indicate affinities with *Xiaohenautilus* Xu, 1988, *Syringoceras* Hyatt, 1894 and *Syringonautilus* Mojsisovics, 1902. Although it is unclear to which subfamily

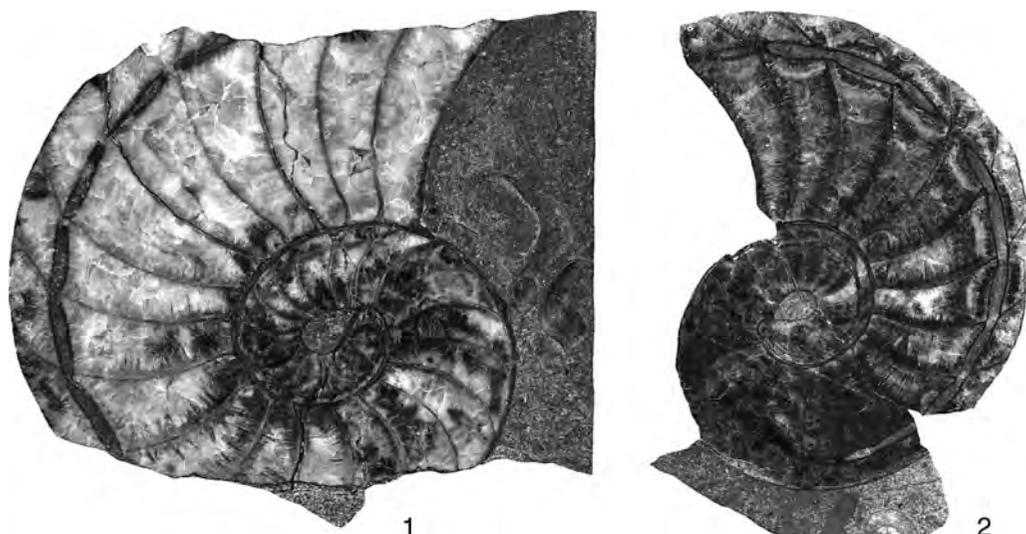


Fig. 42. Median sections of *Xiaohenautilus abrekensis* Shigeta and Zakharov sp. nov. from AB1011. 1, NSM PM23119, paratype, $\times 2.0$. 2, NSM PM23120, paratype, $\times 2.0$.

Xiaohenautilus should be assigned, Shimansky (1962) placed the latter two genera within the subfamily Syringonautilinae. *Menuthionautilus* most likely developed from the *Xiaohenautilus* - Syringonautilinae lineage.

***Menuthionautilus korzchi* Kiparisova, 1960**

Figs. 43–46, 48

Menuthionautilus korzchi Kiparisova, 1960, p. 136, pl. 33, fig. 1; Kiparisova, 1961, p. 18, pl. 2, fig. 2.

Holotype: CGM 6/5504, figured by Kiparisova (1960, p. 136, pl. 33, fig. 1), from the Lower Triassic (Induan, *Flemingites?* beds) in the Abrek Bay area in South Primorye, Russia.

Material examined: Six specimens, NSM PM23121, 23123–23127, from AB1013, and one specimen, NSM PM23122, from AB1014.

Description: Very involute shell characterized by rapidly expanding whorl height, broadly rounded venter, rounded ventral shoulders and broadly convex flanks forming a subqua-

dratic whorl section with maximum whorl width occurring at one third of distance across flank from umbilicus. Umbilicus narrow and deep with well rounded shoulders, and fairly small (2–3 mm) umbilical perforation. Embryonic shell about 8 mm in length and consists of one half whorl. Body chamber equivalent to about 110° in spiral length. Ornamentation includes delicate network lirae consisting of fine, dense spiral lirae and fine, sinuous growth lines as well as a deep, U-shaped hyponomic sinus on venter. Siphuncle located next to venter. Suture simple with shallow ventral lobe and shallow, wide lateral lobe.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23121	12.3	2.6	6.5	6.2	0.21	0.95
NSM PM23122	23.9	5.2	12.8	12.2	0.22	0.95
NSM PM23123*	39.5	3.1	22.6	18.6	0.08	0.82
NSM PM23124*	46.2	3.1	28.9	25.2	0.07	0.87
NSM PM23125*	56.5	3.0	37.2	–	0.05	–
NSM PM23126*	59.1	2.0	34.0	31.2	0.03	0.91
NSM PM23127	69.8	4.0	40.1	37.2	0.06	0.93

* Measurements taken at last septum.

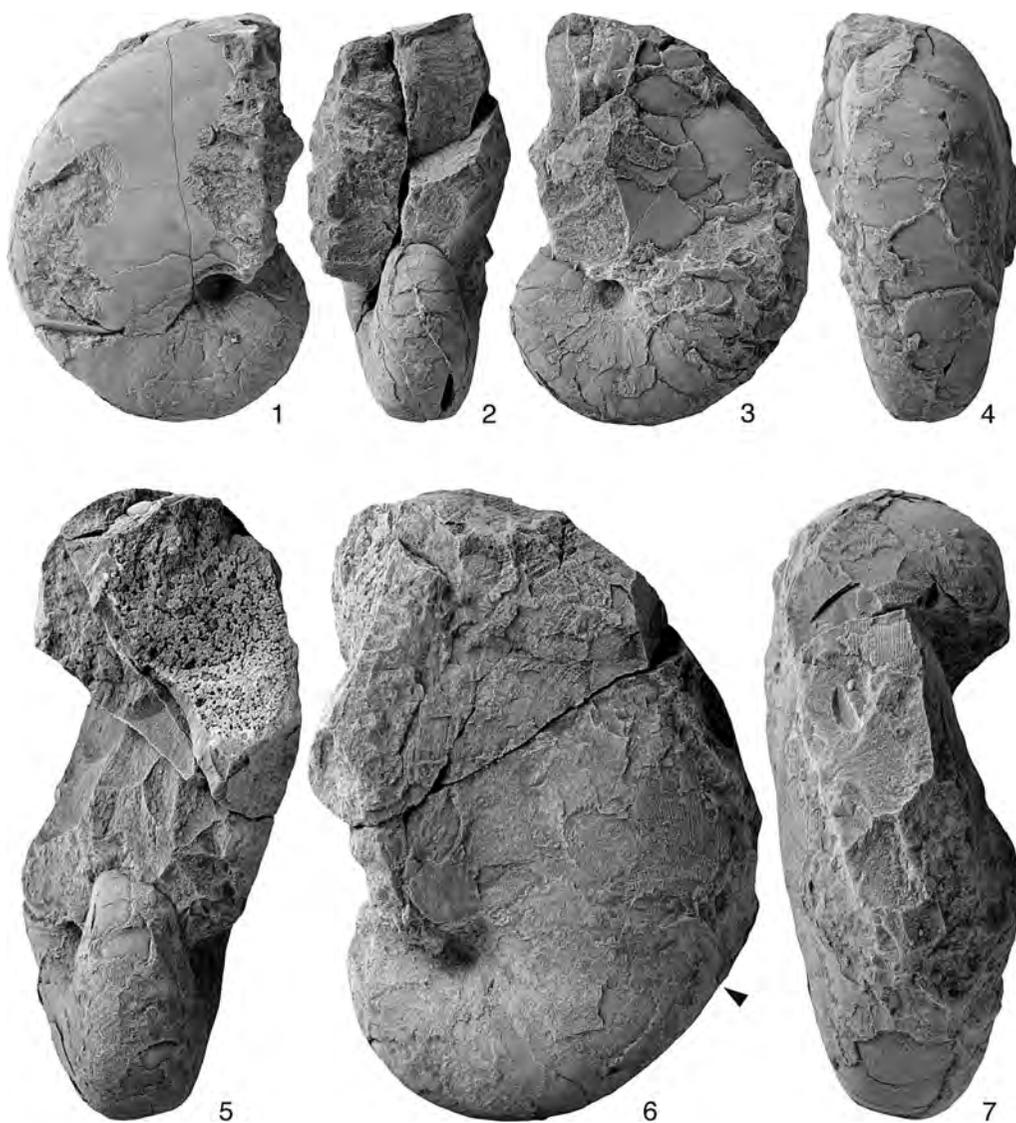
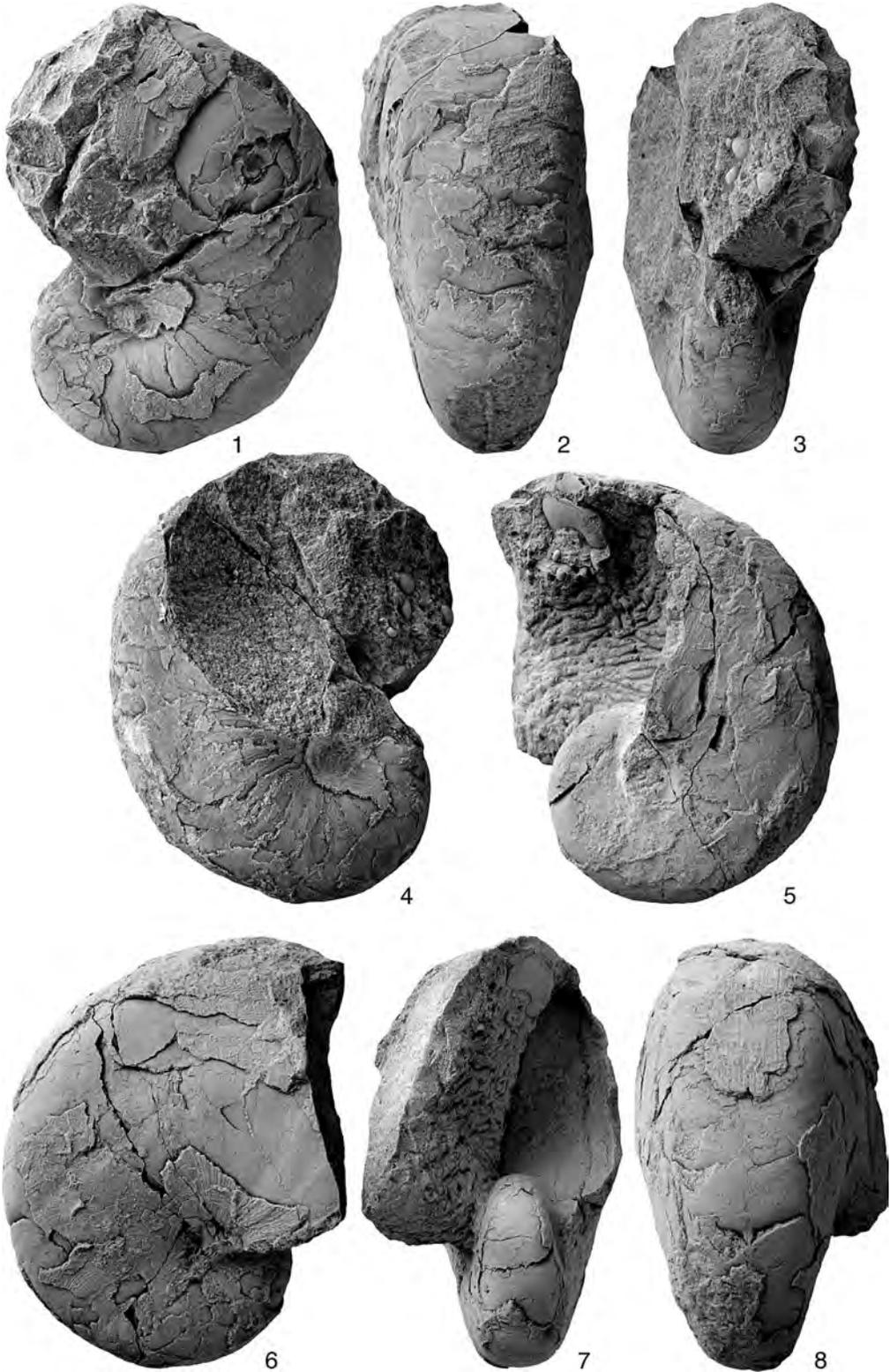


Fig. 43. *Menuthionutilus korzchi* Kiparisova, 1960 from AB1013. 1–4, NSM PM23123, $\times 1.0$. 5–7, NSM PM23124, $\times 1.0$. Black arrow indicates position of last preserved septum.

Fig. 44. *Menuthionutilus korzchi* Kiparisova, 1960 from AB1013. 1–4, NSM PM23125, $\times 1.0$. 5–8, NSM PM23126, $\times 1.0$. →



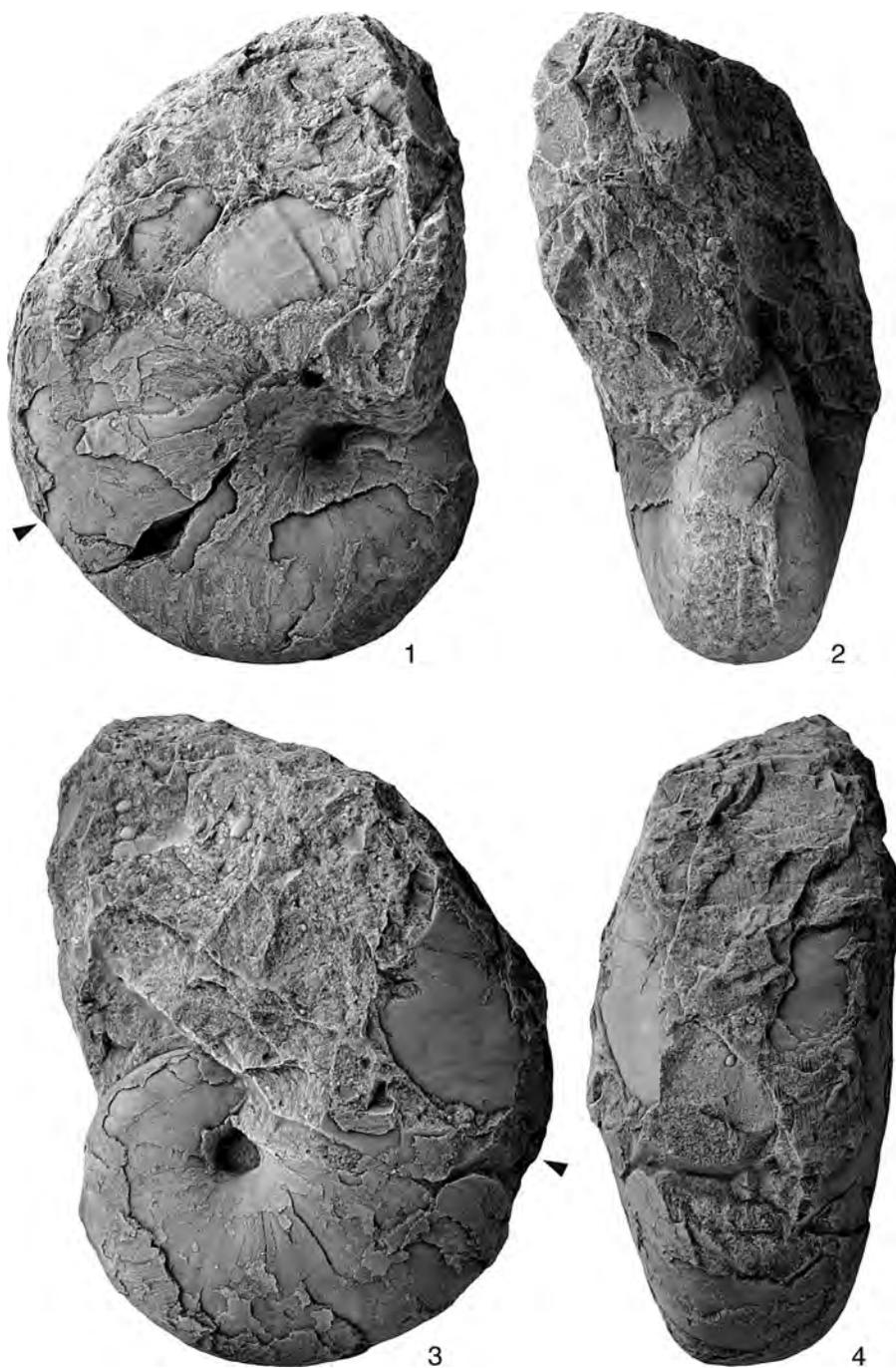


Fig. 45. *Menuthionutilus korzchi* Kiparisova, 1960. 1–4, NSM PM23127, from AB1013, $\times 1.0$. Black arrows indicate position of last preserved septum.

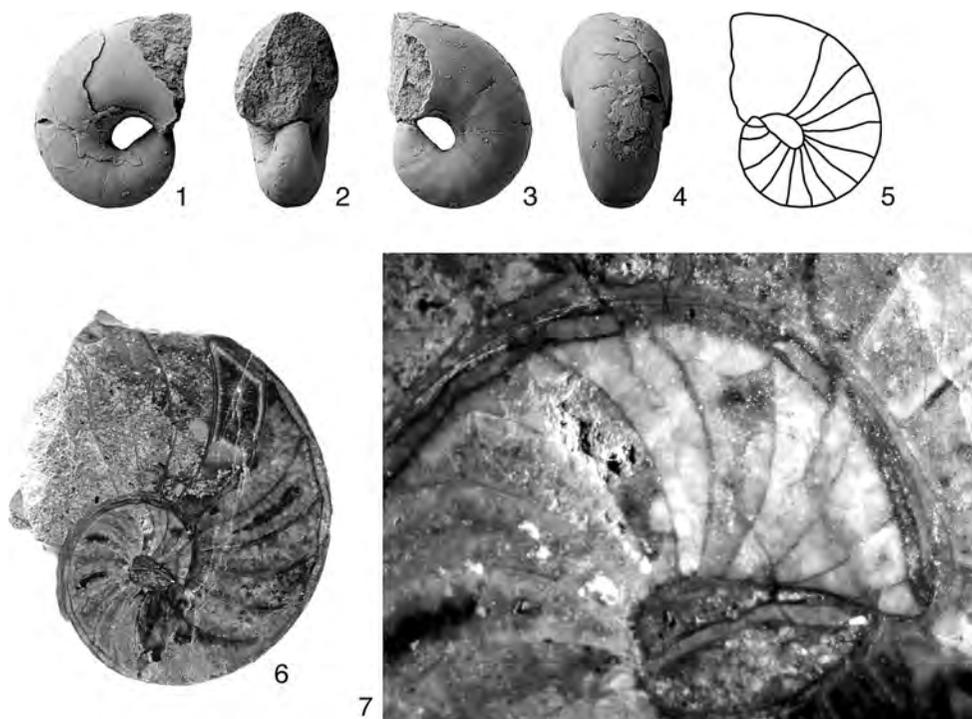


Fig. 46. *Menuthionautilus korzchi* Kiparisova, 1960. 1–5, NSM PM23121, from AB1013, $\times 2.0$. 6, Median section, NSM PM23122, from AB1014, $\times 2.0$. 7, Apical part of NSM PM23122, $\times 10.0$.

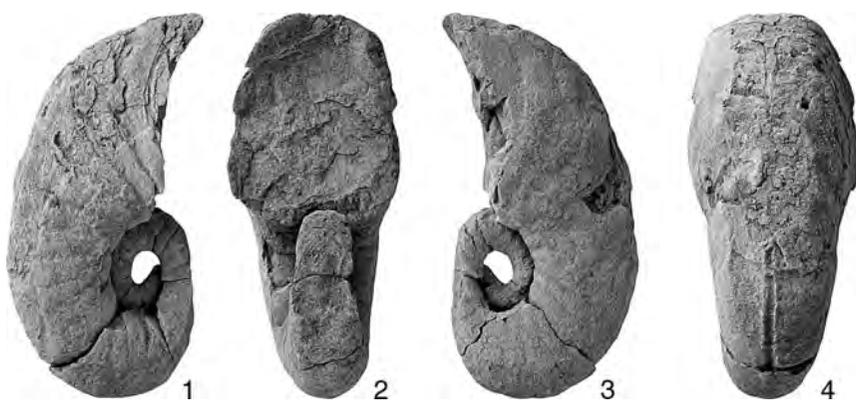


Fig. 47. *Menuthionautilus evolutus* Shigeta and Zakharov sp. nov. 1–4, NSM PM23128, holotype, from AB1012, $\times 1.0$.

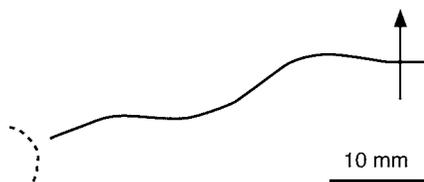


Fig. 48. Suture line of *Menuthionautilus korzchi* Kiparisova, 1960, NSM PM23127, from AB1013, at H=31 mm.

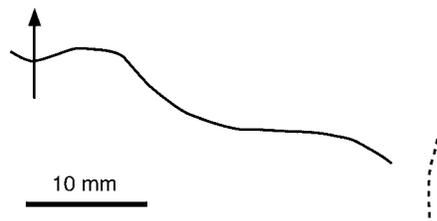


Fig. 49. Suture line of *Menuthionautilus evolutus* Shigeta and Zakharov sp. nov., NSM PM23128, holotype, from AB1012, at H=26 mm.

Occurrence: Described specimens from AB1013 within the *Ambitoides fuliginatus* Zone and from AB1014 within the *Clypeoceras spitiense* “bed”, both early Late Induan (early Dienerian) in the basal part of the Zhitkov Formation, Abrek Bay area, South Primorye.

Discussion: *Menuthionautilus korzchi* Kiparisova, 1960 differs from *M. kieslineri* Collignon (1933, p. 164) by its more inflated shell, and bears some resemblance to *Xiaohenautilus abrekensis* sp. nov. with regard to its delicate network lirae ornamentation and marginal siphuncle position. Although Kummel (1953a, b) believed that it descended from *Domatoceras* Hyatt, 1891 or *Grypoceras* Hyatt, 1883, we now consider *Menuthionautilus* to be an offshoot of *Xiaohenautilus* Xu, 1988.

***Menuthionautilus evolutus* Shigeta and Zakharov sp. nov.**

Figs. 47, 49

Holotype: NSM PM23128, from AB1012.

Diagnosis: Moderately evolute *Menuthionautilus* with subquadratic whorl section.

Etymology: Species name refers to its evolute coiling.

Description: Moderately evolute shell characterized by broadly rounded venter, rounded ventral shoulders and broadly convex flanks forming a subquadratic whorl section. Umbilicus with moderately high, vertical wall with rounded shoulders, and small (3–5 mm) umbil-

ical perforation. Embryonic shell about 7 mm in length and consists of one half whorl. Body chamber not preserved. Shell ornamentation not preserved. Siphuncle located next to venter. Suture simple with shallow ventral lobe, and shallow, wide lateral lobe.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23128	51.0	11.6	26.0	23.3	0.23	0.90

Occurrence: Described specimen from AB1012 within the *Ambitoides fuliginatus* Zone (early Late Induan=early Dienerian) in the uppermost part of the Lazurnaya Bay Formation, Abrek Bay area, South Primorye.

Discussion: *Menuthionautilus evolutus* sp. nov. is easily distinguished from *M. korzchi* Kiparisova (1960, p. 136) and *M. kieslineri* Collignon (1933, p. 164) by its evolute coiling. The moderately evolute shell is very similar to *Xiaohenautilus abrekensis* sp. nov., *X. sinensis* Xu (1988, p. 439) and *X. huananensis* Xu (1988, p. 439) of late Early Induan (late Griesbachian) age. We consider *Menuthionautilus* to be an offshoot of *Xiaohenautilus* Xu, 1988.

Order Ceratitida, Hyatt, 1884

Superfamily Xenodiscoidea Frech, 1902

Family Xenodiscidae Frech, 1902

Genus ***Tompophiceras*** Popov, 1961

Type species: *Tompophiceras fastigatum* Popov, 1961.

***Tompophiceras* sp. indet.**

Fig. 50.7–50.8

Material examined: NSM PM23129 from AB1007.

Description: Very evolute serpenticone with sub-elliptical whorl section, broadly rounded venter, rounded ventral shoulders and convex flanks with maximum whorl width at mid-flank. Umbilicus wide with moderately high, oblique wall and rounded shoulders. Ornamentation consists of distinct, convex ribs arising on umbilical shoulder, becoming more prominent on mid-flank and fading on ventral shoulder. Suture not visible.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23129	34.0	17.7	8.6	–	0.52	–

Occurrence: Described specimen from AB1007 within the *Lyttophiceras* sp. Zone (Early Induan=Griesbachian) in the middle part of the Lazurnaya Bay Formation, Abrek Bay area, South Primorye.

Discussion: Even though the present specimen is fragmental, its distinctive features enable us to assign it with reasonable confidence to the genus *Tompophiceras*. However, a definitive species assignment cannot be made.

Zakharov (Zakharov & Rybalka, 1987, p. 33) described *Glyptophiceras* (*Glyptophiceras*) *ussuriense* from the early Induan of South Primorye, but upon re-examination, its ornamentation and shell shape justify its assignment to the genus *Hypophiceras* Trumphy, 1969 or *Tompophiceras*. This species differs from our specimen by its prominent ribs.

Family Xenoceltitidae Spath, 1930

Genus *Shamaraites* Shigeta and Zakharov
gen. nov.

Type species: *Anakashmirites schamarensis* Zakharov, 1968.

Composition of the genus: Two species, *Dinarites latiplicatus* Diener (1895, p. 11) and

Anakashmirites schamarensis Zakharov (1968, p. 104).

Diagnosis: Moderately evolute shell with subquadratic whorl section, subtabulate to low, arched venter, nearly parallel to slightly convex flanks, variable constrictions and ceratitic suture line.

Etymology: Named after Shamara Bay, Ussury Gulf, in South Primorye.

Occurrence: Lower part of the Lower Olenekian (lower Smithian) in South Primorye, Russia.

Discussion: *Shamaraites* gen. nov. differs from other representatives of Xenoceltitidae such as *Pseudoceltites* Hyatt, 1900, *Kashmirites* Diener, 1913, *Anakashmirites* Spath, 1930, and *Eukashmirites* Kummel, 1969, by the presence of distinct constrictions and the absence of distant, radial ribs. This new genus is close in shape and ornamentation to *Kashmirites varianus* Chao (1959, p. 279), the type species of *Hebeisenites* Brayard and Bucher, 2008, and *Jinyaceras bellum* Brayard and Bucher (2008, p. 31), but it has a well-developed ceratitic suture with a large first lateral saddle and reduced second lateral lobe (Zakharov, 1968, fig. 26).

***Shamaraites schamarensis* (Zakharov, 1968)**

Figs. 50.1–50.4, 51

Anakashmirites schamarensis Zakharov, 1968, p. 104, pl. 20, fig. 3, text-fig. 26b, c.

Holotype: DVGI 211/801, figured by Zakharov (1968, p. 104, pl. 20, fig. 3), from the lower part of the Lower Olenekian (*Hedenstroemia bosphorensis* Zone) on the western coast of Ussuri Gulf, near Tri Kamnya Cape, in South Primorye, Russia.

Material examined: NSM PM23130, from AB1021.

Description: Moderately evolute shell with subquadratic whorl section, subtabulate venter, angular ventral shoulders and nearly parallel to slightly convex flanks. Umbilicus moderately wide, with moderately high, subvertical wall

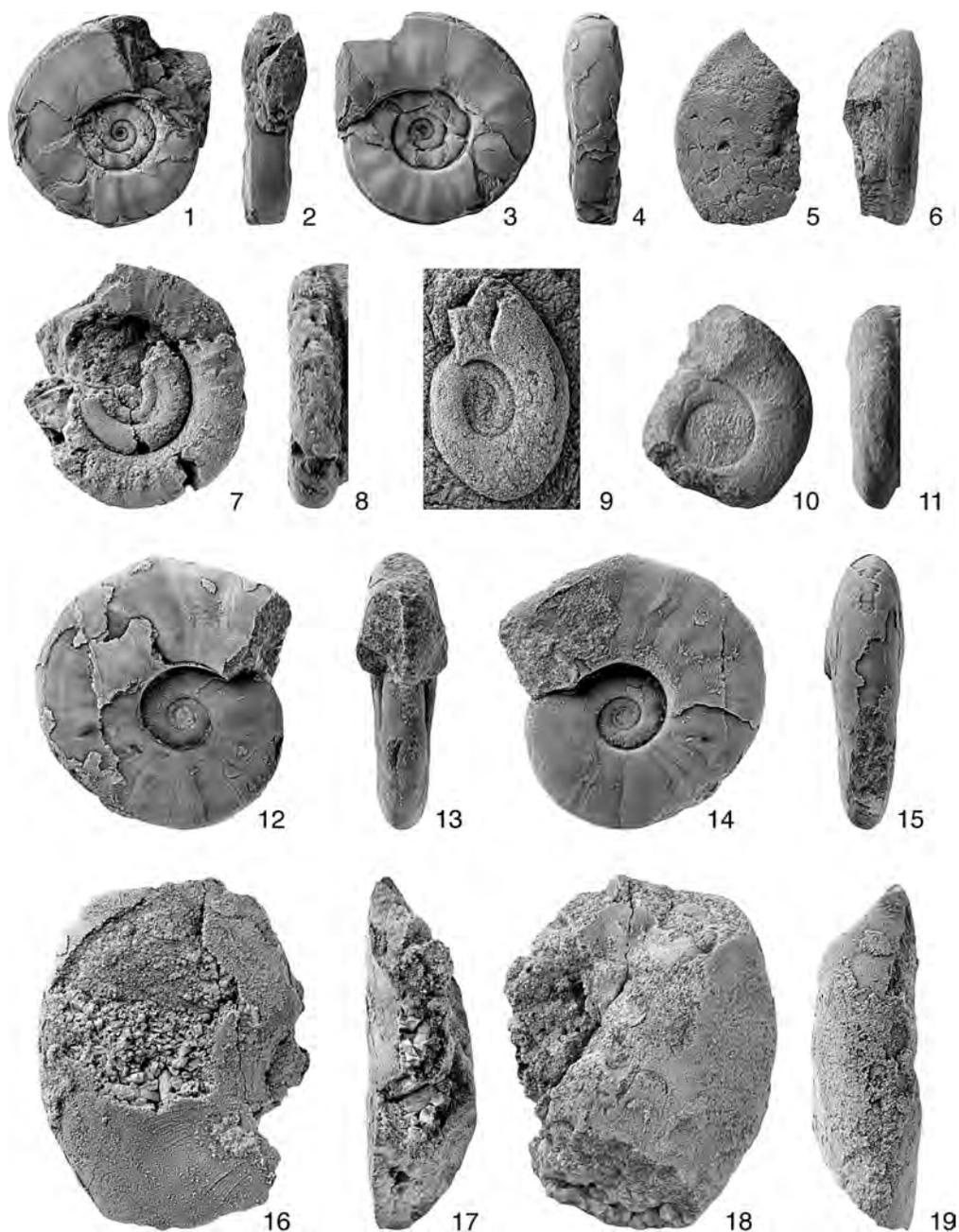


Fig. 50. 1–4, *Shamaraites schamarensis* (Zakharov, 1968) gen. nov., NSM PM23130, from AB1021, $\times 1.0$. 5–6, *Ussuridiscus varaha* (Diener, 1895) gen. nov., NSM PM23135, from AB1009, $\times 1.0$. 7–8, *Tompophiceras* sp. indet., NSM PM23129, from AB1007, $\times 1.0$. 9–11, *Lytrophiceras* (?) sp. indet. 9, NSM PM23132, from AB1004, $\times 1.0$. 10–11, NSM PM23133, from AB1009, $\times 1.0$. 12–15, *Wordieoceras* cf. *wordiei* (Spath, 1930), NSM PM23134, from AB1010, $\times 1.0$. 16–19, *Lytrophiceras* sp. indet., NSM PM23131, from AB1007, $\times 1.0$.

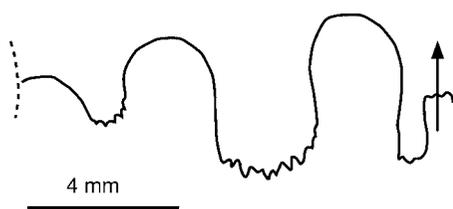


Fig. 51. Suture line *Shamaraites schamarensis* (Zakharov, 1968) gen. nov., NSM PM23130, from AB1021, at H=8 mm.

and rounded shoulders. Ornamentation consists of distinct, prorsiradiate constrictions, which form small plications on body chamber and nearly disappear on venter. Suture ceratitic with wide ventral lobe, divided by a median saddle into two short branches with a few denticulations at each base. First lateral saddle higher than second saddle and third saddle lower. First lateral lobe deep, wide with many denticulations at base, and second lateral lobe about one-half depth of first lobe.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23130	29.8	11.4	10.1	8.3	0.38	0.82

Occurrence: Described specimen from AB1021 within the *Clypeoceras timorensis* Zone (early Early Olenekian=early Smithian) in the main part of the Zhitkov Formation, Abrek Bay area, South Primorye. This species also occurs in the *Hedenstroemia bosphorensis* Zone along the western coast of Ussuri Gulf, near Tri Kamnya Cape, South Primorye (Zakharov, 1968; Markevich & Zakharov, 2004).

Discussion: *Shamaraites schamarensis* (Zakharov, 1968) differs from *S. latiplicata* (Diener, 1895, p. 12) by its subtabulate venter and angular ventral shoulders.

Superfamily Meekoceratoidea Waagen, 1895
 Family Ophiceratidae Arthaber, 1911
 Genus *Lytophyceras* Spath, 1930

Type species: *Ophiceras chamunda* Diener, 1897.

Lytophyceras sp. indet.

Fig. 50.16–50.19

Material examined: NSM PM23131, part of an outer whorl, from AB1007.

Description: Moderately involute, discoidal shell with rounded venter, nearly parallel flanks and umbilicus with low, oblique wall and rounded shoulders. Shell surface either smooth or ornamentated with fine growth lines. Suture ceratitic with deep, weakly indented lateral lobes.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23131*	-	-	28.1	14.0	-	0.50

* Measurements at last septum.

Occurrence: Described specimen from AB1007 within the *Lytophyceras* sp. Zone (Early Induan=Griesbachian) in the middle part of the Lazurnaya Bay Formation, Abrek Bay area, South Primorye.

Discussion: The described specimen possibly represents a portion of an outer whorl of *Lytophyceras eusakuntala* (Zakharov, 1987, p. 35), which displays the same shell shape. However, the fragmental nature of the specimen precludes a definitive assignment.

Waterhouse (1994) assigned *Lytophyceras eusakuntala* to *Himophyceras* Waterhouse, 1994, but we reject this synonymy because *L. eusakuntala* differs from all species of *Himophyceras* by its gently rounded umbilical wall, which is one of the diagnostic features of *Lytophyceras*.

Lytophycerasku? sp. indet.

Fig. 50.9–50.11

Material examined: NSM PM23132 from AB1004, and NSM PM23133 from AB1009. Specimens poorly preserved.

Description: Moderately evolute shell with rounded venter, rounded ventral shoulders, gently convex flanks and moderately wide umbilicus with low, oblique wall and rounded shoulders. Shell surface smooth. Suture not

visible.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23132	20.6	7.7	8.0	—	0.37	—
NSM PM23133	21.1	8.6	7.2	6.6	0.41	0.92

Occurrence: Described specimens from AB1004, AB1009 within the *Lytophicerus* sp. Zone (Early Induan=Griesbachian) in the lower and middle parts of the Lazurnaya Bay Formation, Abrek Bay area, South Primorye.

Discussion: The uncertain assignment of these specimens to *Lytophicerus* is based only on their similar morphology to Ophiceratidae.

Genus *Wordieoceras* Spath, 1930

Type species: *Vishnuites wordiei* Spath, 1930.

Wordieoceras cf. *wordiei* (Spath, 1930)

Figs. 50.12–50.15, 52

cf. *Vishnuites wordiei* Spath, 1930, p. 31, pl. 2, fig. 11; Spath, 1935, p. 41, pl. 4, fig. 5, pl. 12, fig. 2.

cf. *Wordieoceras wordiei* (Spath). Tozer, 1994, p. 58, pl. 5, figs. 1–3, pl. 6, figs. 1–3, pl. 7, figs. 1–4, text-fig. 8.

Material examined: NSM PM23134, from AB1010.

Description: Moderately evolute, fairly compressed shell with subrectangular whorl section, subacute venter, rounded ventral shoulders and nearly parallel to slightly convex flanks with maximum whorl width just above umbilical shoulders. Umbilicus moderately wide with low, subvertical wall, and rounded shoulders. Ornamentation consists of conspicuous, rectiradiate, slightly sinuous constrictions as well as fine, sinuous growth lines. Suture ceratitic with wide ventral lobe divided by a median saddle into two short branches. First lateral saddle lower than second saddle, and third saddle even lower. First lateral lobe deep and narrow with many denticulations at base. Depth of second lateral lobe about one-half of first lobe.

Measurements (mm):

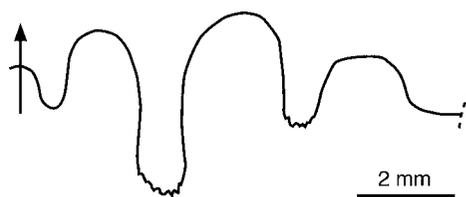


Fig. 52. Suture line of *Wordieoceras* cf. *wordiei* (Spath, 1930), NSM PM23134, from AB1010, at H=9.5 mm.

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23134	35.5	10.9	15.0	9.3	0.31	0.62

Occurrence: Described specimen from AB1010 within the lower *Gyronites subdharinus* Zone (late Early Induan=late Griesbachian) in upper part of the Lazurnaya Bay Formation, Abrek Bay area, South Primorye. *Wordieoceras wordiei* is also known from beds of late Griesbachian age in Greenland (Spath, 1931, 1935) and Arctic Canada (Tozer, 1994).

Discussion: Although the present specimen is ornamented with conspicuous constrictions, its shell morphology enables us to identify it with reasonable confidence as *Wordieoceras wordiei* (Spath, 1930, p. 31). It is close to *W.* aff. *wordiei* and *W. guizhouensis*, (both described by Zakharov & Mu in Mu *et al.*, 2007, p. 862), which are characterized by a narrowly rounded venter and rounded venter, respectively, but differs from them by its subacute venter and more involute shell.

Genus *Vishnuites* Diener, 1897

Type species: *Xenaspis (Vishnuites) pralambha* Diener, 1897.

Vishnuites? sp. indet.

Figs. 53, 54

Material examined: NSM PM23136 from AB1014.

Description: Moderately evolute, fairly compressed shell with acutely keeled venter



Fig. 53. *Vishnuites?* sp. indet. 1–4, NSM PM23136, from AB1014, $\times 3.0$.

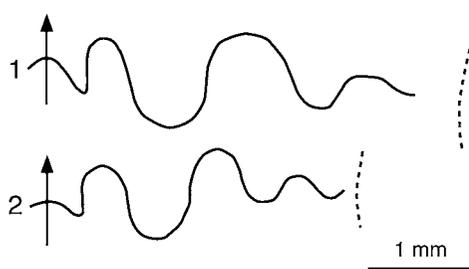


Fig. 54. Suture lines of *Vishnuites?* sp. indet., NSM PM23136, from AB1014. 1, at H=4 mm. 2, at H=3 mm.

and convex flanks with maximum whorl width at mid-flank. Moderately wide umbilicus with low, near vertical wall and rounded shoulders. Ornamentation consists only of weak, radial folds. Suture goniatic with first lateral saddle lower, narrower than second saddle, and third saddle lower than first and second. First lateral lobe deep, wide, and second lateral lobe about two third depth of first lobe.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23136	10.9	3.5	4.6	3.2	0.32	0.70

Occurrence: Described specimen from *Clypeoceras spitiense* “bed” (AB1014, Late Induan=Dienerian) in the lower part of the Zhitkov Formation, Abrek Bay area, South Primorye.

Discussion: The assignment of the specimen to *Vishnuites* is uncertain, and is based only on the similarity of its morphology with *Vishnuites*.

Family Meekoceratidae Waagen, 1895
Genus *Ussuridiscus* Shigeta and Zakharov
gen. nov.

Type species: *Meekoceras (Kingites) varaha* Diener, 1895.

Composition of the genus: Type species only.

Diagnosis: Slender, very involute shell with tabulate venter, narrow umbilicus with overhanging umbilical wall and ceratitic suture line.

Etymology: Named after Ussuri Gulf in South Primorye and the Latin word: *discus*, meaning disk.

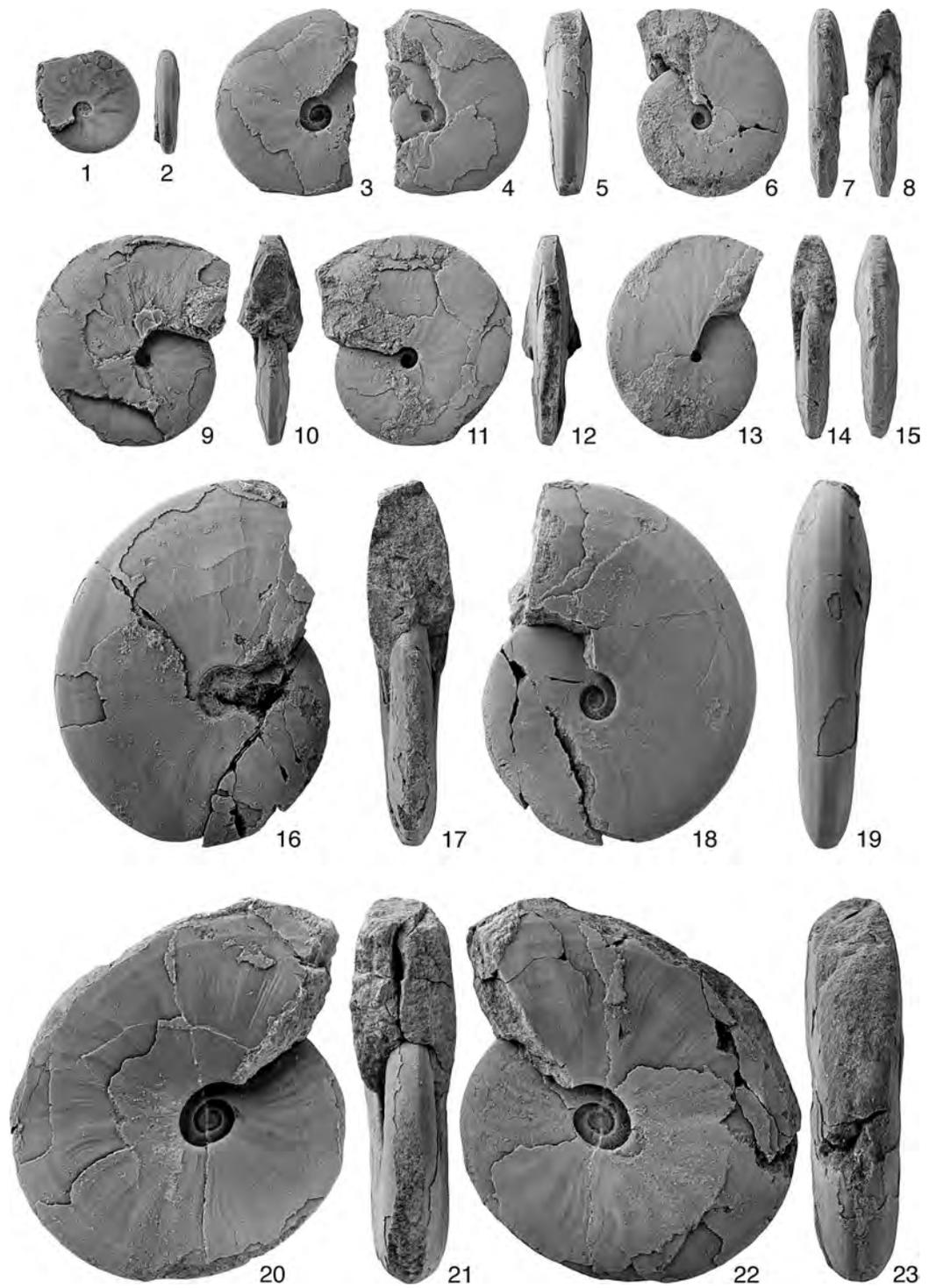
Occurrence: Throughout much of the middle Induan in South Primorye, Russia.

Discussion: *Ussuridiscus* gen. nov. can be easily distinguished from *Khangsaria* Waterhouse, 1994, *Mesokantoa* Waterhouse, 1994, and *Hubeitoceras* Waterhouse, 1994, by its tabulate venter and overhanging umbilical wall. It bears some resemblance to *Radioceras* Waterhouse, 1996a, *Kymatites* Waagen, 1895, and *Koninckites* Waagen, 1895 in terms of its involute shell and tabulate venter, but differs from them by its overhanging umbilical wall. *Zhaojinkoceras* Waterhouse, 1994 is very close to this new genus, but its venter is concave.

Ussuridiscus varaha (Diener, 1895)

Figs. 50.5–50.6, 55–57

Meekoceras (Kingites) varaha Diener, 1895, p. 52, pl. 1, fig. 2.



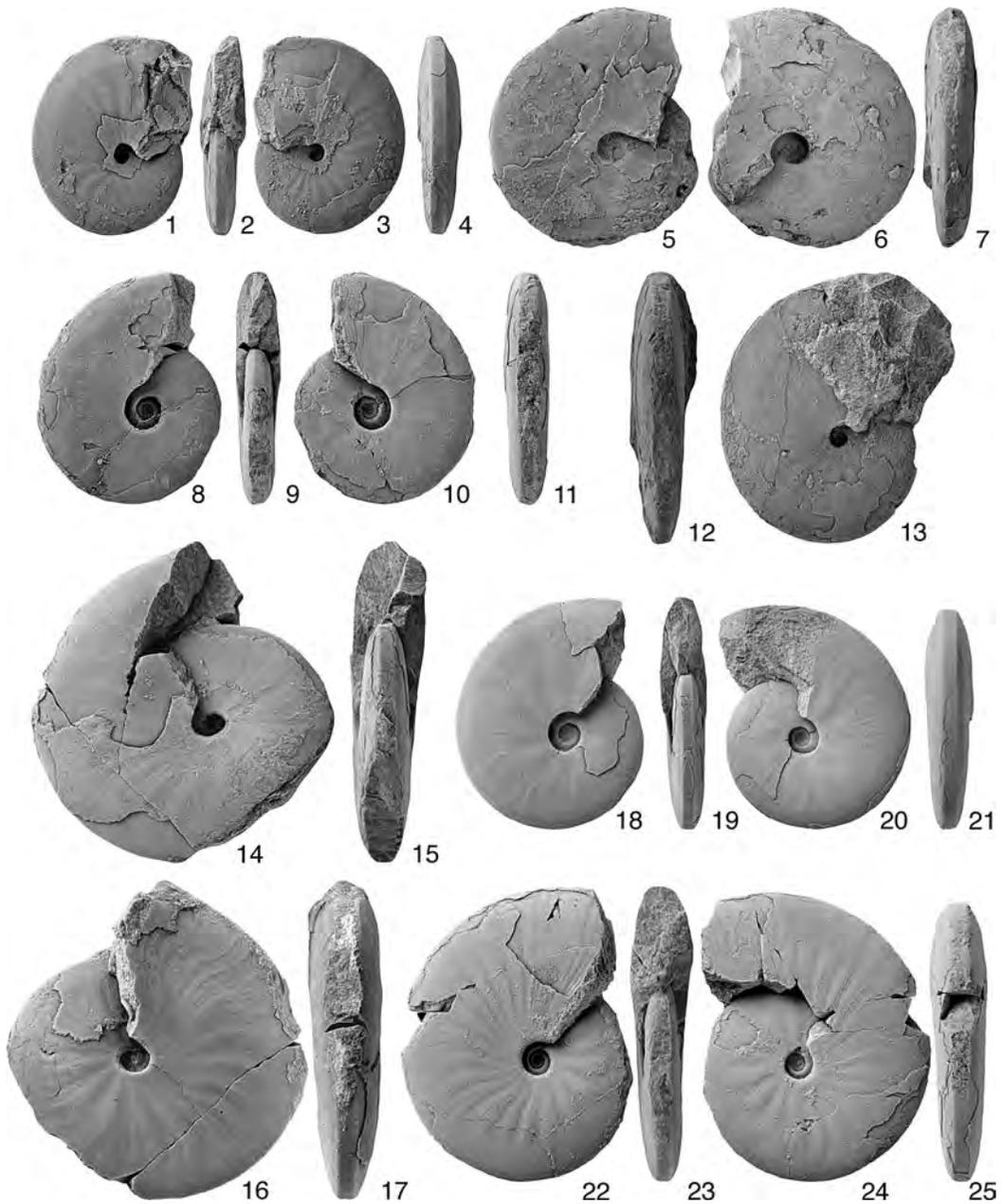


Fig. 56. *Ussuridiscus varaha* (Diener, 1895) gen. nov. 1–17, from AB1011. 1–4, NSM PM23144, $\times 1.0$. 5–7, NSM PM23145, $\times 1.0$. 8–11, NSM PM23146, $\times 1.0$. 12–13, NSM PM23147, $\times 1.0$. 14–17, NSM PM23148, $\times 1.0$. 18–25, from AB1013. 18–21, NSM PM23149, $\times 1.0$. 22–25, NSM PM23150, $\times 1.0$.

←

Fig. 55. *Ussuridiscus varaha* (Diener, 1895) gen. nov. from AB1010. 1–2, NSM PM23137, $\times 1.0$. 3–5, NSM PM23138, $\times 1.0$. 6–8, NSM PM23139, $\times 1.0$. 9–12, NSM PM23140, $\times 1.0$. 13–15, NSM PM23141, $\times 1.0$. 16–19, NSM PM23142, $\times 1.0$. 20–23, NSM PM23143, $\times 1.0$.

Koninckites varaha (Diener). Zakharov, 1968, p. 91, pl. 17, figs. 4, 5, text-fig. 20b.

Hubeitoceras (?) *wangi* Zakharov and Mu in Mu *et al.*, 2007, p. 871, figs. 13.17–13.19, 15.2–15.5.

“*Koninckites*” cf. *timorensis* (Wanner). Brühwiler *et al.*, 2008, p. 1165, pl. 3, figs. 1–4, pl. 4, figs. 1–2.

Holotype: CGM 61/596, figured by Diener (1895, p. 52, pl. 1, fig. 2), from the Lower Triassic along Paris Bay in Russian Island, South Primorye, Russia.

Material examined: NSM PM23135, from AB1009, seven specimens, NSM PM23137–23143, from AB1010, five specimens, NSM PM23144–23148, from AB1011, and two specimens, NSM PM23149, 23150, from AB1013.

Description: Very involute, very compressed platycone with subrectangular whorl section, distinctively tabulate to subtabulate venter, rather abruptly rounded ventral shoulders and flat to slightly convex flanks with maximum whorl width at about two thirds of whorl height. Umbilicus varies from narrow to very narrow with low, overhanging wall and abruptly rounded shoulders. Ornamentation consists of fine, sinuous, slightly prorsiradiate growth lines as well as low radial folds, which are pronounced on inner flank. Suture ceratitic with wide ventral lobe divided by fairly high median saddle into two deep branches with a few denticulations at their bases. First lateral saddle lower than second lateral saddle, and third saddle lower than first and second. First lateral lobe deep and wide with many denticulations at base. Some auxiliary elements present on adumbilical flank.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23137	15.6	2.1	7.9	3.2	0.13	0.41
NSM PM23138	24.4	4.9	11.4	5.5	0.20	0.48
NSM PM23139	29.4	4.0	15.0	5.4	0.14	0.36
NSM PM23140	32.1	3.2	17.1	–	0.10	–
NSM PM23141	31.6	2.0	17.4	6.5	0.06	0.37
NSM PM23142	54.6	7.0	28.4	12.0	0.13	0.42
NSM PM23143	27.9	2.6	15.2	6.0	0.09	0.39
NSM PM23144	49.4	8.5	25.0	12.2	0.17	0.49
NSM PM23145	34.2	4.6	17.7	7.4	0.13	0.42
NSM PM23146	33.0	6.6	15.3	6.5	0.20	0.42

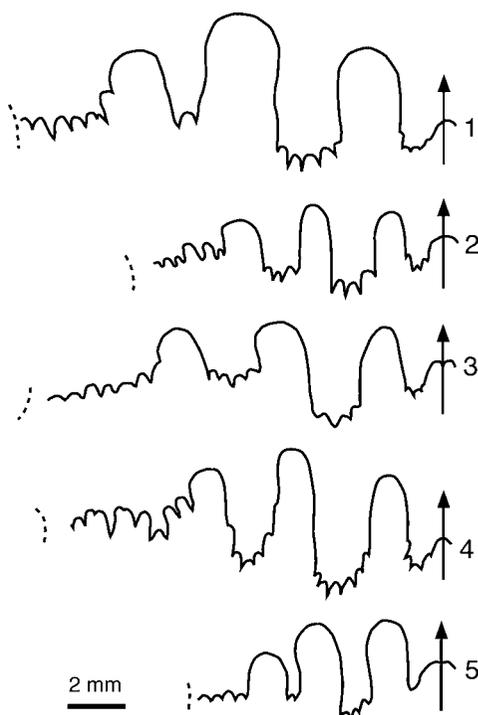


Fig. 57. Suture lines of *Ussuridiscus varaha* (Diener, 1895) gen. nov. 1, NSM PM23143, from AB1010, at H=16 mm. 2, NSM PM23139, from AB1010, at H=12 mm. 3, NSM PM23148, from AB1011, at H=15 mm. 4, NSM PM23147, from AB1011, at H=14 mm. 5, NSM PM23149, from AB1013, at H=9 mm.

NSM PM23147	36.4	3.0	19.9	7.1	0.08	0.36
NSM PM23148	40.2	4.0	20.9	8.6	0.10	0.41
NSM PM23149	29.8	4.9	14.4	6.5	0.16	0.45
NSM PM23150	41.8	4.7	21.6	8.0	0.16	0.37

Occurrence: Described specimens from AB1009 within the *Lytophicerias* sp. Zone, and from AB1010, AB1011 within the *Gyronites subdharmus* Zone in the middle to upper parts of the Lazurnaya Bay Formation, and from AB1013 within the *Ambitoides fuliginatus* Zone in the lowest part of the Zhitkov Formation, Abrek Bay area, South Primorye. Thus, in this particular area, the species ranges from late Early Induan (late Griesbachian) to early Late Induan (early Dienerian). It also occurs abundantly in the *Gyronites subdharmus* Zone

on the western coast of Ussuri Gulf, between Seryj Cape and Nerpa Rock, South Primorye (Zakharov, 1968; Markevich & Zakharov, 2004).

Discussion: *Ussuridiscus varaha* (Diener, 1895) differs from specimens identified as *Meekoceras varaha* Diener by Diener (1897, p. 143) and Kraft and Diener (1909, p. 17) by its flat flanks and overhanging umbilical wall. Aside from its ceratitic suture, it appears to be morphologically very close to the specimen identified as *Aspidites vidarbha* Diener by Kraft and Diener (1909, p. 63, pl. 5, fig. 1). *Hubeitoceras* (?) *wangi* Zakharov and Mu (2007, p. 871) and “*Koninckites*” cf. *timorensis* (Wanner) by Brühwiler *et al.* (2008, p. 1165) are also very close in appearance with regard to their tabulate venters, nearly flat flanks and strong auxiliary suture elements, and in all likelihood, are probably conspecific.

According to Diener (1895), he collected the holotype from Paris Bay on Russian Island, South Primorye. Since sediments of Olenekian and Anisian age are well exposed along this seacoast, Zakharov (1968) naturally assumed the holotype’s collection horizon to be of Olenekian age. However, there has never been a report of this ammonoid’s occurrence at this particular locality other than Diener’s in 1895. This species frequently occurs in the Induan of South Primorye, but no Induan strata have been found in the type locality (Markevich & Zakharov, 2004), and the preservation of the holotype is very similar to that of specimens from Induan strata exposed along the western coast of Ussuri Gulf. Taken together, these facts strongly suggest that Diener made an error when recording the source of the type specimen.

Genus *Gyronites* Waagen, 1895

Type species: *Gyronites frequens* Waagen, 1895.

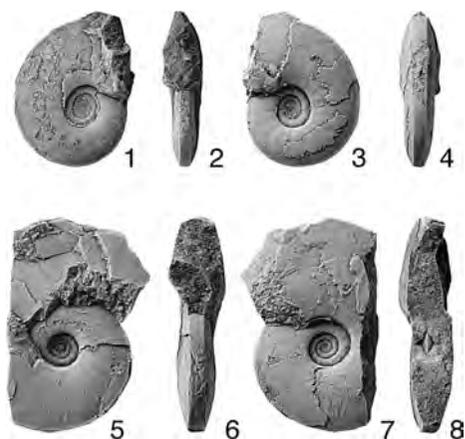


Fig. 58. *Gyronites* sp. indet. from AB1013. 1–4, NSM PM23173, $\times 1.0$. 5–8, NSM PM23174, $\times 1.0$.

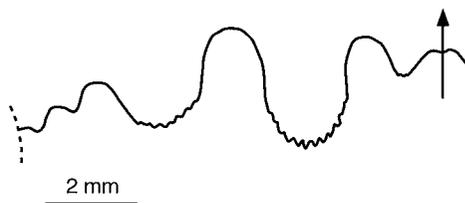


Fig. 59. Suture line of *Gyronites* sp. indet., NSM PM23174, from AB1013, at H=8 mm.

Gyronites sp. indet.

Figs. 58, 59

Material examined: Two specimens, NSM PM23173, 23174, from AB1013.

Description: Moderately evolute, compressed shell with rectangular whorl section, distinctively tabulate venter, angular ventral shoulders, and slightly convex flanks with maximum whorl width on inner flank. Umbilical width moderate to fairly narrow with low, near vertical wall and rounded shoulders. Shell ornamentation consists of weak radial folds as well as fine, sinuous, prorsiradiate growth lines. Suture ceratitic with ventral lobe divided by median saddle into two branches. First lateral saddle lower than second saddle and third

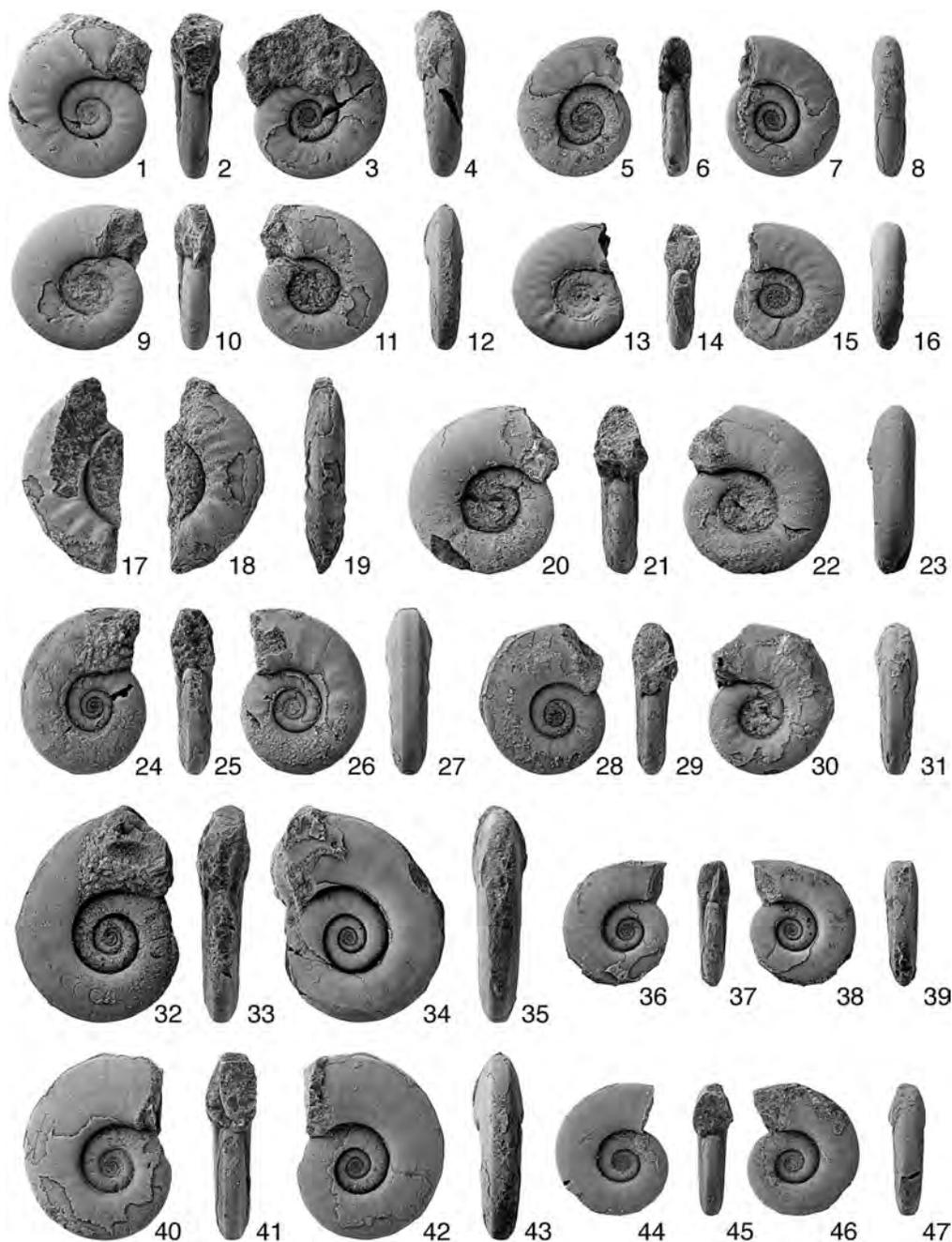


Fig. 60. *Gyroneites subdharmus* Kiparisova, 1961 from AB1010. 1–4, NSM PM23151, $\times 1.0$. 5–8, NSM PM23152, $\times 1.0$. 9–12, NSM PM23153, $\times 1.0$. 13–16, NSM PM23154, $\times 1.0$. 17–19, NSM PM23155, $\times 1.0$. 20–23, NSM PM23156, $\times 1.0$. 24–27, NSM PM23157, $\times 1.0$. 28–31, NSM PM23158, $\times 1.0$. 32–35, NSM PM23159, $\times 1.0$. 36–39, NSM PM23160, $\times 1.0$. 40–43, NSM PM23161, $\times 1.0$. 44–47, NSM PM23162, $\times 1.0$.

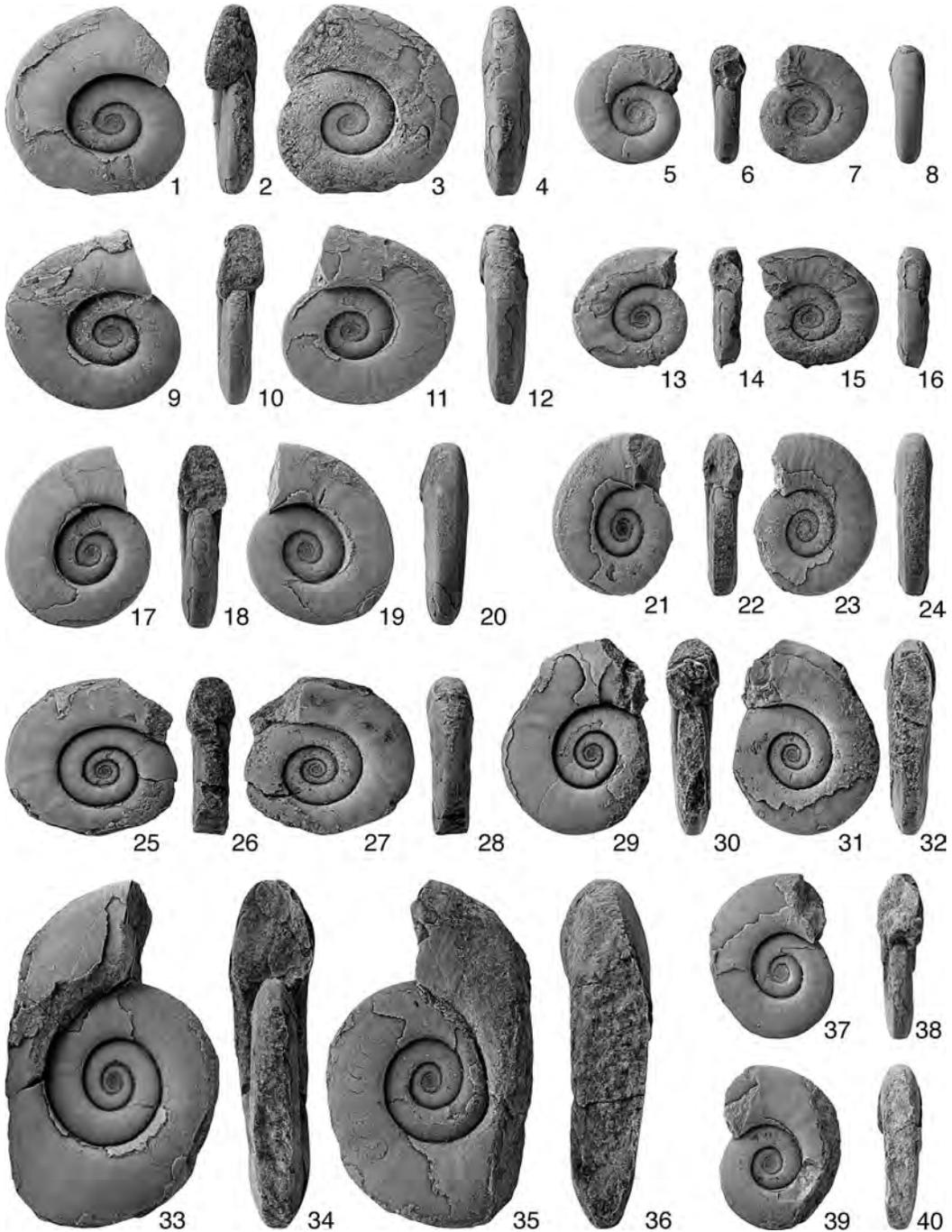


Fig. 61. *Gyronites subdharmaus* Kiparisova, 1961 from AB1011. 1–4, NSM PM23163, $\times 1.0$. 5–8, NSM PM23164, $\times 1.0$. 9–12, NSM PM23165, $\times 1.0$. 13–16, NSM PM23166, $\times 1.0$. 17–20, NSM PM23167, $\times 1.0$. 21–24, NSM PM23168, $\times 1.0$. 25–28, NSM PM23169, $\times 1.0$. 29–32, NSM PM23170, $\times 1.0$. 33–36, NSM PM23171, $\times 1.0$. 37–40, NSM PM23172, $\times 1.0$.

saddle even lower. First lateral lobe deep and wide with many denticulations at base. Second lateral lobe about one half depth of first lobe.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23173	18.6	5.6	7.3	4.4	0.30	0.60
NSM PM23174	28.3	6.3	13.2	–	0.22	–

Occurrence: Described specimens from AB1013 within the *Ambitoides fuliginatus* Zone (early Late Induan=early Dienerian) in the lowest part of the Zhitkov Formation, Abrek Bay area, South Primorye.

Discussion: The described specimens may simply be juvenile *Gyronites* shells. Although they are somewhat similar to *Gyronites frequens* Waagen (1895, p. 292), no definitive species assignment can be made.

***Gyronites subdharmus* Kiparisova, 1961**

Figs. 60–62

Gyronites (?) *subdharmus* Kiparisova, 1961, p. 64, pl. 11, figs. 3–5, text-fig. 23.

Gyronites subdharmus Kiparisova. Zakharov, 1968, p. 60, pl. 6, figs. 1–4, text-fig. 12a.

Gyronites frequens Waagen. Brühwiler *et al.*, 2008, p. 1168, pl. 5, figs. 7–8

Holotype: CGM 54/5504, figured by Kiparisova (1961, p. 64, pl. 11, fig. 3), from the Lower Triassic (Induan, *Flemingites*? beds) in the Abrek Bay area in South Primorye, Russia.

Material examined: Twelve specimens, NSM PM23151–23162, from AB1010, and ten specimens, NSM PM23163–23172, from AB1011.

Description: Evolute, fairly compressed shell with subrectangular whorl section, distinctively tabulate venter, angular ventral shoulders and slightly convex flanks with maximum whorl width on inner flank. Umbilicus fairly wide with low, near vertical wall and rounded shoulders. Ornamentation consists of slightly rusiradiate to rectiradiate, distant folds arising on umbilical shoulder and fading away on ventral shoulder. Folds more prominent near umbilical shoulder, but vary in strength

from fairly strong to very weak. Suture ceratitic with ventral lobe divided by median saddle into two short branches. First lateral saddle lower than second saddle, and third saddle lower yet. First lateral lobe deep, and wide with many denticulations at base, and second lateral lobe about one-half depth of first lobe.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23151	20.9	8.0	7.1	5.4	0.38	0.76
NSM PM23152	20.5	8.6	7.0	4.4	0.42	0.63
NSM PM23153	20.0	7.8	7.4	5.2	0.39	0.70
NSM PM23154	17.0	6.8	6.1	4.6	0.40	0.75
NSM PM23156	22.4	9.1	8.6	5.8	0.41	0.67
NSM PM23157	29.7	12.4	9.7	7.0	0.42	0.72
NSM PM23158	16.1	6.3	6.2	4.3	0.39	0.69
NSM PM23159	23.5	9.1	8.1	5.8	0.39	0.72
NSM PM23160	16.1	6.5	5.7	4.4	0.40	0.77
NSM PM23161	25.6	10.0	9.5	6.3	0.39	0.66
NSM PM23162	17.5	7.2	6.2	4.2	0.41	0.68
NSM PM23163	28.0	11.8	9.7	6.9	0.42	0.71
NSM PM23164	17.4	7.6	5.5	4.5	0.44	0.82
NSM PM23165	26.5	10.8	9.2	5.8	0.41	0.63
NSM PM23166	17.4	7.5	5.9	4.4	0.43	0.75
NSM PM23167	28.0	12.3	8.9	7.0	0.44	0.77
NSM PM23168	23.7	9.8	8.0	5.4	0.41	0.68
NSM PM23169	25.5	11.8	7.7	5.6	0.46	0.73
NSM PM23170	28.2	12.3	9.0	7.0	0.44	0.78
NSM PM23171	51.1	21.2	16.3	12.1	0.41	0.74
NSM PM23172	24.4	9.9	8.7	5.9	0.41	0.68

Occurrence: Described specimens from AB1010, AB1011 within the *Gyronites subdharmus* Zone (late Early Induan=late Griesbachian) in the middle and upper parts of the Lazurnaya Bay Formation, Abrek Bay area, South Primorye. This species is frequently found in Induan strata on the western coast of Ussuri Gulf between Seryj Cape and Nerpa Rock, South Primorye (Zakharov, 1968; Markevich & Zakharov, 2004).

Discussion: *Gyronites subdharmus* Kiparisova, 1961 is easily distinguished from *G. frequens* Waagen (1895, p. 292) by its more evolute coiling and near vertical umbilical wall. The specimens described by Brühwiler *et al.* (2008, p. 1168) are more evolute than *G. frequense*, and they correspond well with *G. subdharmus*. Although the radial ribs of *G. subdharmus* are much weaker, its evolute shell

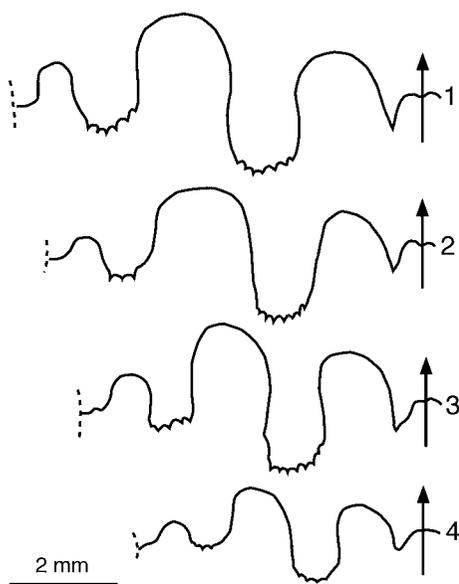


Fig. 62. Suture lines of *Gyronites subdharmus* Kiparisova, 1961. 1, NSM PM23159, from AB1010, at H=7.6 mm. 2, NSM PM23157, from AB1010, at H=7.0 mm. 3, NSM PM23167, from AB1011, at H=6.5 mm. 4, NSM PM23172, from AB1011, at H=5.5 mm.

and tabulate venter invite comparison of shell morphology with *Pleurogyronites krafftii* Tozer (1994, p. 66), *G. plicatus* Waagen (1895, p. 298), *G. rotus* Waagen (1895, p. 300), *G. radians* Waagen (1895, p. 302), *Danubites planidorsatus* Diener (1897, p. 34), and *D. rigidus* Diener (1897, p. 36), as well as specimens identified as *Xenodiscus radians* (Waagen), *X. cf. plicatus* (Waagen), *X. rotula* (Waagen) by Kraft and Diener (1909, pl. 23, fig. 4, pl. 25, figs. 1–4) and *Xenodiscoides* sp. indet. by Brühwiler *et al.* (2008, p. 1158). It also is morphologically very close to *G. nangaensis* Waagen (1895, p. 297) and *G. plicatilis* Waagen (1985, p. 315), which were assigned to *Wangyikangia* by Waterhouse (1996a), but its saddles do not exhibit subphyllloid characteristics. *Meekoceras dubium* Krafft (1909, p. 50), which is the lectotype of *Himoceras* Waterhouse, 1996a, is also close in appearance, but it has a steep, high umbilical wall.

Genus *Ambitoides* Shigeta and Zakharov gen. nov.

Type species: *Ambites fuliginatus* Tozer, 1994.

Composition of the genus: Two species, *Ambites fuliginatus* Tozer, 1994 and *Ambitoides orientalis* sp. nov.

Diagnosis: Discoidal, fairly involute shell with tabulate venter, narrow umbilicus, smooth flanks and ceratitic suture line.

Etymology: From *Ambites* and the Greek suffix: -oides.

Occurrence: Upper Induan in South Primorye, Russia and British Columbia, Canada.

Discussion: *Ambitoides* gen. nov. is morphologically very close to *Ambites* Waagen, 1895, but its suture is ceratitic in contrast to the sub-goniatitic suture typical of *Ambites*. *Radioceras* Waterhouse, 1996a is close to this genus with its tabulate venter and ceratitic suture line, but its shell is very involute with a very narrow umbilicus.

Ambitoides fuliginatus (Tozer, 1994)

Figs. 63, 64

Ambites fuliginatus Tozer, 1994, p. 67, pl. 13, figs. 4, 5, pl. 14, fig. 8, text-fig. 15.

Holotype: GSC 28123, figured by Tozer (1994, p. 67, pl. 14, fig. 8), from the Lower Triassic (Dienerian, *Proptychites candidus* Zone) of the Grayling Formation, near Tuchodi River, British Columbia, Canada.

Material examined: Four specimens, NSM PM23175–23178, from AB1012, two specimens, NSM PM23179, 23180, from AB1013.

Description: Fairly involute, very compressed shell with rectangular whorl section, distinctively tabulate venter, angular ventral shoulders and nearly parallel to slightly convex flanks. Narrow to moderately narrow umbilicus with low, oblique wall and rounded shoulders. Ornamentation consists of fine, slightly sinuous, prorsiradiate growth lines and

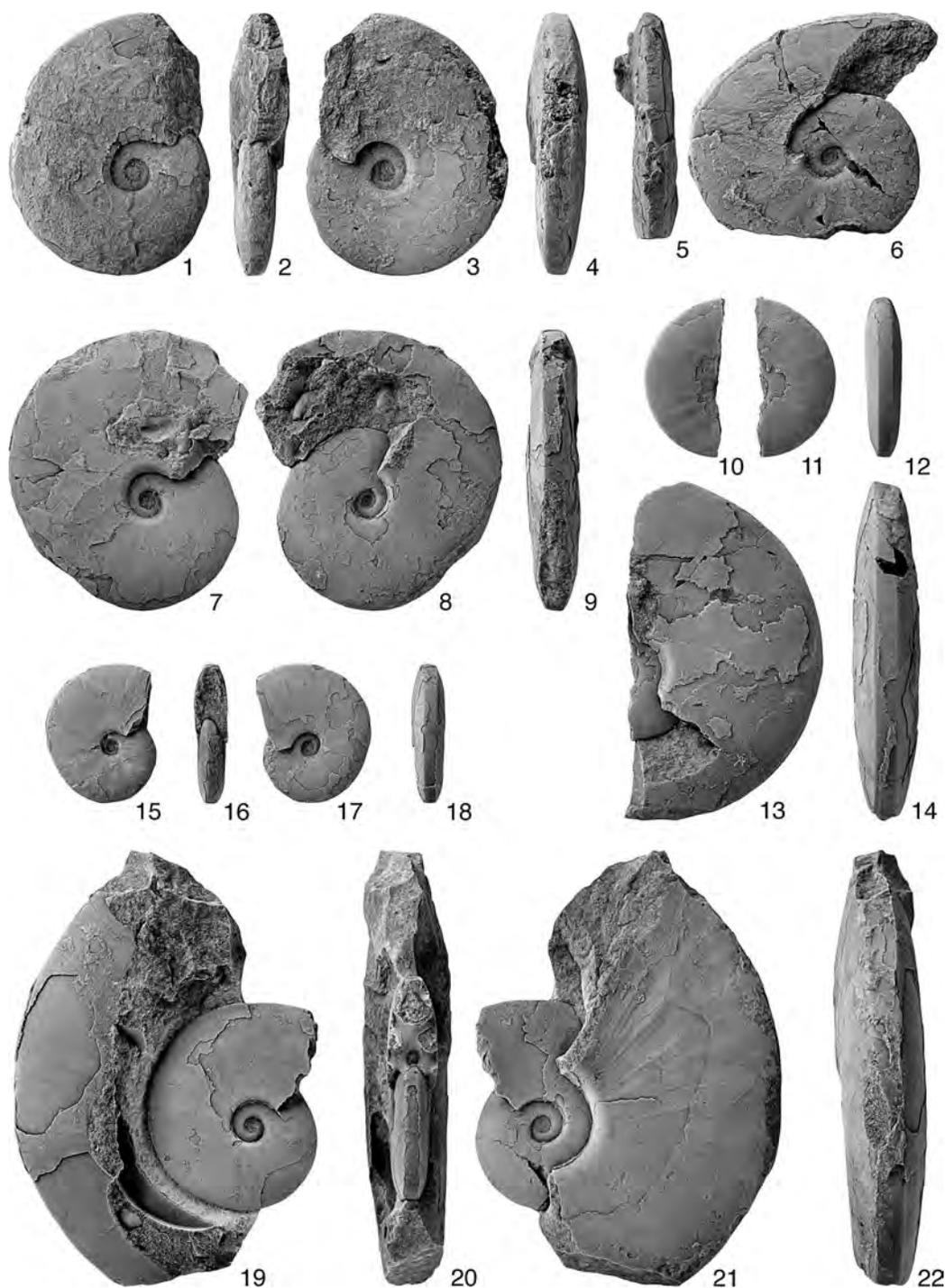


Fig. 63. *Ambitoides fuliginatus* (Tozer, 1994) gen. nov. 1–14, from AB1012. 1–4, NSM PM23175, $\times 1.0$. 5–6, NSM PM23176, $\times 1.0$. 7–9, NSM PM23177, $\times 1.0$. 10–14, NSM PM23178, $\times 1.0$. 15–18, NSM PM23179, $\times 1.0$. 19–22, NSM PM23180, $\times 1.0$.

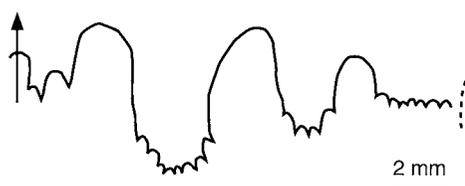


Fig. 64. Suture line of *Ambitoides fuliginatus* (Tozer, 1994) gen. nov., NSM PM23180, from AB1013, at H=15 mm.

low, radial folds becoming prominent on mid-flanks of body chamber. Suture ceratitic with long denticulate suspensive lobe. Ventral lobe divided by median saddle into two short branches with a few denticulations at each base. First lateral saddle lower than 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
NSM PM23175	38.6	4.4	19.2	7.9	0.11	0.41
NSM PM23176	32.0	5.8	15.5	6.3	0.18	0.41
NSM PM23177	37.7	5.8	18.6	7.3	0.15	0.39
NSM PM23178	20.6	3.7	10.0	4.6	0.18	0.46
NSM PM23179	32.8	6.8	15.1	6.4	0.21	0.42

Occurrence: Described specimens from AB1012, AB1013 within the *Ambitoides fuliginatus* Zone (early Late Induan=early Dienerian) in the uppermost part of the Lazurnaya Bay Formation and lowest part of the Zhitkov Formation, Abrek Bay area, South Primorye. This species also occurs in the *Proptychites candidus* Zone (early Dienerian) in northeastern British Columbia, Canada (Tozer, 1994).

Discussion: Morphologically, *Ambitoides fuliginatus* (Tozer, 1994) is very close to *Ambites discus* Waagen (1895, p. 152), *A. magnumillicatus* Waagen (1895, p. 154) and *A. ferruginus* Tozer (1994, p. 67), but its suture is definitely ceratitic. It is also somewhat similar to "*Meekoceras*" *hodgsoni* Diener (1897, p. 133), but its venter is distinctively more tabulate and its whorls are not as compressed.

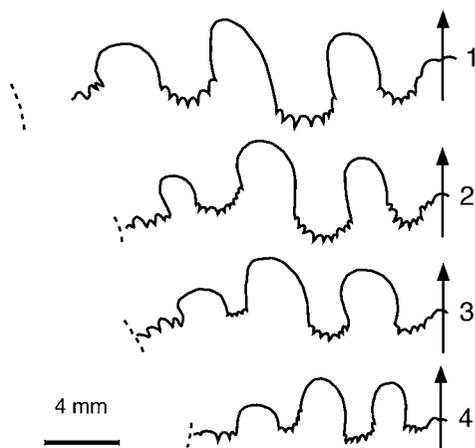


Fig. 65. Suture lines of *Ambitoides orientalis* Shigeta and Zakharov gen. nov. sp. nov. from AB1014. 1, NSM PM23190, paratype, at H=22 mm. 2, NSM PM23189, paratype, at H=17 mm. 3, NSM PM23188, holotype, at H=16 mm. 4, NSM PM23183, paratype, at H=13 mm.

Ambitoides orientalis Shigeta and Zakharov
sp. nov.

Figs. 65–67

? *Ambites fuliginatus* Tozer, 1994, p. 67, pl. 13, fig. 7.

Type specimens: Holotype, NSM PM23188, from AB1014; paratypes, nine specimens, NSM PM23181–23187, 23189, 23190, from AB1014.

Diagnosis: *Ambitoides* with narrow, subtabulate venter, vertical umbilical wall, abruptly rounded umbilical shoulder, fine spiral lirae on shell surface and ceratitic suture line.

Etymology: From the Latin word: *orientalis*, meaning oriental.

Description: Fairly involute, very compressed shell with subrectangular whorl section, narrow subtabulate venter, subangular ventral shoulders, and slightly convex flanks with maximum whorl width near mid-flank. Narrow to fairly narrow umbilicus with moderately high, vertical wall and abruptly rounded shoulders. Ornamentation consists of very

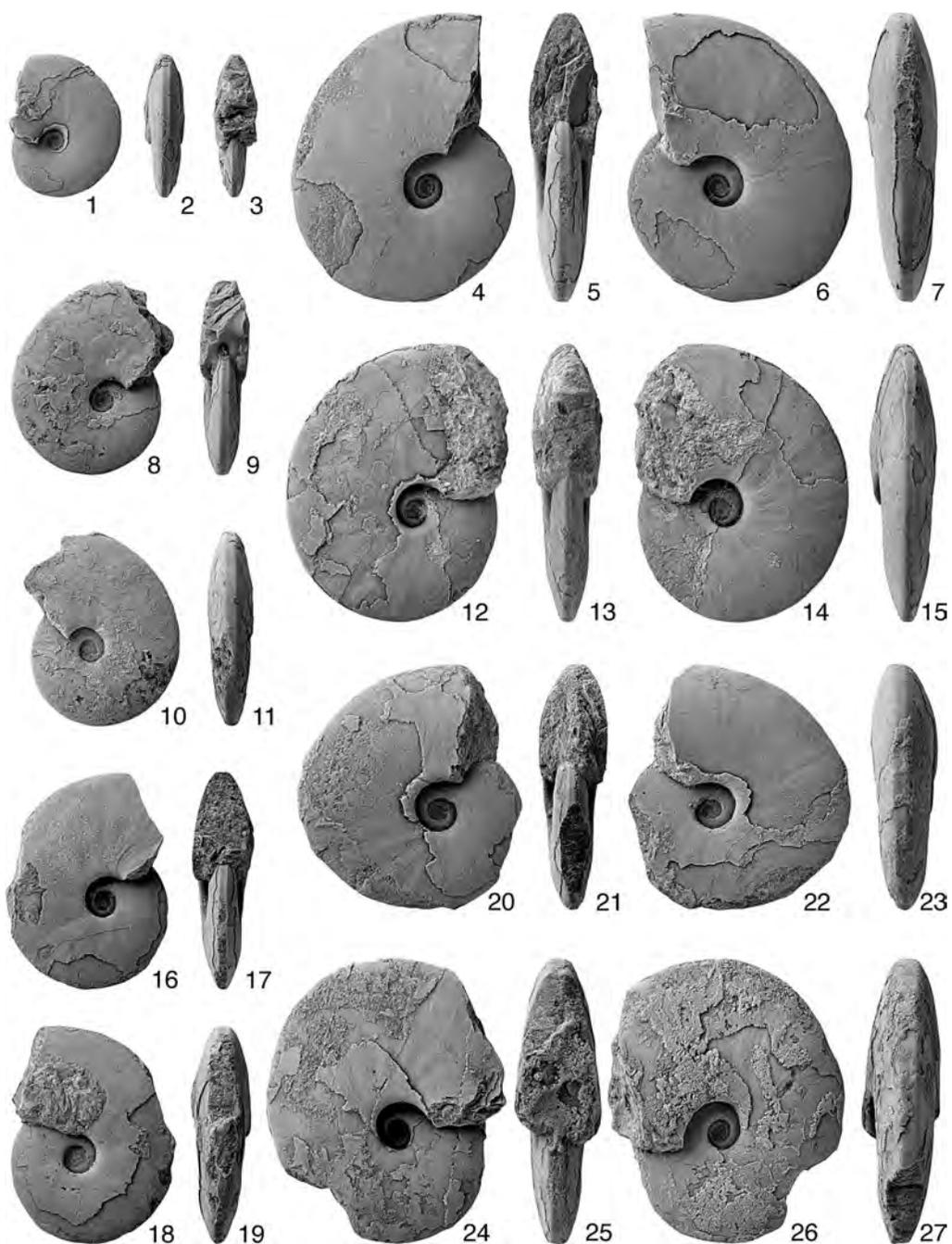


Fig. 66. *Ambitoides orientalis* Shigeta and Zakharov gen. nov. sp. nov. from AB1014. 1–3, NSM PM23181, paratype, $\times 1.0$. 4–7, NSM PM23182, paratype, $\times 1.0$. 8–11, NSM PM23183, paratype, $\times 1.0$. 12–15, NSM PM23184, paratype, $\times 1.0$. 16–19, NSM PM23185, paratype, $\times 1.0$. 20–23, NSM PM23186, paratype, $\times 1.0$. 24–27, NSM PM23187, paratype, $\times 1.0$.

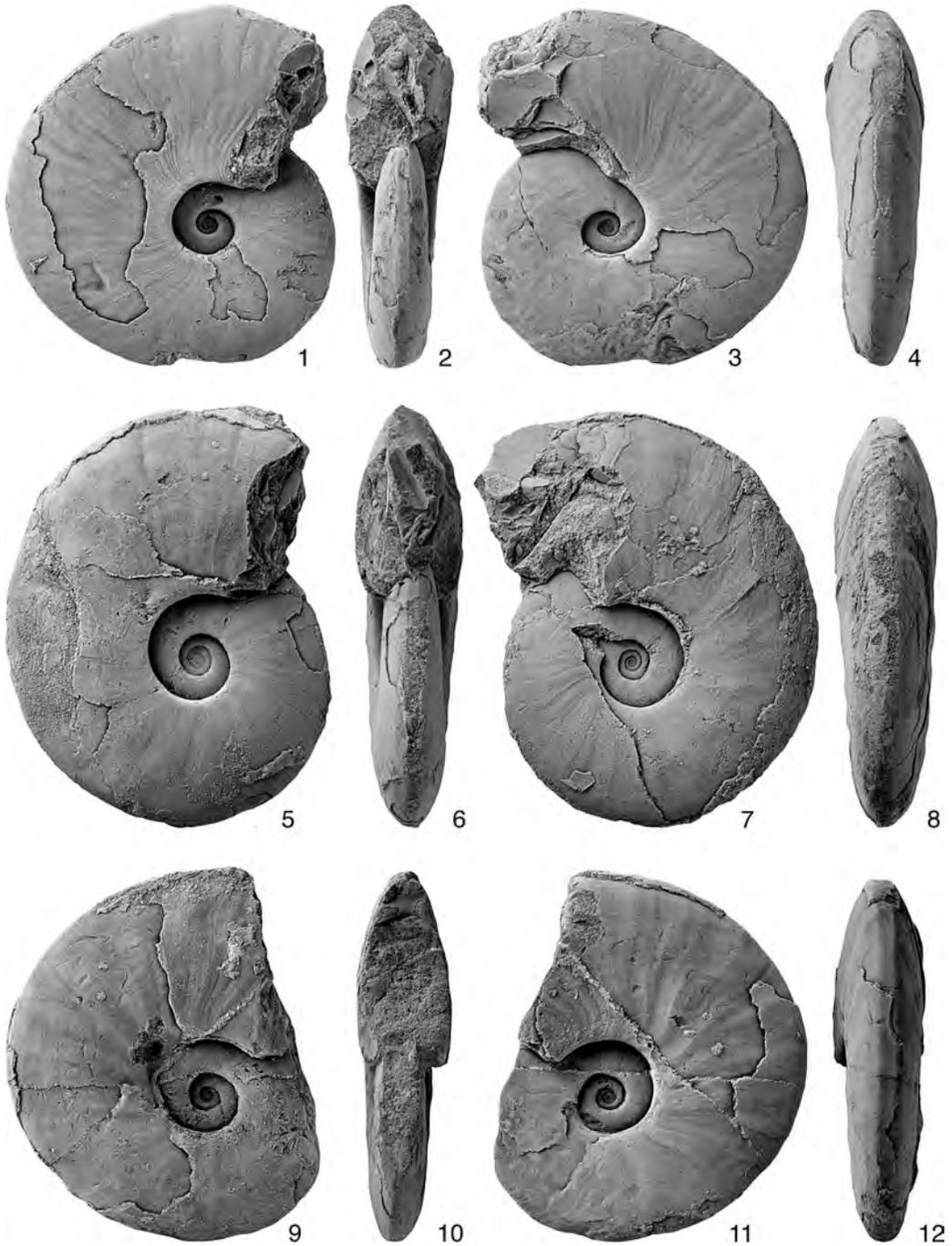


Fig. 67. *Ambitoides orientalis* Shigeta and Zakharov gen. nov. sp. nov. from AB1014. 1–4, NSM PM23188, holotype, $\times 1.0$. 5–8, NSM PM23189, paratype, $\times 1.0$. 9–12, NSM PM23190, paratype, $\times 1.0$.

fine spiral lirae and slightly sinuous, prorsiradiate growth lines as well as low, radial folds, which become more prominent on body chamber. Suture ceratitic with long denticulate suspensive lobe, and wide ventral lobe divided by median saddle into two branches with many denticulations at each base. First lateral saddle lower than 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
NSM PM23181	20.8	3.3	11.0	5.5	0.16	0.50
NSM PM23182	41.9	8.0	20.3	9.6	0.19	0.47
NSM PM23183	29.0	5.2	14.2	6.3	0.18	0.44
NSM PM23184	39.5	7.1	19.0	8.6	0.18	0.45
NSM PM23185	31.6	5.8	15.0	7.5	0.18	0.50
NSM PM23186	35.4	6.7	17.2	9.0	0.19	0.52
NSM PM23187	40.5	6.7	20.7	9.2	0.17	0.44
NSM PM23188	49.8	9.1	24.0	11.9	0.18	0.50
NSM PM23189	57.9	14.4	26.8	14.3	0.25	0.53
NSM PM23190	50.8	12.8	23.3	11.7	0.25	0.50

Occurrence: Described specimens from *Clypeoceras spitiense* “bed” (AB1014, early Late Induan=early Dienerian) in the lower part of the Zhitkov Formation, Abrek Bay area, South Primorye.

Discussion: *Ambitoides orientalis* sp. nov. differs from *Ambites discus* Waagen (1895, p. 152), *A. magnummilicatus* Waagen (1895, p. 154) and *A. ferruginus* (Tozer 1994, p. 67) by its serrated lateral lobes, and differs from *Ambitoides fuliginatus* (Tozer 1994, p. 67) by its vertical umbilical wall. One of Tozer’s paratypes of *A. fuliginatus* (Tozer 1994, pl. 13, fig. 7) has a very narrow, subtabulate venter, radial folds and fine spiral lirae, and is probably quite similar to *Ambitoides orientalis*.

Genus *Abrekites* Shigeta and Zakharov
gen. nov.

Type species: *Abrekites editus* sp. nov.

Composition of the genus: Two species, *Abrekites editus* sp. nov. and *A. planus* sp. nov.

Diagnosis: Discoidal, fairly involute shell

with tabulate venter, fairly narrow umbilicus, overhanging umbilical wall, abruptly rounded umbilical shoulder and ceratitic suture line.

Etymology: Named after Abrek Bay in South Primorye.

Occurrence: Lower part of the Lower Olenekian (lower Smithian) in South Primorye, Russia.

Discussion: *Abrekites* gen. nov. is easily distinguished from *Ambites* Waagen, 1895 and *Ambitoides* gen. nov. by its overhanging umbilical wall and from *Sisupalia* Waterhouse, 1996b by its ceratitic suture line.

Abrekites editus Shigeta and Zakharov sp. nov.

Figs. 68, 69.1–69.12

Type specimens: Holotype, NSM PM23193, from AB1021; paratypes, two specimens, NSM PM23191, 23192, from AB1021.

Diagnosis: *Abrekites* with raised umbilical shoulders and low radial folds on inner flanks.

Etymology: Species name refers to its “rising” umbilical shoulder, from the Latin word: *editus*, meaning rising.

Description: Fairly involute, very compressed shell with rectangular whorl section, tabulate venter, subangular ventral shoulders and slightly convex flanks with maximum thickness at mid-flank. Umbilicus fairly narrow with moderately high, overhanging wall and raised, abruptly rounded shoulders. Ornamentation consists of low radial folds on inner flanks as well as fine, slightly sinuous, prorsiradiate growth lines. Suture ceratitic with long denticulate suspensive lobe, and wide ventral lobe divided by low median saddle into two wide branches with many denticulations at each base. First lateral saddle lower than second saddle, and third saddle wide, but 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
NSM PM23191	28.2	3.4	12.7	5.4	0.12	0.43
NSM PM23192	32.2	6.3	15.9	6.5	0.20	0.41

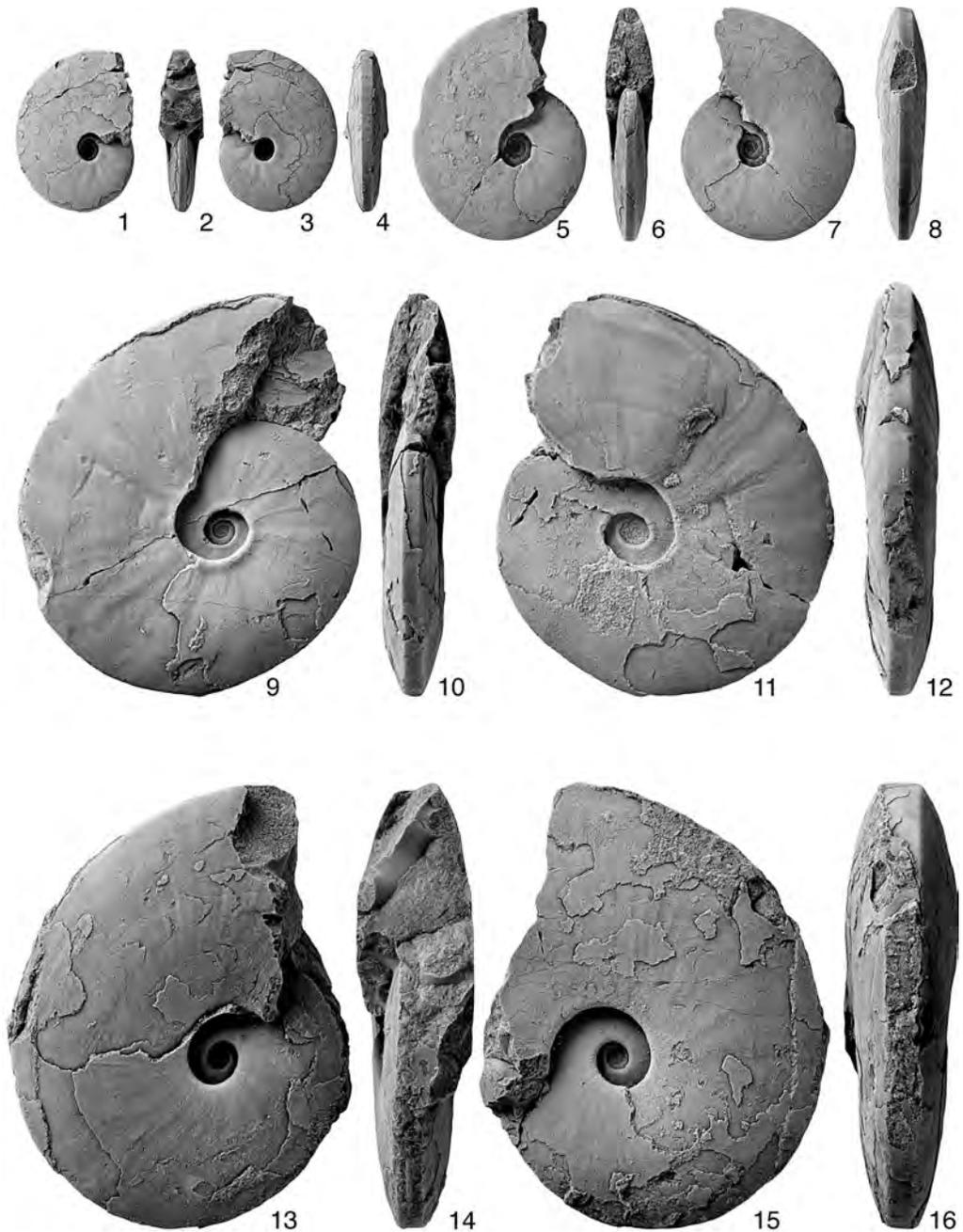


Fig. 68. 1–12, *Abrekites editus* Shigeta and Zakharov gen. nov. sp. nov. from AB1021. 1–4, NSM PM23191, paratype, $\times 1.0$. 5–8, NSM PM23192, paratype, $\times 1.0$. 9–12, NSM PM23193, holotype, $\times 1.0$. 13–16, *Abrekites planus* Shigeta and Zakharov gen. nov. sp. nov., NSM PM23194, holotype, from AB1021, $\times 1.0$.

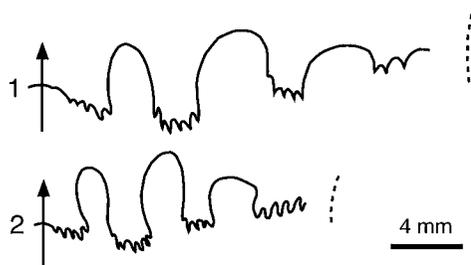


Fig. 69. Suture lines of *Abrekites editus* Shigeta and Zakharov gen. nov. sp. nov. from AB1021. 1, NSM PM23193, holotype, at H=21 mm. 2, NSM PM23192, paratype, at H=14 mm.

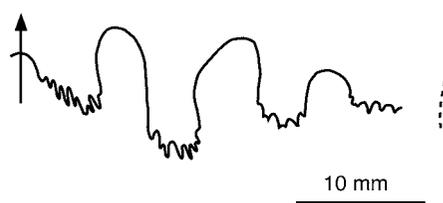


Fig. 70. Suture line of *Abrekites planus* Shigeta and Zakharov gen. nov. sp. nov., NSM PM23194, holotype, from AB1021, at H=29 mm.

NSM PM23193 49.0 10.5 22.5 10.8 0.21 0.48

Occurrence: Described specimen from AB1021 within the *Clypeoceras timorense* Zone (early Early Olenekian=early Smithian) of the main part of the Zhitkov Formation, Abrek Bay area, South Primorye.

Discussion: *Abrekites editus* sp. nov. is very close to the juvenile shell of *Arctoceras strigatus* Brayard and Bucher (2008, p. 52, pl. 25, fig. 2) in that it has raised umbilical shoulders and radial folds, but the latter has very noticeable strigations on its flanks, a subtabulate to broadly rounded venter, and a typical Arctoceratidae suture line.

***Abrekites planus* Shigeta and Zakharov**
sp. nov.

Figs. 69.13–69.16, 70

Holotype: NSM PM23194, from AB1021.

Diagnosis: *Abrekites* with flat, smooth inner flanks, non-raised umbilical shoulders and weak radial ribs near mid-flank.

Etymology: Species name refers to its flat, inner flank, from the Latin word: *planus*, meaning flat.

Description: Fairly involute, very compressed shell with rectangular whorl section, tabulate venter, subangular ventral shoulders, flat inner flanks and slightly convex outer flanks with maximum whorl width at mid-

flank. Umbilicus fairly narrow with moderately high, overhanging wall and abruptly rounded shoulders. Ornamentation consists of low, radial ribs on mid-flank as well as fine, slightly sinuous, prorsiradiate growth lines. Inner flanks smooth. Suture ceratitic with long denticulate suspensive lobe and wide ventral lobe divided by low median saddle into two wide branches with many denticulations at each base. First lateral saddle lower than 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
NSM PM23194	62.8	11.4	30.7	15.4	0.18	0.50

Occurrence: Described specimen from AB1021 within the *Clypeoceras timorense* Zone (early Early Olenekian=early Smithian) of the main part of the Zhitkov Formation, Abrek Bay area, South Primorye.

Discussion: *Abrekites planus* sp. nov. is easily distinguished from *A. editus* sp. nov. by its non-raised umbilical shoulder and smooth, flat inner flanks.

Family Prionitidae Hyatt, 1900

Genus ***Radioprionites* Shigeta and Zakharov**
gen. nov.

Type species: *Radioprionites abrekensis* sp. nov.

Composition of the genus: Three species, *Meekoceras boreale* Diener, 1895, *M. subcristatum* Kiparisova, 1947, and *Radioprionites abrekensis* sp. nov.

Diagnosis: Discoidal, fairly involute shell with tabulate to subtabulate venter, narrow umbilicus, vertical umbilical wall, prominent radial folds on flanks and ceratitic suture line.

Etymology: Genus name refers to the Latin word: radio, meaning radial in reference to the radial folds, and *Prionites*.

Occurrence: Lower part of the Lower Olenekian (lower Smithian) in South Primorye, Russia.

Discussion: *Radioprionites* gen. nov. is close to some representatives of Meekoceratidae such as *Ambites* Waagen, 1895, *Ambitoides* gen. nov. and *Radioceras* Waterhouse, 1996a, but differs by its prominent radial folds. *Jolinkia* Waterhouse, 1996b and *Sisupalia* Waterhouse, 1996b are similar and have radial folds, but the former has a concave, narrow venter and the latter has a goniatic suture line.

This new genus is assigned to the Prionitidae based on the tabulate venter and very sharp ventral shoulders on its juvenile whorls, as well as a long, denticulate suspensive lobe. It can be easily distinguished from *Hemiprionites* Spath, 1929, by its prominent radial folds.

***Radioprionites abrekensis* Shigeta and Zakharov sp. nov.**

Figs. 71–73

Prionites aff. *tuberculatus* Waagen, 1895. Zakharov, 1968, p. 125, pl. 23, figs. 4, 5.

Type specimens: Holotype, NSM PM23195, from AB1025; paratypes, seven specimens, NSM PM23196–23202, from AB1025.

Diagnosis: As for the genus.

Etymology: Named after Abrek Bay in South Primorye.

Description: Fairly involute, very compressed shell characterized by slightly convex flanks with maximum whorl width on inner flank at one third whorl height. Venter varies

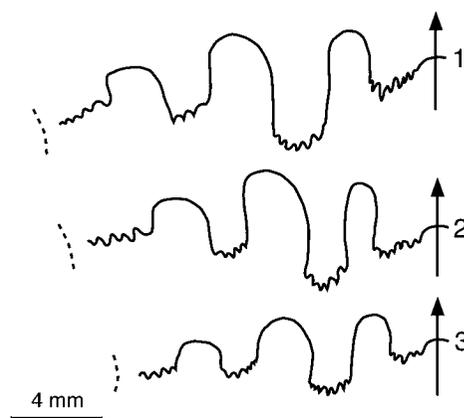


Fig. 71. Suture lines of *Radioprionites abrekensis* Shigeta and Zakharov gen. nov. sp. nov. from AB1025. 1, NSM PM23197, paratype, at H=16.5 mm. 2, NSM PM23195, holotype, at H=16.0 mm. 3, NSM PM23198, paratype, at H=13.5 mm.

from tabulate with very sharp angular shoulders on juvenile whorls to subtabulate with subangular to abruptly rounded shoulders on mature whorls. Umbilicus narrow with moderately high, vertical wall and rounded shoulders. Ornamentation consists of distant, low, radial folds that arise on umbilical shoulder, develop great intensity near mid-flank and disappear near venter, as well as fine, slightly sinuous, prorsiradiate growth lines. Suture ceratitic with long denticulate suspensive lobe, and wide ventral lobe divided by low median saddle into two wide branches with many denticulations at each base. First lateral saddle lower, narrower than second saddle, and third saddle wide, but 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
NSM PM23195	48.0	8.5	23.0	13.0	0.18	0.57
NSM PM23196	27.0	4.0	13.3	7.5	0.15	0.56
NSM PM23197	34.5	6.3	16.4	9.4	0.18	0.57
NSM PM23198	40.3	6.0	20.5	11.1	0.15	0.54
NSM PM23199	27.0	3.9	13.0	7.8	0.14	0.60
NSM PM23201	41.5	5.7	21.0	10.5	0.14	0.50

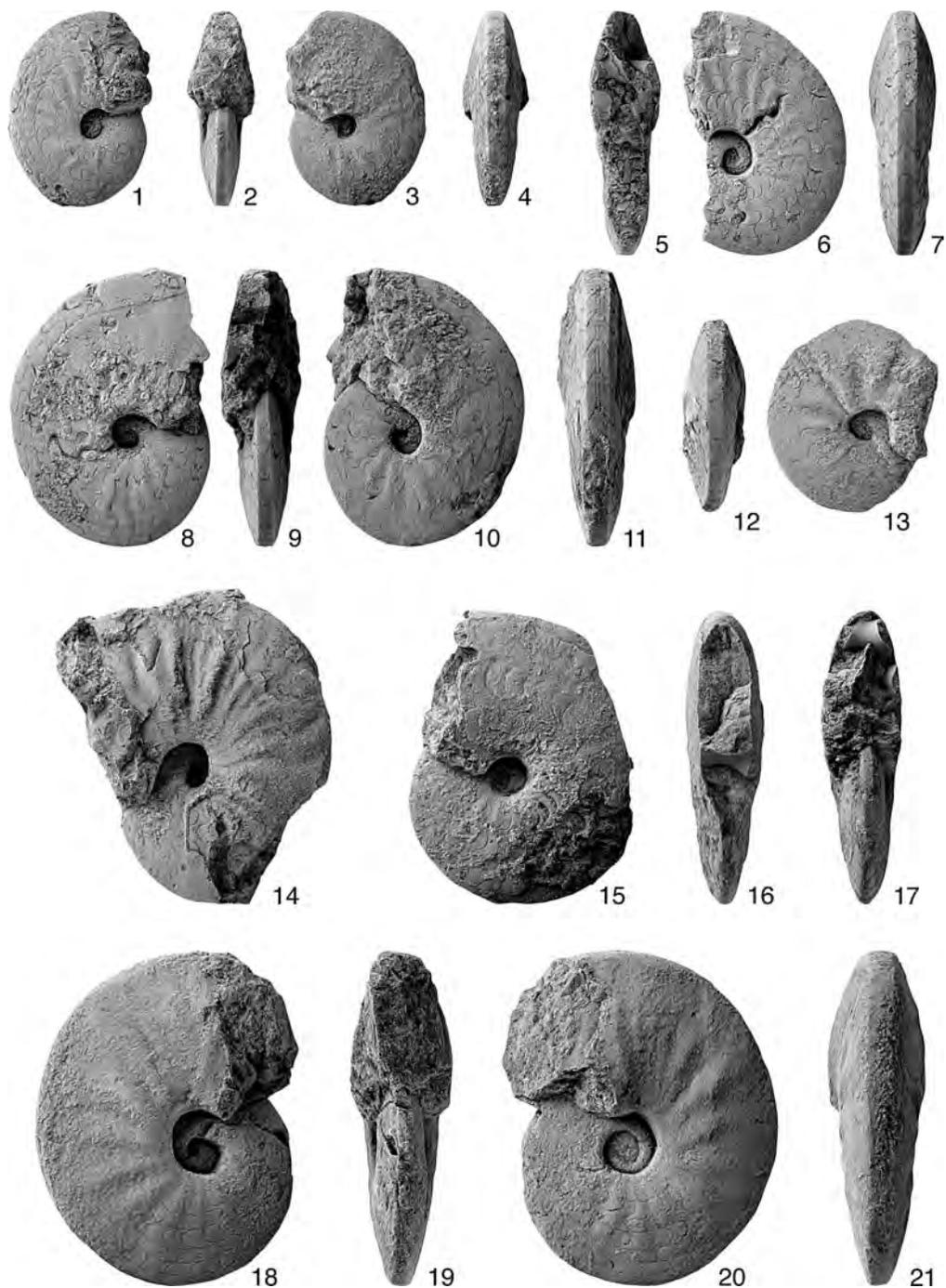


Fig. 72. *Radiopronites abrekensis* Shigeta and Zakharov gen. nov. sp. nov. from AB1025. 1–4, NSM PM23196, paratype, $\times 1.0$. 5–7, NSM PM23197, paratype, $\times 1.0$. 8–11, NSM PM23198, paratype, $\times 1.0$. 12–13, NSM PM23199, paratype, $\times 1.0$. 14, NSM PM23200, paratype, $\times 1.0$. 15–17, NSM PM23201, paratype, $\times 1.0$. 18–21, NSM PM23195, holotype, $\times 1.0$.

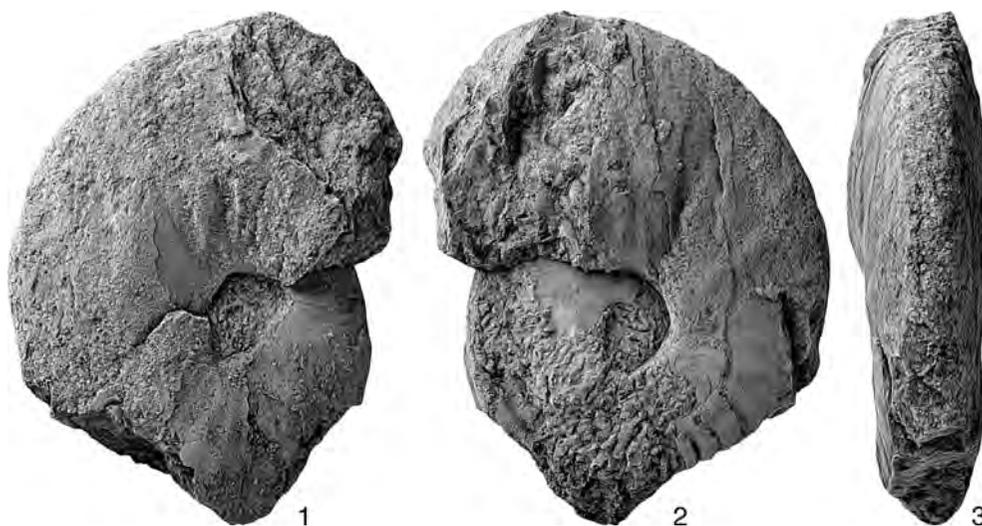


Fig. 73. *Radioprionites abrekensis* Shigeta and Zakharov gen. nov. sp. nov. 1–3, NSM PM23202, paratype, from AB1025, $\times 1.0$.

NSM PM23202 66.8 10.4 33.0 17.4 0.16 0.53

Occurrence: Described specimens from *Radioprionites abrekensis* “bed” (AB1025, lower Early Olenekian=lower Smithian) in the main part of the Zhitkov Formation, Abrek Bay area, South Primorye. This species also occurs in beds of Early Olenekian age on the eastern coast of Ussuri Gulf, near Golyj Cape (=Kom-Pikho-Sakho Cape) and Yuzhnorechensk Village, South Primorye (Zakharov, 1968)

Discussion: *Radioprionites abrekensis* sp. nov. differs from *Meekoceras boreale* Diener (1895, p. 49) and *M. subcristatum* Kiparisova (1947, p. 150) by its narrower third saddle. The specimens assigned to *Prionites* aff. *tuberculatus* Waagen by Zakharov (1968, p. 125, pl. 23, figs. 4, 5) and herein synonymized with *R. abrekensis*, are identical with respect to whorl morphology and ornamentation.

Genus *Hemiprionites* Spath, 1929

Type species: *Goniodiscus typus* Waagen, 1895.

Hemiprionites sp. indet.

Fig. 74

Material examined: NSM PM23203 from AB1026.

Description: Fairly involute, very compressed shell with rectangular whorl section, distinctively tabulate venter, very sharp, angular ventral shoulders and slightly convex flanks with maximum whorl width just above umbilical shoulders. Narrow umbilicus with moderately high, vertical wall and abruptly rounded shoulders. Ornamentation consists of fine, slightly sinuous, prorsiradiate growth lines, and radial folds, which are very pronounced on flanks.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23203	19.5	3.0	10.0	6.0	0.15	0.60

Occurrence: Described specimen from *Balhaeceras balhaense* “bed” (AB1026, middle Early Olenekian=middle Smithian) in the main part of the Zhitkov Formation, Abrek Bay area, South Primorye.

Discussion: It is possible that the described



Fig. 74. *Hemiprionites* sp. indet. 1–4, NSM PM23203, from AB1026, $\times 2.0$.

specimen is actually a juvenile shell of *Hemiprionites dunajensis* Zakharov, 1968, which displays a similar shell shape. However, no definitive assignment can be made.

Family Flemingitidae Hyatt, 1900
Genus *Ussuriflemingites* Shigeta and
Zakharov gen. nov.

Type species: *Ussuriflemingites primorensis* sp. nov.

Composition of the genus: Two species, *Ussuriflemingites primorensis* sp. nov. and *U. abrekensis* sp. nov.

Diagnosis: Very compressed, fairly evolute shell with subtabulate to narrowly rounded venter, moderately narrow umbilicus, low to moderately high umbilical wall, radial folds, and ceratitic suture line.

Etymology: Genus name refers to Ussuri Gulf in South Primorye and *Flemingites*.

Occurrence: Upper Induan (Dienerian) to lower part of the Lower Olenekian (lower Smithian) in South Primorye, Russia.

Discussion: *Ussuriflemingites* gen. nov. differs from *Anaflemingites* Kummel and Steele, 1962 and *Rohillites* Waterhouse, 1996b, by its more involute coiling and narrower umbilicus, and from *Galfettites* Brayard and Bucher, 2008 and *Anaxenaspis* Kiparisova, 1956, by its subtabulate venter. Its ceratitic suture line characterized by subphyllid saddles, in conjunction with spiral lirae ornamentation and radial ribs justify assignment of this genus to the Flemingitidae.

gitidae.

Ussuriflemingites abrekensis Shigeta and
Zakharov sp. nov.

Figs. 75, 77, 78

Type specimens: Holotype, NSM PM23208, from AB1016; paratypes, nine specimens, NSM PM23204–23207, 23209–23213, from AB1016.

Diagnosis: *Ussuriflemingites* with fine spiral lirae on outer flanks and prominent radial folds.

Etymology: Named after Abrek Bay in South Primorye.

Description: Fairly evolute, very compressed shell with tabulate to subtabulate venter, subangular or abruptly rounded ventral shoulders and slightly convex flanks with maximum whorl width at mid-flank. Fairly narrow umbilicus with moderately high, slightly oblique wall and rounded shoulders. Ornamentation consists of fine spiral lirae on outer flanks as well as prominent, slightly sinuous, radial folds. Suture ceratitic with subphyllid saddles and wide ventral lobe divided by low, wide median saddle into two branches with many denticulations at each base. First lateral saddle lower than 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. Suspensive lobe long with many denticulations.

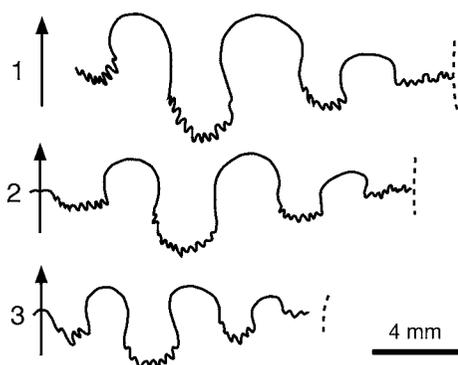


Fig. 75. Suture lines of *Ussuriflemingites abrekensis* Shigeta and Zakharov gen. nov. sp. nov. from AB1016. 1–2, NSM PM23208, holotype. 1, at H=18 mm. 2, at H=16 mm. 3, NSM PM23210, paratype, at H=12 mm.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23204	37.7	8.2	17.7	9.1	0.22	0.51
NSM PM23205	57.6	13.5	24.5	12.3	0.23	0.50
NSM PM23206	56.1	16.4	24.1	9.7	0.29	0.40
NSM PM23207	39.8	10.8	18.3	10.5	0.27	0.57
NSM PM23208	55.0	13.0	24.9	12.8	0.24	0.51
NSM PM23209	54.0	16.2	21.8	10.0	0.30	0.46
NSM PM23210	37.7	9.2	16.1	8.6	0.24	0.53

Occurrence: Described specimens from *Paranorites varians* Zone (AB1016, Late Induan=Dienerian) in the lower main part of the Zhitkov Formation, Abrek Bay area, South Primorye.

Discussion: *Ussuriflemingites abrekensis* sp. nov. exhibits some affinities with *Pleurombites frechi* Tozer (1994, p. 68), but is easily distinguished by its more involute coiling, narrower umbilicus, subphyllid saddles and serrated ventral lobe.

Ussuriflemingites primoriensis Shigeta and Zakharov sp. nov.

Figs. 76, 79–81

Type specimens: Holotype, NSM PM23214, from AB1021; paratypes, six specimens, NSM PM23215–23220, from AB1021.

Diagnosis: *Ussuriflemingites* with weak,

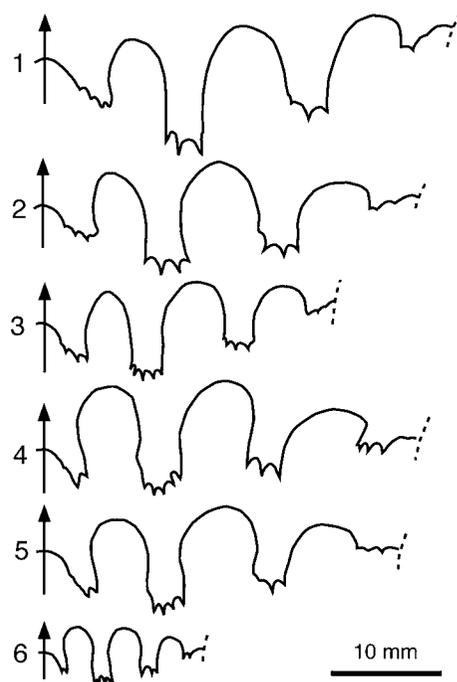
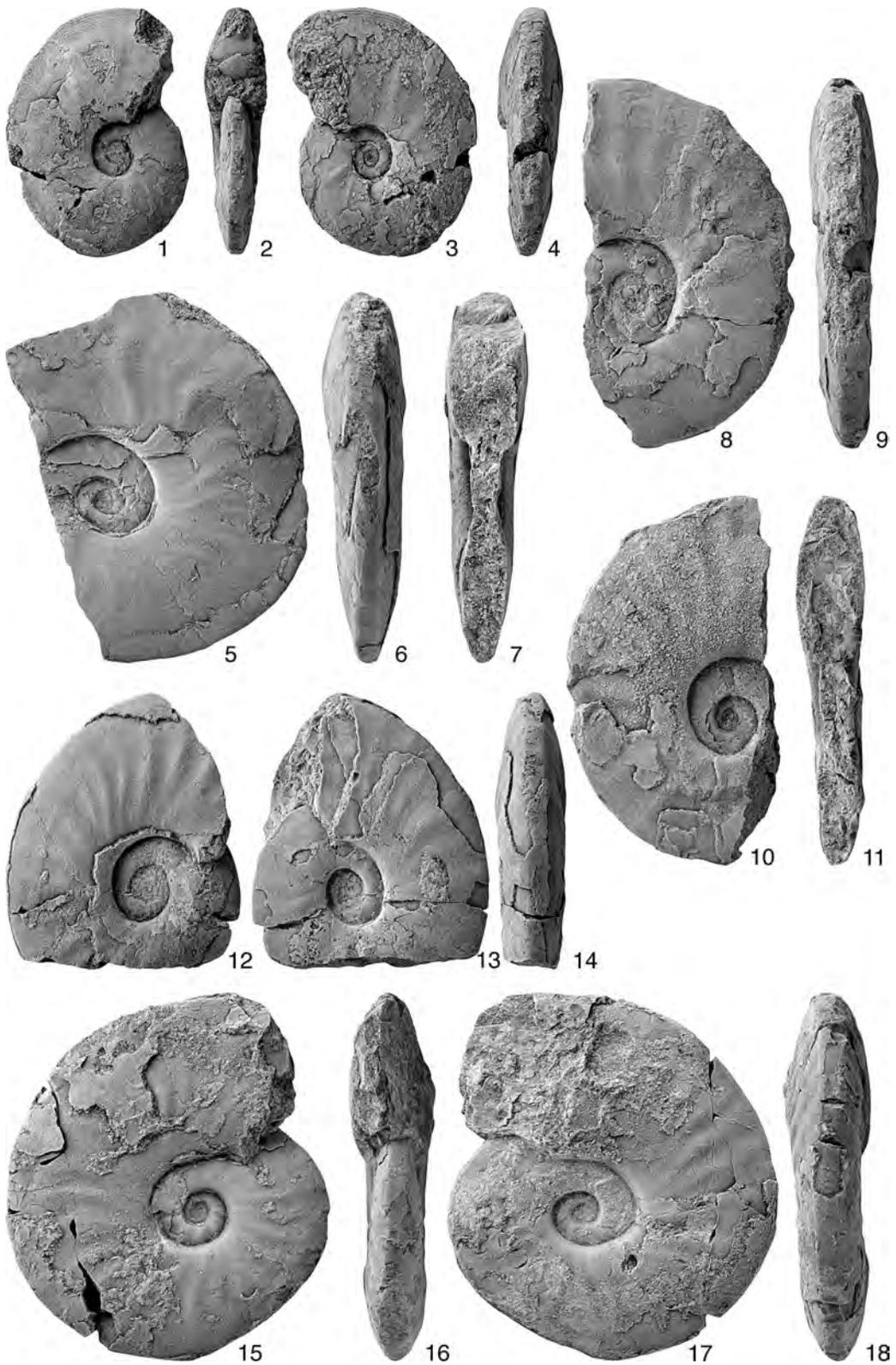


Fig. 76. Suture lines of *Ussuriflemingites primoriensis* Shigeta and Zakharov gen. nov. sp. nov. from AB1021. 1–3, NSM PM23214, holotype. 1, at H=36 mm. 2, at H=32 mm. 3, at H=25 mm. 4, NSM PM23216, paratype, at H=33 mm. 5, NSM PM23218, paratype, at H=31 mm. 6, NSM PM23219, paratype, at H=15 mm.

low, radial folds.

Etymology: Named after Primorye.

Description: Fairly evolute, very compressed shell with elliptical whorl section and gently convex flanks with maximum whorl width at mid-flank. Subtabulate venter with ventral shoulders varying from abruptly rounded on juvenile whorls to more gently rounded on larger specimens. Fairly narrow to moderately wide umbilicus with low to moderately high, vertical to slightly oblique wall, and rounded shoulders. Ornamentation consists of weak, low, radial folds as well as fine, slightly sinuous, prorsiradiate growth lines. Suture ceratitic with wide ventral lobe divided by wide median saddle into two small branch-



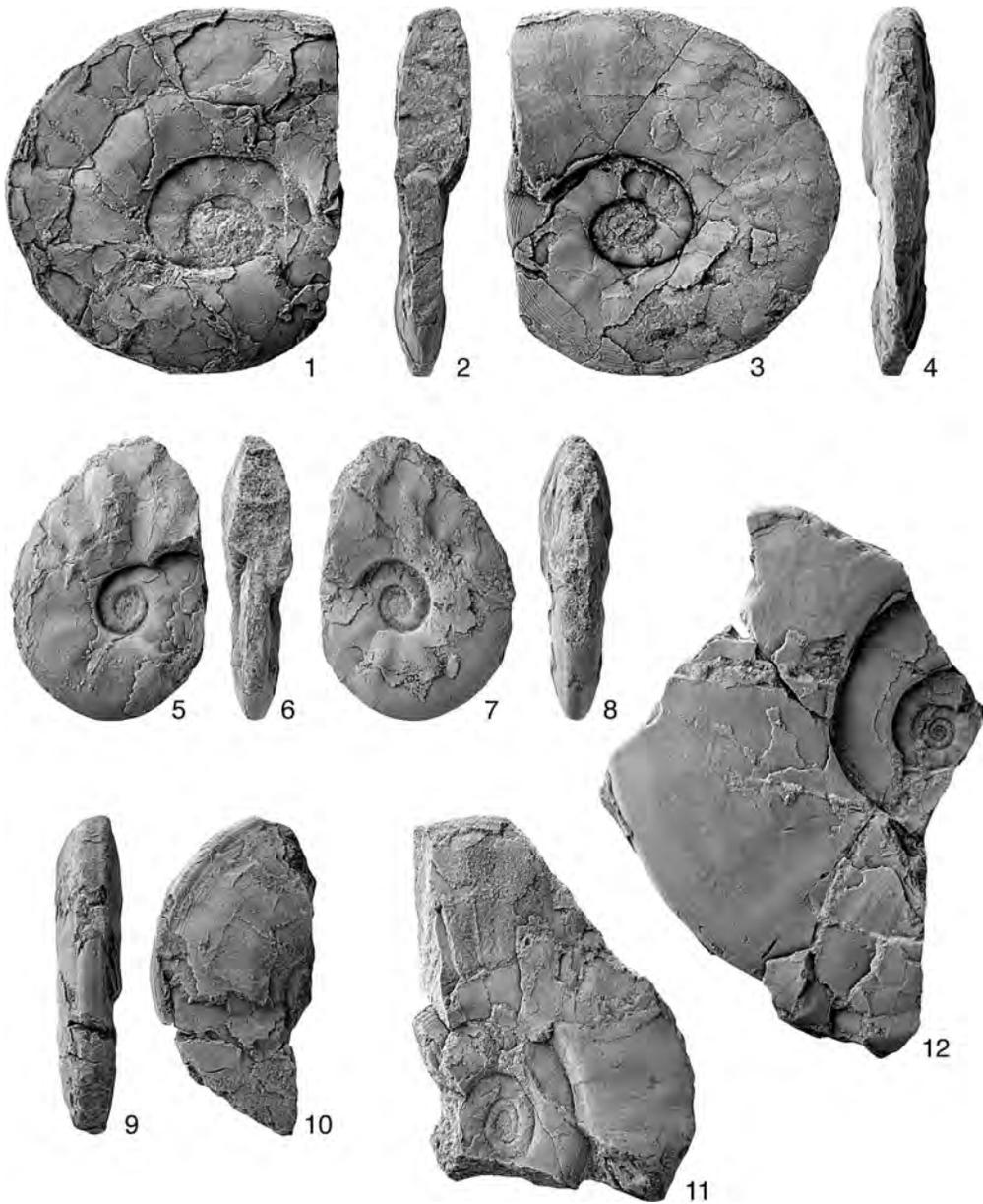


Fig. 78. *Ussuriflemingites abrekensis* Shigeta and Zakharov gen. nov. sp. nov. from AB1016. 1–4, NSM PM23209, paratype, $\times 1.0$. 5–8, NSM PM23210, paratype, $\times 1.0$. 9–10, NSM PM23211, paratype, $\times 1.0$. 11, NSM PM23212, paratype, $\times 1.0$. 12, NSM PM23213, paratype, $\times 1.0$.

←
Fig. 77. *Ussuriflemingites abrekensis* Shigeta and Zakharov gen. nov. sp. nov. from AB1016. 1–4, NSM PM23204, paratype, $\times 1.0$. 5–7, NSM PM23205, paratype, $\times 1.0$. 8–11, NSM PM23206, paratype, $\times 1.0$. 12–14, NSM PM23207, paratype, $\times 1.0$. 15–18, NSM PM23208, holotype, $\times 1.0$.

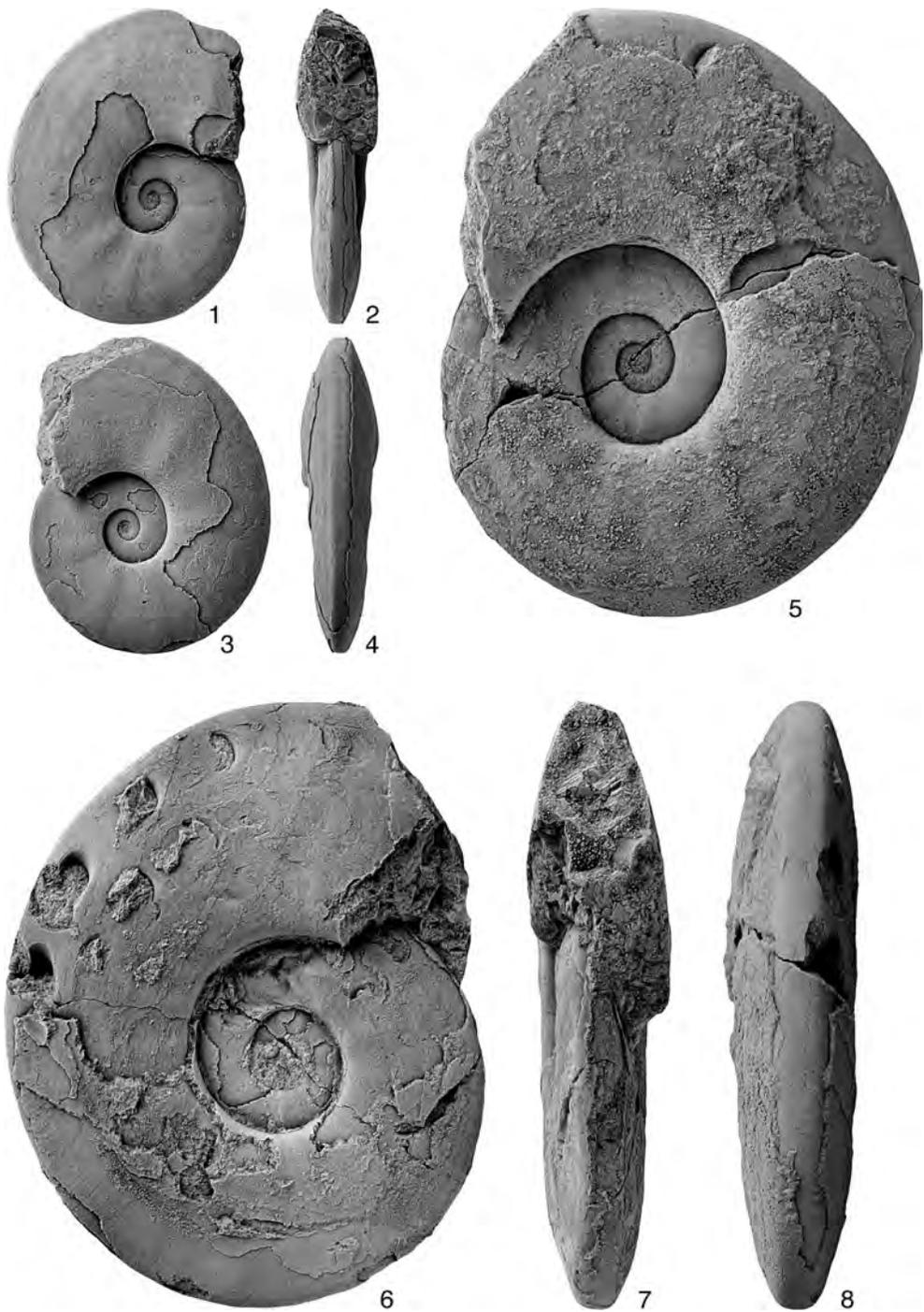


Fig. 79. *Ussuriflemingites primoriensis* Shigeta and Zakharov gen. nov. sp. nov. from AB1021. 1–4, NSM PM23215, paratype, $\times 1.0$. 5–8, NSM PM23216, paratype, $\times 1.0$.

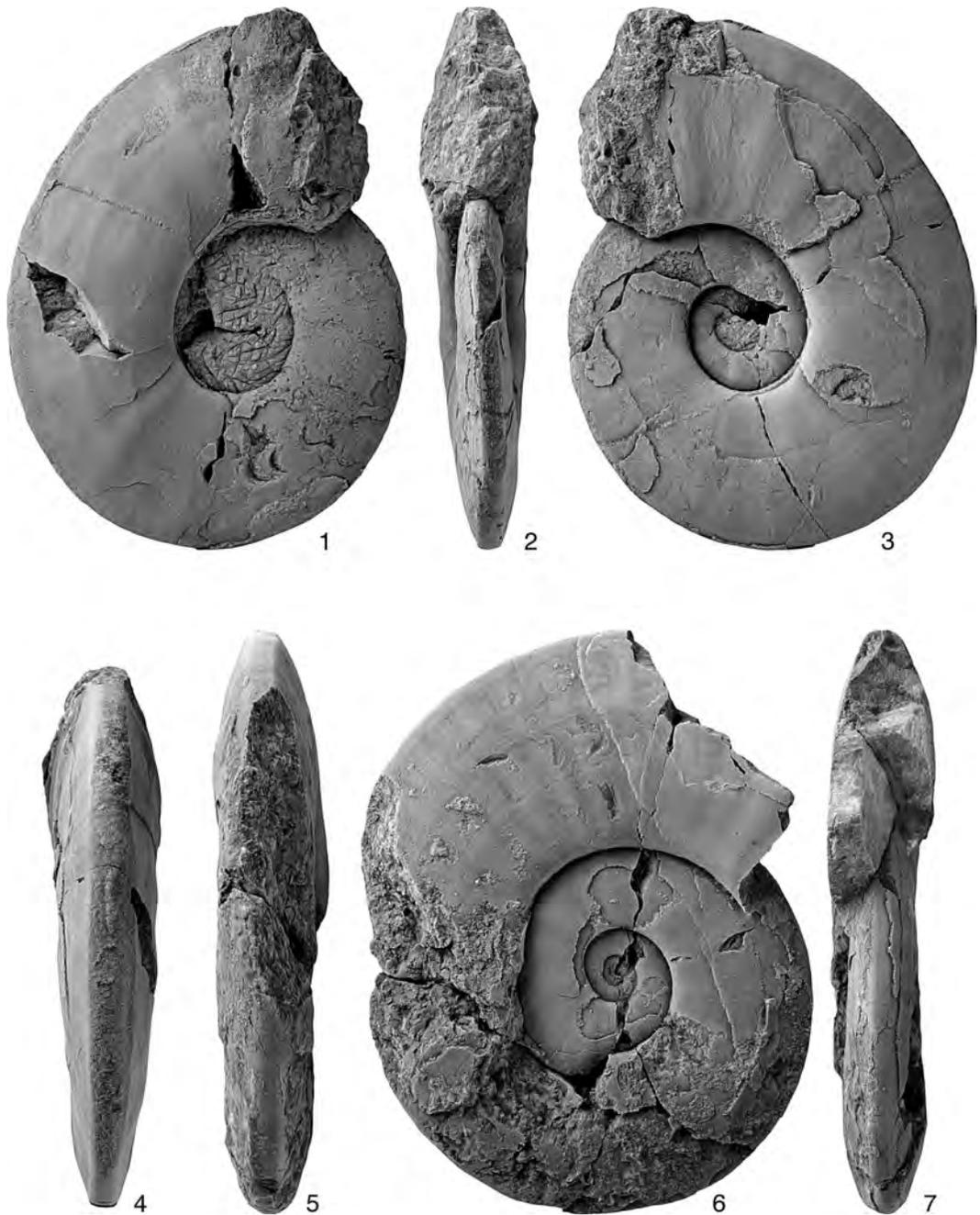


Fig. 80. *Ussuriflemingites primoriensis* Shigeta and Zakharov gen. nov. sp. nov. from AB1021. 1-4, NSM PM23217, paratype, $\times 1.0$. 5-7, NSM PM23218, paratype, $\times 1.0$.

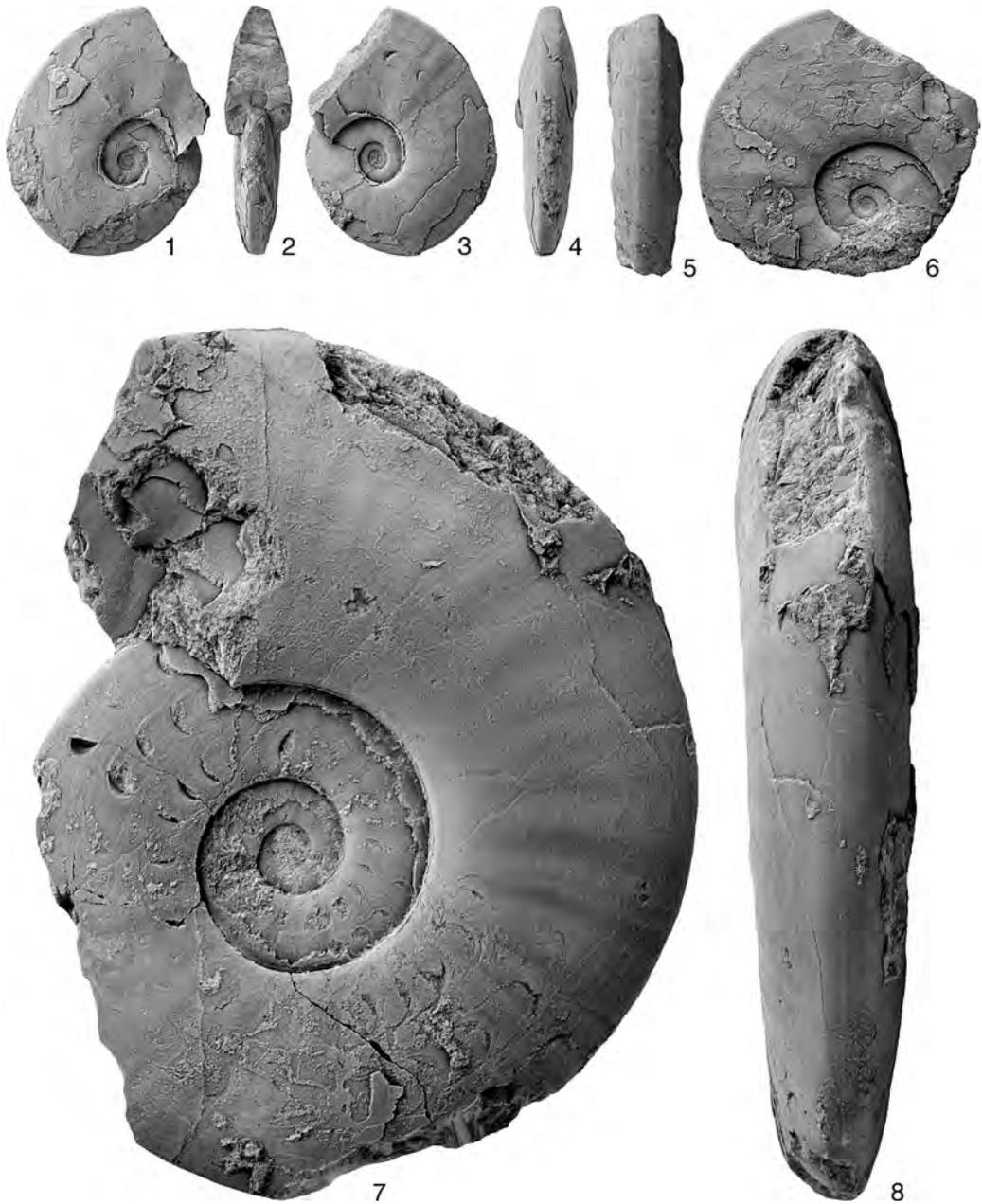


Fig. 81. *Ussuriflemingites primoriensis* Shigeta and Zakharov gen. nov. sp. nov. from AB1021. 1-4, NSM PM23219, paratype, $\times 1.0$. 5-6, NSM PM23220, paratype, $\times 1.0$. 7-8, NSM PM23214, holotype, $\times 1.0$.

es with a few denticulations at each base. First lateral saddle lower than second saddle, and third saddle even lower and asymmetrical. First lateral lobe deep, narrow with 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
NSM PM23214	123.0	41.0	48.5	25.4	0.33	0.52
NSM PM23215	44.0	12.0	19.8	10.0	0.27	0.51
NSM PM23216	86.5	27.8	33.3	17.9	0.32	0.54
NSM PM23217	75.7	23.9	29.4	15.5	0.32	0.53
NSM PM23218	83.6	29.1	31.7	14.3	0.35	0.45
NSM PM23219	34.6	9.1	16.0	7.5	0.26	0.47

Occurrence: Described specimens from AB1021 within the *Clypeoceras timorense* Zone (early Early Olenekian=early Smithian) in the main part of the Zhitkov Formation, Abrek Bay area, South Primorye.

Discussion: *Ussuriflemingites primoriensis* sp. nov. is easily distinguished from *U. abrekensis* sp. nov. by its weak, low, radial folds and lack of fine spiral lirae.

Genus *Balhaeceras* Shigeta and Zakharov
gen. nov.

Type species: *Balhaeceras balhaense* sp. nov.

Composition of the genus: Type species only.

Diagnosis: Very compressed, fairly evolute shell with tabulate venter, fairly narrow umbilicus with very low, vertical umbilical wall and ceratitic suture line with subphyllid saddles.

Etymology: Named after the ancient kingdom of Balhae (A.D. 698–926), which occupied the southern parts of Manchuria and Primorye, and the northern part of the Korean peninsula.

Occurrence: Middle part of the Lower Olenekian (middle Smithian) in South Primorye, Russia.

Discussion: *Balhaeceras* gen. nov. is morphologically close to *Prionolobus* Waagen,

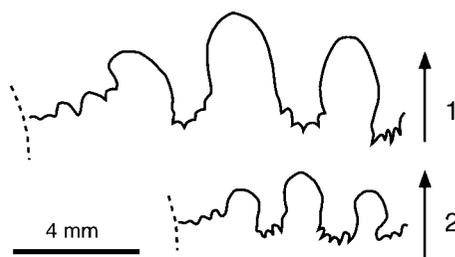


Fig. 82. Suture lines of *Balhaeceras balhaense* Shigeta and Zakharov gen. nov. sp. nov., NSM PM23221, holotype, from AB1026. 1, at H=13 mm. 2, at H=8 mm.

1895 of the Meekoceratidae, but its subphyllid saddles justify its assignment to the Flemingitidae. It differs from *Rohillites* Waterhouse, 1996b by the absence of strigation, from *Anaflemingites* Kummel and Steele, 1962 and *Ussuriflemingites* gen. nov., by its very low umbilical wall and parallel flanks, and from *Galfettites* Brayard and Bucher, 2008 and *Anaxenaspis* Kiparisova, 1956, by its tabulate venter.

Balhaeceras balhaense Shigeta and Zakharov
sp. nov.

Figs. 82, 83.1–83.4

Prionolobus subevolvens Zakharov, 1968, p. 70, pl. 7, figs. 7–9.

Holotype: NSM PM23221, from AB1026.

Diagnosis: As for the genus.

Etymology: Named after the ancient kingdom of Balhae (A.D. 698–926).

Description: Fairly evolute, very compressed shell with subrectangular whorl section, tabulate to weakly concave venter, subangular ventral shoulders and flat flanks with maximum whorl width at two thirds of whorl height. Umbilicus fairly narrow with very low, vertical wall and narrowly rounded shoulders. Ornamentation consists only of weak, low, radial folds. Suture ceratitic with subphyllid saddles, and wide ventral lobe divided by median saddle into two branches with denticula-

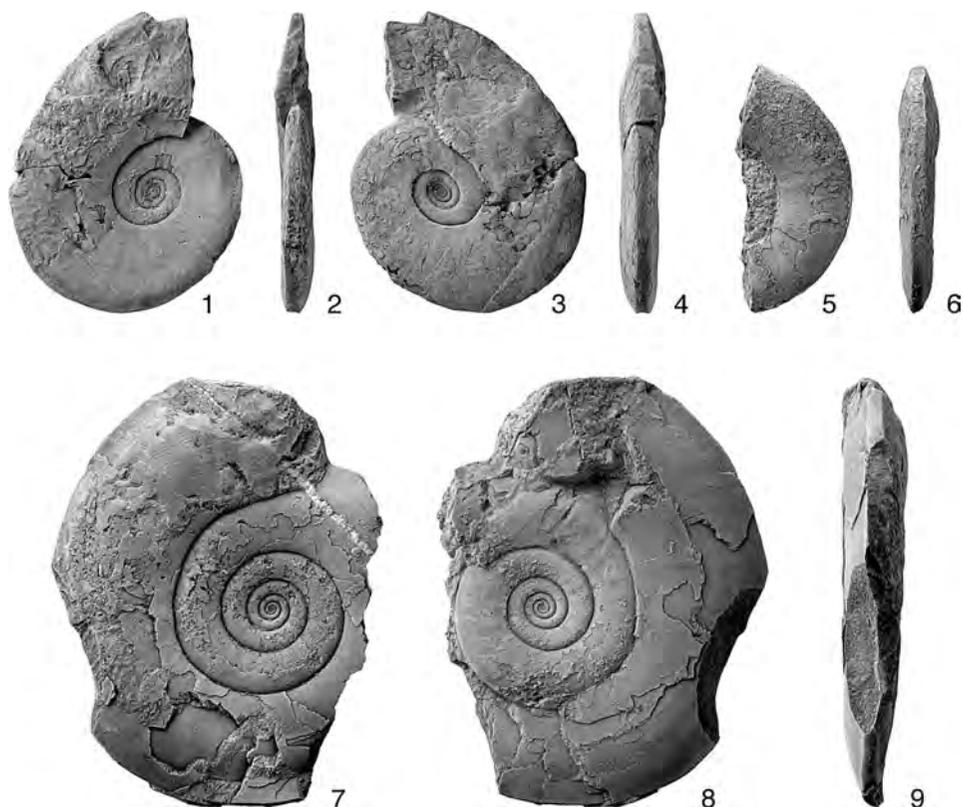


Fig. 83. 1–4, *Balhaeceras balhaense* Shigeta and Zakharov gen. nov. sp. nov., NSM PM23221, holotype, from AB1026, $\times 1.0$. 5–9, *Rohillites laevis* Shigeta and Zakharov sp. nov. from AB1021. 5–6, NSM PM23222, paratype, $\times 1.0$. 7–9, NSM PM23223, holotype, $\times 1.0$.

tions at each base. First lateral saddle lower than second saddle, and third saddle even lower, and asymmetrical. First lateral lobe wide, deep with many denticulations at base, and second lateral lobe nearly equal in size to first lobe. A few auxiliary elements present on adumbilical flank.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23221	30.5	9.2	13.5	4.2	0.30	0.31

Occurrence: Described specimen from *Balhaeceras balhaense* “bed” (AB1026, middle Early Olenekian=middle Smithian) in the main part of the Zhitkov Formation, Abrek

Bay area, South Primorye.

Discussion: A specimen collected from Early Olenekian strata on the western coast of Ussuri Gulf, near Tri Kamnya Cape, and designated by Zakharov (1968, p. 70) as the holotype of *Prionolobus subevolvens*, is very close to *Balhaeceras balhaense* sp. nov., but differs by its slightly convex flanks (maximum thickness at mid flank) and wider umbilicus. It likely belongs either to the genus *Anaflemingites* Kummel and Steele, 1962, or *Rohillites* Waterhouse, 1996b. Three specimens, collected from the eastern coast of Ussuri Gulf, near Golyj Cape and illustrated by Zakhrov (1968,

pl. 7, figs. 7–9) as paratypes of *P. subevolvens*, share many similarities with *B. balhaense* sp. nov. including a very low, vertical umbilical wall and narrowly rounded shoulders, and they are likely conspecific.

Genus *Rohillites* Waterhouse, 1996b

Type species: Flemingites rohilla Diener, 1897.

Rohillites laevis Shigeta and Zakharov sp. nov.

Figs. 83.5–83.9, 84

Type specimens: Holotype, NSM PM23223, from AB1021; paratype, NSM PM23222, from AB1021.

Diagnosis: *Rohillites* with narrow tabulate venter, very low umbilical wall, spiral lirae restricted to outer flank, and without other noticeable ornamentation.

Etymology: From the Latin word: *laevis*, meaning smooth in reference to the absence of marked ribs and folds.

Description: Very evolute, very compressed shell with narrow, tabulate venter, angular ventral shoulders and slightly convex flanks with maximum whorl width at two thirds of whorl height. Fairly wide umbilicus with very low wall and narrowly rounded shoulders. Ornamentation consists of spiral lirae restricted to outer flank as well as fine, radial growth lines. Suture ceratitic with subphyllloid saddles, and wide ventral lobe divided by median saddle into two branches with denticulations at each base. First lateral saddle lower and narrower than second saddle, and third saddle lower and narrower than second. First lateral lobe deep, wide with many denticulations at base, and second lateral lobe shallower than first lobe.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23223	49.7	20.2	16.1	6.8	0.41	0.42

Occurrence: Described specimens from AB1021 within the *Clypeoceras timorensis* Zone (early Early Olenekian=early Smithian)

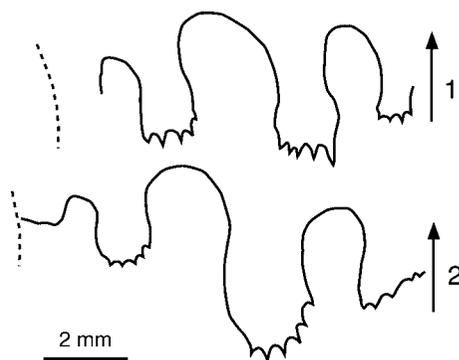


Fig. 84. Suture lines of *Rohillites laevis* Shigeta and Zakharov sp. nov. from AB1021. 1, NSM PM23222, paratype, at H=9 mm. 2, NSM PM23223, holotype, at H=10 mm.

in the main part of the Zhitkov Formation, Abrek Bay area, South Primorye.

Discussion: *Rohillites laevis* sp. nov. is easily distinguished from other species of *Rohillites* such as *R. rohilla* (Diener, 1897, p. 93), *R. bruehwileri* Brayard and Bucher (2008, p. 46), and *R. sobolevi* Brayard and Bucher (2008, p. 47), by the absence of conspicuous ribs and folds. It is clearly distinguished from *Galfettes simplicitalis* Brayard and Bucher (2008, p. 48) by its tabulate venter, and from *Ussuriflemingites primorensis* sp. nov. by its more evolute whorls and the presence of spiral lirae on its outer flanks. Although the holotype of *Prionolobus subevolvens* Zakharov (1968, p. 70) probably could be assigned to either *Anaflemingites* Kummel and Steele, 1962 or *Rohillites* Waterhouse, 1996b, it also could be considered as very close to *Rohillites laevis* sp. nov., except for its lack of spiral lirae.

Genus *Palaeokazakhstanites* Zakharov, 1978

Type species: Wyomingites ussuriensis Zakharov, 1968.

Discussion: *Palaeokazakhstanites* was initially placed within the Sibiritidae by Zakharov (1978), and then later assigned to the

Meekoceratidae by Tozer (1981) and Shevyrev (1986). Waterhouse (1996b) commented that it appears to belong to the xenodiscids. We believe its ornamentation, consisting of spiral lirae and radial ribs, along with its subtabulate venter and ceratitic suture line, justify the placement of this genus within the Flemingitidae. Its shell is very similar to the juvenile shell of *Rohillites* Waterhouse, 1996b, and both possibly belong to the same evolutionary lineage or they may even be congeneric.

Palaeokazakhstanites ussuriensis

(Zakharov, 1978)

Figs. 85, 86

Wyomingites ussuriensis Zakharov, 1968, p. 64, pl. 6, figs. 6–9, text-fig. 12c.

Holotype: DVGI 10/801 figured by Zakharov (1968, p. 64, pl. 6, fig. 6), from the lower part of the Lower Olenekian (*Hedenstroemia bosphorensis* Zone) on the western coast of Ussuri Gulf, near Tri Kamnya Cape in South Primorye, Russia.

Material examined: Seven specimens, NSM PM23224–23230, from AB1021, four specimens, NSM PM23231–23234, from AB1022.

Description: Very small, moderately evolute, fairly compressed shell with elliptical whorl section, narrow, subtabulate venter, angular to abruptly rounded ventral shoulders and gently convex flanks with maximum whorl width at mid-flank. Moderately wide umbilicus with moderately high, slightly oblique wall and rounded shoulders. Ornamentation consists of fine spiral lirae on outer flanks, as well as irregularly spaced, slightly sinuous, prorsiradiate or rursiradiate ribs, which become very faint on inner flanks and disappear on ventral shoulders. Suture ceratitic with wide ventral lobe divided by low median saddle into two branches. First lateral saddle equal to second saddle, but third saddle lower. First lateral lobe deep, wide with many denticulation at base, and second lateral lobe about one-half depth of first lobe.

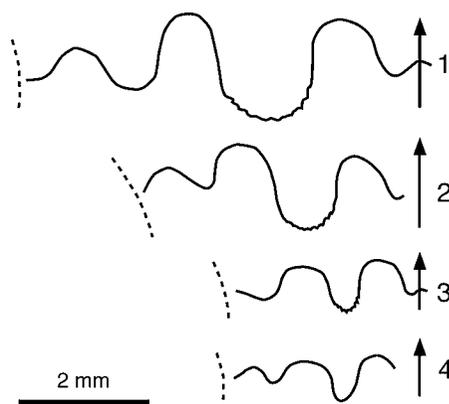


Fig. 85. Suture lines of *Palaeokazakhstanites ussuriensis* (Zakharov, 1968). 1, NSM PM23232, from AB1022, at H=6 mm. 2, NSM PM23231, from AB1022, at H=4 mm. 3, NSM PM23227, from AB1021, at H=3 mm. 4, NSM PM23225, from AB1021, at H=3 mm.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23224	9.8	3.7	3.7	2.6	0.38	0.70
NSM PM23225	12.8	4.6	4.8	3.4	0.36	0.71
NSM PM23226	9.8	3.4	3.8	3.0	0.35	0.79
NSM PM23227	11.2	4.1	3.9	3.0	0.37	0.77
NSM PM23228	18.6	6.9	6.8	5.1	0.37	0.75
NSM PM23231	11.9	5.1	4.9	3.8	0.43	0.78
NSM PM23232	14.8	4.9	6.0	4.8	0.33	0.80
NSM PM23233	10.7	3.8	4.5	3.1	0.36	0.69
NSM PM23234	20.2	7.7	7.5	5.5	0.38	0.73

Occurrence: Described specimens from AB1021, AB1022 within the *Clypeoceras timorense* Zone (early Early Olenekian=early Smithian) in the main part of the Zhitkov Formation, Abrek Bay area, South Primorye. This species also occurs in the *Hedenstroemia bosphorensis* Zone on the western coast of Ussuri Gulf, near Tri Kamnya Cape, South Primorye (Zakharov, 1968; Markevich & Zakharov, 2004).

Discussion: *Palaeokazakhstanites ussuriensis* (Zakharov, 1968) is very similar to *Rohillites bruehwileri* Brayard and Bucher (2008, p. 46), but the maximum shell size of each species appears to be quite different. All specimens of *P. ussuriensis* found thus far are

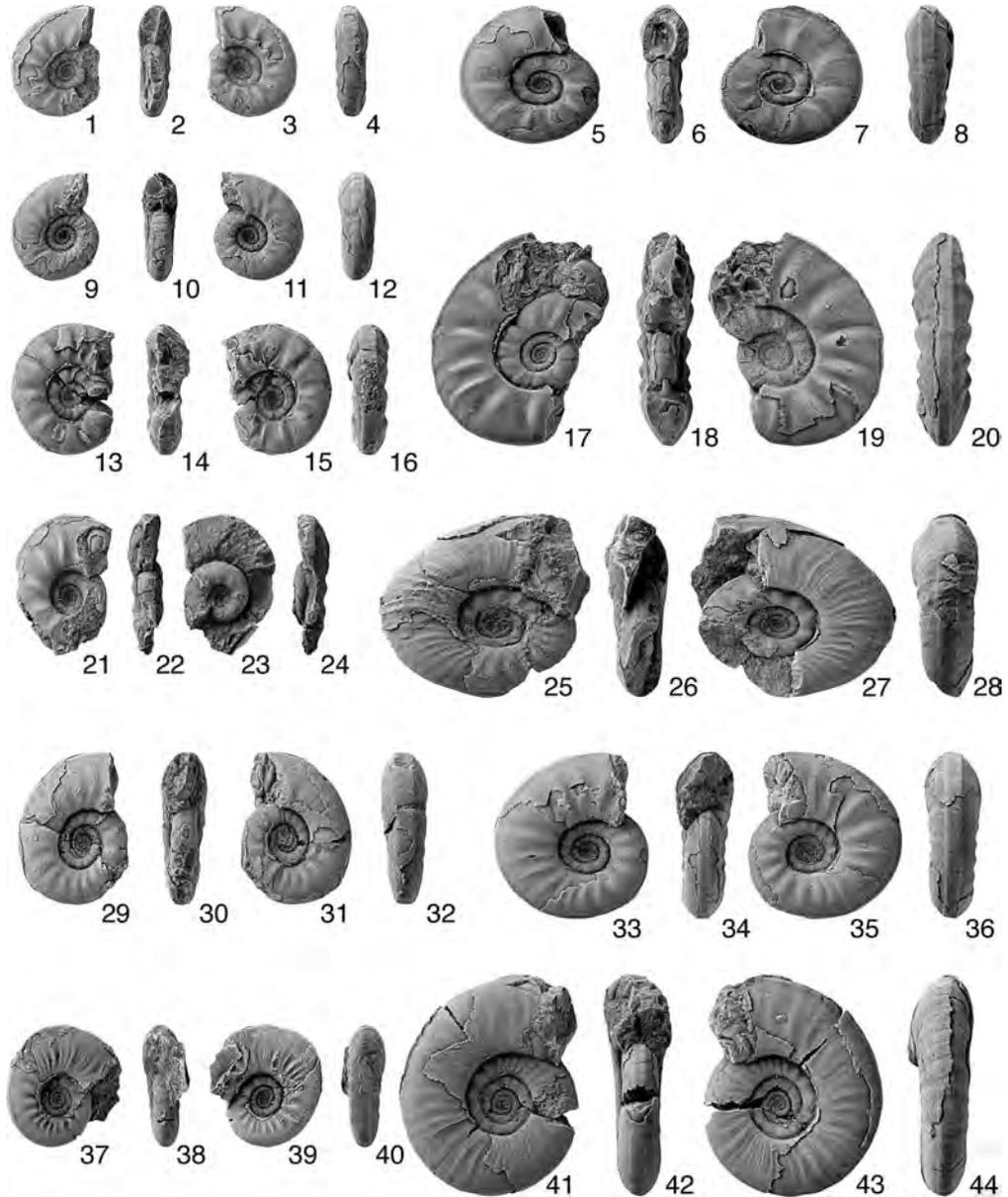


Fig. 86. *Palaeokazakhstanites ussuriensis* (Zakharov, 1968). 1–28, from AB1021. 1–4, NSM PM23224, $\times 1.5$. 5–8, NSM PM23225, $\times 1.5$. 9–12, NSM PM23226, $\times 1.5$. 13–16, NSM PM23227, $\times 1.5$. 17–20, NSM PM23228, $\times 1.5$. 21–24, NSM PM23229, $\times 1.5$. 25–28, NSM PM23230, $\times 1.5$. 29–32, NSM PM23231, $\times 1.5$. 33–36, NSM PM23232, $\times 1.5$. 37–40, NSM PM23233, $\times 1.5$. 41–44, NSM PM23234, $\times 1.5$.

less than 3 cm in diameter, whereas of the six illustrated specimens of *R. bruehwileri*, all are larger than 3 cm and two are nearly 6 cm in diameter. These two species may, in fact, be conspecific, but this cannot be confirmed without a thorough statistical analysis, which would require many additional specimens.

Genus *Euflemingites* Spath, 1934

Type species: Flemingites guyerdetiformis Welter, 1922.

Euflemingites prynadai (Kiparisova, 1947b)

Figs. 87–90

Flemingites prynadai Kiparisova, 1947b, p. 135, pl. 29, fig. 1, pl. 30, fig. 1, text-fig. 18; Kiparisova, 1954, p. 18, pl. 8, fig. 1; Kiparisova, 1961, p. 76, pl. 15, fig. 1, text-fig. 36.

? *Euflemingites tsotengensis* Chao, 1959, p. 209, pl. 5, figs. 1–2, text-fig. 14.

Euflemingites sp. indet. Zakharov, 1968, p. 88, pl. 16, fig. 3.
Euflemingites prynadai (Kiparisova). Zakharov, 1997, pl. 1, fig. 6.

Holotype: CGM 71/5504 figured by Kiparisova (1947b, p. 135, pl. 29, fig. 1, pl. 30, fig. 1), from the Lower Triassic (Olenekian, *Flemingites* beds) on the western coast of Ussuri Gulf, near Tri Kamnya Cape in South Primorye, Russia.

Material examined: NSM PM23235, from AB1027.

Description: Moderately evolute, fairly large shell with arched venter, indistinct ventral shoulders and gently convex flanks forming an elliptical whorl section with maximum whorl width at mid-flank. Umbilicus moderately wide with moderately high, vertical wall and rounded shoulders. Ornamentation consists of rather weak, slightly rursiradiate ribs as well as conspicuous, dense strigation covering entire shell. Spiral ridges number about 25 between umbilical shoulder and mid-line of venter. Suture ceratitic with subphylloid saddles, and wide ventral lobe divided by narrow, high median saddle into two branches with



Fig. 87. Suture line of *Euflemingites prynadai* (Kiparisova, 1947), NSM PM23235, from AB1027, at H=55 mm.

denticulations at each base. First lateral saddle lower than second saddle, and third saddle even lower. First lateral lobe deep, wide with many denticulations at base, and second lateral lobe about one-half depth of first lobe.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23235	165.0	52.0	60.0	49.0	0.32	0.77

Occurrence: Described specimens from *Arctoceras subhydaspis* “bed” (AB1027, middle Early Olenekian=Middle Smithian) in the main part of the Zhitkov Formation, Abrek Bay area, South Primorye. This species also occurs in the *Hedenstroemia bosphorensis* Zone, on the western coast of Ussuri Gulf, near Tri Kamnya Cape, and in the Yuzhnorechensk area, South Primorye (Zakharov, 1968; Markevich & Zakharov, 2004).

Discussion: Although the present specimen is somewhat deformed and is missing about one-third of its whorls, its distinctive features enable us to identify it without doubt as *Euflemingites prynadai*.

This species apparently differs from *E. cirratus* (White, 1879, p. 116) by possessing a greater number of spiral ridges, but in order for this to be considered as diagnostic, one must define the intraspecific variation of strigate ridge density for a sufficient number of specimens of both species. *E. tsotengensis* Chao (1959, p. 209) is very close to this species, and in fact, may be conspecific.



Fig. 88. *Euflemingites prynadai* (Kiparisova, 1947), NSM PM23235, from AB1027, $\times 1.0$.



Fig. 89. *Euflemingites prynadai* (Kiparisova, 1947). 1–2, NSM PM23235, from AB1027, $\times 1.0$.



Fig. 90. *Euflemingites prynadai* (Kiparisova, 1947), NSM PM23235, from AB1027, $\times 1.0$.

Family Proptychidae Waagen, 1895

Genus *Dunedinites* Tozer, 1963

Type species: Dunedinites pinguis Tozer, 1963.

Dunedinites magnumbilocatus

(Kiparisova, 1961)

Figs. 91, 92.1–92.4

Prosphingites magnumbilocatus Kiparisova, 1961, p. 114, pl. 25, fig. 4, text-fig. 78.

Holotype: CGM/121/5504, figured by Kiparisova (1961, p. 114, pl. 25, fig. 4), from the Lower Triassic (Olenekian?) in the Abrek Bay area in South Primorye, Russia.

Material examined: NSM PM23236, from AB1010.

Description: Moderately involute, somewhat globular shell with very depressed, semi-circular whorl section, and convex flanks gradually converging to a circular venter from abruptly rounded umbilical shoulder. Moderately wide, deep umbilicus with high, vertical wall. Shell ornamentation consists of very fine, forward projected plications on body chamber as well as very fine, growth lines. Suture ceratitic with narrow saddles, and wide ventral lobe divided by narrow median saddle into two branches with denticulations at each base. First lateral saddle nearly equal to second saddle, and third saddle lower. First lateral lobe deep, narrow with many denticulations at base, and second lateral lobe nearly equal to first lobe.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23236	30.0	11.5	9.0	21.0	0.38	2.33

Occurrence: Described specimen from AB1010 within the lower *Gyronites subdharinus* Zone (late Early Induan=late Griesbachian) in the upper part of the Lazurnaya Bay Formation, Abrek Bay area, South Primorye.

Discussion: *Dunedinites magnumbilocatus* (Kiparisova, 1961) is very close to *D. pinguis* Tozer (1963, p. 23), and to *D. subtabulatus*

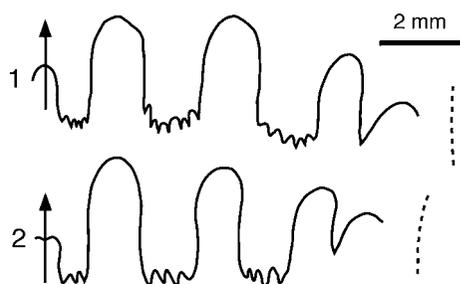


Fig. 91. Suture lines of *Dunedinites magnumbilocatus* (Kiparisova, 1961), NSM PM23236, from AB1010. 1, at H=9 mm. 2, at H=6 mm.

(Brühwiler *et al.*, 2008, p. 1175), which they assigned to *Anotoceras*, but differs by its vertical umbilical wall. It exhibits some affinities with *Anotoceras nala* (Diener, 1897, p. 54) of the family Otoceratidae Hyatt, 1900 (*Anotoceratidae* Waterhouse, 1994), but can be easily distinguished by its circular venter and abruptly rounded umbilical shoulder.

The holotype was collected by N. K. Trifonova in 1948 from the dark-grey, fine-grained, calcareous sandstone in the Abrek Bay section, and Kiparisova (1961) believed that this particular horizon was of Olenekian age. However, this sandstone is typical of the upper part of the Lazurnaya Bay Formation (Induan), and it is highly probable that the holotype was actually collected from this horizon, as was our specimen.

Genus *Bukkenites* Tozer, 1994

Type species: Bukkenites nitidus Tozer, 1994.

***Bukkenites?* sp. indet.**

Figs. 92.5–92.6, 93

Material examined: NSM PM23237 from AB1008.

Description: Fairly involute shell with elliptical whorl section, rounded venter, rounded ventral shoulders and slightly convex flanks with maximum whorl width near umbilicus.

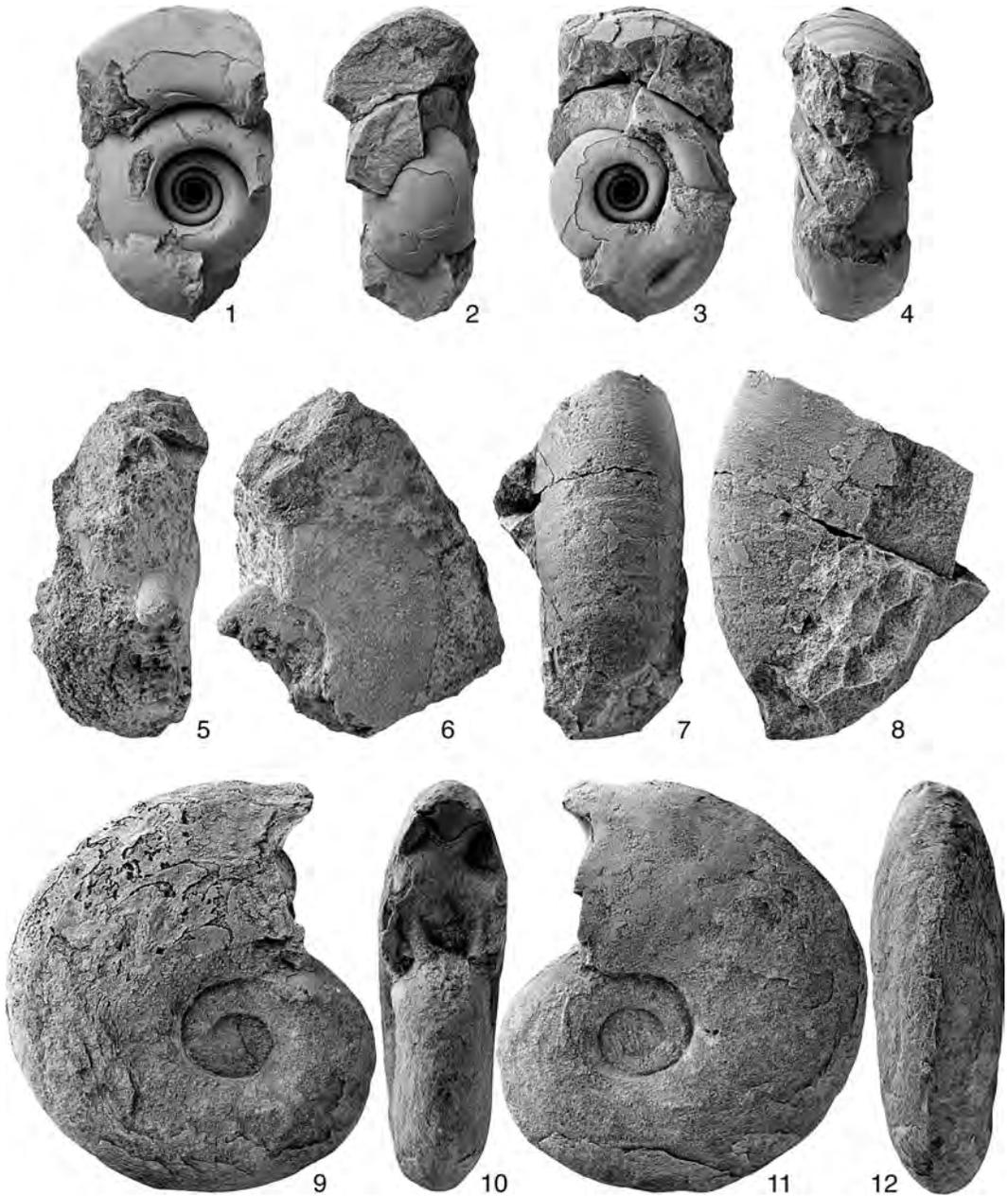


Fig. 92. 1–4, *Dunedinites magnumbilocatus* (Kiparisova, 1961), NSM PM23236, from AB1010, $\times 1.0$. 5–6, *Bukkenites?* sp. indet., NSM PM23237, from AB1008, $\times 1.0$. 7–12, *Pseudoproptychites hiemalis* (Diener, 1895). 7–8, NSM PM23238, from AB1009, $\times 1.0$. 9–12, NSM PM23239, from AB1010, $\times 1.0$.

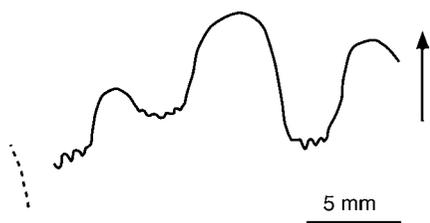


Fig. 93. Suture line of *Bukkenites?* sp. indet., NSM PM23237, from AB1008, at H=19 mm.



Fig. 94. Suture line of *Pseudoprotychites hiemalis* (Diener, 1895), NSM PM23240, from AB1010, at H=22 mm.

Umbilicus fairly narrow with moderately high, vertical wall and rounded shoulders. Shell ornamentation not preserved. Suture ceratitic with denticulate suspensive lobe, but with no discrete auxiliary lobe. First lateral saddle lower than second saddle, and third saddle even lower. First lateral lobe deep, wide with denticulations at base, and second lateral lobe two thirds depth of first lobe.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23237	19.3	4.9	9.2	6.6	0.25	0.72

Occurrence: Described specimen from AB1008 within the *Lytophicerias* sp. Zone (Early Induan=Griesbachian) in the middle part of the Lazurnaya Bay Formation, Abrek Bay area, South Primorye.

Discussion: The assignment of this fragmental specimen to *Bukkenites* is uncertain and is based only on the similarity of its morphology and suture with the Proptychitidae.

Genus *Pseudoprotychites* Bando, 1981

Type species: *Proptychites scheibleri* Diener, 1897.

Pseudoprotychites hiemalis (Diener, 1895)

Figs. 92.7–92.12, 94, 95

Proptychites hiemalis Diener, 1895, p. 34, pl. 2, figs. 2, 4, pl. 5, fig. 4.

Proptychites hiemalis. Zakharov, 1968, p. 93, pl. 17, figs. 6, 7, text-figure 20c.

Lectotype: Designated by Zakharov (1968,

p. 93), is CGM 40/596, original of Diener (1895, p. 34, pl. 2, fig. 6) from the Induan of the Shamara Bay area, along the western coast of Ussuri Gulf in South Primorye, Russia.

Material examined: NSM PM23238, from AB1009, two specimens, NSM PM23239, 23240, from AB1010.

Description: Fairly involute, fairly compressed shell (outer whorls) with arched venter, indistinct ventral shoulders and slightly convex flanks with maximum whorl width at mid-flank. Whorl section varies from elliptical for outer whorls to ovoid for involute inner whorls. Fairly narrow, deep umbilicus with very high, vertical wall on inner whorls, and moderately high, gently inclined wall with broadly rounded shoulder on outer whorls. Shell surface smooth with very fine, prorsiradial, nearly straight growth lines. Suture ceratitic with somewhat differentiated auxiliaries. Lateral saddles high, narrow and slanted slightly toward umbilicus. First lateral lobe wide, deep 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
NSM PM23239	56.2	13.3	27.3	18.1	0.24	0.66
NSM PM23240	65.2	12.8	33.5	21.0	0.20	0.63

Occurrence: Described specimens from AB1009 within the *Lytophicerias* sp. Zone (Early Induan=Griesbachian), and AB1010 within the lower *Gyronites subdharmus* Zone (late Early Induan=late Griesbachian) in the

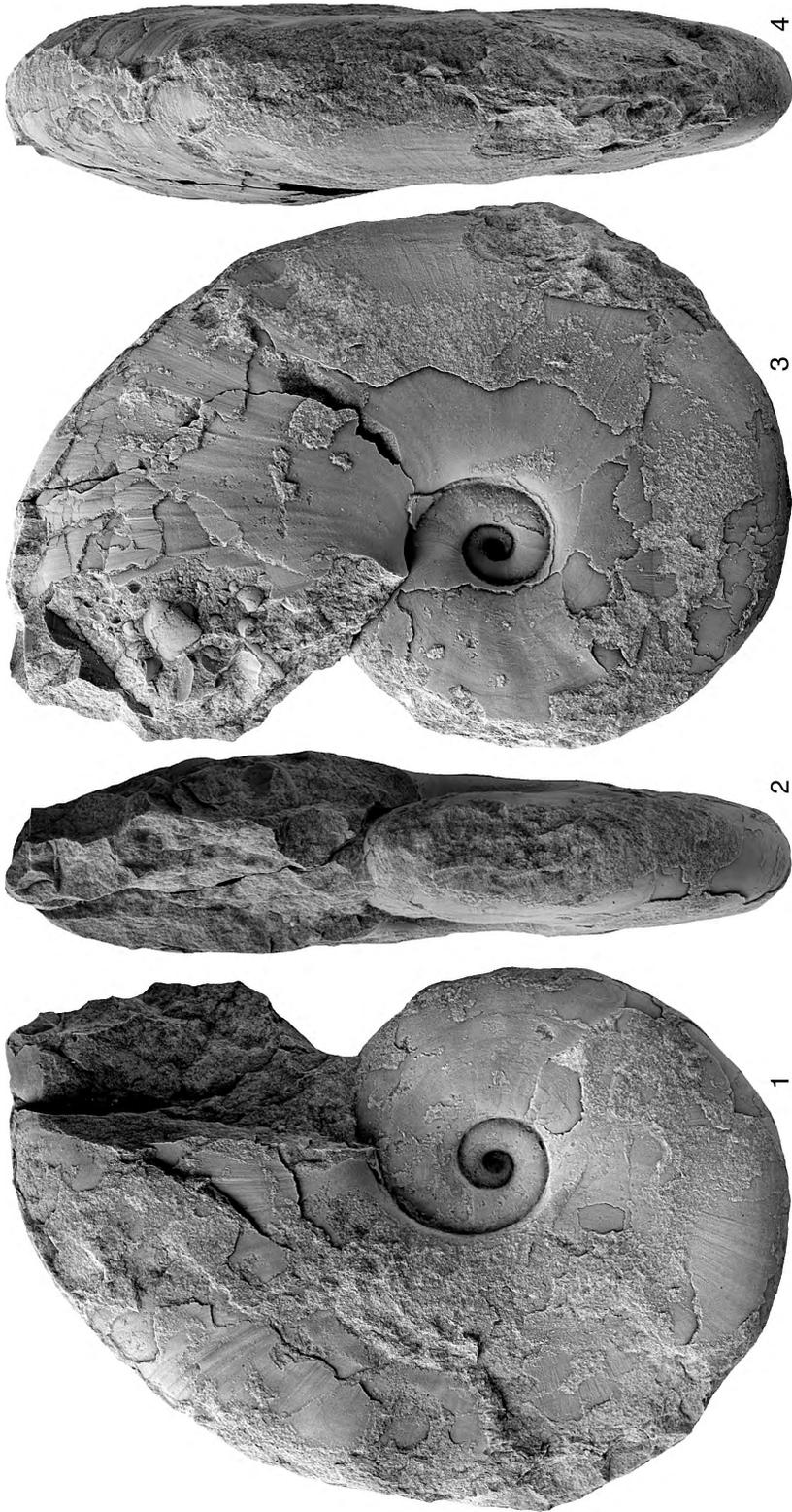


Fig. 95. *Pseudoprotychites hiemalis* (Diener, 1895). 1–4, NSM PM23240, from AB1010, $\times 1.0$.

middle to upper part of the Lazurnaya Bay Formation, Abrek Bay area, South Primorye.

Discussion: Larger specimens are somewhat similar to *Proptychites* Waagen, 1895, but the globular whorl section of its juvenile stage, and its slender lateral saddles and strongly denticulated lateral lobes justify the assignment of this species to *Pseudoproptychites*. This species is close to *P. scheibleri* (Diener, 1897, p. 79), but differs in having fairly compressed whorls at later growth stages. The specimen identified as *Proptychites hiemalis* by Zakharov (1968, p. 93, pl. 17, figs. 6, 7) has a wider umbilicus than the type specimens and our specimens as well, but it is probably con-specific.

Genus *Pachyproptychites* Diener, 1916

Type species: *Proptychites otoceratoides* Diener, 1895.

Discussion: Vavilov and Zakharov (1976) suspected that the holotype of *Proptychites otoceratoides* Diener (1895, p. 36) was actually a poorly preserved specimen of *Arctoceras* Hyatt, 1900. However, *Pachyproptychites* is quite different from *Arctoceras* in shell shape and suture line, and no *Pachyproptychites*-like forms have been discovered among the poorly preserved specimens of *Arctoceras*. Thus, *Pachyproptychites* is probably a valid genus. It is very close to *Bukkenites* Tozer, 1994, but differs by having an auxiliary lobe similar to *Proptychites* Waagen, 1895.

Spath (1934) considered the funnel-shaped umbilicus of *Pachyproptychites* to be a highly significant component of its diagnosis. However, most of the holotype's umbilicus is obscured by matrix. Judging from the umbilical edge or shoulder that is visible in one small area, the umbilical wall appears to be over-

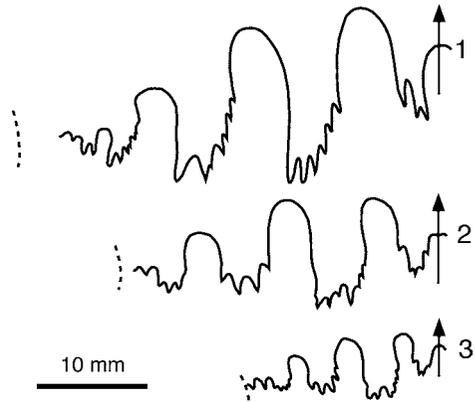


Fig. 96. Suture lines of *Pachyproptychites otoceratoides* (Diener, 1895) from AB1011. 1, NSM PM23242, at H=34 mm. 2, NSM PM23241, at H=25 mm. 3, NSM PM23241, at H=15 mm.

hanging.

Pachyproptychites otoceratoides (Diener, 1895)

Figs. 96, 97

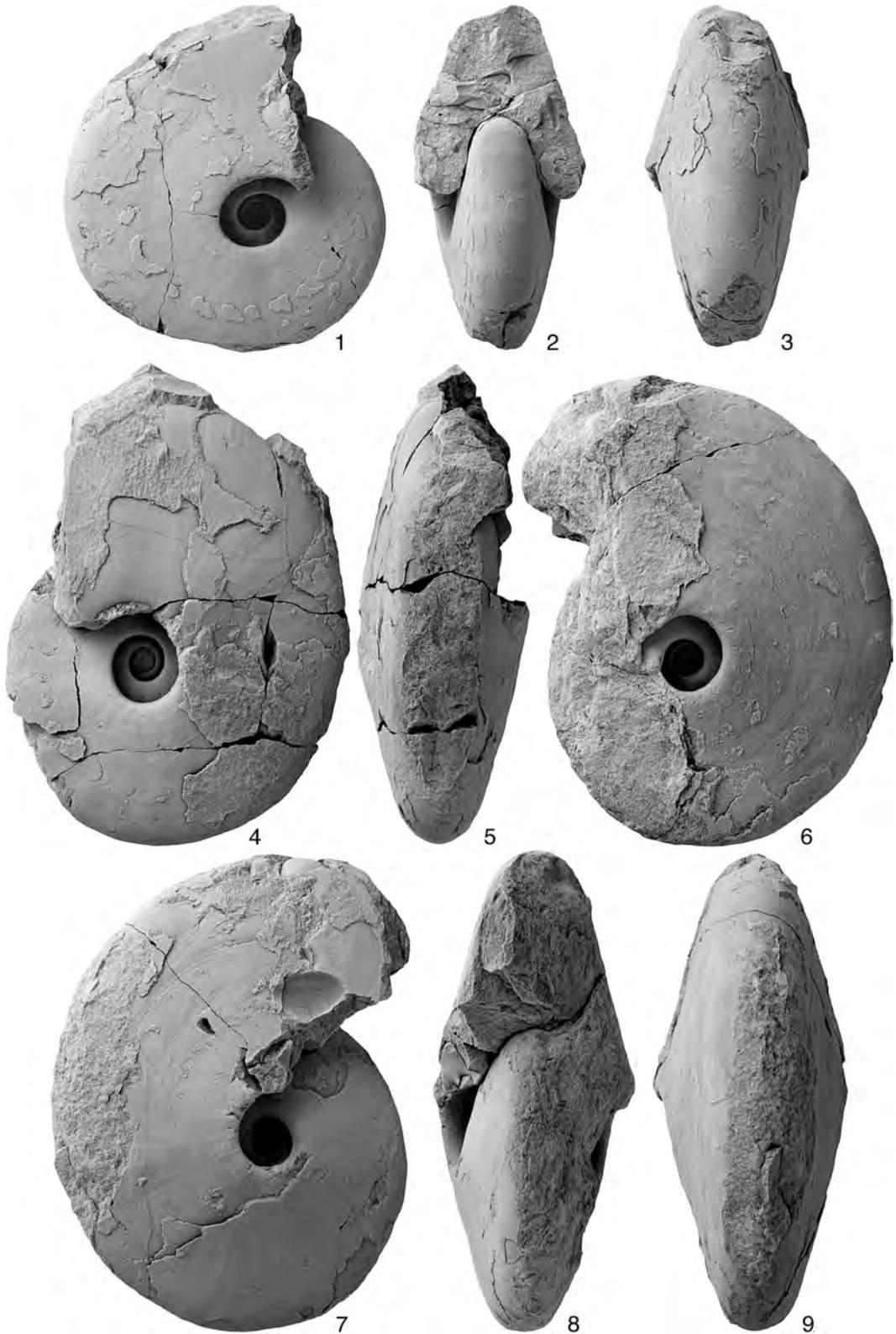
Proptychites otoceratoides Diener, 1895, p. 36, pl. 3, fig. 2.
Pachyproptychites otoceratoides (Diener). Diener, 1916, p. 101.

Proptychites abrekensis Kiparisova, 1961, p. 100, pl. 19, fig. 2, text-fig. 61.

Holotype: CGM 43/596, figured by Diener (1895, p. 36, pl. 3, fig. 2) from the Lower Triassic of the Paris Bay area of Russian Island, South Primorye, Russia.

Material examined: Two specimens, NSM PM23241, 23242, from AB1011.

Description: Very involute, fairly compressed shell with whorl section characterized by swollen dorsum, and flanks tapering to a rounded venter with indistinct shoulders. Maximum whorl width occurs on umbilical shoulders. Narrow umbilicus with high, overhanging wall and abruptly rounded shoulders. Or-



namentation consists of very weak spiral lirae as well as fine, sinuous prorsiradiate growth lines. Suture ceratitic with wide ventral lobe divided by narrow, high median saddle into two branches with denticulations at each base. Lateral saddles high and slightly slanted toward umbilicus. First lateral lobe wide, deep with many denticulations at base, and second lateral lobe about two thirds depth of first lobe. Suspensive lobe includes discrete auxiliary lobe.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23241	51.3	10.6	23.8	21.2	0.21	0.89
NSM PM23242	73.7	11.0	35.9	29.0	0.15	0.81

Occurrence: Described specimens from AB1011 within the upper *Gyronites subdharmaus* Zone (late Early Induan=late Griesbachian) in the upper part of Lazurnaya Bay Formation, Abrek Bay area, South Primorye.

Discussion: *Proptychites abrekensis*, described by Kiparisova (1961, p. 100) from Induan strata of the Abrek Bay area, has a shell shape and suture line that is similar to *Pachyproptychites otoceratoides*, and it almost certainly is conspecific.

The holotype of *P. otoceratoides* (Diener 1895, p. 36) was supposedly collected from Paris Bay on Russian Island, South Primorye, where Olenekian and Anisian strata are well exposed along the seacoast. However, as Vavilov and Zakharov (1976) have already pointed out, there have been no specimens of *P. otoceratoides* collected from this area other than by Diener (1895). Although this species does occur in the Induan of the Abrek Bay area, Induan strata have not been found in the type locality area (Zakharov, 1968; Markevich & Zakharov, 2004). The preservation of the holotype is very similar to that of specimens found in Induan deposits along the western coast of Ussuri Gulf. These inconsistencies certainly

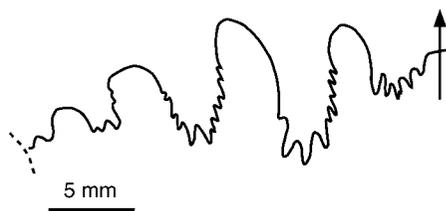


Fig. 98. Suture line of *Proptychites alterammonoides* (Krafft, 1909), NSM PM23243, from AB1013, at H=24 mm.

suggest that Diener may have been mistaken when recording the locality that yielded *P. otoceratoides*.

Genus *Proptychites* Waagen, 1895

Type species: *Ceratites lawrencianus* de Koninck, 1863.

Proptychites alterammonoides (Krafft, 1909)

Figs. 98, 99

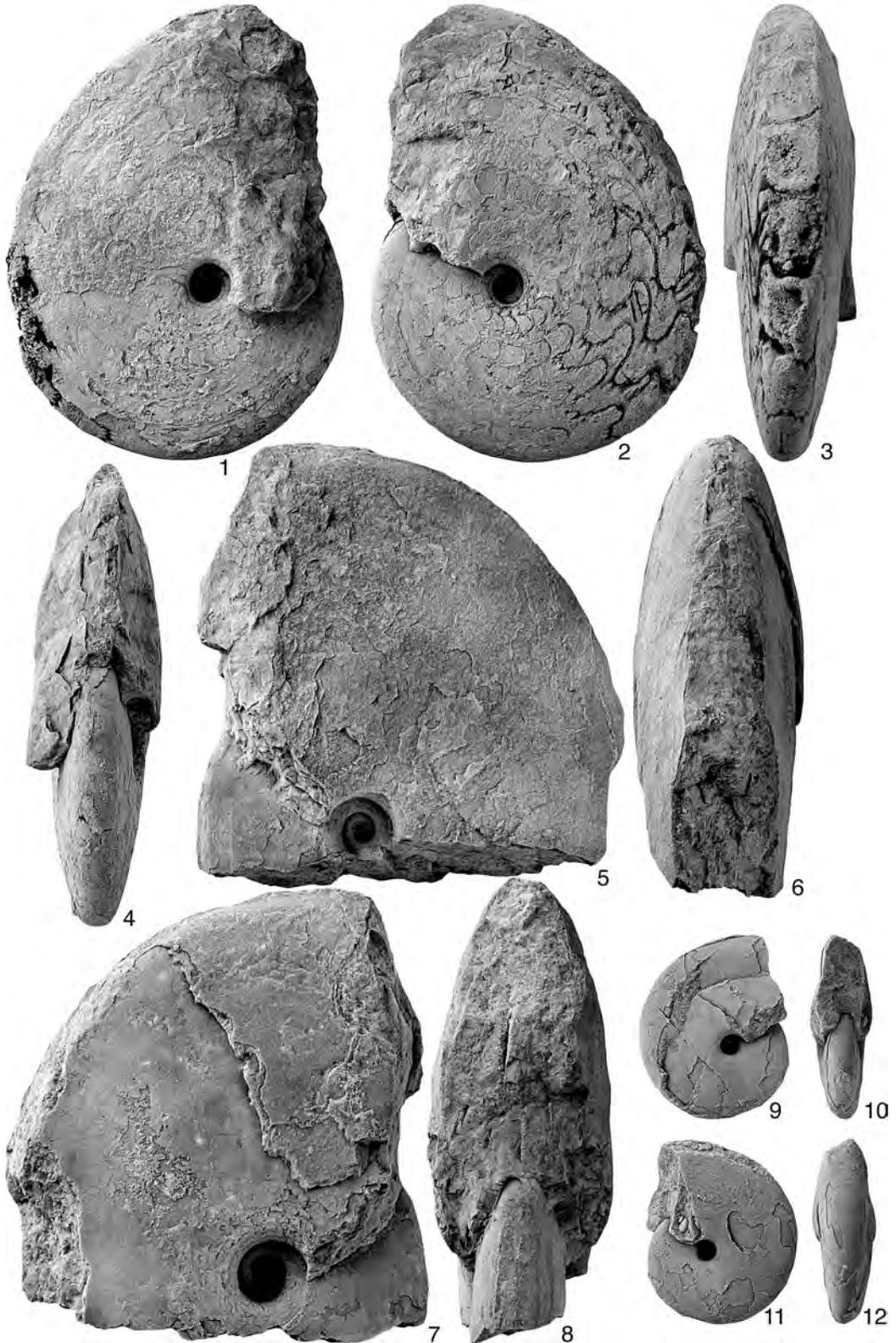
Koninckites alterammonoides Krafft, 1909, p. 70, pl. 16, figs. 1, 2.

Aspidites crassus Krafft, 1909, p. 58, Pl. 8, fig. 1.

Lectotype: Specimen designated by Waterhouse (1996a, p. 67), is GSI 9451, original of Krafft (1909, p. 70, pl. 16, fig. 1) from the "Meekoceras" beds one mile north of Lilang, Spiti area, northwest Himalayan region.

Material examined: Three specimens, NSM PM23243–23245, from AB1013.

Description: Very involute, very compressed shell with elliptical whorl section, arched venter, rounded ventral shoulders and slightly convex flanks with maximum whorl width on inner flank at one fourth of whorl height. Narrow, deep umbilicus with high, vertical or overhanging wall and rounded shoulders. Ornamentation consists of very weak spi-



ral lirae on outer flank of juvenile shell as well as fine, sinuous growth lines. Suture ceratitic with wide ventral lobe divided by median saddle into two branches with denticulations at each base. Lateral saddles high and slightly slanted toward umbilicus. First lateral lobe wide, deep with many denticulations at base, and second lateral lobe about two thirds depth of first lobe. Suspensive lobe includes discrete auxiliary lobe.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23243	65.6	6.0	37.8	19.4	0.09	0.51
NSM PM23244	43.2	5.3	23.3	14.0	0.12	0.60
NSM PM23245	25.2	3.9	13.7	8.0	0.15	0.58

Occurrence: Described specimens from AB1013 within the *Ambitoides fuliginatus* Zone (early Late Induan=early Dienerian) in the lowest part of the Zhitkov Formation, Abrek Bay area, South Primorye. This species also occurs in the “*Meekoceras*” beds of the northwest Himalayan region (Krafft, 1909), which is correlated with the Late Induan (Dienerian) (Waterhouse, 2002).

Discussion: *Proptychites alterammonoides* is very close to several slender, very involute species of *Proptychites*, but differs by the position of maximum whorl width, which for this species, is at one fourth of whorl height versus a mid-flank position for *P. khoorensis* Waagen (1895, p. 176), *P. trilobatus* Waagen (1895, p. 178), and *P. subgrandis* Guex (1978, p. 108), and an umbilical shoulder position for *P. oldhamianus* Waagen (1895, p. 166), *P. tenuistriatum* (Krafft, 1909, p. 34), *P. markhami* Diener (1897, p. 75) and *P. chuluensis* Waterhouse (1996a, p. 68). *P. abundans* Waterhouse (1996a, p. 67) is similar in regard to its position of maximum whorl width, but it has thicker whorls. Although one of the illustrated specimens of *Aspidites crassus* Krafft (1909, p. 58, Pl. 8, fig. 1, GSI 9406) was drawn with rather thick whorls, it is actually more slender and is very much similar to this species. More than likely, it is conspecific.

Genus *Paranorites* Waagen, 1895

Type species: *Paranorites ambiensis* Waagen, 1895.

Paranorites varians (Waagen, 1895)

Figs. 100–102

Meekoceras varians Waagen, 1895, p. 247, pl. 29, figs. 2–5.

Lectotype: Designated by Waterhouse (1996a, p. 45), is GSI 7170, original of Waagen (1895, p. 247, pl. 29, fig. 2) from the Lower Ceratite Limestone of the Salt Range.

Material examined: Three specimens, NSM PM23246–23248, from AB1016, one specimen, NSM PM23250, from AB1019

Description: Moderately involute, very compressed shell with subrectangular whorl section, subtabulate venter, rounded ventral shoulders and parallel flanks with weak curvature at mid-flank. Umbilicus fairly narrow with moderately high, vertical wall and rounded shoulders. Ornamentation consists of very weak radial folds as well as fine, sinuous prosiradiate growth lines. Suture ceratitic with first lateral saddle lower, narrower than second saddle, and second lateral saddle slightly slanted toward umbilicus. First lateral lobe wide, deep with many denticulations at base, and second lateral lobe about two thirds depth of first lobe. Suspensive lobe includes discrete auxiliary lobe.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23246	39.0	8.6	20.7	10.6	0.22	0.51
NSM PM23247	42.0	8.9	22.3	10.8	0.21	0.48
NSM PM23248	77.3	15.6	37.9	17.9	0.20	0.47
NSM PM23250	108.1	23.5	50.1	28.6	0.22	0.57

Occurrence: Described specimens from *Paranorites varians* Zone (AB1016 and AB1019, Late Induan=Dienerian) in the main part of the Zhitkov Formation, Abrek Bay area, South Primorye. This species also occurs in the Lower Ceratite Limestone of the Salt Range (Waagen, 1895).

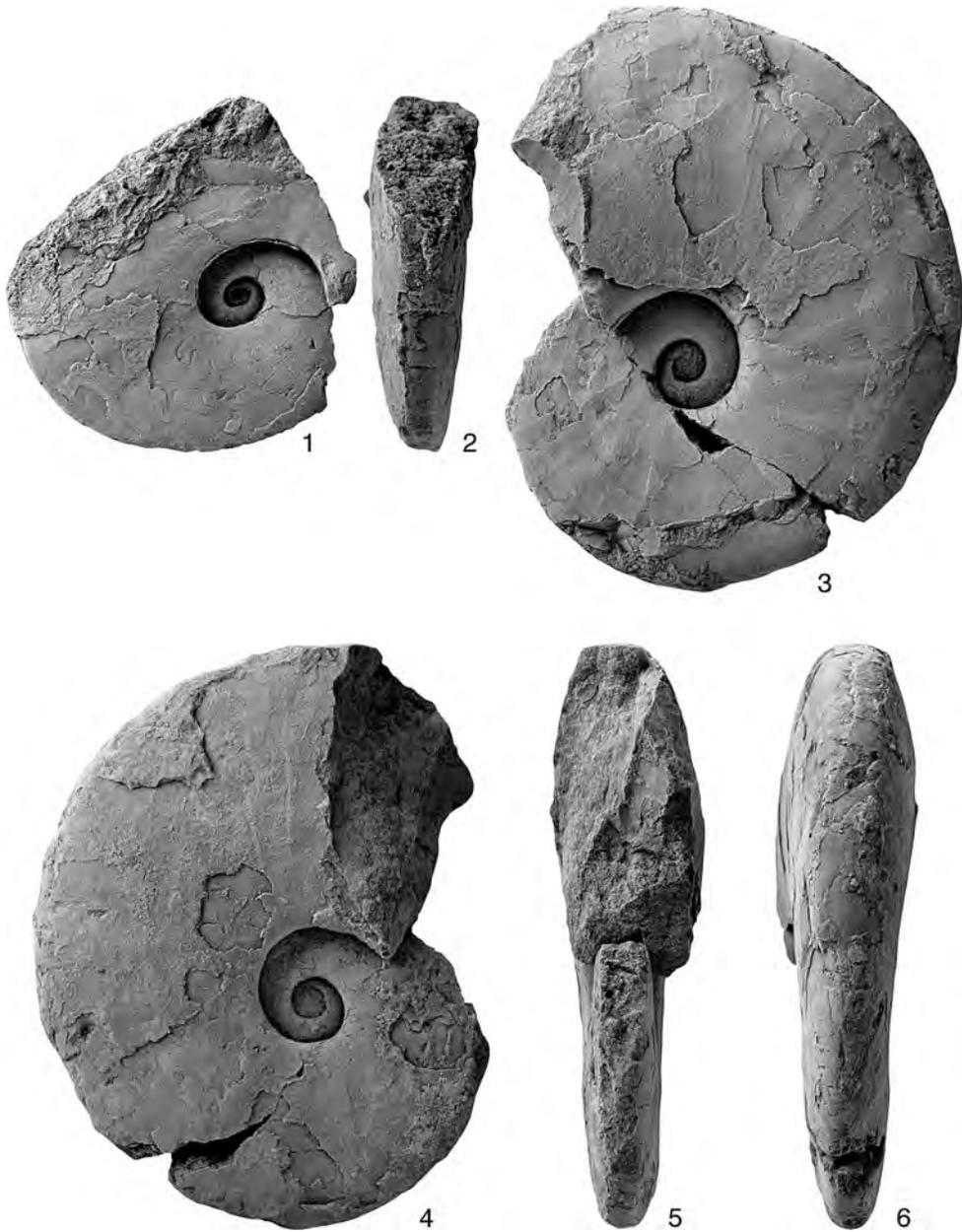


Fig 100. *Paranorites varians* (Waagen, 1895) from AB1016. 1–2, NSM PM23247, $\times 1.0$. 3–6, NSM PM23248, $\times 1.0$.



Fig. 101. *Paranorites varians* (Waagen, 1895). 1–4, NSM PM23246, from AB1016, $\times 1.0$. 5–6, NSM PM23250, from AB1019, $\times 1.0$.

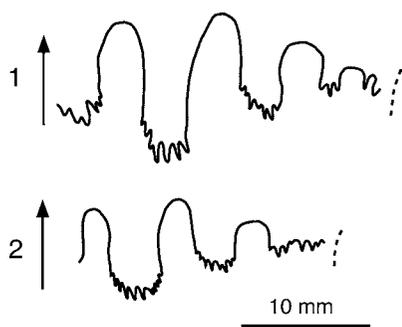


Fig. 102. Suture lines of *Paranorites varians* (Waagen, 1895) from AB1016. 1, NSM PM23248, at H=21 mm. 2, NSM PM23247, at H=21 mm.

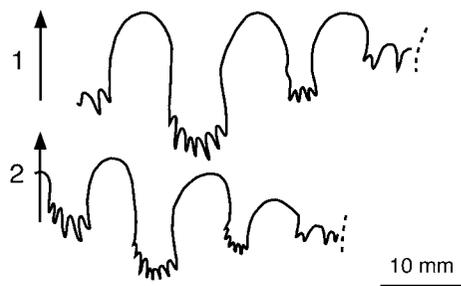


Fig. 103. Suture lines of *Kummelia?* sp. indet., NSM PM23249, from AB1019. 1, at H=41 mm. 2, at H=34 mm.

Discussion: Although the opposite side of the holotype (GSI 7170) is partly weathered away, it is apparent from Waagen's hand-drawn illustration (1895, pl. 29, fig. 2) that the specimen was reconstructed with its whorl section much too wide ($W/H=0.65$). The actual comparison of whorl width and height is given as 0.53 (Waagen, 1895, p. 249), which is very similar to our described specimens.

This species was originally described as *Meekoceras* Hyatt, 1879 by Waagen (1895, p. 247), but the slender, moderately involute shell with its subtabulate venter and vertical umbilical wall leads us to assign this species to *Paranorites*, as already suggested by Waterhouse (1996a, p. 44).

Genus *Kummelia* Waterhouse, 1996a

Type species: *Paranorites kummeli* Bando, 1981.

Kummelia? sp. indet.

Figs. 103–105

Material examined: NSM PM23249 from AB1019.

Description: Quite large, moderately involute, fairly compressed shell with elliptical whorl section and rounded venter with round-

ed ventral shoulders. Flanks convex with maximum whorl width varying from mid-flank to one third of whorl height. Fairly narrow umbilicus with moderately high, vertical wall and rounded shoulders. Ornamentation consists of weak radial folds only on middle growth stage as well as fine, sinuous, fairly rusiradiate growth lines. Suture ceratitic with moderately developed auxiliaries, and wide ventral lobe divided by median saddle into two branches with denticulations at each base. First lateral saddle highest, second saddle slanted slightly toward umbilicus, and third saddle lower. First lateral lobe wide, deep 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
NSM PM23249	106.8	30.3	43.6	31.6	0.28	0.72

Occurrence: Described specimens from *Paranorites varians* Zone (AB1019, late Late Induan=late Dienerian) in the main part of the Zhitkov Formation, Abrek Bay area, South Primorye.

Discussion: The assignment of the specimen to *Kummelia* is uncertain, and it based only on the similarity of its morphology with *Kummelia*. It is very close to *Kummelia kummeli* (Bando, 1981, p. 155), which is the type species of the genus, but differs by its wider

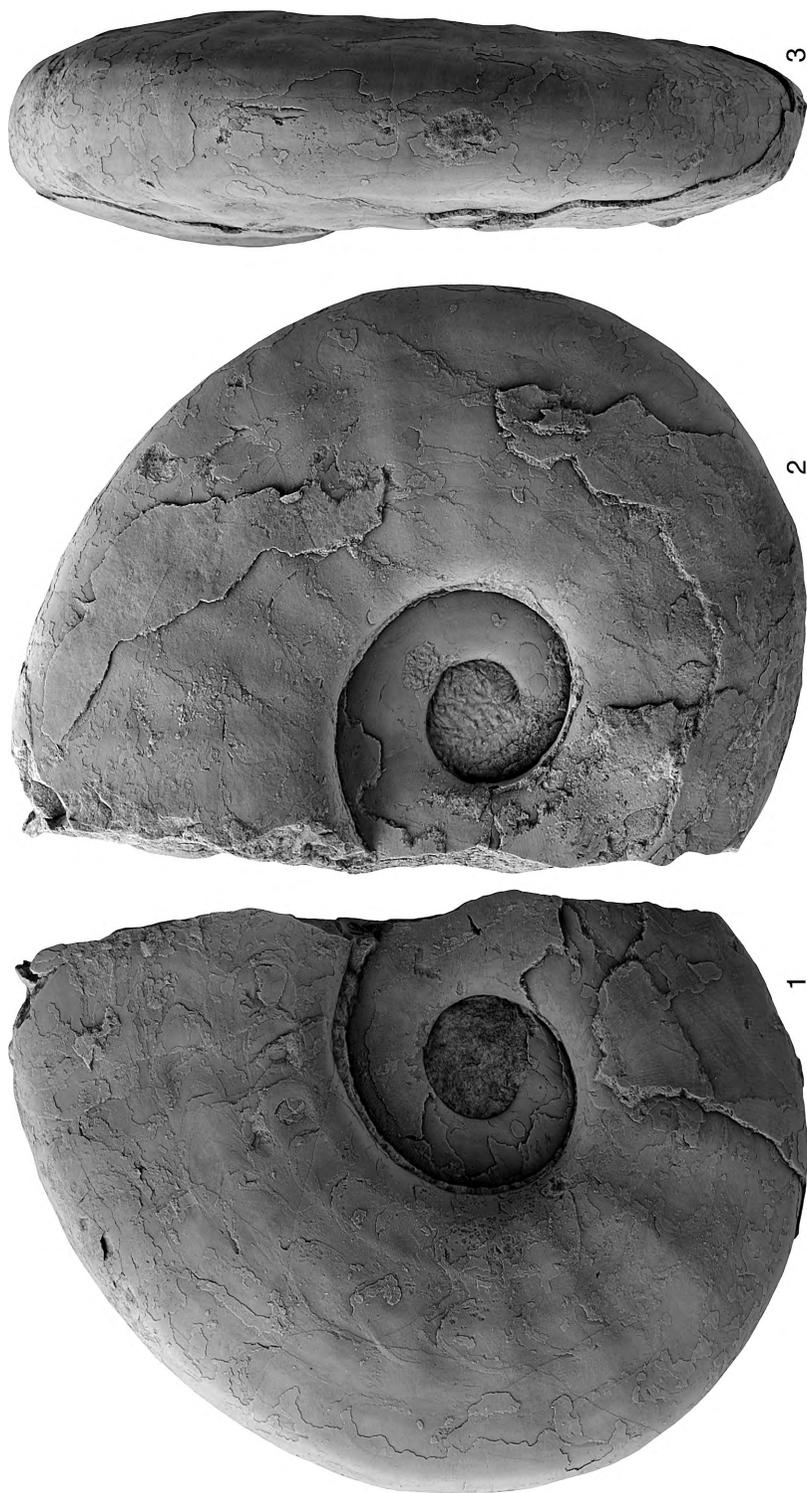


Fig. 104. *Kummelia?* sp. indet. from AB1019. 1–3, NSM PM23249, $\times 1.0$.



Fig. 105. *Kummelia?* sp. indet., NSM PM23249, from AB1019, $\times 1.0$.

venter and the presence of radial folds on the middle growth stage.

Family Arctoceratidae Arthaber, 1911

Genus *Arctoceras* Hyatt, 1900

Type species: Ceratites polaris Mojsisovics, 1886.

Arctoceras septentrionale (Diener, 1895)

Figs. 106, 107

Meekoceras (Koninckites) septentrionale Diener, 1895, p. 53, pl. 1, fig. 1.

Discoprotychites septentrionalis (Diener). Kiparisova, 1956, p. 77.

Protychites (Discoprotychites) septentrionale (Diener). Kiparisova, 1961, p. 103, pl. 23, figs. 1–4, text-figs. 63–65.

Submeekoceras ussuriense Kiparisova, 1961, p. 73, pl. 14, fig. 1, text-fig. 34.

Proptychites (Discoprotychites) prynadai Buriĭ, 1962, p. 87, pl. 3, figs. 1, 2, text-fig. 5.

Arctoceras septentrionale (Diener). Zakharov, 1968, p. 75, pl. 8, fig. 4, pl. 9, figs. 1, 2, pl. 10, figs. 1–4, text-fig. 14.

Arctoceras aff. septentrionale (Diener). Zakharov, 1968, p. 78, pl. 11, figs. 1, 2, pl. 12, fig. 1.

Holotype: CGM 71/596, figured by Diener (1895, p. 53, pl. 1, fig. 1), from the Lower Triassic of Ajax Bay on Russian Island, South Primorye, Russia.

Material examined: Two specimens, NSM PM23251, 23252, from AB1022, one specimen, NSM PM23253, from AB1024, two specimens, NSM PM23254, 23255, from AB1025.

Description: Fairly involute, fairly compressed shell with elliptical whorl section, arched venter, indistinct ventral shoulders, and slightly convex flanks with maximum whorl width at mid-flank. Narrow umbilicus with moderately high, vertical wall and abruptly rounded or subangular shoulders. Ornamentation consists of very weak spiral lirae on outer flanks as well as weak radial folds and fine, sinuous prorsiradiate growth lines. Suture ceratitic with wide ventral lobe divided by median saddle into two branches with denticulation at each base. First lateral saddle higher than second saddle, and third saddle lower. First lateral lobe deep, wide with many strong denticulations at base, and second lateral lobe shallower than first lobe with few denticulations. Suspensive lobe includes discrete auxiliary lobe.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23251	20.2	5.0	9.3	6.4	0.25	0.69
NSM PM23252	27.0	6.3	13.0	9.3	0.23	0.72
NSM PM23253	45.2	7.5	23.7	13.3	0.17	0.56
NSM PM23254	42.1	7.5	20.2	12.0	0.18	0.59
NSM PM23255	66.2	11.4	34.8	–	0.17	–

Occurrence: Described specimens from AB1022, AB1024 within the *Clypeoceras timorense* Zone and from AB1025 within the *Radioprionites abrekensis* “bed”, early Early Olenekian (early Smithian) in the main part of

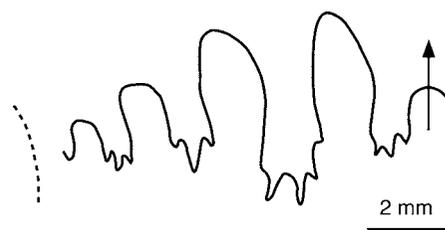


Fig. 106. Suture line of *Arctoceras septentrionale* (Diener, 1895), NSM PM23252, from AB1022, at H=10 mm.

the Zhitkov Formation, Abrek Bay area, South Primorye. This species also occurs frequently in the lower part of the *Owenites koeneni* Zone and the *Hedenstroemia bosphorensis* Zone of South Primorye (Zakharov, 1968; Markevich & Zakharov, 2004).

Discussion: *Arctoceras septentrionale* is the type species of *Discoprotychites* Kiparisova, 1956, but the genus was later synonymized with *Arctoceras* by Zakharov (1978), Tozer (1981) and Shevyrev (1986). Later, Waterhouse (1996a, p. 88) indicated that the sutures, as represented by Kiparisova (1956) and Diener (1895), exhibit a well-developed second lateral lobe with many strong denticulations, unlike the constricted paucidenticulate second lateral lobe of typical *Arctoceras*, and suggested that *Discoprotychites* is not the same as *Arctoceras*. However, Kummel (1961) illustrated the suture line of several specimens of *A. tuberculatum* (Smith, 1932), and each suture includes a well-developed second lateral lobe very much like the figures in Kiparisova (1956) and Diener (1895). Therefore, the suggestion of Waterhouse (1996a) must be rejected.

Submeekoceras ussuriense Kiparisova (1961, p. 73) and *Proptychites (Discoprotychites) prynadai* Buriĭ (1962, p. 87), which were both collected from Golyj Cape (=Kom-Pikho-Sakho Cape), South Primorye, are very close to adult specimens of *A. septentrionale* (Diener) and are probably conspecific.

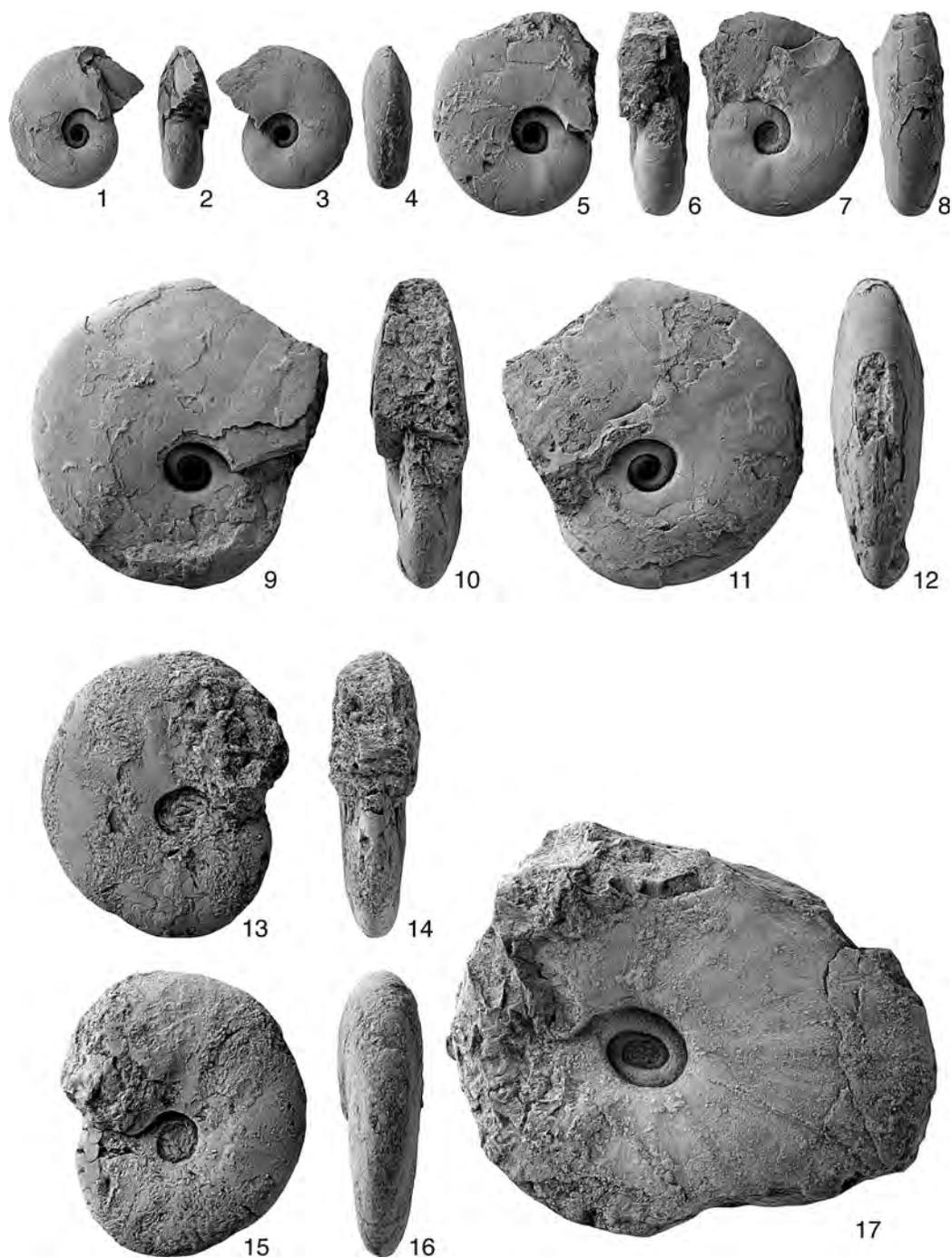


Fig. 107. *Arctoceras septentrionale* (Diener, 1895). 1–4, NSM PM23251, from AB1022, $\times 1.0$. 5–8, NSM PM23252, from AB1022, $\times 1.0$. 9–12, NSM PM23253, from AB1024, $\times 1.0$. 13–16, NSM PM23254, from AB1025, $\times 1.0$. 17, NSM PM23255, from AB1025, $\times 1.0$.

Arctoceras subhydaspis (Kiparisova, 1961)

Figs. 108–112

Paranorites subhydaspis Kiparisova, 1961, p. 89, pl. 18, fig. 1, text-fig. 48.

Paranorites labogense Zharnikova, 1962, p. 85, pl. 2, fig. 1, text-fig. 4.

Arctoceras labogense (Zharnikova). Zakharov, 1968, p. 78, pl. 12, figs. 2, 3, text-figs. 15a, 16a–d.

Holotype: CGM 84/5504, figured by Kiparisova (1961, p. 89, pl. 18, fig. 1), from the Lower Triassic of the Abrek Bay area in South Primorye.

Material examined: Three specimens, NSM PM23256–23258, from AB1027.

Description: Fairly large, moderately evolute shell with ovoid whorl section, rounded venter, rounded ventral shoulders and convex flanks with maximum whorl width at mid-flank. Umbilicus moderately wide with moderately high, vertical wall and abruptly rounded shoulders with prominent tubercles. Ornamentation consists of weak radial folds on juvenile whorls and distant, radial, sinuous, fold-like ribs on adult whorls as well as clearly visible very fine, sinuous, prorsiradiate growth lines and very weak spiral lirae on outer flanks. Suture ceratitic with wide ventral lobe divided by median saddle into two branches with many denticulations at each base. First lateral saddle higher than second saddle, and third saddle even lower. First lateral lobe deep, wide with many strong denticulations at base, and second lateral lobe shallower than first lobe. Suspensive lobe includes discrete auxiliary lobe.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23256	–	–	40.6	25.0	–	0.62
NSM PM23257	–	–	60.7	40.0	–	0.66
NSM PM23258	175.0	63.5	67.0	43.4	0.36	0.65

Occurrence: Described specimens from *Arctoceras subhydaspis* “bed” (AB 1027, middle Early Olenekian = middle Smithian) in the main part of the Zhitkov Formation, Abrek Bay area, South Primorye. *A. subhydaspis* frequently occurs above the *Arctoceras septentrionale* Zone in South Primorye (Zakharov,

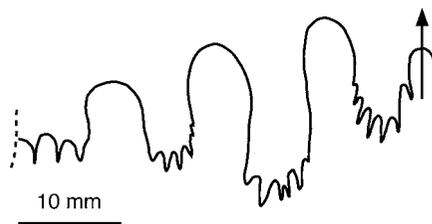


Fig. 108. Suture line of *Arctoceras subhydaspis* (Kiparisova, 1961), NSM PM23256, from AB1027, at H=35 mm.

1968; Markevich & Zakharov, 2004).

Discussion: *Arctoceras subhydaspis* was originally described as *Paranorites* Waagen, 1895 by Kiparisova (1961), but its umbilical tuberculation justifies its assignment to the genus *Arctoceras*. It is very similar to *A. labogense* (Zharnikova, 1962, p. 85) from the Lower Olenekian of South Primorye, but Zharnikova (1962) maintained that the rib strength is different on the adult shell of each species. However, this difference is barely perceptible and is probably due to intraspecific variation. Therefore, *A. labogense* is synonymized with *A. subhydaspis* on the basis of their similar shell morphology.

This species is very close to *A. tuberculatum* (Smith, 1932, p. 62), but differs by its wider umbilicus. *A. gigas* Tozer (1994, p. 75) is also close, but is more evolute.

The juvenile shell of *A. subhydaspis* is very similar to *A. septentrionale* (Diener, 1895, p. 53), which is always found stratigraphically below it (Markевич & Zakharov, 2004), and thus, both species probably belong to the same evolutionary lineage.

Family Clypeoceratidae Waterhouse, 1996a

Genus ***Clypeoceras*** Smith, 1913

Type species: *Aspidites superbus* Waagen, 1895.



Fig. 109. *Arctoceras subhydaspis* (Kiparisova, 1961) from AB1027. 1–3, NSM PM23256, $\times 1.0$. 4–5, NSM PM23257, $\times 1.0$.



Fig. 110. *Arctoceras subhydaspis* (Kiparisova, 1961), NSM PM23258, from AB1027, $\times 0.9$.



Fig. 111. *Arctoceras subhydaspis* (Kiparisova, 1961). 1–2, NSM PM23258, from AB1027, $\times 0.9$.



Fig. 112. *Arctoceras subhydaspis* (Kiparisova, 1961), NSM PM23258, from AB1027, $\times 0.9$.

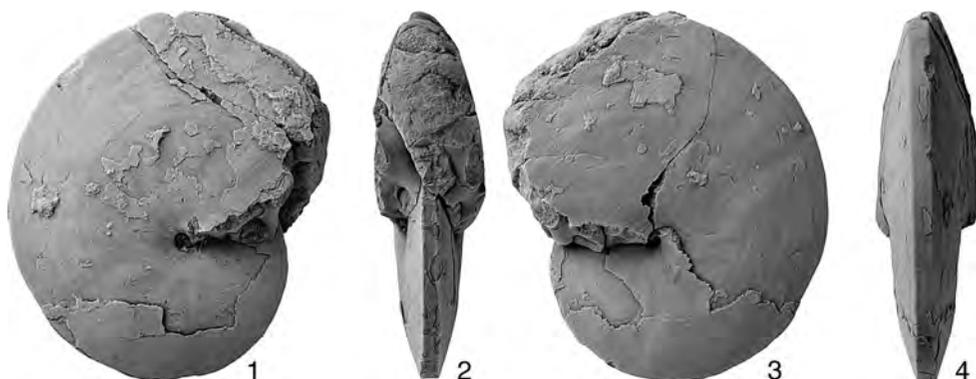


Fig. 113. *Clypeoceras spitiense* (Krafft, 1909). 1–4, NSM PM23259, from AB1014, $\times 1.0$.

Clypeoceras spitiense (Krafft, 1909)

Figs. 113, 114

Aspidites spitiensis Krafft, 1909, p. 54, pl. 4, figs. 4, 5, pl. 16, figs. 3–8.

Clypeoceras spitiense (Krafft). Waterhouse, 1996a, p. 50, pl. 2, figs. 21, 22, text-fig. 4j.

Lectotype: Designated by Waterhouse (1996a, p. 50), GSI 9391, original of Krafft (1909, p. 54, pl. 4, fig. 4) from the “*Meekoceras*” beds, five miles south of Ensa, Spiti area, northwest Himalayan region.

Material examined: NSM PM23259, from AB1014.

Description: Very involute, very compressed shell, with narrow tabulate venter, angular ventral shoulders and gently convex flanks with maximum whorl width at mid-flank. Very narrow, nearly occluded umbilicus with low, oblique wall and rounded shoulders. Ornamentation consists of weak radial folds on inner flank and fine, sinuous prorsiradiate growth lines. Suture ceratitic with wide ventral lobe divided by median saddle into two branches with many denticulations at each base. Lateral saddles elongated, and second saddle slanted slightly toward umbilicus. First lateral lobe deep, wide with many denticulations at base, and second lateral lobe about two thirds depth of first lobe. Suspensive lobe includes numerous, poorly differentiated auxiliaries.



Fig. 114. Suture line of *Clypeoceras spitiense* (Krafft, 1909), NSM PM23259, from AB1014, at $H=21$ mm.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23259	47.1	0.6	29.7	12.0	0.01	0.40

Occurrence: Described specimen from *Clypeoceras spitiense* “bed” (AB1014, early Late Induan=early Dienerian) in the lower part of the Zhitkov Formation, Abrek Bay area, South Primorye. This species also occurs in the “*Meekoceras*” beds of the northwest Himalayan region (Krafft, 1909), which is correlatable with the Upper Induan (Dienerian) (Waterhouse, 2002).

Discussion: Although the described specimen shares a similar shell morphology with the lectotype of *Clypeoceras spitiense* (Krafft, 1909), there are a few differences in their suture lines. The first lateral saddle of our specimen is more slender than that of the lectotype (Krafft, 1909, pl. 4, fig. 4c), and the second lateral saddle is slanted slightly toward

the umbilicus. However, Krafft (1909) illustrated very similar saddles for other specimens of *C. spitiense* (e.g., GSI 9457, pl. 16, fig. 7). Therefore, it seems reasonable that we identify our specimen as *C. spitiense*.

Clypeoceras timorensis (Wanner, 1911)

Figs. 115–124

Meekoceras timorensis Wanner, 1911, p. 185, pl. 6, figs. 2, 3, pl. 7, figs. 5, 6, text-fig. 2; Welter, 1922, p. 129.
Koninckites timorensis (Wanner). Spath, 1934, p. 156; Kiparisova, 1947b, p. 136, pl. 29, fig. 4, pl. 30, fig. 2, text-fig. 20; Kiparisova, 1961, p. 82, pl. 16, figs. 2–4, 6, text-figs. 39–42; Zakharov, 1968, p. 89, pl. 17, figs. 1–3, text-fig. 20a.

Lectotype: Designated by Spath (1934, p. 156), is original of Wanner (1911, p. 185, pl. 6, fig. 2) from the “*Meekoceras*” beds of Nifoekoko, Timor.

Material examined: Eighteen specimens, NSM PM23260–22277, from AB1021, one specimen, NSM PM23278, from AB1022, three specimens, NSM PM23279–23281, from AB1024.

Description: Fairly large, very involute, very compressed shell with narrow, highly variable (concave, bicarinate or tabulate) venter with angular shoulders on juvenile whorls, becoming subtabulate with abruptly rounded shoulders on mature whorls. Flanks gently convex with maximum width at mid-flank. Narrow umbilicus with moderately high, vertical or overhanging wall and abruptly rounded shoulders. Ornamentation consists of weak radial folds as well as fine, sinuous prorsiradiate growth lines. Suture ceratitic with wide ventral lobe divided by median saddle into two branches with many denticulations at base. First lateral saddle subphylloid and smaller than second saddle. First lateral lobe narrow, deep with many denticulations at base, and second lateral lobe about two thirds depth of first lobe. Suspensive lobe includes numerous, well differentiated auxiliaries.

Measurements (mm):

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

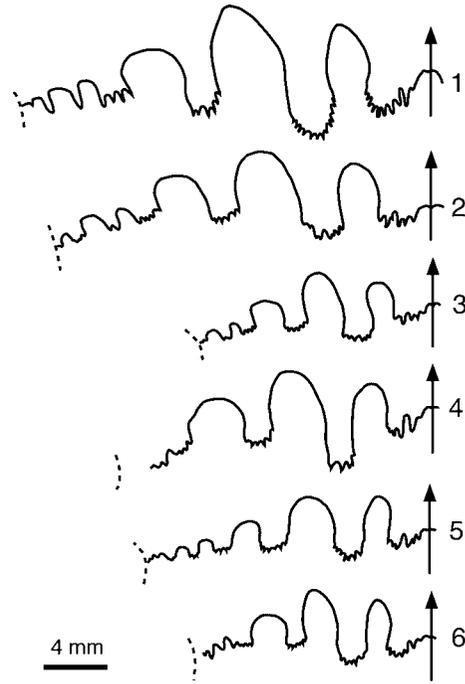


Fig. 115. Suture lines of *Clypeoceras timorensis* (Wanner, 1911) from AB1021. 1, NSM PM23270, at H=26 mm. 2, NSM PM23269, at H=24 mm. 3, NSM PM23269, at H=16 mm. 4, NSM PM23271, at H=20 mm. 5, NSM PM23265, at H=18 mm. 6, NSM PM23274, at H=15 mm.

NSM PM23260	14.2	1.9	7.9	3.9	0.13	0.49
NSM PM23261	21.2	2.4	11.4	4.3	0.11	0.38
NSM PM23262	20.1	2.4	11.5	4.9	0.12	0.42
NSM PM23263	18.6	2.2	10.4	4.9	0.12	0.47
NSM PM23264	24.0	2.2	13.4	6.1	0.09	0.46
NSM PM23265	30.3	3.4	16.7	7.7	0.11	0.46
NSM PM23266	31.5	2.6	17.2	7.9	0.08	0.46
NSM PM23267	26.0	2.0	14.5	6.4	0.08	0.44
NSM PM23268	45.0	5.5	23.0	10.0	0.12	0.43
NSM PM23269	44.1	4.6	23.7	11.7	0.10	0.49
NSM PM23270	47.8	4.9	25.6	12.4	0.10	0.48
NSM PM23271	51.2	5.6	27.0	11.5	0.11	0.43
NSM PM23272	50.0	5.5	25.4	14.0	0.11	0.55
NSM PM23273	91.2	13.8	43.8	22.3	0.15	0.51
NSM PM23274	29.8	2.9	16.5	6.5	0.10	0.39
NSM PM23275	63.9	7.0	34.4	17.0	0.11	0.49
NSM PM23276	112.0	17.2	52.3	27.5	0.15	0.53
NSM PM23277	28.3	2.6	15.2	6.2	0.09	0.41
NSM PM23278	56.5	4.9	30.0	11.2	0.09	0.37
NSM PM23279	54.1	5.2	29.2	12.0	0.10	0.41
NSM PM23280	66.5	5.7	35.8	13.5	0.09	0.41

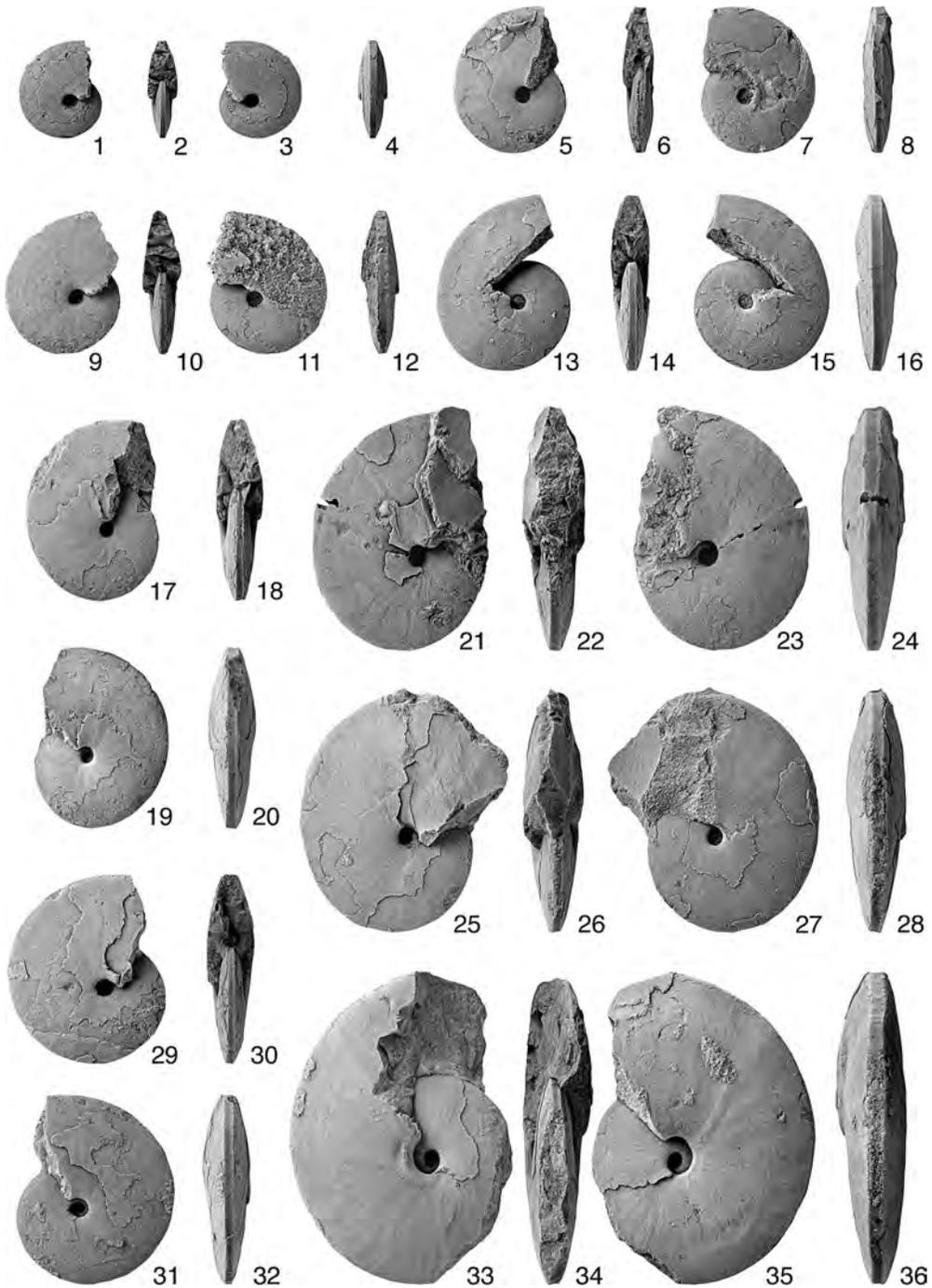


Fig. 116. *Clypeoceras timorensis* (Wanner, 1911) from AB1021. 1–4, NSM PM23260, $\times 1.0$. 5–8, NSM PM23261, $\times 1.0$. 9–12, NSM PM23262, $\times 1.0$. 13–16, NSM PM23263, $\times 1.0$. 17–20, NSM PM23264, $\times 1.0$. 21–24, NSM PM23265, $\times 1.0$. 25–28, NSM PM23266, $\times 1.0$. 29–32, NSM PM23267, $\times 1.0$. 33–36, NSM PM23268, $\times 1.0$.

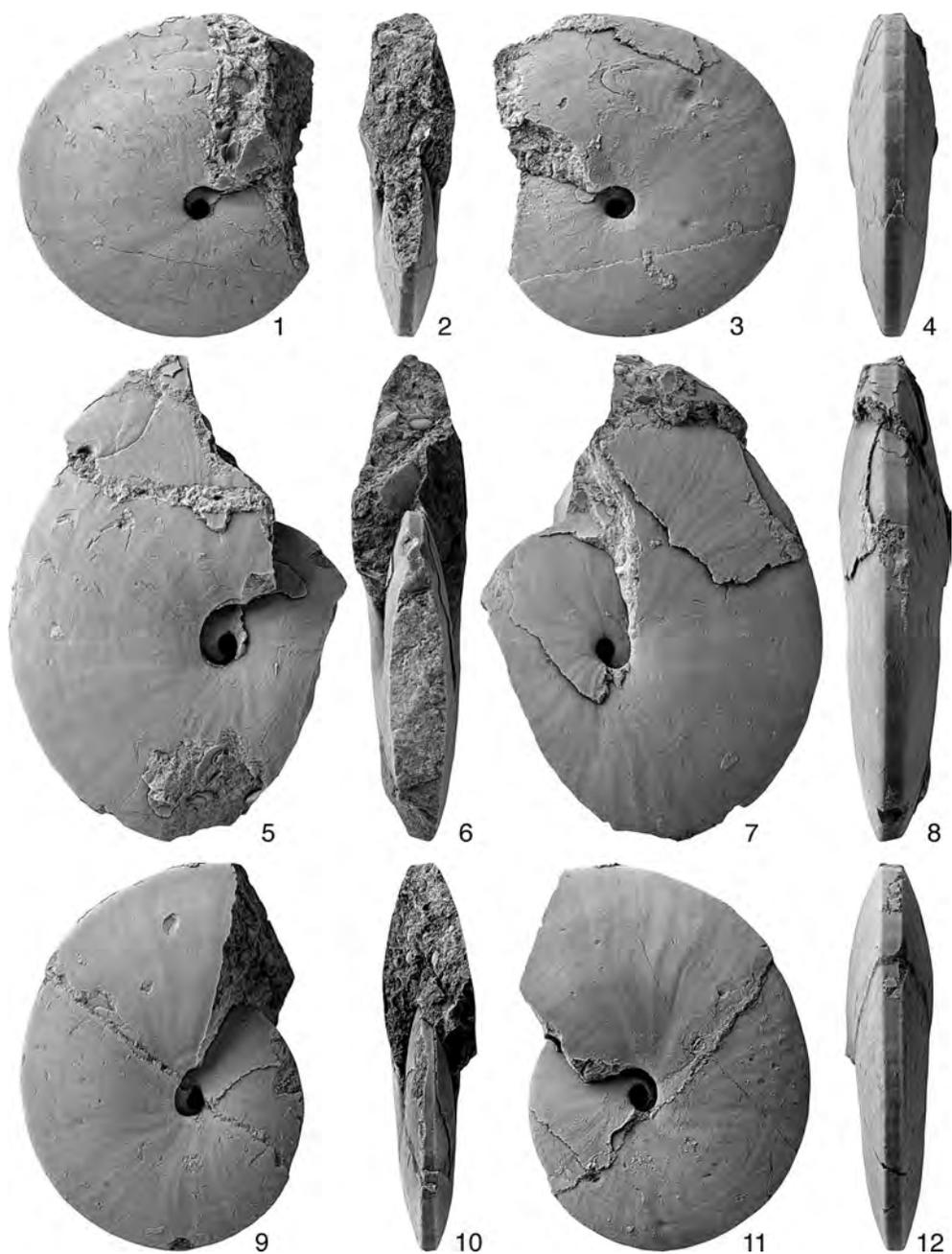
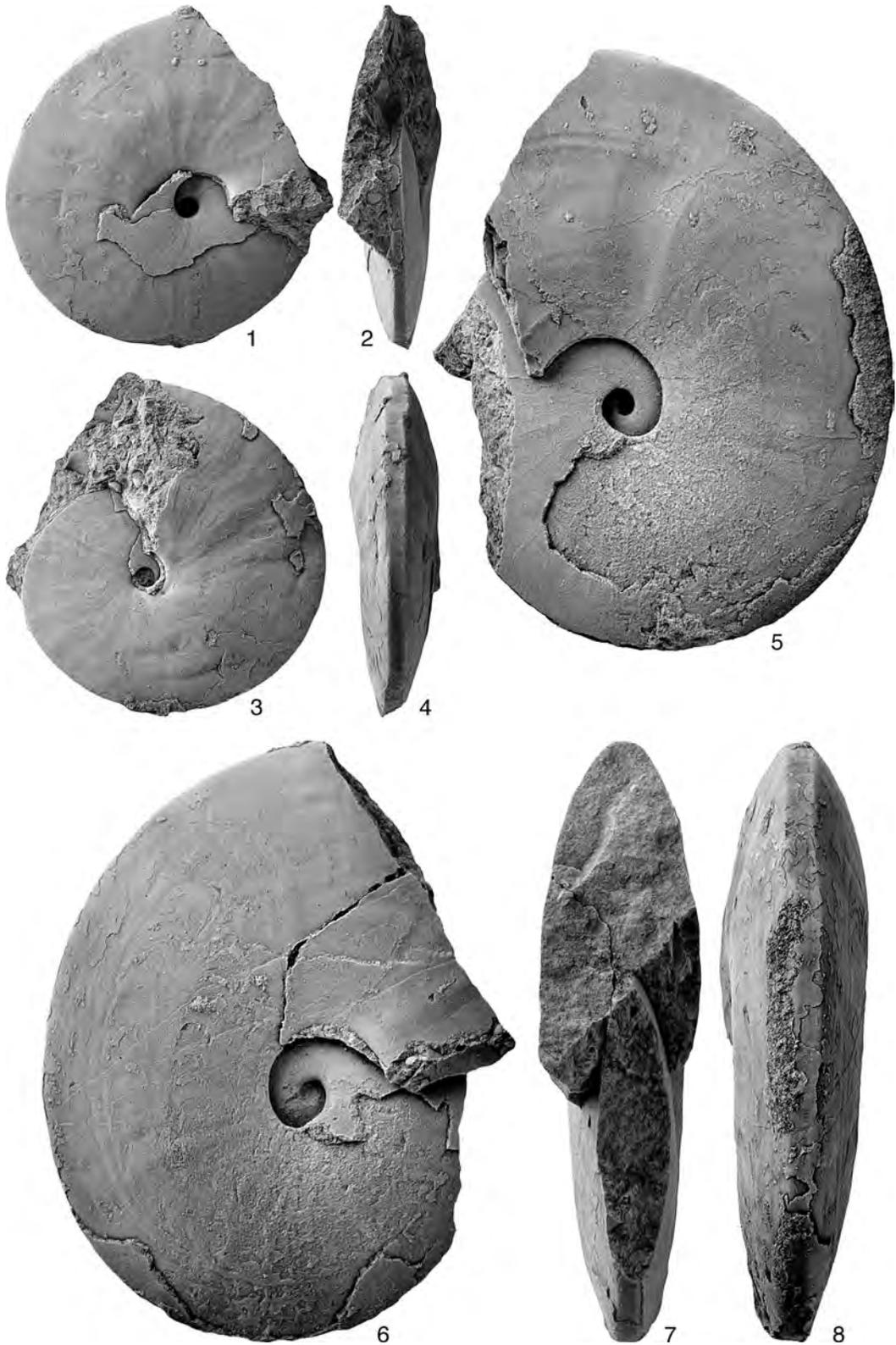


Fig. 117. *Clypeoceras timorense* (Wanner, 1911) from AB1021. 1–4, NSM PM23269, $\times 1.0$. 5–8, NSM PM23270, $\times 1.0$. 9–12, NSM PM23271, $\times 1.0$.

Fig. 118. *Clypeoceras timorense* (Wanner, 1911) from AB1021. 1–4, NSM PM23272, $\times 1.0$. 5–8, NSM PM23273, $\times 1.0$.



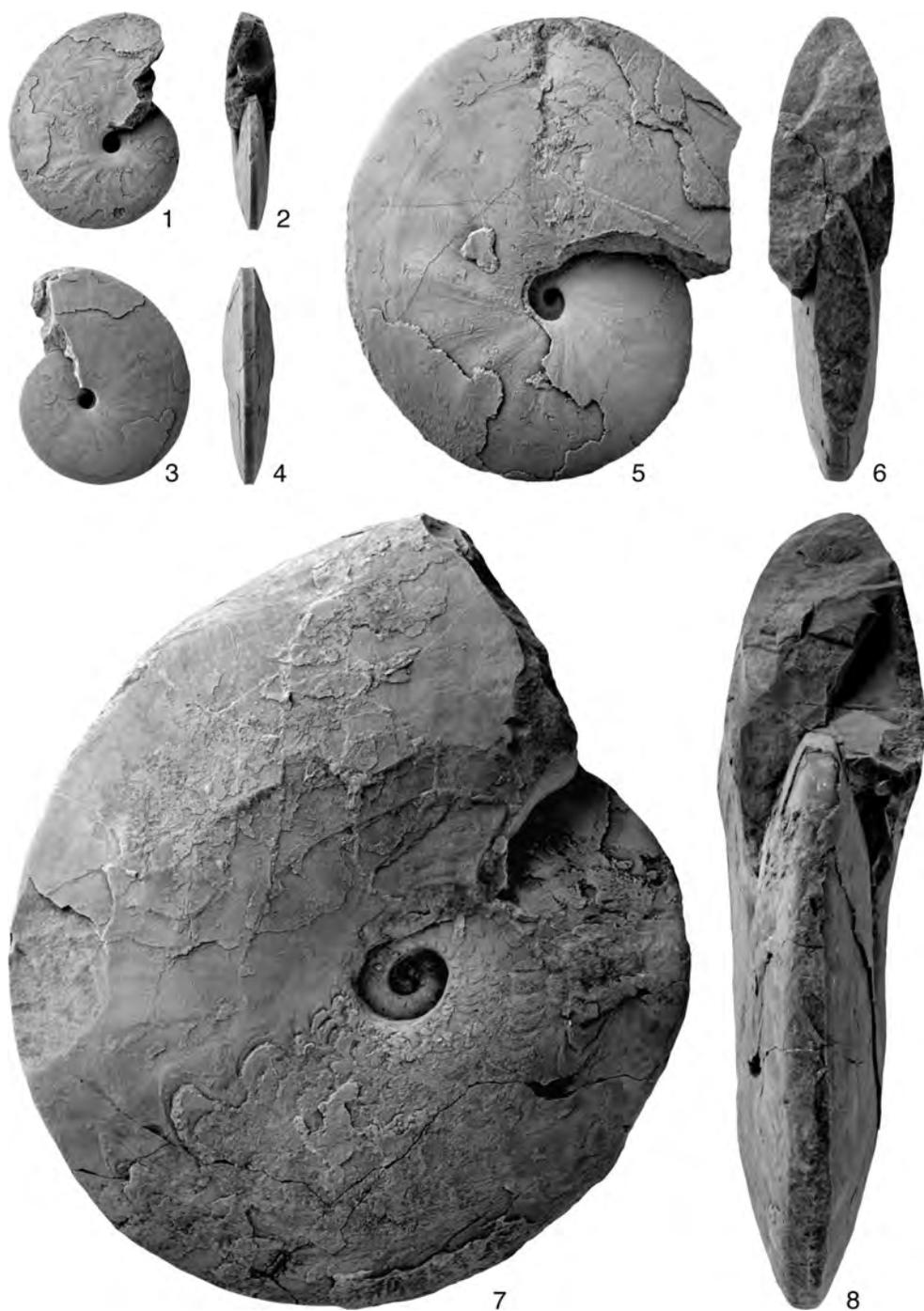


Fig. 119. *Clypeoceras timorense* (Wanner, 1911) from AB1021. 1–4, NSM PM23274, $\times 1.0$. 5–6, NSM PM23275, $\times 1.0$. 7–8, NSM PM23276, $\times 1.0$.

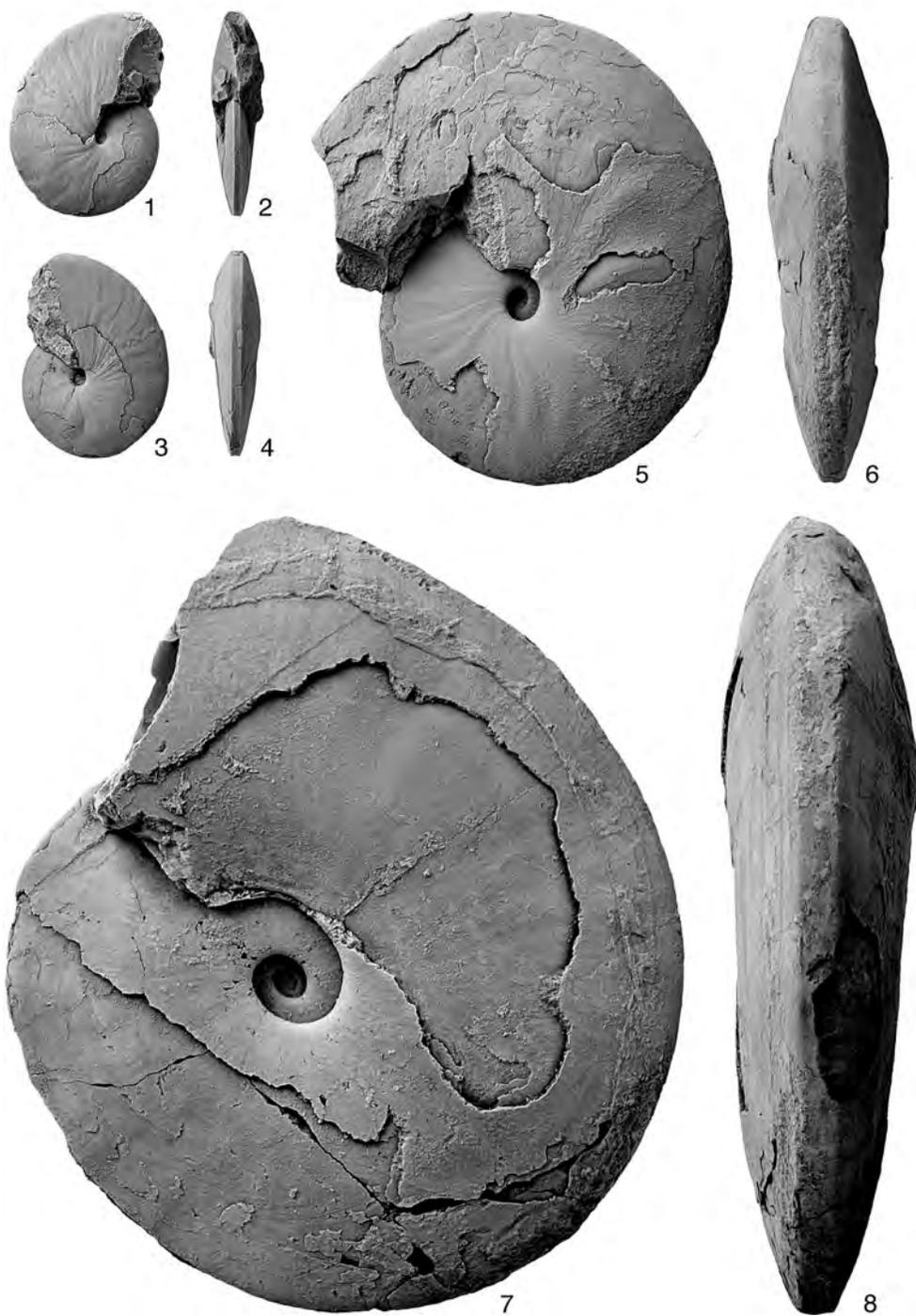


Fig. 120. *Clypeoceras timorense* (Wanner, 1911) from AB1021. 1-4, NSM PM23277, $\times 1.0$. 5-6, NSM PM23275, $\times 1.0$. 7-8, NSM PM23276, $\times 1.0$.

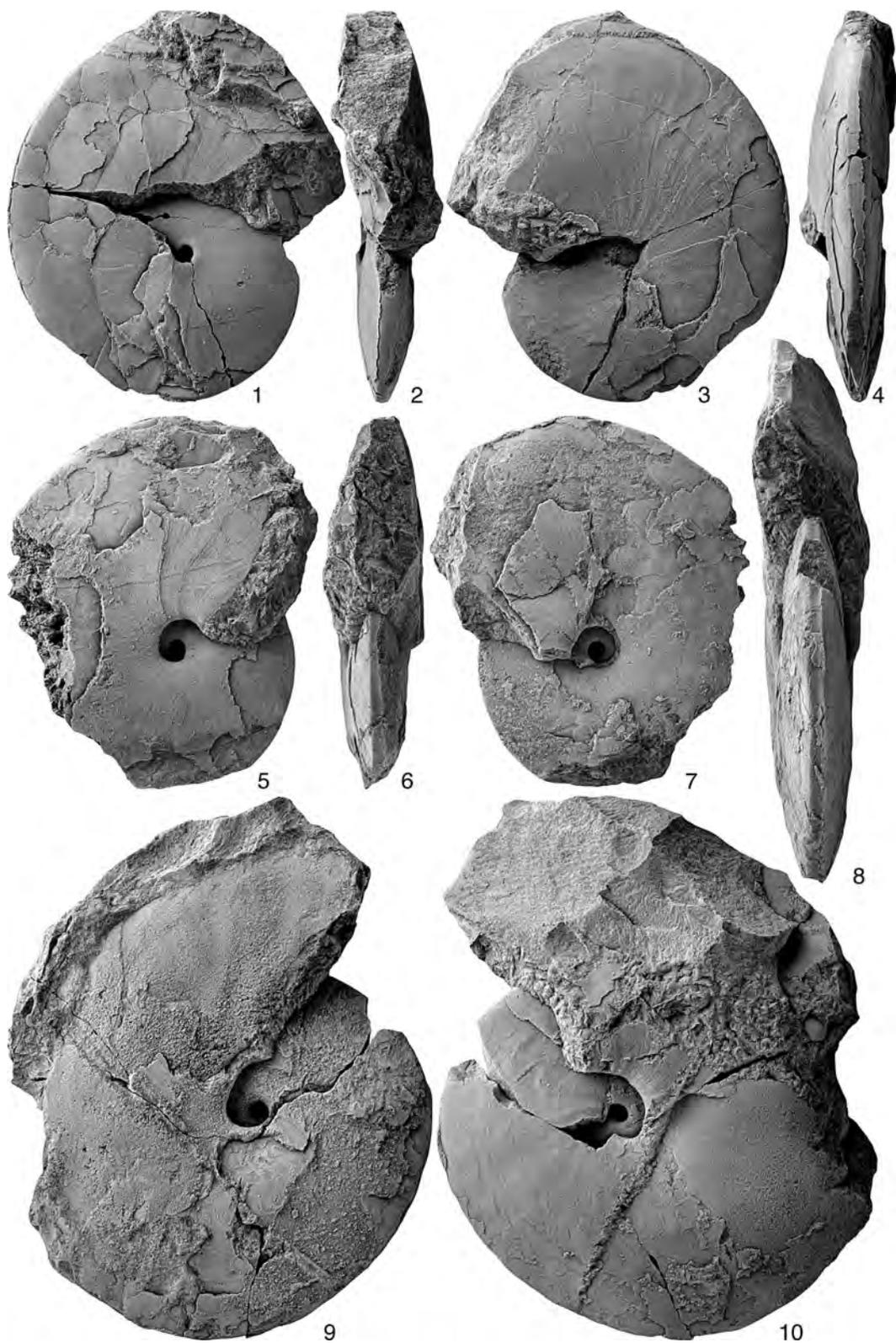




Fig. 122. *Clypeoceras timorense* (Wanner, 1911), NSM PM23281, from AB1024, $\times 0.9$.

←

Fig. 121. *Clypeoceras timorense* (Wanner, 1911). 1–4, NSM PM23278, from AB1022, $\times 1.0$. 5–7, NSM PM23279, from AB1024, $\times 1.0$. 8–10, NSM PM23280, from AB1024, $\times 1.0$.



Fig. 123. *Clypeoceras timorense* (Wanner, 1911). 1–2, NSM PM23281, from AB1024, $\times 0.9$.



Fig. 124. *Clypeoceras timorense* (Wanner, 1911), NSM PM23281, from AB1024, $\times 0.9$.

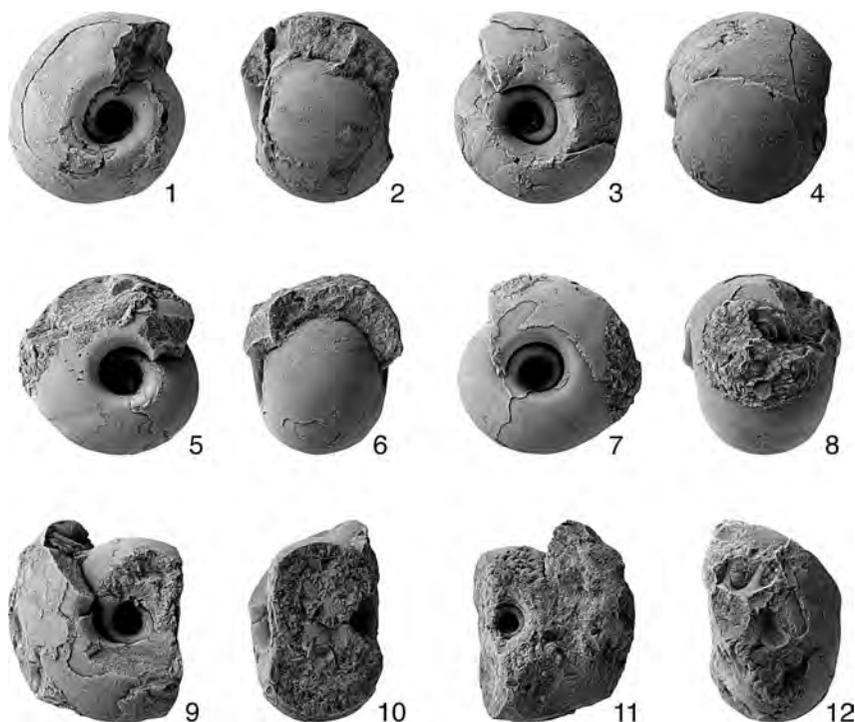


Fig. 125. *Prospingitoides* sp. indet. 1–4, NSM PM23282, from AB1027, $\times 1.5$. 5–8, NSM PM23283, from AB1022, $\times 1.5$. 9–12, NSM PM23284, from AB1022, $\times 1.5$.

NSM PM23281 142.0 19.0 77.3 35.0 0.13 0.45

Occurrence: Described specimens from AB1021, AB1022 and AB1024 within the *Clypeoceras timorense* Zone (early Early Olenekian=early Smithian) of the main part of the Zhitkov Formation, Abrek Bay area, South Primorye. This species is abundant in the *Hedenstroemia bosphorensis* Zone on the western coast of Ussuri Gulf, near Tri Kamnya Cape, South Primorye (Zakharov, 1968; Markevich & Zakharov, 2004), and in the “*Meekoceras*” beds of Timor (Wanner, 1911; Spath, 1934), which are correlatable with the early Early Olenekian (early Smithian).

Discussion: Spath (1934, p. 156) changed the generic assignment of this species from *Meekoceras* Hyatt, 1879 to *Koninckites* Waagen, 1895, but its tabulate venter, very steep umbilical wall, and the well-differentiated auxiliaries within its suspensive lobe enable us to assign it to the genus *Clypeoceras*.

Clypeoceras timorense is very close to *C. ensanum* (Krafft, 1909, p. 56), but differs by its high, vertical or overhanging umbilical wall. *C. spitiense* (Krafft, 1909, p. 54) is also very close, but its umbilicus is very narrow or nearly occluded. This species exhibits some similarities to *Wailiceras aemulus* Brayard and Bucher (2008, p. 38) and *Koninckites lingyuenensis* Chao (1959, p. 220) from South China, both of which are probably conspecific, but differs by its narrow venter.

Family Paranannitidae Spath, 1930
Genus *Prospingitoides* Shevyrev, 1995

Type species: *Prospingites austini* Hyatt and Smith, 1905.

Prospingitoides sp. indet

Figs. 125, 126

Material examined: Two specimens, NSM



Fig. 126. Suture line of *Prospingitoides* sp. indet., NSM PM23283, from AB1022, at H=5 mm.

PM23283, 23284, from AB1022, one specimen, NSM PM23282, from AB1027.

Description: Very involute, very depressed shell with semicircular whorl section and convex flanks gradually converging to an arched venter from abruptly rounded umbilical shoulders. Fairly narrow, deep umbilicus with high, vertical wall. Ornamentation consists only of very weak, prorsiradiate constrictions and fine growth lines. Suture ceratitic with ventral lobe divided by median saddle into two branches with denticulations at each base. First lateral saddle higher than second saddle, and third saddle lower than second saddle. 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
NSM PM23282	15.4	4.6	6.9	13.3	0.30	1.93
NSM PM23283	14.1	3.6	5.3	11.5	0.25	2.17
NSM PM23284	15.4	3.9	6.5	–	0.25	–

Occurrence: Described specimens from AB1022 within the *Clypeoceras timorense* Zone and from the *Arctoceras subhydaspis* “bed” (AB1027), early to middle Early Olenekian (early to middle Smithian) in the main part of the Zhitkov Formation, Abrek Bay area, South Primorye.

Discussion: It is entirely possible that our specimens represent the juvenile whorls of *Prospingites ovalis* Kiparisova (1960, p. 137), which was synonymized with *Prospingitoides austini* (Hyatt and Smith, 1905, p. 72) by Shevyrev (1995). However, no definitive assignment can be made.

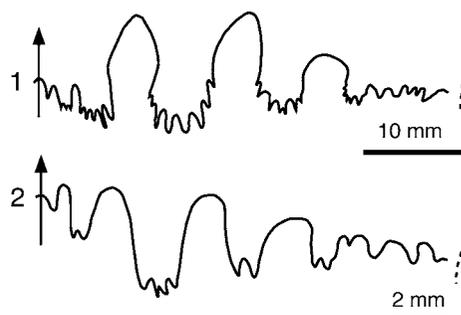


Fig. 127. Suture lines of *Parahedenstroemia kiparisovae* Shigeta and Zakharov sp. nov. from AB1014. 1, NSM PM23285, holotype, at H=41 mm. 2, NSM PM23286, paratype, at H=15 mm.

Superfamily Sageceratoidea Hyatt, 1884

Family Hedenstroemiidae

Genus *Parahedenstroemia* Spath, 1934

Type species: *Hedenstroemia acuta* Krafft, 1909.

Parahedenstroemia kiparisovae Shigeta and Zakharov sp. nov.

Figs. 127, 128

Type specimens: Holotype, NSM PM23285, from AB1014; paratypes, three specimens, NSM PM23286–23288, from AB1014.

Diagnosis: *Parahedenstroemia* with acute venter at juvenile stage, becoming narrowly rounded at mature stage, narrow umbilicus and ceratitic suture with adventitious and numerous well-individualized auxiliary elements.

Etymology: Named for L. D. Kiparisova, who energetically studied the Triassic fauna of South Primorye.

Description: Very involute, very compressed shell with somewhat oxyconic whorl section, acute venter at juvenile stage, becoming narrowly rounded at mature stage, and gently convex flanks with maximum width at mid-flank. Umbilicus narrow with moderately high, oblique wall and rounded shoulders. Shell surface smooth with fine, sinuous prorsiradiate growth lines. Suture ceratitic with

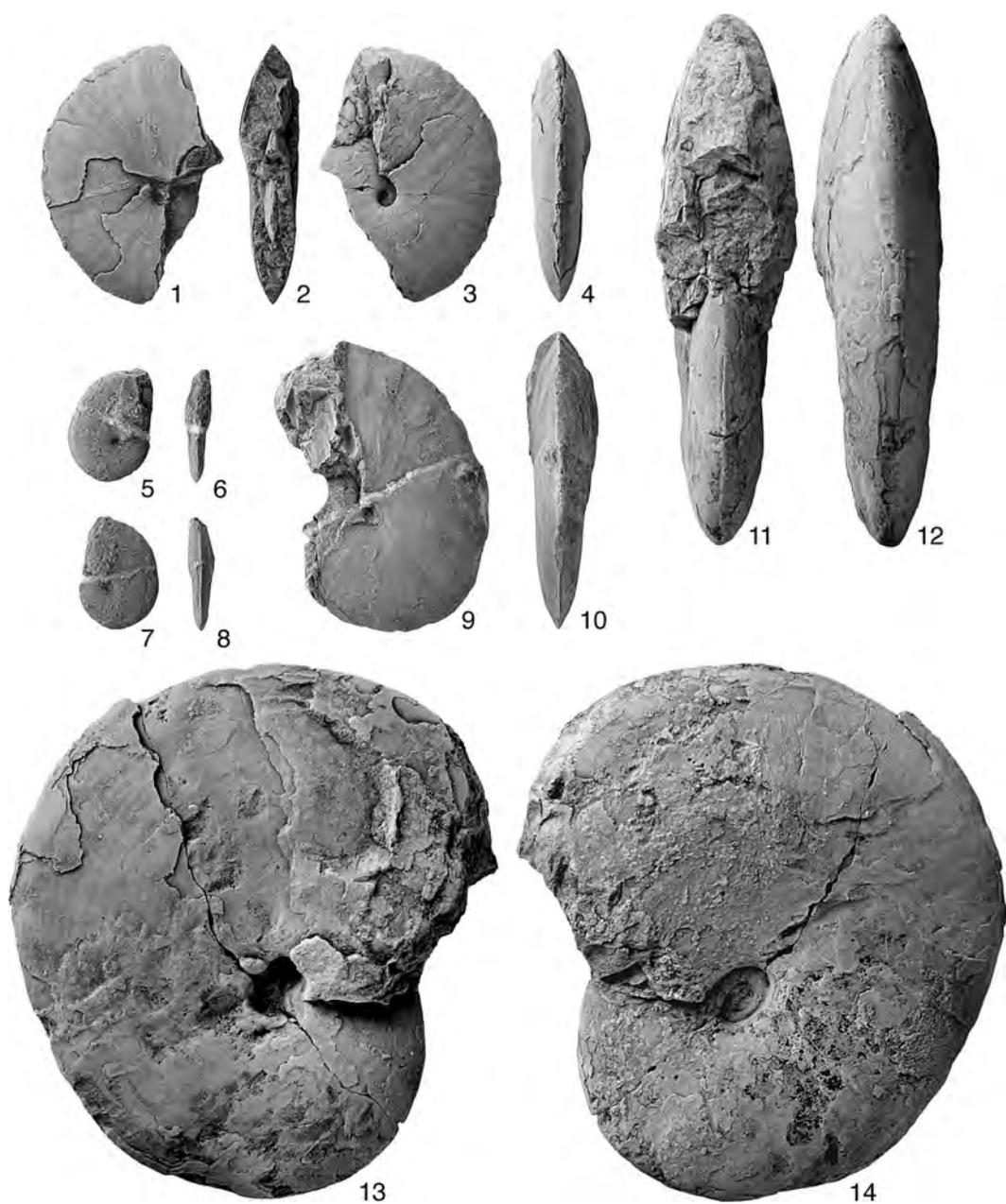


Fig. 128. *Parahedenstroemia kiparisovae* Shigeta and Zakharov sp. nov. from AB1014. 1–4, NSM PM23286, paratype, $\times 1.0$. 5–8, NSM PM23287, paratype, $\times 1.0$. 9–10, NSM PM23288, paratype, $\times 1.0$. 11–14, NSM PM23285, holotype, $\times 1.0$.

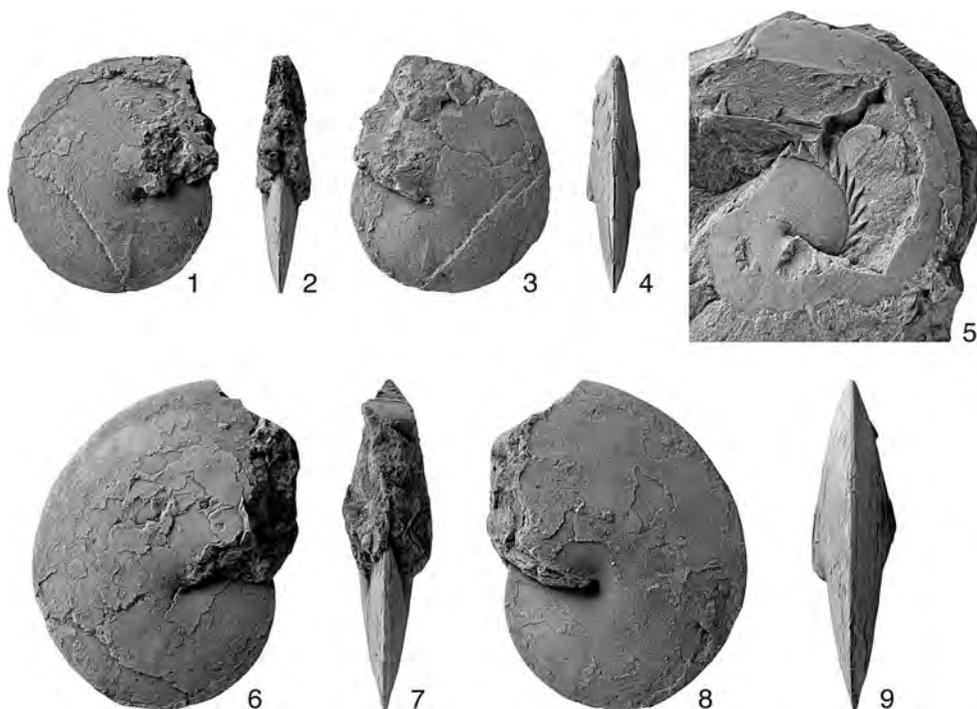


Fig. 129. *Pseudosageceras multilobatum* Noetling, 1905. 1–4, NSM PM23289, from AB1024, $\times 1.0$. 5, NSM PM23290, from AB1022, $\times 1.0$. 6–9, NSM PM23291, from AB1022, $\times 1.0$.

wide ventral lobe with low median and adventitious saddles. First lateral lobe nearly equal to second saddle, becoming subphylloid at mature stage. First lateral lobe wide, deep with many denticulations at base, and second lateral lobe about two thirds depth of first lobe. Suspensive lobe wide with numerous well-individualized auxiliary elements.

Measurements (mm):

Specimen no.	D	U	H	W	U/D	W/H
NSM PM23285	74.5	8.7	40.6	16.2	0.12	0.40
NSM PM23286	25.6	2.5	13.8	6.6	0.10	0.48
NSM PM23287	16.4	1.2	9.0	3.5	0.07	0.39
NSM PM23288	40.7	2.6	21.3	7.9	0.06	0.37

Occurrence: Described specimens from *Clypeoceras spitiense* “bed” (AB1014, early Late Induan=early Dienerian) in the lower part of the Zhitkov Formation, Abrek Bay area, South Primorye.

Discussion: The acute venter and hedenstroemid suture line of this species enable us to

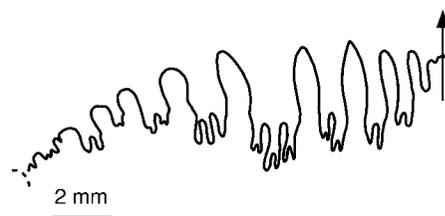


Fig. 130. Suture line of *Pseudosageceras multilobatum* Noetling, 1905, NSM PM23291, from AB1022, at H=14 mm.

assign it to the genus *Parahedenstroemia*. It differs from other representatives of *Parahedenstroemia* such as *P. acuta* (Krafft, 1909, p. 157) and *P. conspicienda* Zakharov (1968, p. 57), by its umbilicus, which is neither occluded nor extremely narrow. Since both species are of early Early Olenekian (early Smitian) age, our new species is the oldest representative of *Parahedenstroemia*.

Genus *Pseudosageceras* Diener, 1895

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

Pseudosageceras multilobatum

Noetling, 1905

Figs. 129, 130

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; 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; Kiparosova, 1947, p. 127, pl. 25, figs. 3, 4; Chao, 1959, p. 183, pl. 1, figs. 9, 12; Kummel and Steele, 1962, p. 701, pl. 102, figs. 1, 2; 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; Weitschat and Lehmann, 1978, p. 95, pl. 10, fig. 2; Tozer, 1994, p. 83, pl. 18, fig. 1, text-fig. 17; Bra-yard and Bucher, 2008, p. 70, pl. 37, figs. 1–5.

Lectotype: Designated by Spath (1934, p. 54), is original of Noetling (1905a, p. 181, pl. 19, fig. 1, pl. 24, fig. 12) from the Ceratite Marls of Salt Range, Pakistan.

Material examined: One specimen, NSM PM23289, from AB1024, two specimens, NSM PM23290, 23291, from AB1022.

Description: Very involute, very compressed oxycone with very narrow, bicarinate venter and weakly convex flanks, convergent from occluded umbilicus to venter. Surface smooth without ornamentation. Suture line ceratitic with many adventitious elements. Lateral lobes trifid, other lobes bifid.

Measurements (mm):

Specimen no.	D	U	H	W	W/H
NSM PM23289	30.2	0.0	18.7	6.2	0.33
NSM PM23291	43.8	0.0	28.0	10.0	0.36

Occurrence: Described specimens from AB1022, AB1024 within the *Clypeoceras timorense* Zone (early Early Olenekian=early Smithian) in the main part of the Zhitkov Formation, Abrek Bay area, South Primorye.

Discussion: The specimen Diener (1895, p.

28) described as *Pseudosageceras* sp. indet from the Early Triassic of the Shamara Bay area, South Primorye is only a partial phargmocone, but it displays the same shell shape and suture as *Pseudosageceras multilobatum* Noetling, and it is probably conspecific. *P. multilobatum* is one of the most cosmopolitan species of the Early Triassic.

Scaphopods (by Y. Shigeta)

Systematic descriptions basically follow the classification by Palmer (1974), Skelton and Benton (1993), and Steiner and Kabat (2001).

Abbreviations for shell dimensions: L=shell length; D=diameter of anterior aperture.

Institution abbreviations: NSM=National Museum of Nature and Science, Tokyo.

Class Scaphopoda Bronn, 1862

Order Dentalioida Palmer, 1974

Family Laevidentaliidae Palmer, 1974

Genus *Laevidentalium* Cossmann, 1888

Type species: Dentalium incertum Deshayes, 1825.

Laevidentalium? sp. indet.

Fig. 131

Material examined: NSM PM23344 from AB1014, and NSM PM23345 from AB1016.

Description: Shell slender, tapering, moderately curved, with circular cross section. Shell wall thin to moderately thick. Ornamentation consists of oblique, circular annulations of various strength as well as fine growth lines. Internal mould smooth.

Measurements (mm):

Specimen no.	L	D
NSM PM23344	12.4	2.1
NSM PM23345	9.6	1.4

Occurrence: Described specimens from AB1014 within the *Clypeoceras spitiense* “bed” (early Late Induan=early Dienerian) and from AB1016 within the *Paranorites vari-*