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Maastrichtian ammonites and biostratigraphy of the Sakhalin and the Shikotan Islands, Far Eastern Russia

ABSTRACT: Stratigraphy, ammonite paleontology, and regional characteristics are presented from the Maastrichtian deposits of the Sakhalin and the Shikotan Islands, Far Eastern Russia. Two different ammonite biostratigraphic zonal schemes based on the representatives of the family Desmocerataceae and the Tetragnostaceae, respectively, are established and their correlation with the Japanese ammonite zonation is suggested. All ammonites are monographed, and of the recognized 17 species, part is reported for the first time from the Maastrichtian of the studied area, the Kamchatka Peninsula including.

INTRODUCTION

The aim of the present paper is to describe the ammonite fauna and biostratigraphy of the Maastrichtian deposits of the Sakhalin and the Shikotan Islands, Far Eastern Russia. Besides inoceramids, the ammonites represent the second group allowing the refined biostratigraphic subdivision of the topmost Cretaceous (Upper Campanian—Maastrichtian) strata of the area. Moreover, they provide an opportunity to the direct correlation on the global scale. The revised ammonite material contains also a relatively large collection yielded from the famous exposures of the Kamchatka Peninsula.

The field studies were carried out by the Author in the years 1986-89, mainly in the area of the Sakhalin Island. Over 20 sections were studied, with 150 ammonite specimens collected, and stratigraphically labelled in the column. Four sections were selected for detailed works on the Shikhotan Island. For paleontological purposes the vast ammonite collections of the late Dr. V.N. VERESHAGIN and Dr. J.G. MIROLUBOV, both from VSEGEI, St.-Peterburg, were also studied.

The subject of this paper forms a part of the Ph.D. thesis presented in 1993 at the Paleontological Department of the Moscow University, and prepared under the supervision of Prof. Dr. I.A. MIKHAILOVA.

PREVIOUS RESEARCH

The first report on the Cretaceous deposits of the Sakhalin Island was published by SCHMIDT (1868), who gave the geological description and the faunal list of fossils collected during the expedition to the Cretaceous of Zhonker Cape; during the same expedition LOPATIN stated the presence of the Upper Cretaceous deposits at the eastern coasts of the Island. The paleontological description of the fauna was completed some years later (SCHMIDT 1873), whereas MICHAEL (1899) gave a description of the radially ribbed inoceramids from that area.

At the turn of the century, there appeared a series of regional studies (TIKHONOVICH & POLEVOY 1915) as well as many paleontological descriptions of the inoceramid and ammonite faunas (JIMBO 1894, YABE 1909, SOKOLOV 1914). SOKOLOV (1914) regarded the radially ribbed inoceramids as being of Late Campanian age and the beds with *Inoceramus balchi* MEEK & HAYDEN as of Maastrichtian age. This opinion was accepted later in the whole northern Pacific Region (Japan, Vancouver Island, and Alaska).

In 1917 the geological study of the area was undertaken by KRISHTAFOVITCH, who proposed the first local stratigraphic scheme for the Cretaceous of Sakhalin. The four stages distinguished by him (KRISHTAFOVITCH 1920, 1932), i.e. the Inuss, the Gylayk, the Orochern, and the Zagayan, correspond approximately to the Albian, Cenomanian-Turonian, lower Maastrichtian, and the topmost Maastrichtian, respectively. His later publications (KRISHTAFOVITCH 1935, 1937) were devoted to the Cretaceous flora from the northern part of Sakhalin.

In 20's and 30's, the southern part of the Island was intensively studied by Japanese workers. YABE (1927), and later MATSUMOTO (1942-43), completed the scheme of the zonal subdivision of the Upper Cretaceous succession, including the very detailed ammonite and inoceramid zonation for the reference section on the river Nayba (see also MATSUMOTO 1959).

Since 1957 the comprehensive studies over the whole Sakhalin were undertaken by VERESHAGIN and his co-workers. Through many years of research they recognized the general succession, established the biostratigraphic scheme (see e.g. VERESHAGIN 1963, VERESHAGIN & al. 1961, 1978), as well as provided the description of the stratigraphically important fauna, including ammonites, inoceramids, and foraminifers (see e.g. PERGAMENT 1966, 1971, 1974; ZONOVA 1992 and papers cited herein; ZONOVA & al. 1993; YAZIKOVA 1992). They published also a very detailed description of the Nayba reference section (see POYARKOVA 1987) with the extended paleontological characteristics of the faunal remains.

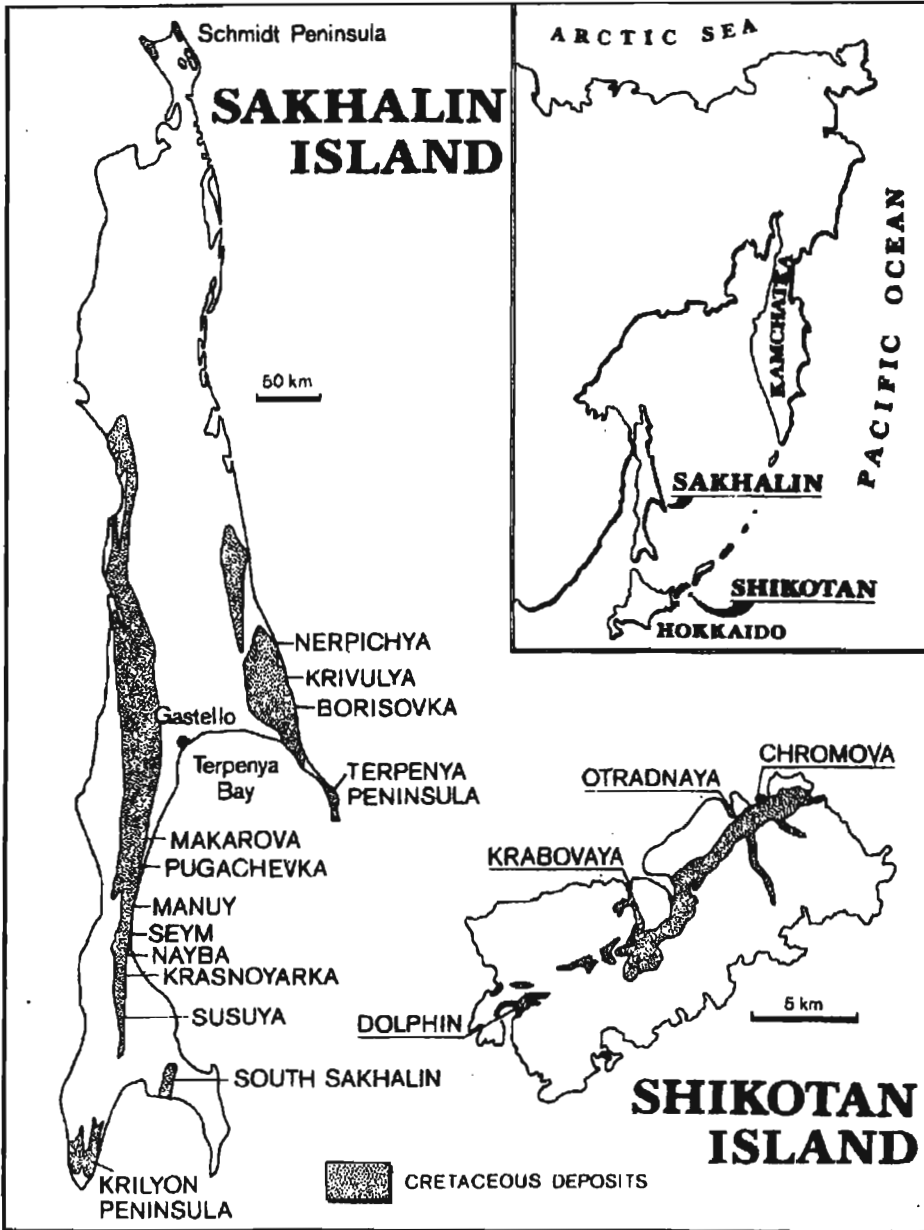


Fig. 1

Location map of the reference sections in the Sakhalin Island and the Shikotan Island, Far Eastern Russia

GEOLOGIC SETTING

The Upper Cretaceous deposits of the Sakhalin Island occur in three areas: (1) West Sakhalin Region, (2) East Sakhalin Region, stretching almost N-S along the western and eastern sides of the Island, respectively, and (3) Schmidt Peninsula, in the northernmost part of the Island (*see* Text-fig. 1).

Within the area of the West Sakhalin Region, the Upper Cretaceous deposits display quite a distinct, longitudinal facies change. Open marine, non-carbonate clastics in the south are gradually replaced northward by near-shore clastics passing in the northernmost part into continental, coal-bearing strata.

The critical area for the purposes of this study is thus the southern part of the West Sakhalin Region, providing marine, continuous and fossiliferous Maastrichtian (as well as the whole Upper Cretaceous) sections. They are exposed the best along the Nayba River and its tributaries, with the succession observed here representing the reference section for the whole Upper Cretaceous sequence of the Sakhalin Island (*see* POYARKOVA 1987).

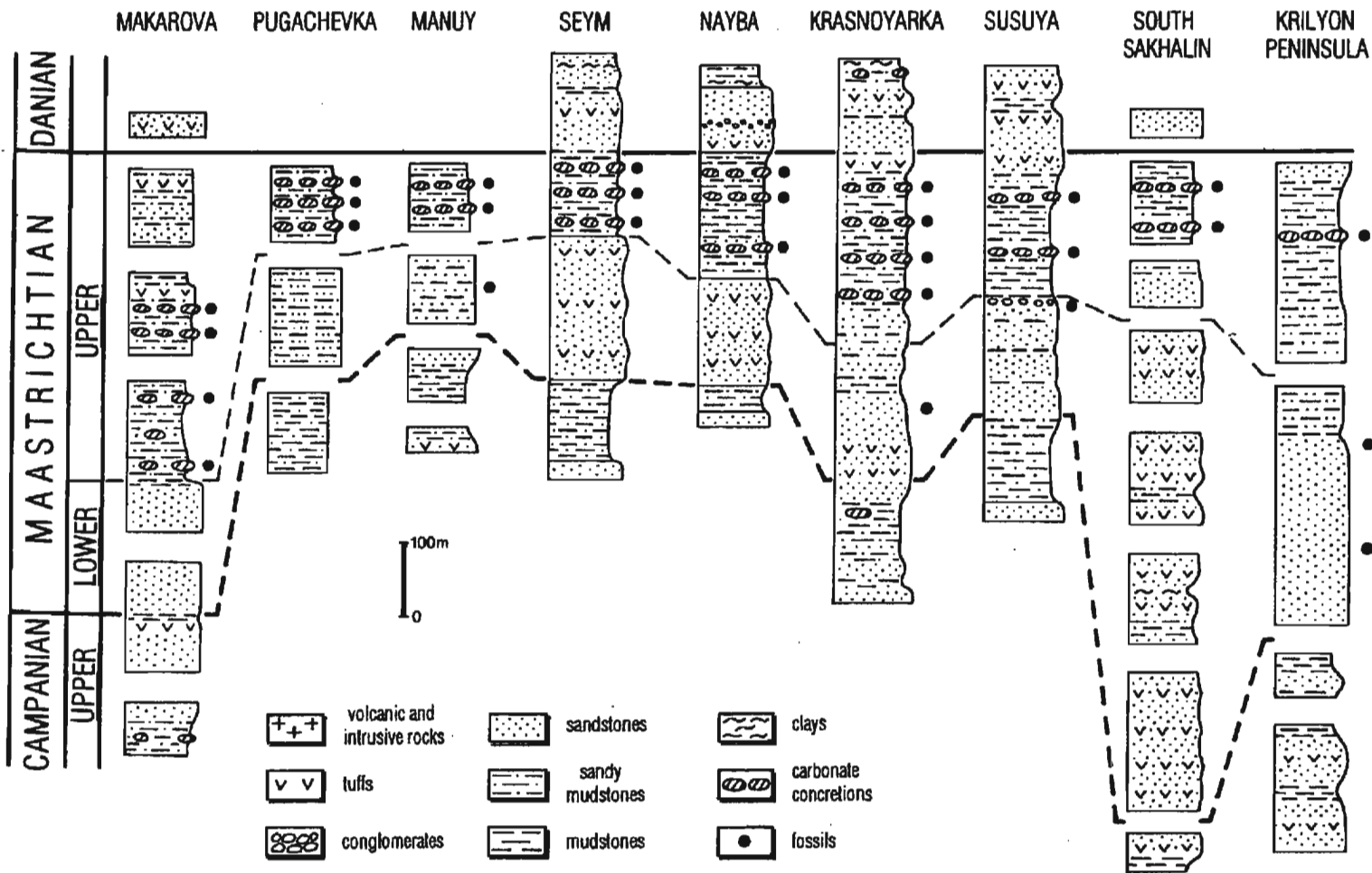
Much less exposed and more complicated tectonically are Upper Cretaceous deposits within the East Sakhalin Region, where marine, non carbonate clastics are interlayered with thick masses of acid to alcalic volcanogenic rocks. The fossil occurrences, limited to marine facies, are extremely rare. Similar conditions are characteristic of the Upper Cretaceous of the SCHMIDT Peninsula, only a lower part of the Upper Cretaceous succession is exposed.

WEST SAKHALIN REGION

Detailed investigations were limited to the southern part of the region, approximately to the latitude of the town Gastello, at the north-western edge of the Terpeniya Bay (*see* Text-fig. 2).

The Maastrichtian deposits, in spite of their remarkable thickness variation, display a twofold lithological succession, relatively uniform all over the area, giving base to two, successive lithostratigraphic units (*see* Text-fig. 6). The lower unit (bed 4 of Krasnoyarka Formation), corresponding to the Lower Maastrichtian, is composed of coarse- to fine-grained, brown to dark gray sandstones with tuffaceous mudstone or claystone intercalations. The unit is generally poorly fossiliferous, with macrofauna represented by single ammonite and inoceramid specimens of a bad preservation state. The upper unit (bed 5 of the Krasnoyarka Formation), corresponding roughly to the Upper Maastrichtian, is represented by mudstones, or sandy mudstones with very characteristic, oval, marly concretions. The latter are up to 50 cm in diameter and contain numerous and well preserved ammonite and inoceramid faunas.

Lithologic and chronostratigraphic columns of selected sections in the West Sakhalin



EAST SAKHALIN REGION

The Upper Cretaceous deposits in the area form an extensive belt of exposures, about 250 km long in N-S direction, and up to 25 km in width (*see* Text-fig. 1). A very complicated tectonic structure of the East Sakhalin Region is the reason for remarkable variations in interpretations of the Cretaceous succession there. The relative position, as well as the chronostratigraphic range of the distinguished Utchirsk, Zaslonsk, Turovsk, and Oldonsk Formations are still a matter of controversies (*see e.g.* SHUVAEV 1968, VERESHAGIN & *al.* 1972, ROTMAN & MARKOVSKY 1992). Based on the new results of the studies in the southern part of the area, the interpretation presented by VERESHAGIN & *al.* (1972) seems to be the most reliable, at least in the interval concerned, *i.e.*

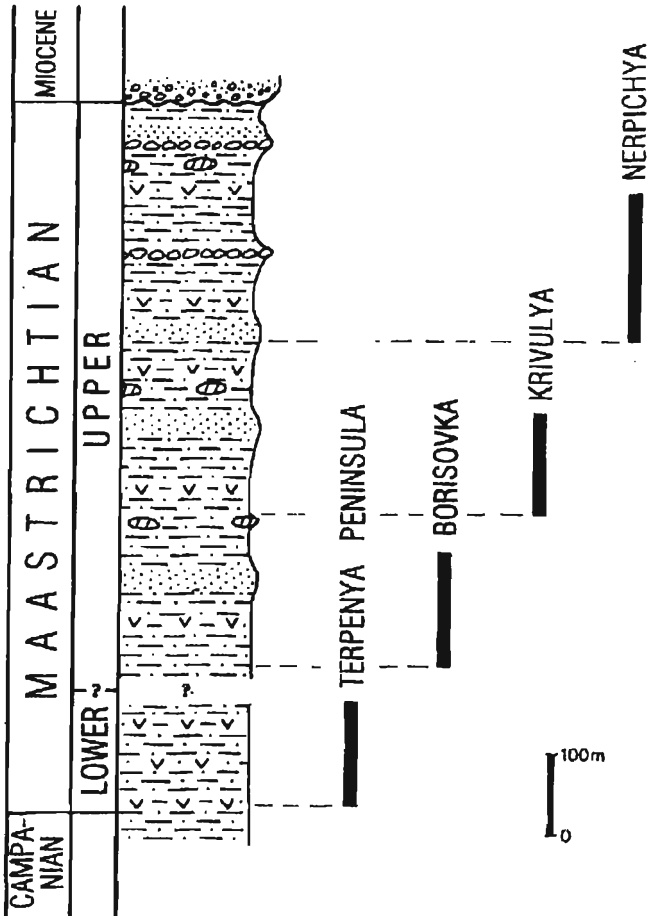


Fig. 3. General lithologic and chronostratigraphic succession of the Maastrichtian stage in the East Sakhalin Region with the stratigraphic ranges of selected sections; explanations as for Text-fig. 2

within the Maastrichtian. Thus, within the Maastrichtian part of the succession two formations may be distinguished. The Turovsk Formation at the bottom (overlying Zaslouovsk Formation dated for the Campanian), and the Oldonsk Formation above. Both these two formations are regarded to be the lateral equivalents of the Krasnoyarka Formation of the West Sakhalin Region.

The whole Maastrichtian succession of the area is represented by a thick, approximately 1 km, sequence of mudstones with tuffaceous clay and sandy intercalations, and with a sparse ammonite and inoceramid fauna (see Text-fig. 3). Good biostratigraphic evidences were found only within the Oldonsk Formation where *Gaudryceras hamanakense* MATSUMOTO & YOSHIDA, *Neogaudryceras hetonaiense* MATSUMOTO, and *Pachydiscus (Pachydiscus) cf. subcompressum* MATSUMOTO, as well as numerous inoceramids, e.g. *Shachmaticeramus shachmati* (SALNIKOVA & ZONOVA), *Sh. kusiroensis* (NAGAO & MATSUMOTO) and *Sh. shikotanensis* (NAGAO & MATSUMOTO), allow to place it safely into the Maastrichtian, and the presence of *Gaudryceras hamanakense* MATSUMOTO suggests their Late Maastrichtian age.

SHIKOTAN ISLAND

Shikotan Island, the most southerly located island of the Kuril Archipelago, is the only island within it with the Cretaceous deposits preserved. The twofold Cretaceous succession is here composed (see Text-fig. 4) of

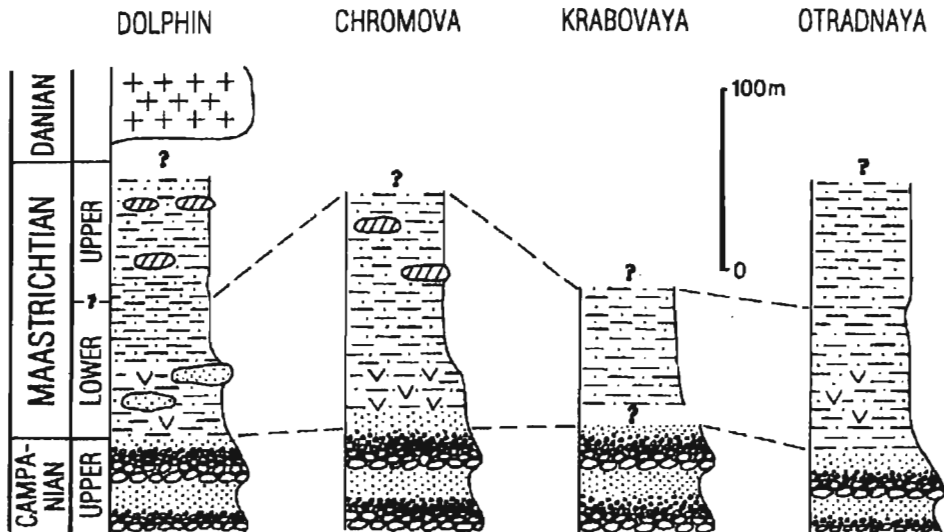


Fig. 4. Lithologic and chronostratigraphic columns of selected sections in the Shikotan Island; explanations as for Text-fig. 2

volcanogenic deposits at the bottom, consisting of basalts, tuffaceous conglomerates and breccias (Matakotan Formation) and of the marine mudstones with sandstone interlayers and marly concretions above (Malokurile Formation). The ammonite and associated numerous inoceramid fauna are to be found only within the Malokurile Formation.

Two sections, one in Chromov Bay and the other in the Dolphin Bay in the western part of the Island, were studied in detail. The Malokurile Formation is represented here by 80 up to 120 m thick succession of mudstones and siltstones with sandy intercalations, and with highly fossiliferous marly concretions (see Text-fig. 4). The biostratigraphic position of the studied successions is based primarily on the inoceramid fauna. It allows two zones to be distinguished, *i.e.* the *Sh. shikotanensis* Zone at the bottom, and the *Sh. delphinensis* Zone above. Based on the interrelations of the inoceramid and ammonite schemes, known for example from the West Sakhalin successions, both inoceramid zones distinguished may be regarded as equivalents of the Lower Maastrichtian *Pachydiscus japonicus* Zone and the Upper Maastrichtian *Pachydiscus* (*Pachydiscus*) *flexuosus* — *Pachydiscus* (*Neodesmoceras*) *gracilis* Zone, respectively. The ammonite fauna on the Island was found only in the lower, *Sh. shikotanensis* Zone. The recorded forms, *Canadoceras cf. multicos-tatum* MATSUMOTO, *Pachydiscus* (*Pachydiscus*) *cf. subcompressus* MATSUMOTO, and *Neophylloceras* sp. suggest generally its Early Maastrichtian age.

AMMONITE ZONATION

The applied ammonite zonation (see Text-figs 5-6) is based on a rich collection of ammonites which were obtained during a bed-by-bed collecting in the selected sections, first of all within the West Sakhalin Region. Supplementary materials came from the area of the East Sakhalin Region as well as from the Shikotan Island.

The presented zonal scheme is based on the representatives of the ammonite superfamily Desmocerataceae. The additional scheme, based on the representatives of the superfamily Tetragonitaceae, widely used in Japan, is for the first time shown to be useful in the Sakhalin Maastrichtian as well (see Text-fig. 5).

Two zones, *i.e.* *Pachydiscus* (*Neodesmoceras*) *japonicus* and *Pachydiscus* (*Pachydiscus*) *flexuosus* — *Pachydiscus* (*Neodesmoceras*) *gracilis*, were distinguished within the Maastrichtian stage, based on the representatives of the superfamily Desmocerataceae (see Text-fig. 5). Both zones are distinguished within the *Pachydiscus* (*Pachydiscus*) *subcompressus* Superzone, regarded as a time equivalent of the whole Maastrichtian stage.

Pachydiscus (Pachydiscus) subcompressus Superzone

This zone was first distinguished within the Nayba section, by MATSUMOTO (1959). Some years later, its equivalent, *Pachydiscus* aff. *gollevillensis* — *Pachydiscus subcompressus* Zone was applied by VERESHAGIN (1963) whereas the *Pachydiscus subcompressus* Zone, as the uppermost Cretaceous ammonite zone on the Sakhalin was formally accepted by the All-Russian stratigraphic Union in 1974. The lower boundary of the Zone, i.e. the appearance level of the index taxon, *Pachydiscus (P.) subcompressus* MATSUMOTO, is regarded as nearly corresponding to the lower boundary of the Maastrichtian stage. The upper boundary coincides with the final extinction of the ammonite fauna, approximating thus the K/T boundary.

Pachydiscus (Pachydiscus) japonicus Zone: Interval Range Zone

The lower boundary of the zone marks the appearance level of the index taxon. The upper boundary delimits the first occurrence of the representatives of the species *P. (P.) flexuosus* MATSUMOTO, or *P. (N.) gracilis* MATSUMOTO.

STAGES	Substages	JAPANESE AMMONITE ZONATION	SAKHALIN AMMONITE ZONATION			
			Desmocerataceae <small>as based on</small>		Tetragonitaceae	
			super-zones	zones	super-zones	zones
MAASTRICHTIAN	UPPER	<i>Pachydiscus (P.) flexuosus</i>	<i>Pachydiscus (P.) subcompressus</i>	<i>Pachydiscus (P.) flexuosus</i>	<i>Zelandites varuna</i>	<i>Zelandites japonicus</i>
		<i>Pachydiscus (N.) gracilis</i>		<i>Pachydiscus (N.) gracilis</i>		<i>Gaudryceras hamanakense</i>
	LOWER	<i>Pachydiscus (P.) kobayashii</i>		<i>Pachydiscus (N.) japonicus</i>		<i>Pseudophyllites indra</i>
		<i>Pachydiscus (N.) japonicus</i>				
CAMPANIAN	UPPER	<i>Pachydiscus (P.) awajiensis</i>	<i>Canadoceras multicoatum</i>	<i>Pachydiscus (P.) egertoni</i>	<i>Tetragonites popetensis</i>	
		<i>Patagiosites laevis</i>				
		<i>Anapachydiscus fascicostatus</i>				

Fig. 5. Proposed biostratigraphic schemes for the Upper Campanian and Maastrichtian of the Sakhalin Island and the Shikotan Island, and their correlation with the Japanese ammonite zonation

CAMPANIAN		MAASTRICHTIAN		STAGES	Ammonite zonation	Ammonite ranges
Lower	Upper	Lower	Upper			
Bykov	KR ₁ ¹ , KR ₂ ²⁻³	Kрасноярск	KR ₁ ⁶ , KR ₂ ⁵	Formations	Members	Pachydiscus (P.) subcompressus Pachydiscus (P.) japonicus
BK ₃ ¹⁰						
						Pachydiscus (P.) flexuosus Pachydiscus (N.) gracilis
						Matsumoto
						Zelandites japonicus Matsumoto
						Z. varuna (Forbes)
						Gaudryceras denmanense Whiteaves
						G. hamanake Matsumoto & Yoshida
						G. venustum Matsumoto
						Pseudophyllites indra (Forbes)
						Tetragonites popetensis Yabe
						T. epigonus Kosmat
						Canadoceras multicostratum Matsumoto
						Patagiosites alaskensis Jones
						Pachydiscus (P.) flexuosus Matsumoto
						P. (P.) gollevillensis (d'Orbigny)
						P. (P.) neubergicus (Hauer)
						P. (P.) subcompressus Matsumoto
						Pachydiscus (N.) gracilis Matsumoto
						P. (N.) japonicus Matsumoto

Fig. 6. Stratigraphic distribution of the ammonite species in the Campanian and Maastrichtian deposits of the Sakhalin Island and the Shikotan Island

This zone corresponds to the Zone P. japonicus — D. hetonaiense of MATSUMOTO (1959), recognized by this author on the Hokkaido Island (see also MATSUMOTO & TAKAYANAGI 1982). In the inoceramid scheme it approximates the range of the *Shahmaticeramus shikotanensis* Zone of ZONOVA (1992).

Besides *P. (N.) japonicus* MATSUMOTO, the characteristic ammonite species occurring within the Zone are *P. (P.) subcompressus* MATSUMOTO and *Neophylloceras ramosum* (MEEK). Moreover, the frequently occurring are the inoceramid species *Shahmaticeramus shikotanensis* (NAGAO & MATSUMOTO) and *Inoceramus pectiniformis* ZONOVA.

The species *P. (N.) japonicus* MATSUMOTO is known also from the north-eastern Russia (see DUNDO 1971) where it co-occurs with *Pachydiscus kamishakensis* JONES. The latter species, as well as *Pachydiscus alaskensis* JONES, found there, are the typical forms of the lower Maastrichtian strata of southern Alaska (JONES 1963).

Pachydiscus (Pachydiscus) flexuosus — Pachydiscus (Neodesmoceras) gracilis Zone: Interval Range Zone

This zone was recognized for the first time by MATSUMOTO & TAKAYANAGI (1982) on the Hokkaido Island, and recently recognized by the Author in the Sakhalin Maastrichtian. Presumably, it corresponds to the *P. neubergicus* — *P. gollevillensis* Zone, distinguished in Kamchatka. It is suggested by the ammonite species: *P. (P.) flexuosus* MATSUMOTO, *N. ramosum* (MEEK), and *N. hetonaiense* MATSUMOTO, common to both regions.

The lower boundary of the zone marks the first occurrence of any of the index taxon. The upper boundary is placed at the final extinction level of the ammonite fauna marking the end of the Cretaceous.

The ammonite fauna recorded within the Zone is variable though the particular forms are rather rare in the analyzed sections. Among the most characteristic are the following: *P. (P.) flexuosus* MATSUMOTO, *P. (N.) gracilis* MATSUMOTO, *P. (P.) gollevillensis* (D'ORBIGNY), *P. (P.) neubergicus* (HAUER), *P. (P.) subcompressus* MATSUMOTO, *Zelandites japonicus* MATSUMOTO, *Z. varuna* (FORBES), *Neophylloceras hetonaiense* MATSUMOTO, and *N. ramosum* (MEEK). Of the common non-ammonite fauna first of all are the inoceramids, represented by *Shahmaticeramus shahmati* (SALNIKOVA & ZONOVA), *Sh. kusiroensis* (NAGAO & MATSUMOTO), *Sh. subkusiroensis* ZONOVA, *Sh. pilovensis* (SOKOLOV), and *Sh. delphinensis* (SALNIKOVA & ZONOVA).

The supplementary zonal scheme based on the representatives of the superfamily Tetragonitaceae comprises one Superzone, *Zelandites varuna*, divisible into three zones. From the top downward these are as follows (see Text-fig. 5): the *Pseudophyllites indra* Zone, the *Gaudryceras hamanakense* Zone, and the *Zelandites japonicus* Zone.

***Zelandites varuna* Superzone**

This superzone comprises the interval from the first occurrence of the index taxon to the final disappearance of the ammonite fauna. In the chronostratigraphic scheme it approximates the whole Maastrichtian stage. The zone was firstly distinguished by MATSUMOTO (1959) within the Cretaceous of the Sakhalin and Hokkaido Islands.

***Pseudophyllites indra* Zone: Interval Range Zone**

The interval from the first occurrence of the index species to the appearance level of the species *Gaudryceras hamanakense* MATSUMOTO & YOSHIDA. This zone was firstly distinguished in Nayba section, southern Sakhalin by MATSUMOTO (1959), who later recognized its applicability in the Japanese Cretaceous. Besides the index taxon, the species *Neophylloceras ramosum* (MEEK) and *Gaudryceras denmanense* WHITEAVES, are the most characteristic elements within the Zone.

Gaudryceras hamanakense Zone: Interval Range Zone

The lower boundary is placed at the appearance level of the index taxon and the upper boundary at the entrance level of the index taxon of the succeeding Zone, the *Zelandites japonicus* (see Text-fig. 5). The Zone was originally distinguished by MATSUMOTO (*in*: MATSUMOTO & TAKAYANAGI 1982) in Japan. It is easily recognizable in the Cretaceous of the West and East Sakhalin.

Zelandites japonicus Zone: Taxon Range Zone

The Zone is proposed here for the first time. As the stratotypic section the Krasnoyarka succession (see Text-fig. 2) is here suggested. The Zone is well developed in the Cretaceous of the West Sakhalin Mountains. The index species *Zelandites japonicus* MATSUMOTO is known also from the Upper Cretaceous of Japan (MATSUMOTO 1938).

SYSTEMATIC ACCOUNT

Seventeen species representing seven genera are described. The systematics is applied after MIKHAILOVA (*in*: BOGOSLAVSKAYA & *al.* 1990). All specimens are stored at the Geologic Museum of the All-Russian Geological Institute, St.-Peterburg.

The following dimensions are measured: D — diameter; Wb — Whorl breadth; Wh — Whorl height; U — umbilicus; all dimensions are given in millimeters.

Class Cephalopoda CUVIER, 1797
Subclass Ammonoidea ZITTEL, 1884
Order Phylloceratida ARKELL, 1950
Suborder Phylloceratina ARKELL, 1950
Superfamily Phylloceratacae ZITTEL, 1884
Family Phylloceratidae ZITTEL, 1884

Genus *Neophylloceras* SHIMIZU *in*: SHIMIZU & OBATA, 1934

TYPE SPECIES: *Ammonites (Scaphites?) ramosus* MEEK, 1858, from the Maastrichtian of the Vancouver Island, Canada.

Neophylloceras ramosum (MEEK, 1858)
 (Pl. 1, Figs 9-10)

1876. *Phylloceras? ramosum* (MEEK); F.B. MEEK, p. 371, Pl. 5, Fig. 1.

1942. *Neophylloceras ramosum* (MEEK); T. MATSUMOTO, p. 674, Text-figs 1-2.

1952. *Neophylloceras ramosum* (MEEK); J.L. UNTER, p. 59, Pl. 1, Figs 4-5.

1958. *Phylloceras ramosum* (MEEK); F.M. ANDERSON, p. 181, Pl. 58, Fig. 4.
 1959. *Neophylloceras ramosum* (MEEK); T. MATSUMOTO, p. 1, Pl. 1, Fig. 1; Pl. 2, Fig. 2; Pl. 8, Fig. 1.
 1963. *Neophylloceras ramosum* (MEEK); D.L. JONES, p. 22; Pl. 6, Figs 1-8.
 1970. *Neophylloceras ramosum* (MEEK); R.A. HENDERSON, p. 5, Text-fig. 2a; Pl. 1, Fig. 3.

HOLOTYPE: The specimen of MEEK (1858, p. 45) from the Maastrichtian of the Vancouver Island, Canada.

MATERIAL: Seven specimens.

West Sakhalin: Specimen No. 118/12769 from Krasnoyarsk section and specimens Nos 417/10693 and 21/12632 from Makarova section, P. (P.) subcompressus Superzone.

Shikotan Island: Specimens Nos 4/12757 and 29/12632 from Dolphin section, P. (P.) subcompressus Superzone.

Kamchatka: Specimens Nos 144/12769 and 18/12632, from Niklekuyl Section, P. neubergicus — P. gottevilensis Zone.

DIMENSIONS:

Specimen	D	Wb	Wh	U	Wh/D(%)	Wb/D(%)	Wh/Wb	U/D(%)
144/12769	70	12	32	5	46	17	2.6	7
118/12769	27	3	17	—	62	11	5.5	—
18/12632	107	32	52	8	49	45	1.6	4

DESCRIPTION: Markedly involute, moderately compressed laterally, discoid in shape. Ventral side narrowly rounded. Whorl section oval, high. Umbilicus narrow, deep. Umbilical wall steep, flat with umbilical shoulder rounded. Ornament consisting of first and second order ribs. First order ribs arise at the umbilical shoulder, branching approximately one third of the whorl height into 4 to 5 secondary ribs. Slightly flexuous on lateral sides pass onto ventral side with some ribs bifurcating. On ventral side the ribs slightly curve forward.

DISCUSSION: From very similar species *Neophylloceras subramosum* SPATH, the MEEK's species differs in possessing convex bullae at the umbilical shoulder and in much more pronounced ribs at the final growth stage.

OCCURRENCE: The species is known from the Campanian — Lower Maastrichtian of the Vancouver Island, from the Turonian through Campanian of California, Upper Maastrichtian of southern Alaska, and the Campanian — Maastrichtian of Japan and Kamchatka. In the studied area it occurs in the Turonian through Maastrichtian of the Sakhalin Island and in the Upper Maastrichtian of the Shikotan Island.

Neophylloceras hetonaiense MATSUMOTO, 1942
(Pl. 1, Figs 5-7)

1942. *Neophylloceras hetonaiense* MATSUMOTO; T. MATSUMOTO, p. 675, Text-figs 1a3, b3.
 1963. *Neophylloceras hetonaiense* MATSUMOTO; D.L. JONES, p. 23, Pl. 6, Figs 9-10.
 1990. *Neophylloceras hetonaiense* MATSUMOTO; E.A. ZONOWA, Pl. D, Fig. 6; Pl. E, Fig. 8.
 1991. *Neophylloceras hetonaiense* MATSUMOTO; E.A. YAZIKOVA, p. 71, Pl. 2, Fig. 1.
 1992. *Neophylloceras hetonaiense* MATSUMOTO; E.A. YAZIKOVA, p. 194, Pl. 110, Figs 3-5.

LECTOTYPE: The specimen illustrated by SPATH (1953, Pl. 5, Fig. 1) from the Upper Maastrichtian of the Hetonai area, Hokkaido Island, Japan.

MATERIAL: Five specimens.

East Sakhalin: Specimens Nos 132/12769, 16/12621, 154/12632, 24/12632 and 17a/12632 from Nerpichya section, G. hamanakense Zone.

DIMENSIONS:

Specimen	D	Wb	Wh	U	Wh/D(%)	Wb/D(%)	Wh/Wb	U/D(%)
132/12769	32	6	10	2	31	19	1.7	6
24/12632	34	8	17	3	50	21	2.1	8
17a/12632	29	5	—	—	—	28	—	—
154/12632	39	8	16	4	41	21	2.0	9

DESCRIPTION: Involute, discoidal in shape with slightly convex lateral sides. Ventral side narrowly rounded. Whorl section oval. Umbilicus narrow to very narrow. Umbilical wall flat with rounded umbilical shoulder. Ornament consists of primary and secondary ribs. At early stages well developed umbilical tubercles. Rib clusters well seen almost on the whole lateral sides of the whorls; they consist of primary ribs, but the one third of the whorl height the secondary ribs appear. Flexuously shaped ribs are more and more pronounced with the growing diameter.

DISCUSSION: The more pronounced involutness, narrower umbilicus and much more convex lateral sides well distinguish this species from the very close species *Neophylloceras ramosum* (MEEK).

OCCURRENCE: The species is recorded from the Maastrichtian of Japan, New Zealand, Chile, and India. It is known from the Upper Maastrichtian of southern Alaska, California, and Vancouver Island, Canada, Kamchatka, as well as from the Crimea in Europe. In the studied area it was found in the Maastrichtian of the Sakhalin Island.

Order Lytoceratida HYATT, 1889
Suborder Lytoceratina HYATT, 1889
Superfamily Tetragonitacae HYATT, 1900
Family Gaudryceratidae SPATH, 1927
Genus *Zelandites* MARSHALL, 1926

TYPE SPECIES: *Zelandites kaiparaensis* MARSHALL (1926, p. 147, Pl. 19, Fig. 9; Pl. 31, Figs 1-2) from the Campanian of New Zealand.

***Zelandites varuna* (FORBES, 1846)**
(Pl. 1, Fig. 8)

1846. *Ammonites varuna*; E. FORBES, p. 107, Pl. 8, Fig. 5.

HOLOTYPE: The specimen illustrated by FORBES (1846, p. 107, Pl. 8, Fig. 5) from the Maastrichtian of southern India.

MATERIAL: Two specimens (Nos 100/12769 and 181/12769) from West Sakhalin (Pugachevka section), G. hamanakense Zone.

DIMENSIONS:

Specimen	D	Wb	Wh	U	Wh/D(%)	Wb/D(%)	Wh/Wb	U/D(%)
181/12769	14	4	3	2	30	21	1.3	17
24/12632	42	17	11	15	40	28	1.5	35

DESCRIPTION: Semiinvolute, slightly convex laterally. Ventral side narrowly rounded. Whorl section ellipsoidal in shape much higher than wide. Umbilicus relatively wide, shallow with steep umbilical wall and with rounded umbilical shoulder.

DISCUSSION: From *Z. inflatus* (JIMBO) the species may be distinguished by its lower grade of involutness, more compressed lateral sides and wider umbilicus. Moreover, *Z. varuna* (FORBES) possesses relatively well expressed ornament while JIMBO's species is almost smooth.

OCCURRENCE: Maastrichtian of India, Japan, Sakhalin, Chile, and Seymour Island. In the studied area known from the Sakhalin Island.

Zelandites japonicus MATSUMOTO, 1938
(Pl. 1, Figs 1-4 and Pl. 2, Figs 1-18)

1938. *Zelandites varuna* (FORBES) var. *japonicus*; T. MATSUMOTO, p. 140, Text-fig. 1; Pl. 14, Figs 5-7.

1976. *Zelandites japonicus* MATSUMOTO; V.S. KRIVOLAPKINA, p. 74, Pl. 90, Figs 1-5.

1988. *Zelandites varuna* (FORBES); T. MATSUMOTO, p. 184, Pl. 51, Fig. 4.

1991. *Zelandites japonicus* MATSUMOTO; E.A. YAZIKOVA, p. 71, Pl. 2, Fig. 2.

HOLOTYPE: The specimen illustrated by MATSUMOTO (1938, p. 140; Pl. 14, Fig. 7) from the Maastrichtian of the Nayba section, southern Sakhalin.

MATERIAL: Forty four specimens.

West Sakhalin: Specimen No. 101/12769 from Pugachevka section; specimens Nos 3/12913, 4/12913, 6/12913 through 11/12913, 85/12769, 86/12769, 103/12769 through 119/12769, 99/12769, 124/12769 through 131/12769, 148/12760 through 151/12769, 153/12769, 106a/12769, and 130a/12769 from Susuya section, *Z. japonicus* Zone.

Kamchatka: Specimen No. 2/12913, *P. neubergericus* — *P. gollevillensis* Zone.

DIMENSIONS:

Specimen	D	Wb	Wh	U	Wh/D(%)	Wb/D(%)	Wh/Wb	U/D(%)
86/12769	30	13	7	5	43	23	1.9	17
103/12769	47	19	9	8	48	19	1.2	17
104/12769	29	11	9	4	38	31	1.3	14
105/12769	25	10	8	4	40	32	2.0	16
106/12769	30	8	6	5	26	20	1.3	16
107/12769	24	10	9	3	40	38	1.1	25
108/12769	21	9	6	4	33	28	1.1	19
110/12769	25	8	8	5	36	32	1.1	28
111/12769	20	9	7	4	48	35	1.1	20
113/12769	32	11	8	4	37	25	1.3	12
120/12769	21	8	6	4	38	28	1.3	19
121/12769	24	9	7	3	38	29	1.3	25
122/12769	17	6	5	3	35	30	1.1	17
124/12769	45	16	9	5	36	20	1.8	11
125/12769	45	17	12	5	37	27	1.4	11
127/12769	30	10	7	4	33	23	1.4	13
148/12769	23	8	7	4	35	30	1.1	17
151/12760	31	12	9	5	39	29	1.3	16
153/12760	39	13	9	5	33	23	1.4	13

REMARKS: The surface is almost smooth, only some elements appear on the most adult parts of the whorl. The species *Z. varuna* (FORBES) is much less involute, less convex and possesses easily detectable ornament.

OCCURRENCE: Maastrichtian of Japan and Kamchatka. In the studied area limited to the Upper Maastrichtian, Z. japonicus Zone, of the Sakhalin Island.

Genus *Gaudryceras* GROSSOUVRE, 1894

TYPE SPECIES: *Ammonites mitis* HAUER (see BOULE & al. 1906) from the Campanian of Germany.

Gaudryceras denmanense WHITEAVES, 1901 (Pl. 6, Fig. 1 and Pl. 8, Fig. 2)

1901. *Lytoceras (Gaudryceras) denmanense*; J.F. WHITEAVES, p. 32.

1952. *Gaudryceras denmanense* WHITEAVES; J.L. USNER, p. 60, Pl. 4, Fig. 1.

1971. *Gaudryceras denmanense* WHITEAVES; O.P. DUNDO, Pl. 1, Fig. 2.

1992. *Gaudryceras denmanense* WHITEAVES; E.A. YAZIKOVA, p. 195, Pl. 3, Fig. 3.

LECTOTYPE: The specimen reported by WHITEAVES (1901, p. 32) from the Campanian of British Columbia, reillustrated by USNER (1952, Pl. 4, Fig. 1).

MATERIAL: Three specimens.

West Sakhalin: Specimens Nos 27/12632 and 123/12769, Makarova section, P. (P.) subcompressus Superzone.

East Sakhalin: Specimen No. 80/12769, Nerpichya section, P. (P.) subcompressus Superzone.

DIMENSIONS:

Specimen	D	Wb	Wh	U	Wh/D(%)	Wb/D(%)	Wh/Wb	U/D(%)
123/12769	83	27	27	36	33	33	1.0	40
88/12769	124	44	40	50	35	32	1.1	40

DESCRIPTION: Medium size for the genus, semiinvolute, with involutness approximately 50%. Lateral sides convex, ventral side rounded. In early stages the whorl section almost circular, slightly wider than high. Then, the height becomes gradually greater than width and the whorl section becomes oval. Umbilicus wide, with low, rounded umbilical wall and rounded umbilical shoulder.

Juveniles possess very weak ornament consisting of numerous, faint primary and secondary ribs. The latter arise at the umbilical shoulder and disappear in the middle of the lateral side, or they arise in the mid-height of the whorl passing onto the ventral side. Both primary and secondary ribs curve forward on the ventral side. On the 3th to 6th whorls rare constrictions.

Adults possess wide, weakly convex, evenly distributed primary ribs, and rare but well developed secondaries that appear in the mid-height of the lateral side and pass onto the ventral side.

REMARKS: The presence of the more convex ribs and constrictions associated with swells and their lower number per whorl distinguishes this species from *Gaudryceras venustum* MATSUMOTO.

OCCURRENCE: Maastrichtian of Canada, Japan and Campanian of California. In the studied area found in the Maastrichtian of the Sakhalin Island.

Gaudryceras hamanakense MATSUMOTO & YOSHIDA, 1979
(Pl. 3, Figs 2-3; Pl. 4, Figs 1-3; Pl. 6, Figs 2-3)

1960. *Gaudryceras* aff. *kayei* (FORBES); S. YOSHIDA, p. 2, Text-fig. 2.

1979. *Gaudryceras hamanakense*; T. MATSUMOTO & S. YOSHIDA, p. 68, Pl. 10, Figs 1-5; Pl. 11, Figs 1-2.

1990. *Gaudryceras hamanakense* MATSUMOTO & YOSHIDA; E.A. ZONOVA, p. 33, Pl. 1, Fig. 1.

1991. *Gaudryceras hamanakense* MATSUMOTO & YOSHIDA; E.A. YAZIKOVA, p. 68, Pl. 1, Fig. 1.

1992. *Gaudryceras hamanakense* MATSUMOTO & YOSHIDA; E.A. YAZIKOVA, Pl. 110, Figs 1-2; Pl. 111, Figs 1-2.

HOLOTYPE: The specimen illustrated by MATSUMOTO & YOSHIDA (1979, Pl. 10, Figs 1-3), from the Upper Maastrichtian of the Hokkaido Island, Japan.

MATERIAL: Twenty three specimens from West Sakhalin.

Makarova section: Specimens Nos 1/12621 through 7/12621, 10/12621, 22/12632, 23/12632, 25/12632, 26/12632, 12/12913 through 14/12913, and 424/10693; *G. hamanakense* Zone.

Krasnoyarsk section: Specimen No. 133/12769, *G. hamanakense* Zone.

Pugachevka section: Specimens Nos 79/12769, 146/12769, 102/12769, and 114/12769; *G. hamanakense* Zone.

Nituy section: Specimen No. 8/12621, *G. hamanakense* Zone.

DIMENSIONS:

Specimen	D	Wb	Wh	U	Wh/D(%)	Wb/D(%)	Wh/Wb	U/D(%)
26/12623	50	13	13	25	26	36	0.7	50
25/12623	95	24	24	45	25	43	1.0	43
146/12769	70	23	28	34	33	40	0.7	49
137/12769	86	26	23	35	30	28	1.2	41
79/12769	77	24	22	34	30	29	1.1	44
114/12769	66	19	21	26	29	30	0.9	42
133/12769	44	12	18	20	27	40	0.6	47

DESCRIPTION: Medium size for the genus, evolute passing to almost semiinvolute in adults, moderately inflated. Ventral side uniformly rounded. Early whorls wider than high, becoming gradually higher than wide in adults. Umbilicus wide, shallow, with rounded umbilical shoulder. Ornament consisting of faint, flexuous, numerous ribs, arising at the umbilical shoulder passing onto ventral side with slightly curving at the mid-flank. On the outer flank and ventral side tiny secondaries occur. Adult whorls bear rare, 3-4 per whorl and up to 5 on the last whorl, constrictions. Ribs become thicker on the last whorl.

REMARKS: From *Gaudryceras denmanense* WHITEAVES, the species differs in having more numerous primary and secondary ribs, greater number of constrictions and less thick and high ribs on the last whorl.

OCCURRENCE: Upper Maastrichtian, *G. hamanakense* Zone, of Japan. In the same stratigraphic position known from the Sakhalin Island.

Gaudryceras venustum MATSUMOTO, 1984
(Pl. 5, Fig. 2; Pl. 14; Pl. 15, Fig. 2)

1984. *Gaudryceras venustum*; T. MATSUMOTO, p. 5; Pl. 3, Figs 1-2.

HOLOTYPE: The specimen illustrated by MATSUMOTO (1984, Pl. 3, Figs 1-2) from the Upper Maastrichtian of the Kiusu Island, Japan.

MATERIAL: Three specimens from West Sakhalin.

Pugachevka section: Specimens Nos 134/12769 and 75/12769, G. hamanakense Zone.

Makarova section: Specimen No. 136/12769, G. hamanakense Zone.

DIMENSIONS:

Specimen	D	Wb	Wh	U	Wh/D(%)	Wb/D(%)	Wh/Wb	U/D(%)
75/12769	130	45	40	40	35	31	1.7	31
134/12769	160	70	50	47	44	31	1.4	23
136/12769	130	55	40	45	42	31	1.4	35

DESCRIPTION: Large size for the genus, semievolute, weakly inflated. Ventral side oval, rounded. Last whorl quickly increasing in size toward aperture. Whorl section oval, higher than wide. Umbilicus varies between wide to moderately wide with low umbilical wall. Ornament composed of evenly spaced primary and secondary, flexuously shaped ribs. Primaries arise at the umbilical shoulder, and the secondaries at the mid flank; both curve slightly forward. At the juvenile the secondary ribs appear every two primaries, and then, toward the adult, every three. Finally they are unevenly distributed. Moreover, there occur rare (usually 4 ribs per whorl and on the last whorl up to 6) thick, inflated ribs, with even interrib interval, branching into two at the ventral side.

REMARKS: From *G. hamanakense* MATSUMOTO this species differs in a lower number of ribs, the presence of thick, inflated ribs on the surface of the last whorl, and the pattern of appearance of the secondary ribs at the juveniles.

OCCURRENCE: Upper Maastrichtian, G. hamanakense Zone, of Japan. Known from the same zone from the Sakhalin Island.

Family Tetragonitidae HYATT, 1900

Genus *Tetragonites* KOSSMAT, 1895

TYPE SPECIES: *Ammonites timotheanus* PICTET, 1847 from the Upper Albian of France.

OCCURRENCE: Albian through Campanian of the Pacific Region and Albian — Cenomanian of the Mediterranean.

***Tetragonites popetensis* YABE, 1903**

(Pl. 3, Fig. 1)

1903. *Tetragonites popetensis*; H. YABE, p. 48, Pl. 7, Figs 4, 6.

1984. *Tetragonites popetensis* YABE; T. MATSUMOTO, p. 52, Pl. 23, Fig. 3.

HOLOTYPE: The specimen illustrated by YABE (1903, Pl. 7, Fig. 4) from the Upper Campanian of the Hokkaido Island, Japan.

MATERIAL: Two specimens from West Sakhalin.

Nayba section: Specimen No. 76/12769a, T. popetensis Zone.

Kura section: Specimen No. 15/12913, T. popetensis Zone.

DIMENSIONS:

Specimen	D	Wb	Wh	U	Wh/D(%)	Wb/D(%)	Wh/Wb	U/D(%)
76/12769	60	26	19	18	43	32	1.4	30

DESCRIPTION: Semiinvolute, moderately compressed. Ventral side triangular, rounded. Whorl section pentagonal, rounded, higher than wide. Umbilicus shallow, with moderately wide, vertical umbilical wall and rounded shoulder. Whorl surface almost smooth bearing only growth lines. In adults appear evenly distributed distinct, deep constrictions, which arise at the umbilical shoulder and curve markedly forward on the flanks.

REMARKS: This species differs from the close *Tetragonites superstus* VAN HOEPEN in much wider umbilicus, in being more compressed, the pentagonal shape of the whorl cross section and the occurrence of constrictions.

OCCURRENCE: Known from the Santonian-Campanian of California and Campanian of Patagonia. In the studied area *T. popetensis* YABE was recorded from the Upper Campanian, *T. popetensis* Zone, of Sakhalin.

Tetragonites epigonus KOSSMAT, 1895
(Pl. 5, Fig. 1)

1895. *Lyoceras (Tetragonites) epigonus*; F. KOSSMAT, p. 135, Pl. 17, Figs 4-5, 10.

1977. *Tetragonites cf. epigonus* KOSSMAT; W.J. KENNEDY & H.C. KLINGER, p. 165, Text-fig. 9.

LECTOTYPE: The specimen illustrated by KOSSMAT (1895, Pl. 17, Fig. 4) from the Campanian of India, by subsequent designation of KENNEDY & KLINGER (1977).

MATERIAL: Three specimens from the West Sakhalin.

Nayba section: Specimen No. 98/12769, *T. popetensis* Zone.

Krasnoyarka section: Specimens Nos 77/12769 and 78/12769, *T. popetensis* Zone.

DIMENSIONS:

Specimen	D	Wb	Wh	U	Wh/D(%)	Wb/D(%)	Wh/Wb	U/D(%)
98/12769	50	29	29	13	58	58	1.0	26

DESCRIPTION: Semiinvolute, inflated, with widely rounded ventral side. Whorl section subquadrate, rounded. Umbilicus moderately narrow, shallow with vertical umbilical wall. Whorl surface smooth with only growth lines and rare constrictions, being curved on the ventral side backward, and with flexuous shape on the flanks.

REMARKS: From *T. popetensis* YABE this species differs in more narrow umbilicus, greater inflation, different whorl section and another characteristics of the constrictions.

OCCURRENCE: Known from the Turonian through Santonian of southern India, Antarctica, Angola, Madagascar, South Africa, southern France, and Canada. In the studied area reported from the Campanian strata of the Sakhalin Island.

Order Ammonitida ZITTEL, 1884
 Suborder Perisphinctina BESNOSOV & MIKHAILOVA, 1983
 Superfamily Desmocerataceae ZITTEL, 1895
 Family Pachydiscidae SPATH, 1922
 Genus *Canadoceras* SPATH, 1922

TYPE SPECIES: *Ammonites newberryannus* MEEK, 1876, from the Campanian of British Columbia, Canada.

OCCURRENCE: Known from the Santonian through Campanian of Madagascar, Japan, Canada, California and Brazil. In the studied area found in the Santonian — Lower Maastrichtian of the Sakhalin Island and from the Lower Maastrichtian of the Shikotan Island.

Canadoceras multicostratum MATSUMOTO, 1954
 (Pl. 11, Fig. 1 and Pl. 12, Fig. 2)

1954. *Canadoceras multicostratum*; T. MATSUMOTO, p. 304, Text-fig. 28; Pl. 34, Figs 1-2.
 1984. *Canadoceras multicostratum* MATSUMOTO; T. MATSUMOTO, Part I: p. 19, Pl. 3, Figs 1-3; Part II: p. 47; Pl. 18, Figs 1-2; Pl. 20, Fig. 2.
 1987. *Canadoceras multicostratum* MATSUMOTO; Z.N. POYARKOVA, p. 142, Pl. 28, Fig. 3.

HOLOTYPE: The specimen illustrated by MATSUMOTO (1954, Text-fig. 28 and Pl. 34, Fig. 1) from the Upper Campanian of the Sakhalin Island.

MATERIAL: Six specimens, from the West Sakhalin.

Krasnoyarsk section: Specimens Nos 18/12913 and 418/10693, *C. multicostratum* Zone.
 Makarova section: No. 115/12769, *C. multicostratum* Zone.

DIMENSIONS:

Specimen	D	Wb	Wh	U	Wh/D(%)	Wb/D(%)	Wh/Wb	U/D(%)
115/12769	111	45	35	40	41	32	1.2	38

DESCRIPTION: Large size for the genus, moderately compressed. Ventral side widely rounded. Whorl section oval, higher than wide. Umbilicus relatively narrow, deep, with moderately steep umbilical wall and rounded umbilical shoulder. Ornament at the juvenile consists of thin, inflated ribs, arising just above the umbilical shoulder. Approximately at the mid-flank the secondary ribs arise. Both, primary and secondary ribs pass onto the ventral side where they curve slightly forward. The similar shape possess the rare (usually 4 per whorl) constrictions. At adults the ribs become thicker and the constrictions become deeper.

REMARKS: The species *Canadoceras kossmati* MATSUMOTO possesses more inflated form, much larger umbilicus, more distinct ornament, and another characteristics of constrictions.

OCCURRENCE: Upper Campanian of Japan. In the studied area known from the Campanian and lowermost Maastrichtian of the Sakhalin Island.

Genus *Patagiosites* SPATH, 1953

TYPE SPECIES: *Ammonites patagiosus* SCHLÖTER, 1867, from the Campanian of Germany.

OCCURRENCE: Known from the Campanian through Maastrichtian of the north-western Europe, Patagonia, California, Alaska, and from the Lower Maastrichtian of the Kamchatka.

Patagiosites alaskensis JONES, 1963

(Pl. 9, Fig. 2 and Pl. 20, Fig. 3)

1963. *Patagiosites alaskensis*; JONES, p. 45, Text-figs 24-25; Pls 38-40, Pl. 41, Figs 1,3,7,9.

HOLOTYPE: The specimen illustrated by JONES (1963, Pls 40-41, Fig 1, 7) from the Lower Maastrichtian of southern Alaska.

MATERIAL: One specimen (No. 143/12769) from Penzhina Section, Kamchatka; P. kamishakensis Zone.

DIMENSIONS:

Specimen	D	Wb	Wh	U	Wh/D(%)	Wb/D(%)	Wh/Wb	U/D(%)
143/12769	86	37	28	22	43	33	1.3	26

DESCRIPTION: Semiinvolute, with involuteness about 70%, compressed, ventral side narrowly rounded. Whorl section triangular, oval. Umbilicus moderately wide, shallow, with moderately steep umbilical wall and rounded shoulder. Ornament, at the juveniles consists of faint, evenly spaced ribs, growth lines and constrictions. One deep constriction occur every three ribs. Growth lines distributed in interrib intervals as well as between ribs and constrictions. Adults possess more markedly developed, deeper constrictions, and singular, unevenly distributed ribs and growth lines inbetween. All ornament elements are flexuously shaped, and curve forward on the ventral side.

REMARKS: From close form *Patagiosites compressus* (MATSUMOTO) the species differs in triangularly rounded whorl section, shallower umbilicus, less steeper umbilical wall, and less pronounced ornament at the middle stage of growth. Moreover, at the latter stage the number of ribs is distinctly lower.

OCCURRENCE: Lower Maastrichtian, P. kamishakensis Zone, of southern Alaska and Kamchatka. Not reported formerly from the studied area.

Genus *Pachydiscus* ZITTEL, 1884

TYPE SPECIES: *Ammonites neubergicus* HAUER, 1858, by subsequent designation of GROSSOUVRE (1894) from the Maastrichtian of southern Europe.

Subgenus *Pachydiscus* ZITTEL, 1884

Pachydiscus (Pachydiscus) neubergicus (HAUER, 1858)

(Pl. 13, Fig. 1)

1858. *Ammonites neubergicus*; HAUER, p. 12, Pl. 2, Figs 1-3; Pl. 3, Figs 1-2.

1894. *Pachydiscus neubergicus* (HAUER); A. GROSSOUVRE, p. 207; Pl. 27, Fig. 3; Pl. 30, Fig. 4; Pl. 38, Fig. 3.

1909. *Pachydiscus neubergicus* (HAUER); J. NOWAK, p. 769, Pl. 1, Fig. 6.

1951. *Pachydiscus neubergicus* (HAUER); I.A. MIKHAILOVA, p. 62, Pl. 7, Figs 36-37.

1959. *Pachydiscus neubergicus* (HAUER); D.P. NAIDIN, p. 186; Pl. 10, Figs 1-3.

LECTOTYPE: The specimen illustrated by HAUER (1858, Pl. 2, Figs 1-3), by subsequent designation of GROSSOURE (1894), from the Maastrichtian of the western Alps.

MATERIAL: Two specimens (Nos 138/12769 and 138a/12769) from Pugachevka section, West Sakhalin; *P. (P.) flexuosus* — *P. (N.) gracilis* Zone.

DIMENSIONS:

Specimen	D	Wb	Wh	U	Wh/D(%)	Wb/D(%)	Wh/Wb	U/D(%)
138/12769	130	55	40	35	42	31	1.4	27
138a/12769	270	112	80	70	42	30	1.3	26

DESCRIPTION: Large size for the genus, semiinvolute, with involuteness about 70%, slightly inflated. Ventral side narrowly rounded. Whorl section oval, much higher than wide. Umbilicus narrow, shallow, with steep wall and rounded shoulder. At early and medium growth stages ornament consists of thin, short primary ribs, arising at the umbilical shoulder and the secondary ribs occurring on the ventral side of the whorl. The number of secondary ribs approximately twice larger than of primaries. Gradually with age the primary ribs become longer, passing onto the ventral side, and their number grow. Simultaneously, the secondary ribs become less pronounced.

REMARKS: From *Pachydiscus (Pachydiscus) egertoni* (FORBES) this species differs in being more inflated, and possessing more delicate ornament.

OCCURRENCE: Maastrichtian of Western Europe, Poland, Western Ukraine, Crimea, Caucasus, India, Madagascar. Known also in the Upper Maastrichtian *P. neubergicus* — *P. gollevillensis* Zone of Kamchatka. In the studied area found in the Upper Maastrichtian, *P. (P.) flexuosus* — *P. (N.) gracilis* Zone of the Sakhalin Island.

Pachydiscus (Pachydiscus) gollevillensis (D'ORBIGNY, 1850) (Pl. 11, Fig. 2)

1894. *Pachydiscus gollevillensis* (D'ORBIGNY); A. GROSSOURE, p. 214; Pl. 29, Fig. 4; Pl. 30, Fig. 9.

1951. *Pachydiscus gollevillensis* (D'ORBIGNY); N.P. MIKHAILOV, p. 66; Pl. 8, Fig. 39.

1959. *Pachydiscus gollevillensis* (D'ORBIGNY); D.P. NAIDIN, p. 187, Pl. 11, Fig. 3.

1969. *Pachydiscus gollevillensis* (D'ORBIGNY); A.A. ATAMBKIAN & V.T. AKOPIAN, p. 4; Pl. Fig. 1.

1986. *Pachydiscus gollevillensis* (D'ORBIGNY); W.J. KENNEDY, p. 168, Pl. 15, Figs 10-11; 22, Figs 1-5.

HOLOTYPE: The specimen illustrated by D'ORBIGNY (1841, Pl. 101) from the Maastrichtian of France.

MATERIAL: Six specimens.

West Sakhalin: Specimens Nos 25/12913, 83/12769, 26/12913, and 27/12913; from Nayba section; *P. (P.) subcompressus* Superzone.

Kamchatka: Specimens Nos 28/12913 and 1/11799; from Penzhina section; *P. neubergicus*—*P. gollevillensis* Zone.

DIMENSIONS:

Specimen	D	Wb	Wh	U	Wh/D(%)	Wb/D(%)	Wh/Wb	U/D(%)
83/12769	190	70	50	60	33	24	1.4	30

DESCRIPTION: Medium size for the genus, semiinvolute, with the involuteness about 70%, compressed. Ventral side narrowly rounded. Whorl section ellipsoid. Umbilicus narrow, shallow with low, vertical wall. Ornament consists of primary and secondary ribs. Thin, slightly curved forwardly primary ribs arise at the umbilical shoulder and disappear approximately at the mid flank. Evenly distributed secondary ribs are limited to the ventral side. Growth lines are seen the best on the whorl flanks.

REMARKS: Lateral compression, ellipsoid shape of whorl section and ribs characteristics distinguish the species from *Pachydiscus (Pachydiscus) neubergicus* (HAUER).

OCCURRENCE: Maastrichtian of Europe, Madagascar, Australia, North America. Known also from the Upper Maastrichtian *P. neubergicus* — *P. gollevillensis* Zone of Kamchatka. In the studied area known from the Upper Maastrichtian *P.(P.) flexuosus* — *P. (N.) gracilis* Zone of the West Sakhalin.

Pachydiscus (Pachydiscus) subcompressus MATSUMOTO, 1954
(Pl. 8, Fig. 3; Pl. 10, Figs 2-3; Pl. 13, Fig. 2; Pl. 15, Fig. 1; Pls 16-17;
Pl. 18, Fig. 1)

1954. *Pachydiscus subcompressus*; T. MATSUMOTO, p. 287, Pl. 10, Fig. 4.
1979. *Pachydiscus subcompressus* MATSUMOTO; T. MATSUMOTO & al., p. 58, Fig. 5.
1987. *Pachydiscus subcompressus* MATSUMOTO; Z.N. POYARKOVA, p. 143, Pl. 28, Fig. 4.
1991. *Pachydiscus subcompressus* MATSUMOTO; E.A. YAZIKOVA, p. 68, Pl. 1, Fig. 2.
1992. *Pachydiscus subcompressus* MATSUMOTO; E.A. YAZIKOVA, p. 198, Pl. 16, Fig. 2.

HOLOTYPE: The specimen illustrated by MATSUMOTO (1954, Pl. 10, Fig. 4) from the Maastrichtian of the Sakhalin Island.

MATERIAL: Twenty three specimens.

West Sakhalin: Specimens Nos 81/12769, 421/10693, and 423/10693 from Nayba section; Specimens Nos 31/12913, 34/12913, 94/12769, 419/10693, 32/12913, 422/10693, 95/12769, 82/12769 and 30/12913 from Krasnoyarka section; Specimen No. 29/12913 from Susuya section; Specimens Nos 96/12769 and 88/12769 from Pugachevka section; Specimens Nos 92/12769, 93/12769, 30/12913, 145/12769, and 28/12632 from Makarova section; Specimen No. 89/12769 from Krilyon Peninsula; *P. (P.) subcompressus* Superzone.

Shikotan Island: Specimen No. 2/12757, from Chromova section, *P. (P.) subcompressus* Superzone.

DIMENSIONS:

Specimen	D	Wb	Wh	U	Wh/D(%)	Wb/D(%)	Wh/Wb	U/D(%)
93/12769	137	75	30	40	55	22	2.5	29
145/12769	180	84	48	56	47	27	1.75	36
81/12769	270	110	40	70	41	15	2.75	26
88/12769	164	84	54	42	51	33	1.6	26
92/12769	148	64	38	45	43	26	1.7	30
96/12769	270	100	50	80	37	30	2.0	30

DESCRIPTION: Medium to large size for the genus, semiinvolute with the involuteness reaching 70%, moderately compressed. Ventral side rounded. Whorl section oval, higher than wide. Body chamber with flexuously shaped aperture (specimen No. 96/12769). Umbilicus moderately narrow, shallow, with a low, steep wall. At the early stages the ornament consists of slightly inflated, flexuous, evenly distributed ribs. Medium stages are characterized by thicker ribs arising at the umbilical shoulder passing onto the ventral side. Interrib intervals covered with numerous growth lines. Similarly like in other representatives of the genus the ornament is best pronounced at the early and to medium ontogenetic stages. Later on, the whorl surface becomes gradually weaker ornamented, with body chamber being almost smooth.

REMARKS: Well pronounced ornament at the medium stage distinguishes this species from *P. (P.) gollevillensis* (D'ORBIGNY).

OCCURRENCE: Known from the Lower Maastrichtian of Japan. In the studied area relatively common in the *P. subcompressus* Superzone of the Sakhalin Island and from the Lower Maastrichtian of the Shikotan Island.

Pachydiscus (Pachydiscus) flexuosus MATSUMOTO, 1979
(Pl. 8, Fig. 1; Pl. 9, Fig. 1; Pl. 10, Fig. 1; Pl. 12, Fig. 1)

1979. *Pachydiscus (Pachydiscus) flexuosus* MATSUMOTO; T. MATSUMOTO & al., p. 53, Text-Fig. 4; Pl. 9, Figs 1-3; Pl. 10, Fig. 4; Pl. 12, Fig. 1.

1980. *Pachydiscus (Pachydiscus) flexuosus* MATSUMOTO; T. MATSUMOTO & Y. MOROZUMI, p. 10, Pl. 5, Fig. 1.

1991. *Pachydiscus (Pachydiscus) flexuosus* MATSUMOTO; E.A. YAZIKOVA, p. 197, Pl. 107, Fig. 1.

HOLOTYPE: The specimen illustrated by MATSUMOTO & al. (1979, Text-fig. 4; Pl. 9, Fig. 3) from the Upper Maastrichtian of the Hokkaido Island, Japan.

MATERIAL: Nine specimens.

West Sakhalin: Specimens Nos 116/12769, 147/12769, and 117/12769 from Pugachevka section; Specimen No. 84/12769 from Makarova section, and Specimen No. 87/12769 from Manuy section; *P. (P.) flexuosus* — *P. (N.) gracilis* Zone.

Kamchatka: Specimen No. 141/12632 from Niklekuyl section; and Specimens Nos 19/12913, 24/12913 and 21/12913 from Penzhina section; *P. neubergicus* — *P. gollevillensis* Zone.

DIMENSIONS:

Specimen	D	Wb	Wh	U	Wh/D(%)	Wb/D(%)	Wh/Wb	U/D(%)
84/12769	176	94	40	34	53	23	2.35	19
116/12769	74	34	22	18	46	30	1.5	24
141/12769	85	42	30	20	50	35	1.4	24

DESCRIPTION: Medium size for the genus, involute with involuteness reaching 70%, slightly inflated laterally. Ventral side narrowly rounded. Whorl section ellipsoid in shape, higher than wide. Umbilicus narrow, shallow, with low wall and rounded umbilical shoulder. Whorl surface almost smooth, bearing only growth lines, well visible on the umbilical shoulder and on the flanks. At the early stages the growth lines are patchily distributed, invisible on the ventral side.

REMARKS: Lateral inflation, narrower umbilicus and the lack of ribs well distinguishes this species from *P. (P.) subcompressus* MATSUMOTO.

OCCURRENCE: Upper Maastrichtian of Japan and Kamchatka. In the studied area known from the Upper Maastrichtian of the Sakhalin Island.

Subgenus *Neodesmoceras* MATSUMOTO, 1947

TYPE SPECIES: *Pachydiscus (Neodesmoceras) japonicus* MATSUMOTO, 1947, from the Lower Maastrichtian of Japan.

Pachydiscus (Neodesmoceras) japonicus MATSUMOTO, 1947
(Pl. 7, Figs 1-2 and Pl. 9, Fig. 3)

1947. *Pachydiscus (Neodesmoceras) japonicus*; T. MATSUMOTO, p. 39.

1965. *Pachydiscus (Neodesmoceras) japonicus* MATSUMOTO; V.N. VEREZHAIIN & al., p. 57, Pl. 68, Fig. 1; Pl. 69, Figs 1-2.

1991. *Pachydiscus (Neodesmoceras) japonicus* MATSUMOTO; E.A. YAZIKOVA, Pl. 2, Fig. 3.

1992. *Pachydiscus (Neodesmoceras) japonicus* MATSUMOTO; E.A. YAZIKOVA, Pl. 112, Fig. 1.

HOLOTYPE: The specimen from the Lower Maastrichtian of Hokkaido, Japan, mentioned by MATSUMOTO (1947, p. 39), stored at the Museum of the Kyushu University.

MATERIAL: Five specimens.

West Sakhalin: Specimens Nos 90/12769, 91/12769, 97/12769, and 135/12769 from Manuy section; Specimen No. 30/12632 from Krilyon Peninsula; P. (N.) japonicus Zone.

DIMENSIONS:

Specimen	D	Wb	Wh	U	Wh/D(%)	Wb/D(%)	Wh/Wb	U/D(%)
90/12769	160	48	46	40	30	29	1.0	25
30/12769	166	77	41	52	46	25	1.9	20
97/12769	110	45	34	22	41	31	1.3	20

DESCRIPTION: Involute, with the involuteness reaching over 70%, moderately compressed. Ventral side rounded. Whorl section oval, higher than wide, except the final whorl, where the relative height increases rapidly and the section becomes ellipsoidal. Whorl surface almost smooth with only faint flexuously-shaped secondary ribs on the flanks. At the early stages there occur short, primary ribs at the lower half of the flanks. No ribs detectable on the ventral side.

REMARKS: The species is close to *Pachydiscus (Neodesmoceras) obsoletiformis* JONES, from which it differs in relatively higher whorl sections, narrower umbilicus, and the occurrence of the primary ribs at the lower half of the whorl flanks at the early whorls.

OCCURRENCE: Lower Maastrichtian, P. (N.) japonicus Zone of Japan and P. kumischakensis Zone of Kamchatka. Known from the P. (N.) japonicus Zone of the Sakhalin Island.

Pachydiscus (Neodesmoceras) gracilis MATSUMOTO, 1979
(Pl. 19 and Pl. 20, Figs 1-2)

1979. *Pachydiscus (Neodesmoceras) gracilis* MATSUMOTO; T. MATSUMOTO & al., p. 60, Text-fig. 6; Pl. 10, Fig. 1; Pl. 12, Fig. 2.

1980. *Pachydiscus (Neodesmoceras) gracilis* MATSUMOTO; T. MATSUMOTO & Y. MOROZUMI, p. 11, Pl. 8, Figs 1-2; Pl. 9, Fig. 1; Pl. 10, Figs 1-2.

1991. *Pachydiscus (Neodesmoceras) gracilis* MATSUMOTO; E.A. YAZIKOVA, p. 68, Pl. 1, Fig. 4.

1992. *Pachydiscus (Neodesmoceras) gracilis* MATSUMOTO; E.A. YAZIKOVA, p. 198, Pl. 108, Fig. 1; Pl. 109, Fig. 1.

HOLOTYPE: The specimen illustrated by MATSUMOTO & al. (1979, Pl. 10, Fig. 1; Pl. 12, Fig. 2) from the Upper Maastrichtian of Japan.

MATERIAL: Five specimens.

West Sakhalin: Specimens Nos 114/12769 and 144/12769 from Pugachevka section, P. (P.) flexuosus — P. (N.) gracilis Zone.

Kamchatka: Specimens Nos 17/12632 and 142/12769 from Niktekruyul section, and Specimen No. 20/12632 from Ionajvcom section; P. neubergicus — P. gollevillensis Zone.

DIMENSIONS:

Specimen	D	Wb	Wh	U	Wh/D(%)	Wb/D(%)	Wh/Wb	U/D(%)
144/12769	200	96	60	40	48	30	1.6	20
142/12769	105	52	30	20	50	29	1.7	19
17/12632	113	56	35	28	50	31	1.6	25

DESCRIPTION: Medium size for the genus, semiinvolute, with the involuteness reaching up to 70%, slightly inflated. Ventral side flattened with rounded margins. Whorl section oval to ellipsoidal, markedly higher than wide. Umbilicus relatively narrow, shallow, with a low wall and rounded umbilical shoulder. Ornament consists of delicate, flexuous growth lines and faint ribs, disappearing on the ventral side. Usually two to three growth lines with every rib occur.

REMARKS: The flattened ventral side, lateral inflation and smooth whorl surface at almost all ontogenetic stages easily distinguish *P. (N.) gracilis* MATSUMOTO from very close *P. (N.) japonicus* MATSUMOTO.

OCCURRENCE: Upper Maastrichtian of Japan and Kamchatka. Known from the Upper Maastrichtian of the Sakhalin Island.

Acknowledgements

The Author expresses her heartfelt thanks to Professor A. RADWAŃSKI and Dr. I. WALASZCZYK, both of the University of Warsaw, for critical reading and linguistic comments during the preparation of this paper. Moreover, the Author is most grateful to Dr. T.D. ZONOVA, of the VSEGEI in St.-Peterburg, for the support and useful advices.

Warm thanks are to B. WAKSMUNDZKI, M.Sc. for making carefully the line drawings.

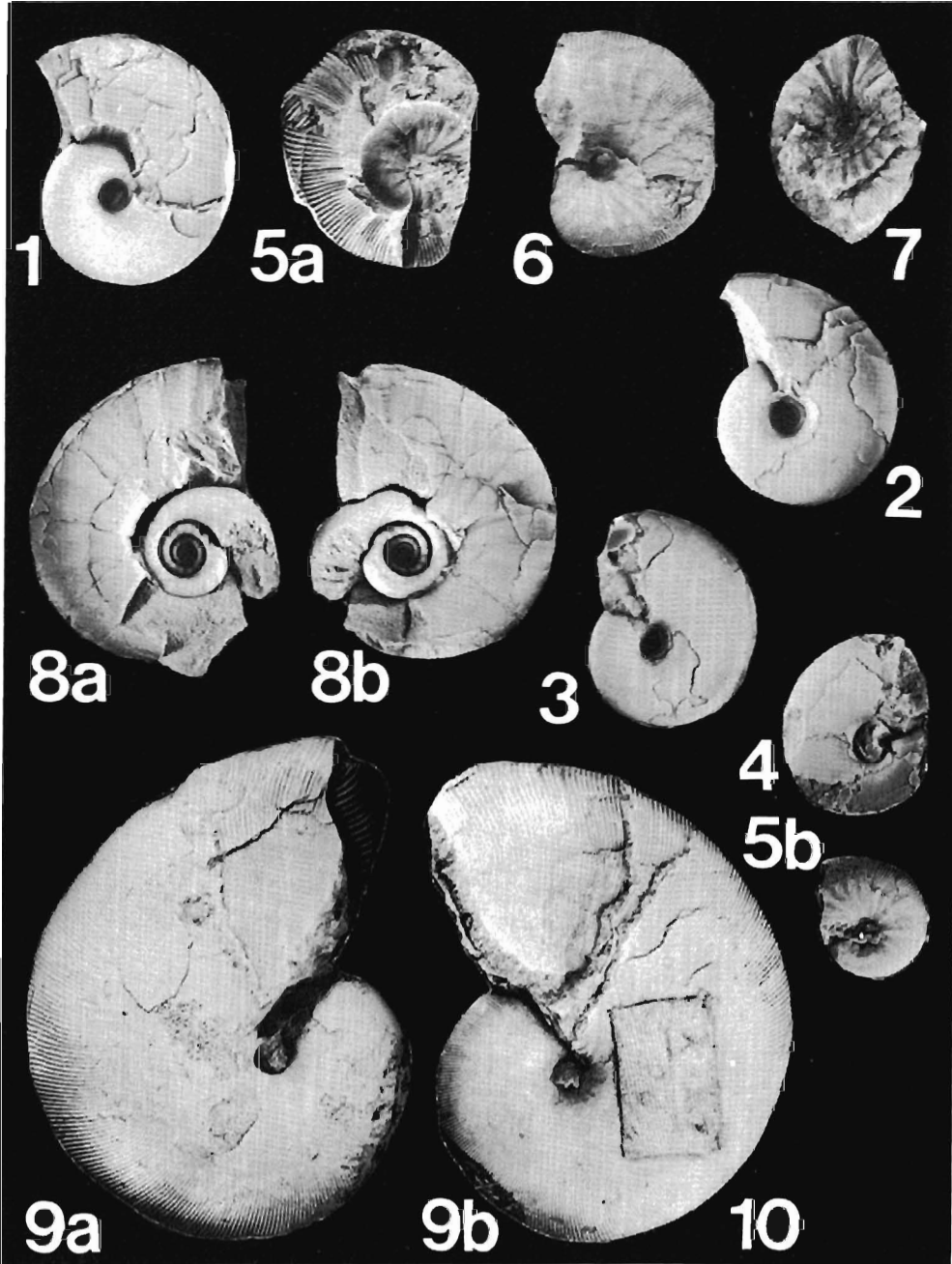
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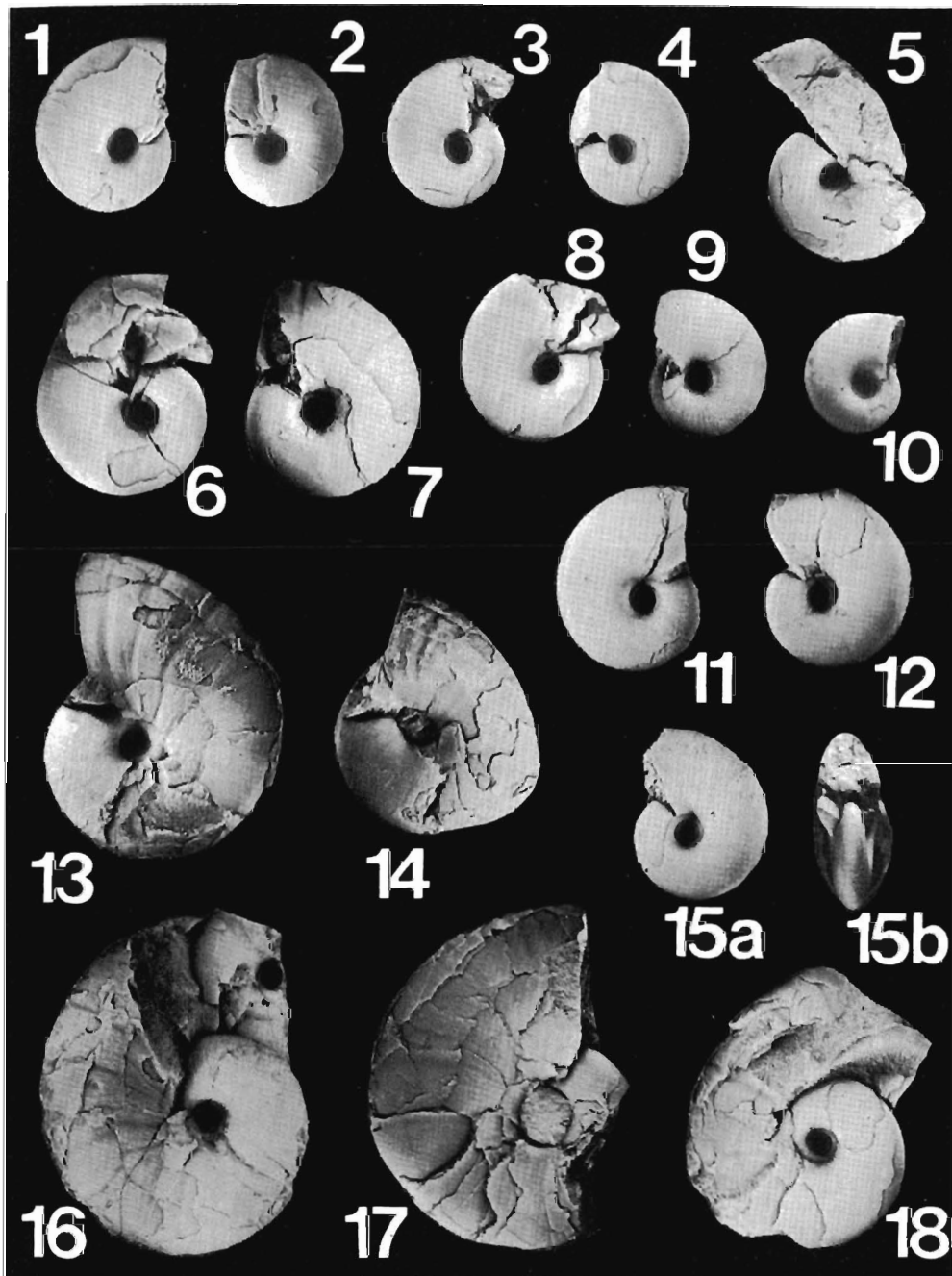
1-4 — *Zelandites japonicus* MATSUMOTO; 1 — Specimen No. 52/12769, 2 — No. 151/12769, 3 — No. 104/12769, 4 — No. 110/12769; West Sakhalin, Krasnoyarka section; Upper Maastrichtian, Z. japonicus Zone

5-7 — *Neophylloceras hetonaiense* MATSUMOTO; 5a-5b — Specimen No. 132/12769 (5a outer whorl, 5b nucleus), 6 — No. 24/12632, 7 — No. 17a/12632; East Sakhalin, Nerpichya section; Upper Maastrichtian, G. hamanakense Zone

8a-8b — *Zelandites oaruna* (FORBES); Specimen No. 100/12769; West Sakhalin, Pugachevka section; Upper Maastrichtian, G. hamanakense Zone

9-10 — *Neophylloceras ramosum* (MUEK); 9a-9b — Specimen No. 144/12769; NW Kamchatka, Niklekuyul section; Maastrichtian, P. neubergicus — P. gollevillensis Zone; 10 — Specimen No. 118/12769; West Sakhalin, Krasnoyarka section; Upper Maastrichtian, Z. japonicus Zone

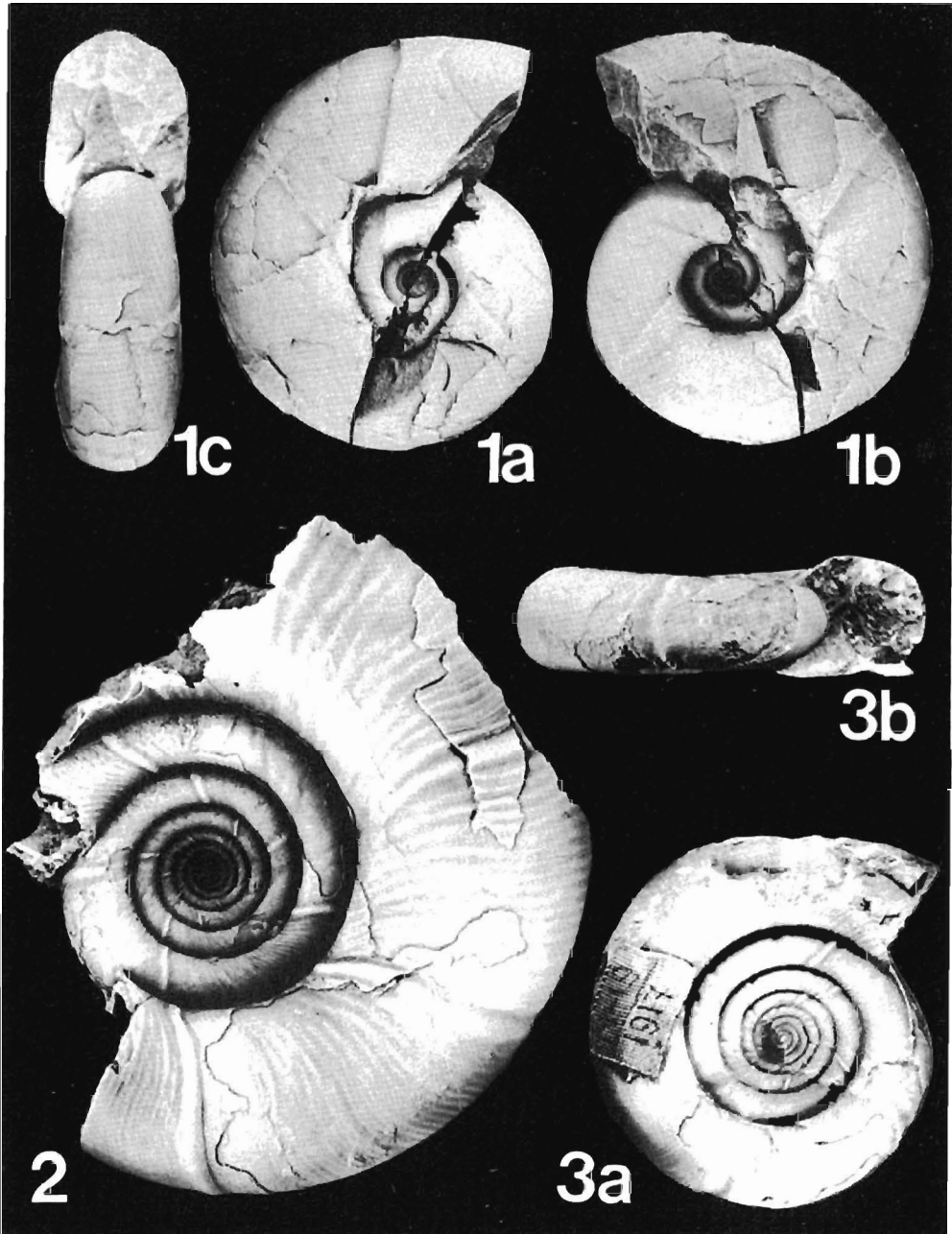
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Zelandites japonicus MATSUMOTO; West Sakhalin, Krasnoyarka section; Upper Maastrichtian, *Z. japonicus* Zone

1 — Specimen No. 121/12769, 2 — No. 120/12769, 3 — No. 108/12769, 4 — No. 111/12769, 5 — No. 113/12769, 6 — No. 86/12769, 7 — No. 127/12769, 8 — No. 148/12769, 9 — No. 121/12769, 10 — No. 122/12769, 11 — No. 149/12769, 12 — No. 105/12769, 13 — No. 125/12769, 14 — No. 106/12769, 15a-15b — No. 107/12769, 16 — No. 124/12769, 17 — No. 103/12769, 18 — No. 153/12769

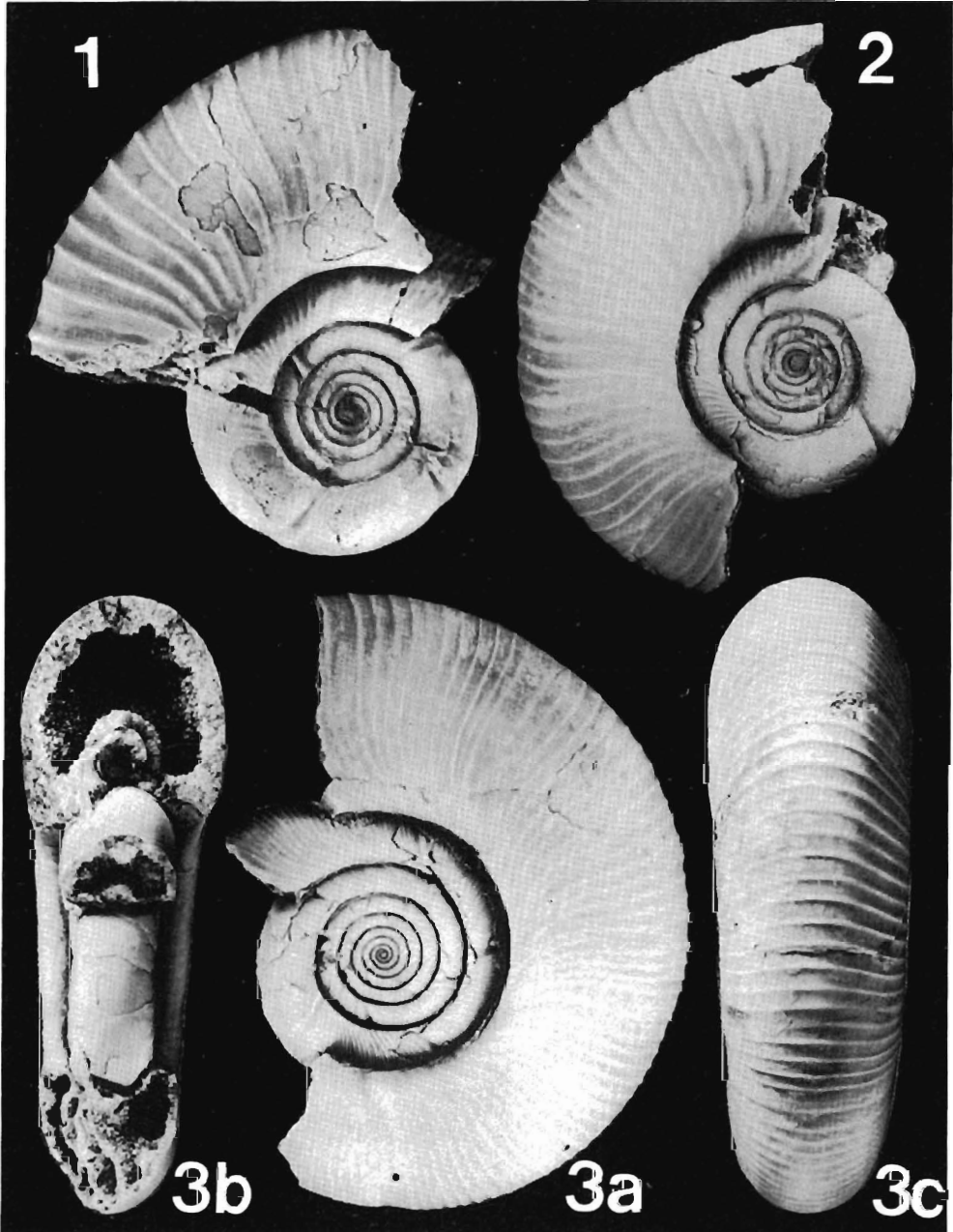
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1a-1c — *Tetragonites popetensis* YABE; Specimen No. 76/12769; West Sakhalin, Naiba section; Upper Campanian, T. popetensis Zone

2-3 — *Gaudryceras hamanakense* MATSUMOTO & YOSHIDA; 2 — Specimen No. 25/12632, 3a-3b — No. 26/12632; West Sakhalin, Makarova section; Upper Maastrichtian, G. hamanakense Zone

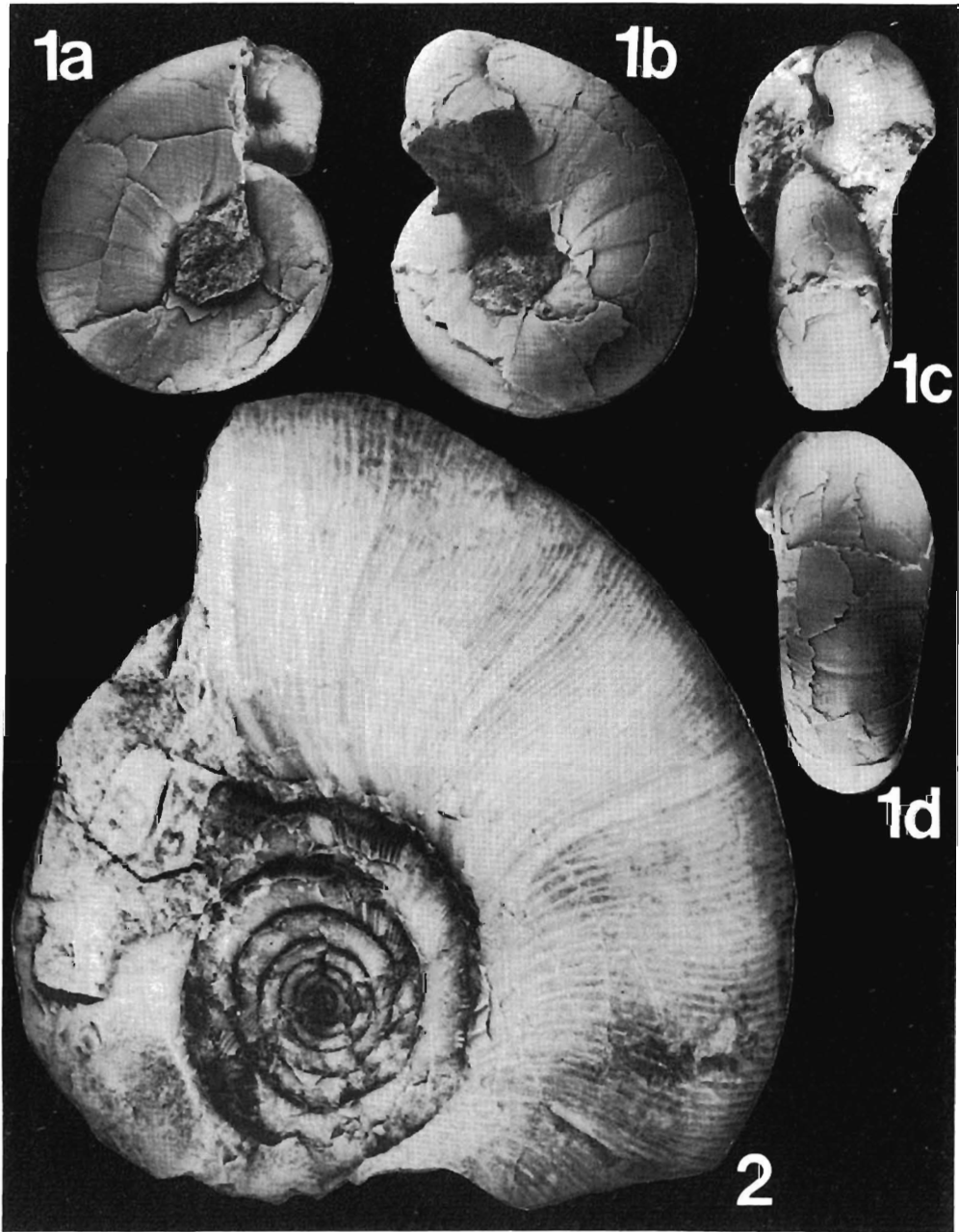
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Gaudryceras hamanakense MATSUMOTO & YOSHIDA; West Sakhalin, Pugachevka section; Upper Maastrichtian, *G. hamanakense* Zone

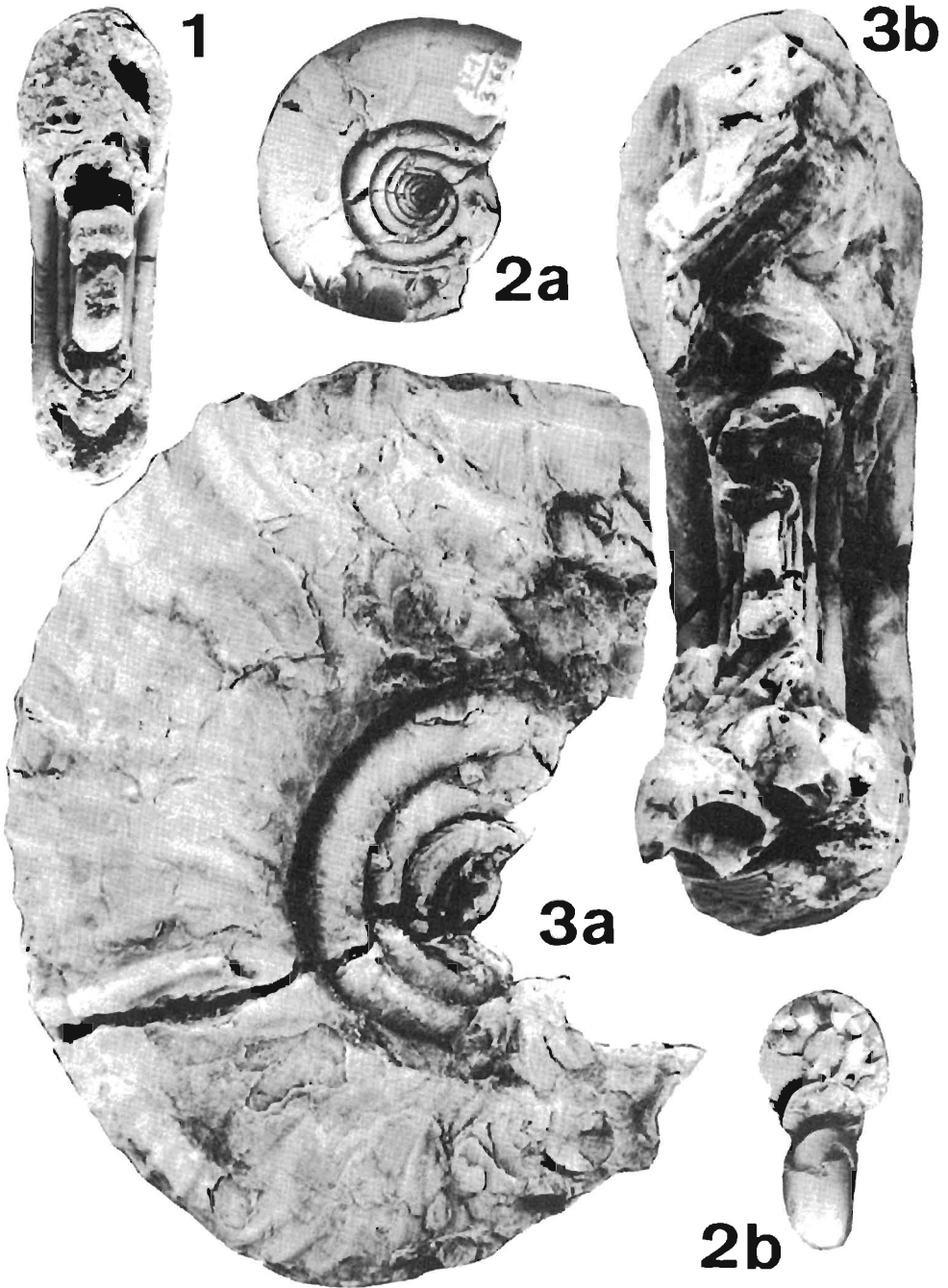
1 — Specimen No. 146/12769, 2 — No. 79/12769, 3a-3c — No. 137/12769

All figures in natural size



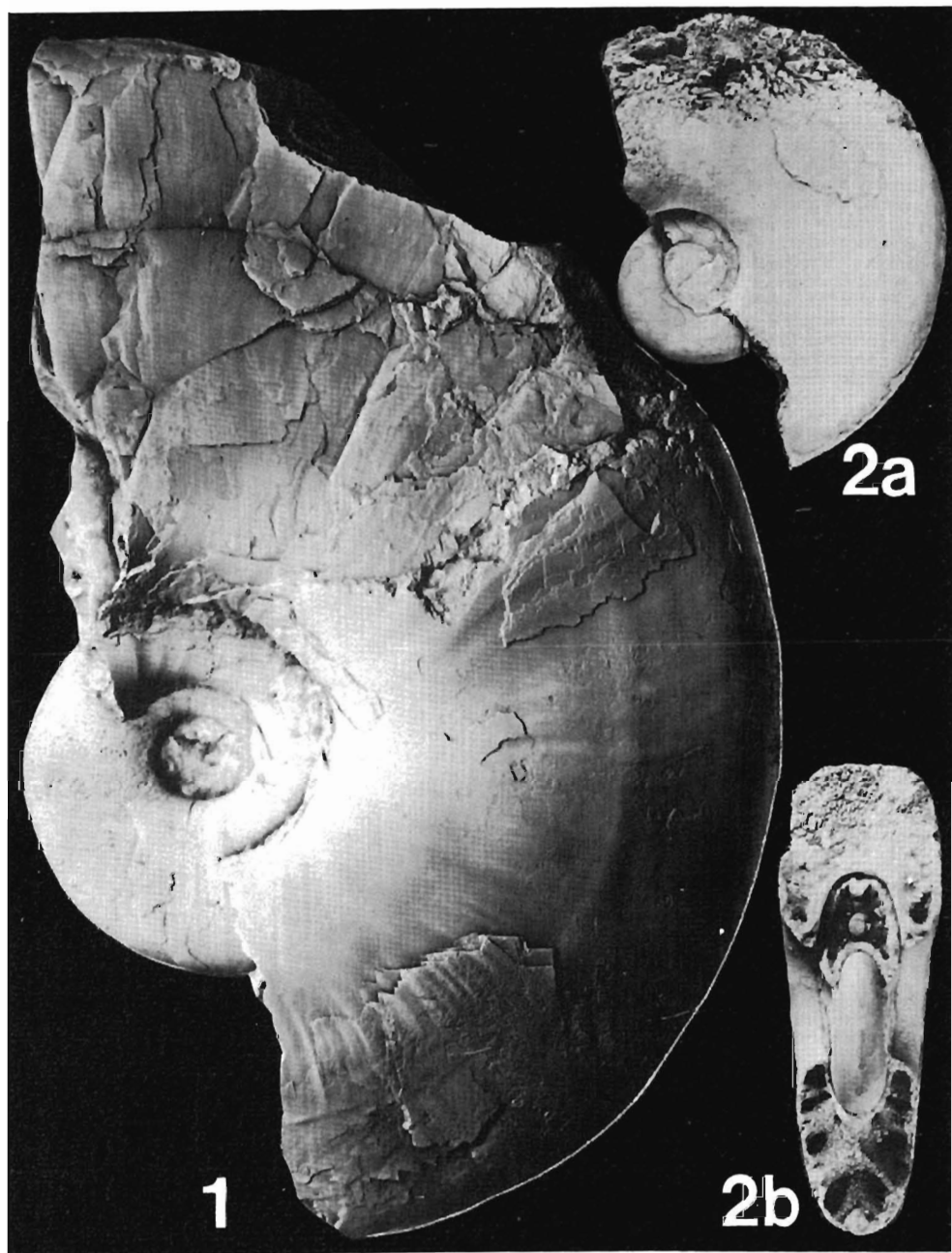
1a-1d — *Tetragonites epigonus* KOSSMAT; Specimen No. 96/12769; West Sakhalin, Nayba section; Lower Maastrichtian, P. (P.) subcompressus Superzone
2 — *Gaudryceras venustum* MATSUMOTO; Specimen No. 134/12769; West Sakhalin, Pugachevka section; Upper Maastrichtian, G. hamanakense Zone

All figures in natural size



1 — *Gaudryceras denmanense* WHITEAVES; Specimen No. 80/12769; East Sakhalin, Nerpichya section; Upper Maastrichtian, G. hamanakense Zone
 2-3 — *Gaudryceras hamanakense* MATSUMOTO & YOSHIDA; 2a-2b — Specimen No. 114/12769; West Sakhalin, Puhachevka section; Upper Maastrichtian, G. hamanakense Zone; 3a-3b — Specimen No. 133/12769; West Sakhalin, Krasnoyarka section; Upper Maastrichtian, G. hamanakense Zone

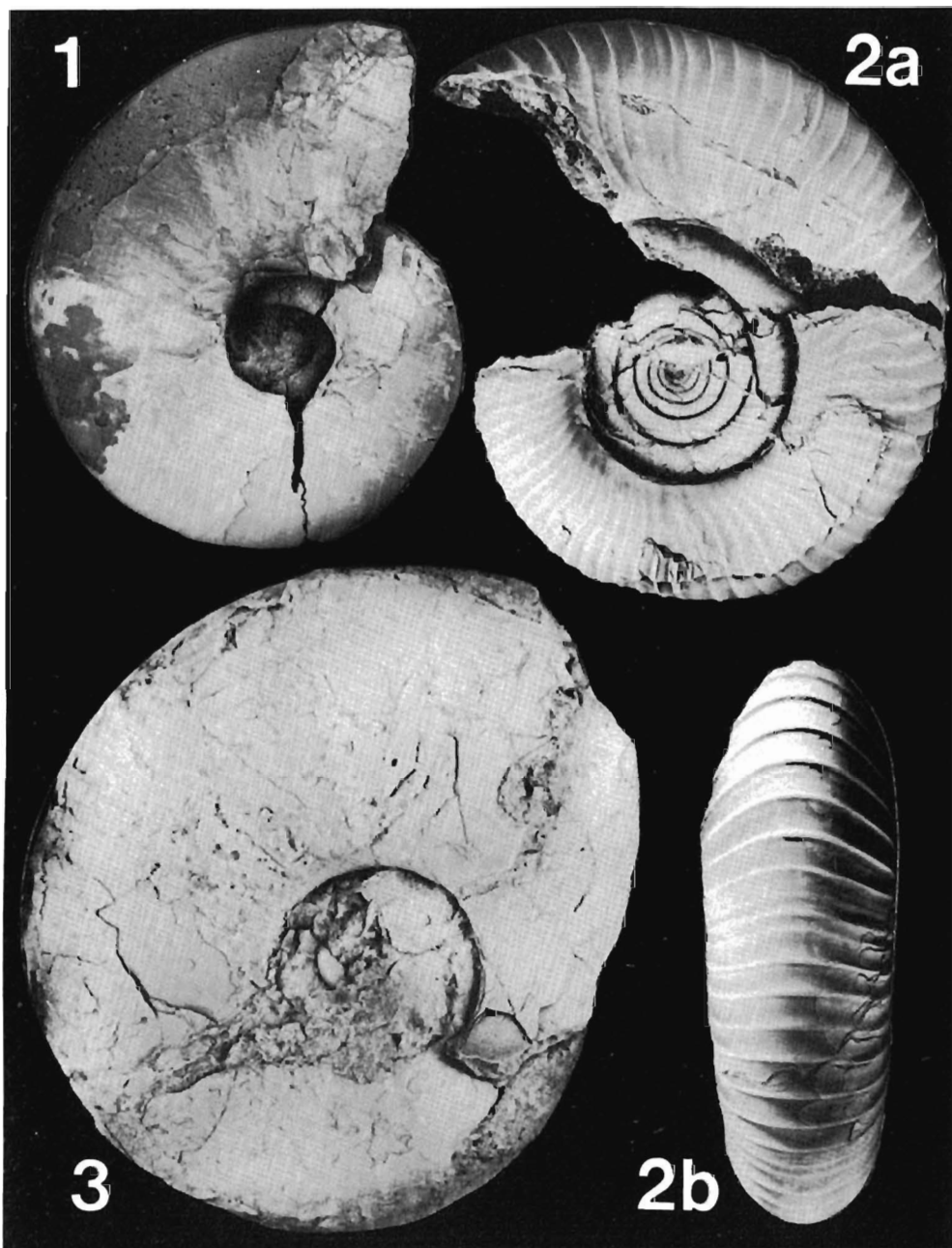
All figures in natural size



Pachydiscus (Neodesmoceras) japonicus MATSUMOTO

1 — Specimen No. 30/12769; West Sakhalin, Krilyon Peninsula, Gorbusha section; Lower Maastrichtian, P. (N.) japonicus Zone; 2a-2b — Specimen No. 90/12769; West Sakhalin, Manuy section; Lower Maastrichtian, P.(N.) japonicus Zone

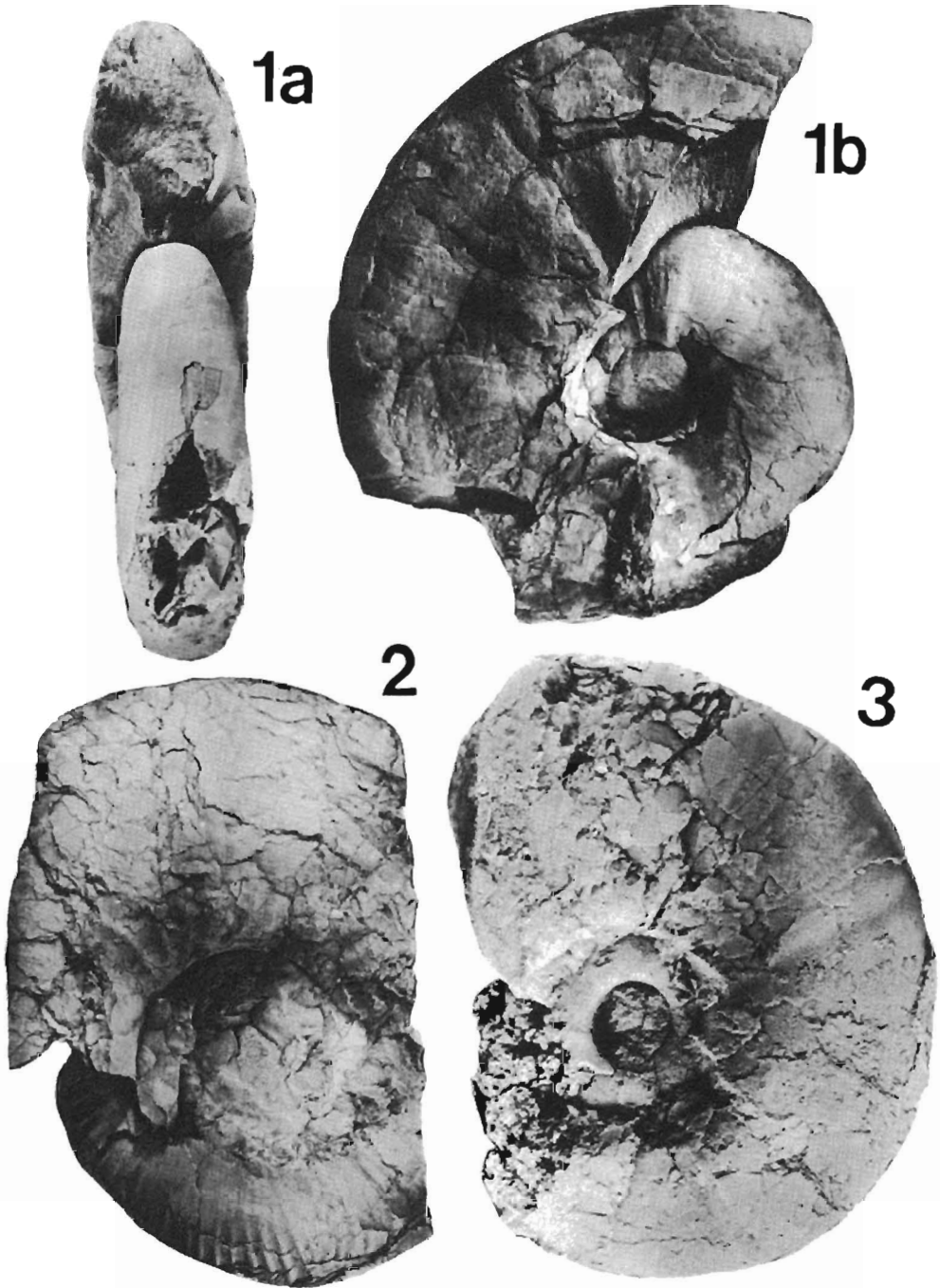
All figures in natural size



- 1 — *Pachydiscus (Pachydiscus) flexuosus* MATSUMOTO; Specimen No. 116/12769; West Sakhalin, Pugachevka section; Upper Maastrichtian, P.(P.) flexuosus - P.(N.) gracilis Zone; nat. size
- 2a-2b — *Gaudryceras denmanense* WHITEAVES; Specimen No. 123/12769; West Sakhalin, Pugachevka section; Upper Maastrichtian, G. hamanakense Zone; nat. size
- 3 — *Pachydiscus (Pachydiscus) subcompressus* MATSUMOTO; Specimen No. 145/12769; West Sakhalin, Makarova section; Maastrichtian, P.(P.) subcompressus Superzone; $\times 0.5$



1 — *Pachydiscus (Pachydiscus) flexuosus* MATSUMOTO; Specimen No. 116/12769; West Sakhalin, Pugachevka section; Upper Maastrichtian, P.(P.) flexuosus — P.(N.) gracilis Zone
 2 — *Patagiosites alaskensis* JONES; Specimen No. 143/12769; NW Kamchatka; Lower Maastrichtian, P. kamishakensis Zone
 3a-3b — *Pachydiscus (Neodesmoceras) japonicus* MATSUMOTO; Specimen No. 97/12769; West Sakhalin, Manuy section; Lower Maastrichtian, P.(N.) japonicus Zone
 All figures in natural size

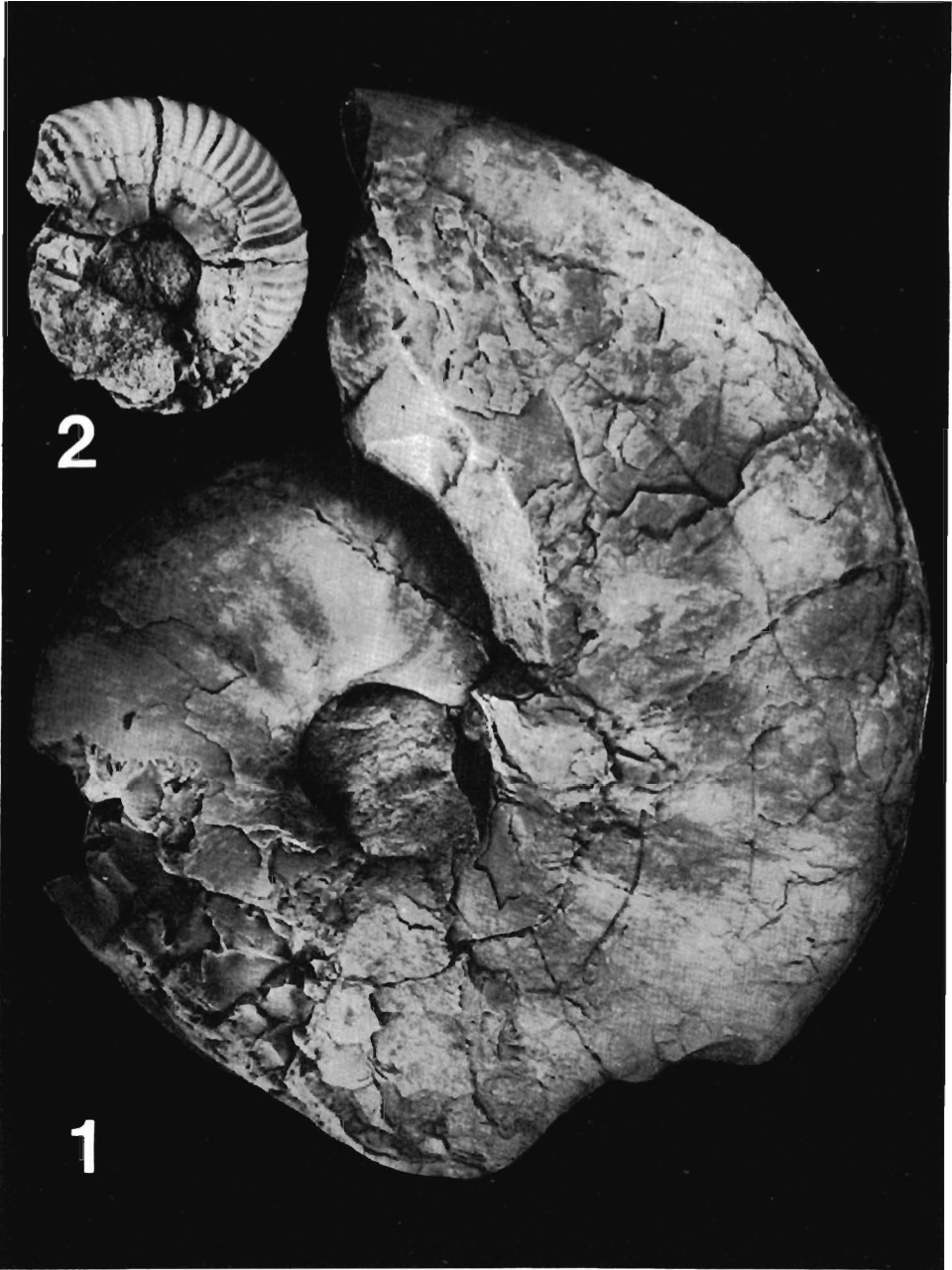


1 — *Pachydiscus (Pachydiscus) flexuosus* MATSUMOTO; Specimen No. 87/12769; West Sakhalin, Manuy section; Upper Maastrichtian, P.(P.) flexuosus — P.(N.) gracilis Zone; $\times 0.35$
 2-3 — *Pachydiscus (Pachydiscus) subcompressus* MATSUMOTO; 2 — Specimen No. 81/12769; West Sakhalin, Nayba section; Maastrichtian, P.(P.) subcompressus Superzone; $\times 0.35$; 3 — Specimen No. 93/12769; West Sakhalin, Makarova section; Maastrichtian, P.(P.) subcompressus Superzone; $\times 0.65$



1a-1b — *Canadoceras multicostratum* MATSUMOTO; Specimen No. 115/12769; West Sakhalin, Krilyon Peninsula, Gorbusha section; Lower Maastrichtian, P.(N.) japonicus Zone; nat. size

2 — *Pachydiscus (Pachydiscus) gollevillensis* (D'ORBIGNY); Specimen No. 83/12769; West Sakhalin, Nayba section; Upper Maastrichtian, P.(P.) flexuosus — P.(N.) gracilis Zone; × 0.5



1 — *Pachydiscus (Pachydiscus) flexuosus* MATSUMOTO; Specimen No. 87/12769; West Sakhalin, Manuy section; Upper Maastrichtian, P.(P.) flexuosus — P.(N.) gracilis Zone; $\times 0.5$

2 — *Canadoceras multicostatum* MATSUMOTO; Specimen No. 115/12769; West Sakhalin, Krilyon Peninsula, Gorbusha section; Lower Maastrichtian, P.(N.) japonicus Zone; nat. size



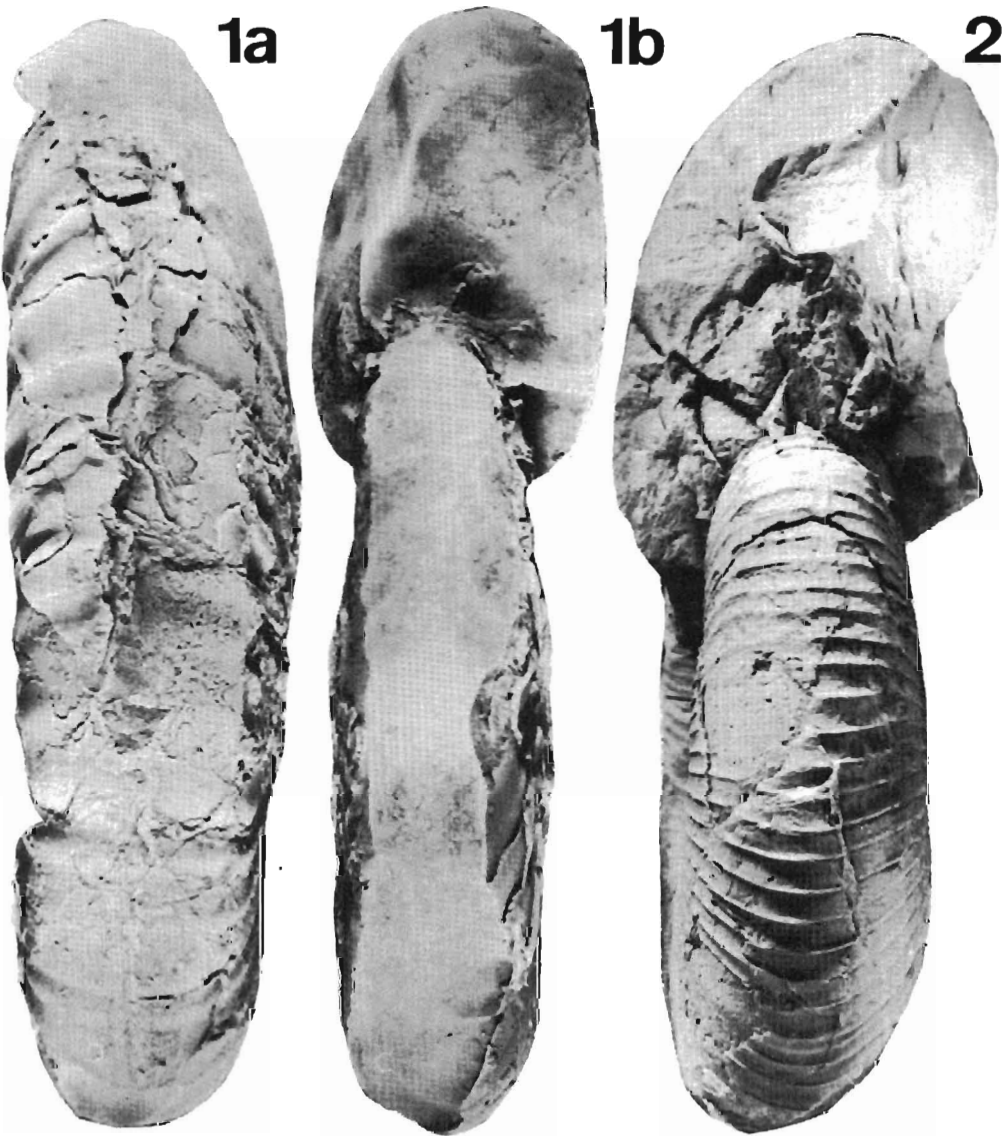
1 — *Pachydiscus (Pachydiscus) neubergicus* (HAYES); Specimen No. 138/12769; West Sakhalin, Pugachevka section; Upper Maastrichtian, P.(P.) flexuosus — P.(N.) gracilis Zone; $\times 0.7$

2 — *Pachydiscus (Pachydiscus) subcompressus* MATSUMOTO; Specimen No. 89/12769; West Sakhalin, Krilyon Peninsula, Kura section; Maastrichtian, P.(P.) subcompressus Superzone; $\times 0.7$



Gaudryceras venustum MATSUMOTO

Specimen No. 134/12769; West Sakhalin, Pugachevka section; Upper Maastrichtian, *G. hamana-*
kense Zone; nat. size



1a-1b — *Pachydiscus (Pachydiscus) subcompressus* MATSUMOTO; No. 92/12769, West Sakhalin, Makarova section; Maastrichtian, *Pachydiscus subcompressus* Superzone

2 — *Gaudryceras venustum* MATSUMOTO; Specimen No. 134/12769; West Sakhalin, Pugachevka section; Upper Maastrichtian, *G. hamanakense* Zone

All figures in natural size



Pachydiscus (Pachydiscus) subcompressus MATSUMOTO

Specimen No. 92/12769; West Sakhalin, Makarova section; Maastrichtian, P.(P.) subcompressus Superzone; nat. size



Pachydiscus (Pachydiscus) subcompressus MATSUMOTO

Specimen No. 88/12769; West Sakhalin, Pugachevka section; Upper Maastrichtian, P.(P.) flexuosus — P.(N.) gracilis Zone; nat. size



Pachydiscus (Pachydiscus) subcompressus MATSUMOTO

1a-1b — Specimen No. 88/12769; West Sakhalin, Pugachevka section; Upper Maastrichtian, P.(P.)
flexuosus — P.(N.) gracilis Zone; nat. size



Pachydiscus (Neodesmoceras) gracilis MATSUMOTO

Specimen No. 114/12769; West Sakhalin, Pugachevka section; Upper Maastrichtian, P.(P.)
flexuosus — P.(N.) gracilis Zone; nat. size



1-2 — *Pachyliscus (Neodesmoceras) gracilis* MATSUMOTO; 1 — Specimen No. 17/12632; Kamchatka, Penzhina section; Maastrichtian, P. neubergicus — P. gollevillensis Zone; 2a-2b — Specimen No. 20/12832; Kamchatka, Inajveen section; Upper Maastrichtian, P. neubergicus — P. gollevillensis Zone; × 0.95

3 — *Patagiosites alaskensis* JONES; Specimen No. 143/12769; Kamchatka, Penzhina section; Lower Maastrichtian, P. kamischakensis Zone; × 0.95