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Jurassic Radiolarians and Age of Cherty Rocks in the Povorotnyi Cape, the Taigonos Peninsula (Northeast Russia)

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Abstract—Radiolaria-based dating of chert intercalations in basaltic sequences of ophiolitic associations, which are widespread in the west of circum-Pacific foldbelt being barren of macrofossils, is an important source of information about tectonic events and factors responsible for opening and destruction of basins floored by oceanic crust and for emplacement of relevant tectonic sheets into accretionary prisms and orogenic structures. Described in the work are the Middle (Bajocian–Callovian), Middle–Late (Callovian–Oxfordian) and Late Jurassic (Kimmeridgian–Tithonian) radiolarian assemblages. According to taxonomic composition and morphology of radiolarian tests, the first assemblage is of the North Tethyan type, while the other two are of the Boreal affinity.

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Key words: Jurassic, radiolarians, volcanogenic–cherty deposits, accretionary complex, Taigonos Peninsula.

INTRODUCTION

An achievement of radiolarian stratigraphy is opportunity to date Mesozoic cherty deposits barren of macrofossils and intercalated with volcanics of ophiolitic associations widespread in the west of circum-Pacific foldbelt (*Practical Manual…*, 1999). In tectonic accretionary complexes subjected to recurrent horizontal and vertical movements, ophiolites are commonly delaminated, and cherty–volcanogenic sequences are frequently detached from their basement. Because of tectonic deformations and imbrication, accretionary prisms incorporate ophiolitic terranes, which are composed of tectonic sheets and slices of rocks derived from fore-arc zones and back-arc basins, the cherty deposits of a considerable age range included. Tectonic packets of these rocks used to be interpreted as stratigraphic successions dated often conventionally based on age extrapolations and lithostratigraphic correlation with comparable rock complexes in adjacent regions.

Current methods of separating and identifying radiolarians from deep-water deposits associated with pillow lavas yield important information about tectonic events and factors responsible for opening and destruction of basins floored by oceanic crust and for emplacement of relevant tectonic sheets into accretionary prisms and orogenic structures. This approach appears reasonably suitable for investigation of the Mesozoic cherty–volcanogenic complexes in the West Koryak fold system, a classical area of deformed accretionary prisms with fragmented rock complexes derived from lithosphere of fore-arc and back-arc basins and from the Late Paleozoic–Mesozoic (pre-Albian) island-arc ensemble (Sokolov et al., 2003). In the southwestern part of that fold system (Penzhinskii Ridge, Pribrezhnyi belt of the Taigonos Peninsula), thick packets of tectonic sheets composed of basalts with chert intercalations are attributed according tradition to the Kingiveem Formation of the upper Tithonian–Berriasian, dated based on radiolarians studied in petrographic thin sections and macrofossils found occasionally. However, radiolarian assemblages extracted by maceration from cherty rocks of the "Kingiveem Formation" and studied in detail beginning since the 1990s turned out to be ranging in age from the Late Permian to Valanginian (Grigor'ev et al., 1992; Chekhov and Palandzhan, 1994; Kemkin et al., 1996; Vishnevskaya et al., 1998). These results and comprehensive geological survey in several areas (area of Kuyul tectonic complex, Povorotnyi Cape, Elistratov Peninsula) showed that ophiolitic terranes are of a much more complex structure than it was thought before after regional geological survey.

The Povorotnyi Cape is an area of the Taigonos Peninsula, where accretionary complex of the Pribrezhnyi belt is very representative (Sokolov et al., 2001). Cherty–clayey deposits in sequences of the "Kingiveem" type have been attributed here to the Late Triassic, different Jurassic ages, and to the Early Cretaceous. The known dating results characterize mostly rocks from coastal outcrops of large tectonic blocks of basalts with chert intercalations. Large erratic blocks and tectonic slices, which are composed of the same rocks and occur in serpentinite melange away from the coastline in the watershed reaches, remain unstudied so far. Accordingly, the main objective of this work was to continue investigations initiated by Kemkin et al.

(1996) and aimed at study of microfauna in cherty rocks from melange in order to compare radiolarian assemblages from different structural units of the accretionary complex.

During his fieldwork of 2003 in the Povorotnyi Cape area, Palandzhan collected 28 samples of cherty and terrigenous rocks, which have been studied. After petrographic examination and preliminary analysis, radiolarians of different preservation state have been chemically macerated from the rocks and identified (Tables 1, 2). They represent three assemblages of the Middle (Bajocian–Callovian), Middle–Late (Callovian–Oxfordian) and Late Jurassic (Kimmeridgian–Tithonian) ages (Table 1, Plates I–VII), which are described below and used to date their host deposits.

REGIONAL GEOLOGY

In the Povorotnyi Cape area, there is exposed a complicated packet of tectonic sheets and slices, which are composed of ophiolitic rocks, flyschoid and olistostrome deposits (figure). In terms of geodynamics, the Late Paleozoic–Early Cretaceous tectonic history of the study area was controlled by development of the Koni–Taigonos and Uda–Murgal island arcs (Sokolov et al., 2003). In the eastern zone, there are exposed thick tectonic sheets of "Kingiveem"-type rocks (abyssal pillow basalts, radiolarian jaspers, and shales) and a part of the Main Melange with large erratic blocks and tectonic slices of basalts with chert intercalations. The Upper Jurassic to Lower Cretaceous boninites, basalts, andesites, and volcaniclastic turbidites, which originated in paleobasins of an island-arc ensemble, are exposed in westerly areas. Judging from results of petrographic examination and geochemical analysis (Konstantinovskaya, 1998; Silantyev et al., 2000), cherty–volcanogenic sequences could be deposited in abyssal zone of a marginal sea or oceanic basin.

Tectonic sheets and blocks of the "Kingiveem"-type rocks are of a very complex structure. These are complicatedly imbricated fragments of identical sequences composed of pillow basalts interacted with rhythmically bedded red to cherry-red and yellow radiolarian jaspers, shales, and occasional lenses or fragmented lenticular beds of light-colored limestones. It is impossible to reconstruct a composite succession of these rocks. Concrete sections, composition and geological relations of their rocks are described in a series of works (Kemkin et al., 1996; Konstantinovskaya, 1998; Silantyev et al., 2000). Radiolarians from cherty rocks of the Povorotnyi Cape area have been studied by V.T. Krymsalova (Chekhov and Palandzhan, 1994), I.V. Kemkin (Kemkin et al., 1996), V.S. Vishnevskaya (Vishnevskaya et al., 1998) and I.E. Pral'nikova (2000). These researchers described the Late Triassic, Early Jurassic (Toarcian, probably Toarcian–Aalenian), Middle Jurassic, Middle–Late Jurassic (Callovian–Oxfordian), Late Jurassic and Late Jurassic–Early Cretaceous (Tithonian–Berriasian) radiolarian assemblages from different tectonic sheets of the "Kingiveem"-type rocks (traditionally designated by symbols KN-1 to KN-4). In addition, N.Yu Bragin (Belyi and Akinin, 1985) and Vishnevskaya (1998) identified the Bathonian–early Callovian, late Kimmeridgian, and Valanginian radiolarian assemblages in the Elistratov Peninsula, the northeastern continuation of the Pribrezhnyi ophiolite belt. Further northeastward, in the Penzhinskii Ridge (Kuyul ophiolite terrane), Grigor'ev et al. (1992) detected the Late Permian, Middle Triassic, Late Triassic–Middle Jurassic and Late Jurassic radiolarians in former stratotype sections of the Kingiveem Formation.

Thus, cherty–volcanogenic deposits of the "Kingiveem" type correspond in fact to tectonically juxtaposed fragments of sequences, which are of "oceanic" affinity, different in age, and represented by dissimilar facies. It is important that radiolarians of different ages are established in rocks of one tectonic sheet. For instance in the small tectonic sheet KN-1 exposed in the Povorotnyi Cape extremity, radiolarian jaspers and shales range in age from the Late Triassic to Berriasian inclusive.

Consequently, it is important to study comparative geochronology of the "Kingiveem"-type radiolarites in different tectonic sheets and their fragments set in serpentinite melange. Radiolarite samples studied in this work are collected from two largest tectonic elements of the Povorotnyi Cape area: from sheet KN-4 (Sample T123/1) and from the Main serpentinite melange. In the last case, they characterize a chert intercalation in basalts of a large block surrounded by serpentinite matrix (Sample T133/1) and cherty shales of a tectonic slice about 1 km long (Sample T101/4) that is juxtaposed with slices of metamorphic schists (Figure).

JURASSIC RADIOLARIAN ASSEMBLAGES

The Bajocian–Callovian radiolarian assemblage (Sample T123/1, tectonic sheet KN-4) is represented by *Pantanellium* cf. *riedeli* Pessagno, *Praeconocaryomma immodica* Pessagno et Poison, *Xiphostylus* ex gr. *gasquetensis* Pessagno et Yang, *Archaeodictyomitra* cf. *prisca* Kozur et Mostler, *Archaeodictyomitra* sp. C, *Hsuum* sp. cf. *H.* busuangaense Yeh et Cheng, *Hsuum* sp. G, *Lupherium* ex gr. *officerense* Pessagno et Whalen, *Lupherium* sp. C, *Higumastra inflata* Baumgartner, *Higumastra* ex gr. *devilsgapensis* Pessagno, Blome et Hull, *Tetraditryma pseudoplena* Baumgartner, *Homoeoparonaella* sp., *Tritrabs* sp., *Archaeohagiastrum* sp., *Angulobracchia* sp., *Emiluvia* sp., *Paronaella* ex gr. *mulleri* Pessagno, *Stichocapsa* aff. *convexa* Yao, *Tricolocapsa* sp., *Syringocapsa* sp., *Bernoullius ?* sp., and *Actinomma ?* sp. (Tables 1, 2, Plates I–IV).

The assemblage studied is diverse and very specific, containing abundant representatives of Pantanellidae (up to 60% in the sample) with well-preserved deli-

Table 1. Jurassic radiolarians from cherty rocks of the Taigonos Peninsula

Sample no.	Radiolarian taxa	J_2				J_3			K_1	
		aal.	baj.	bat.	cal.	oxf.	kim.	tit.	ber.	val.
T123/1	*Pantanellium* cf. *riedeli* Pessagno									
	Praeconocaryomma immodica Pess. et Poison									
	Xiphostylus ex gr. *gasquetensis* Pess. et Yang									
	Stichocapsa aff. *convexa* Yao									
	Tricolocapsa sp.									
	Syringocapsa sp.									
	Archaeodictyomitra cf. *prisca* Kozur et Mostler									
	Archaeodictyomitra cp. C									
	Lupherium ex gr. *officerense* Pess. et Whalen									
	Lupherium sp. C									
	Hsuum cf. *busuangaense* Yeh et Cheng									
	Hsuum sp. G									
	Higumastra inflata Baumgartner									
	Higumastra ex gr. *davilsgapensis* Pess., Bl. et Hull									
	Tetraditryma pseudoplena Baumgartner									
	Paronaella ex gr. *mulleri* Pessagno									
	Tritrabs sp.									
	Archaeohagiastrum sp.									
	Angulobracchia sp.									
	Bernoullius ? sp.									
	Actinomma ? sp.									
T133/1	*Parvicingula* cf. *vera* Pessagno et Whalen									
	Parvicingula elegans Pessagno et Whalen									
	Tricolocapsa sp. A									
	Archaeodictyomitra sp.									
	Bagotum ? sp.									
T101/4	*Stichocapsa convexa* Yao									
	Gongylothorax favosus Dumitrica									
	Tricolocapsa sp.									
	Stichocapsa sp. B									
	Archaeodictyomitra cf. apiara (Rüst)									
	Archaeodictyomitra (?) sixi Yang									
	Thanarla ex gr. *conica* (Aliev)									
	Parvicingula ex gr. *boesii* (Parona)									
	Loopus ex gr. *primitivus* (Matsuoka et Yao)									
	Windalia sp.									
	Pseudoristola sp.									
	Stichomitra ? sp.									
	Paronaella ? sp.									
	Actinommidae gen. et sp. indet.									
	Spongodiscidae gen. et sp. indet.									
	Hagiastridae gen. et sp. indet.									

Note: Age ranges of assemblages are shaded; (aal) Aalenian; (baj) Bajocian; (bat) Bathonian; (cal) Callovian; (oxf) Oxfordian; (kim) Kimmeridgian; (tit) Tithonian; (ber) Berriasian; (val) Valanginian.

Table 2. Taxonomic composition of radiolarians in the studied rock samples from the Taigonos Peninsula

Radiolarian taxa	Sample numbers										
	T101/3	T115/2	T116/2	T116/4	T117/1	T117/2	T123/4	T124/1	T124/2	T128/3	T134/1
Archaeodictyomitra cf. apiara (Rüst)	+										
Archaeodictyomitra sp.			+								
Thanarla sp.							?				
Parvicingula sp.	+	+	+					+	+	?	+
Cryptamphorella sp.	+		+				+				
Stichocapsa sp.	+										
Sethocapsa sp.		+									
Syringocapsa sp.		+									
Stichomitra sp.	+					?					
Praeconocaryomma sp.		+									
Orbiculiforma sp.	+		+				+				+
Archaeospongoprunum sp.		?									
Crucella sp.	+	+	+				+	+			
Paronaella sp.	+	+	+		?		+		+	+	+
Bagotum sp.			?								
Xitus sp.					+	?	+		?		
Williridelidae gen. et sp. indet.		+						+	+		
Archaeodictyomitridae gen. et sp. indet.							+				
Actinommidae gen. et sp. indet.		+									
Spongodiscidae gen. et sp. indet.				+							
Hagiastridae gen. et sp. indet.						+					
Nassellaria				+							
Sponges spicules	+										+

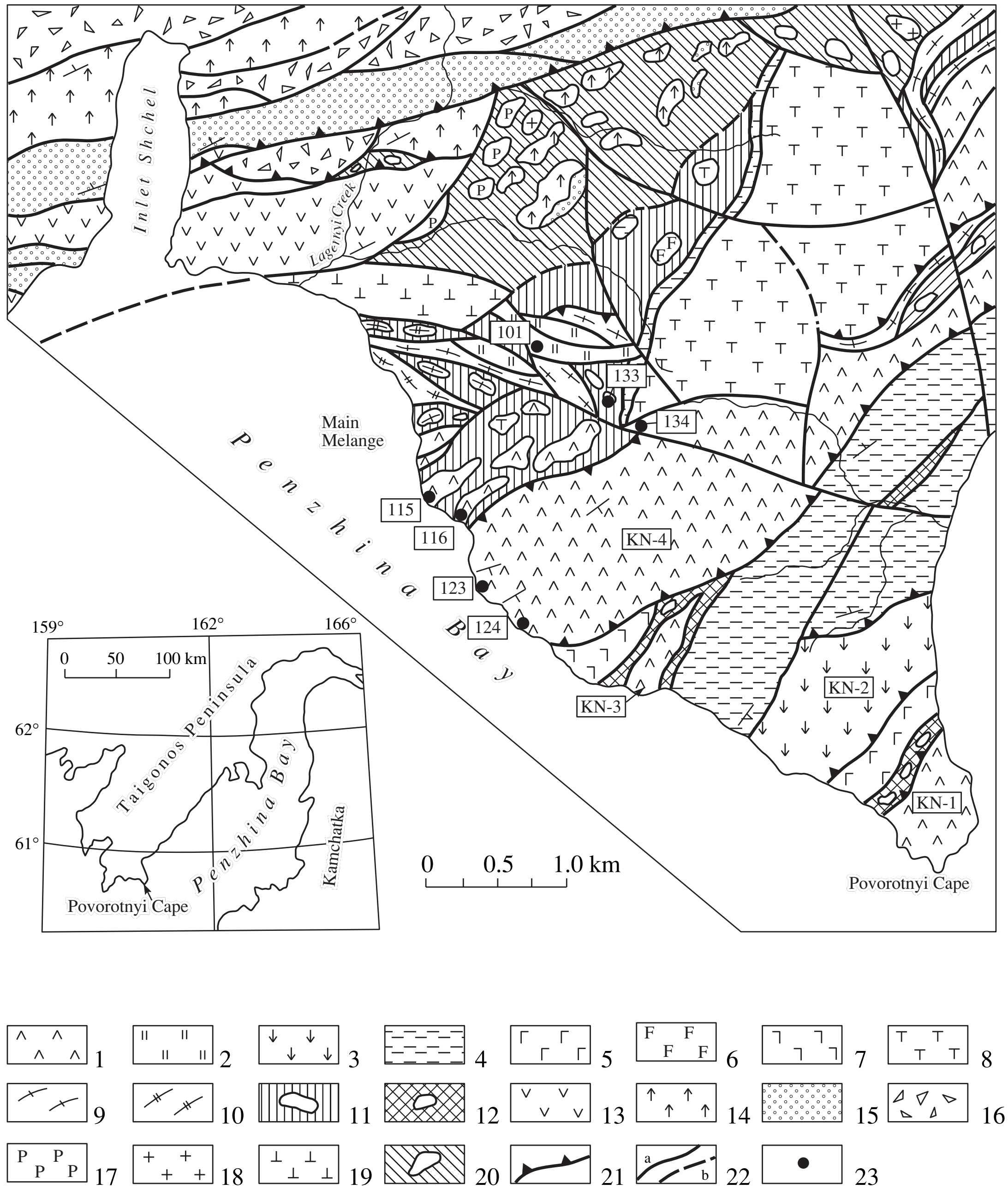
Note: Shaded boxes denote radiolarian taxon present in rock samples.

cated tests and numerous spines. High-conical tests of genera *Hsuum* and *Lupherium* are also quite diverse.

In its general composition, the described assemblage is most close to the Bajocian assemblage from Oregon (Yeh, 1987; Yang, 1995), where the following species in common have been described: *Lupherium officerense* Pessagno et Whalen, *Hsuum* cf. *busuangaense* Yeh et Cheng, *Archaeodictyomitra prisca* Kozur et Mostler, *Pantanellium* cf. *riedeli* Pessagno, *Higumastra inflata* Baumgartner, *H.* aff. *devilsgapensis* Pessagno, Blome et Hull, *Tritrabs* sp., *Angulobracchia* sp., and *Xiphostylus* sp. In terms of paleogeography, the Bajocian radiolarian assemblage of Oregon is of the North Tethyan type (Pessagno et al., 1987a, 1993; Yang, 1995). It is dominated by pantanellids occurring in association with parvicingulids. Consequently, the Bajocian–Callovian assemblage that has been studied can be attributed to the North Tethyan type.

Vishnevskaya et al. (1998) described the Bathonian–early Callovian assemblage of *Stichocapsa globosa* Vishnevskaya, *S. robusta* Matsuoka, *Tricolocapsa* sp., *Archaeodictyomitra elliptica* Vishnevskaya and other forms from cherty rocks of tectonic block KN-1, the Povorotnyi Cape area, and noted that it is similar in composition to Middle Jurassic radiolarians from the Kingiveem Formation of the Omgon Cape in the western Kamchatka. However, the Middle Jurassic radiolarians from block KN-4 differ in composition from assemblages of the Omgon area (Vishnevskaya et al., 2005).

Comparing our assemblage with the Middle Jurassic assemblages described by Kemkin et al. (1996) from cherty rocks of erratic boulders and tectonic sheets of the Main Melange in the Povorotnyi Cape area, we should mention several characteristics in common. Representatives of genera *Hsuum, Parahsuum* and *Lupherium* are rather diverse in both cases. These are *Hsuum hisuikyoense* Isozaki et Matsuoka, *H. medium* (Takemura), *H. parasolense* Pessagno et Whalen, *Parahsuum levicostatum* Takemura, and *P.* cf.



Geological map of the Povorotnyi Cape area (compiled by S.A. Palandzhan with allowance for data of G.E. Bondarenko, O.L. Morozov, S.D. Sokolov, and A.D. Chekhov). Rock complexes of back-arc (and/or oceanic) lithosphere: (1) Mesozoic chert-basaltic sequences T_3, J_1, J_2, J_{2-3}, J_3–K_1b; (2) cherty rocks J_2–J_3; (3) basalts, high-Mg andesites (pillow lavas, lava breccias), tuffs, intercalations of volcaniclastic sandstones and siltstones, dolerite dikes, J_3 km–tt; (4) polymictic turbidites of the Povorotnyi Cape and watershed reach, J_2b–J_3^1k; (5) cumulative leucogabbro, olivine gabbro, microgabbro; (6) amphibole gabbro; (7) gabbro-diabase; (8) lherzolite, Greben massif; (9) metamorphic rocks of greenschist facies; (10) amphibolite, garnet amphibolite; (11) serpentinite melange with apolherzolite matrix, tectonic slices and erratic blocks of rocks listed above; (12) serpentinite melange of the Povorotnyi Cape (erratic blocks of cherts, volcanics and gabbroids). Island-arc rock complexes: (13) boninites, andesites, basaltic andesites and basalts with intercalations of siltstones and sandstones; (14) high-Ti basalts, calc-alkaline and subalkaline andesites and basaltic andesites; (15) volcaniclastic and polymictic turbidites; (16) tectono-gravitational mixtites (olistostrome, gravelstones, sandstones and siltstones), age of rock complexes 13–16 J_3km–K_1vg (?); (17) rodingite after gabbro, gabbro-norite; (18) plagiogranite; (19) harzburgite, diopside harzburgite, chromite-bearing dunite (Beregovoi massif). Other complexes and symbols: (20) serpentinite melange of the Lagernyi Creek (apoharzburgite matrix with inclusions of rock types 13–19); (21) normal and thrust faults; (22) reversed and strike-slip faults proved (a) and presumable (b); (23) sampling sites and their numbers. Blocks in melange zones are shown out of scale. The inset map illustrates geographic locality of the Povorotnyi Cape; tectonic sheets KN-1 to KN-4 are composed of the "Kingiveem"-type rocks.

magnum Takemura described by Kemkin, while *Hsuum sp.* cf. *H. busuangaense* Yeh et Cheng, *Hsuum* sp. G.), *Lupherium* ex gr. *officerense* Pessagno et Whalen, and *Lupherium* sp. C are present in our assemblage. The listed taxa occur in association with genera *Tricolocapsa* (*Tricolocapsa* aff. *yaoi* Matsuoka, *T.* aff. *conexa* Matsuoka) and *Stichocapsa* (*Stichocapsa* aff. *convexa* Yao, *S. japonica* Yao). On the other hand, assemblages described by Kemkin (Kemkin et al., 1996) are lacking pantanellids in distinction from our assemblage.

Pral'nikova (2000) described the Middle Jurassic (Aalenian ?–Bajocian–Bathonian) radiolarian assemblage from several samples collected in tectonic sheet KN-1. Like our assemblage, this one includes abundant forms bearing spines associated with conical to high-conical nassellarians. Pral'nikova who attributed the described radiolarians to the Boreal and South Boreal types did not published, unfortunately their figures. Nevertheless, they are comparable in general taxonomic composition with the assemblage from Sample T123/1.

The Callovian–Oxfordian radiolarian assemblage (Sample T133/1, erratic boulder in the Main melange zone, watershed reach) consists of *Parvicingula elegans* Pessagno et Whalen, *Parvicingula* cf. *vera* Pessagno et Whalen, *Tricolocapsa* sp. A Matsuoka et Yao, *Archaeodictyomitra* sp., and *Bagotum ?* sp. (Table 1, Plate V). This assemblage dominated by representatives of the genus *Parvicingula* obviously is of the Boreal affinity. It is very similar to concurrent assemblage from the Omgon Cape of western Kamchatka (Vishnevskaya et al., 2005).

The Kimmeridgian–Tithonian radiolarian assemblage has been detected in Sample T101/4 collected from a tectonic slice of cherty shales intercalated with slices of metamorphic schists and amphibolites. This tectonic packet divides northern and southern parts of the Main Melange (figure). Kemkin described the Middle Jurassic (Aalenian–Callovian) assemblage of radiolarians from three samples collected in a tectonic slice located northward. Both tectonic sheets composed of cherty rocks are lacking basaltic intercalations.

The radiolarian assemblage we detected includes *Archaeodictyomitra* cf. *apiara* (Rüst), *Archaeodictyomitra (?)* cf. *sixi* Yang, *Archaeodictyomitra* sp. A, *Parvicingula* ex gr. *boesii* (Parona), *Loopus* ex gr. *primitivus* (Matsuoka et Yao), *Stichocapsa convexa* Yao, *Gongylothorax favosus* Dumitrica, *Zhamoidellum* sp., *Stichocapsa* sp. B, *Windalia* sp., *Pseudoristola* sp., *Stichomitra ?* sp., *Paronaella ?* sp., Actinommidae gen. et sp. indet., Spongodiscidae gen. et sp. indet., and Hagiastridae gen. et sp. indet. (Table1, Plates VI, VII). Multicyrtoid forms of the family Archaeodictyomitridae are dominant in the assemblage. The studied assemblage is comparable to some extent with the Late Jurassic (Kimmeridgian–Tithonian) assemblages of Antarctica (Kiessling, 1999) and can be also correlated with assemblages of the Cape Omgon in western Kamchatka (Vishnevskaya et al., 2005). Pral'nikova (2000) who studied Late Jurassic radiolarians of tectonic sheet KN-1 suggested their South Boreal affinity.

N.Yu. Bragin described the late Kimmeridgian radiolarian assemblage from the Elistratov Cape. This assemblage is similar in taxonomic composition to concurrent, so-called mixed assemblages of California and Alaska (Belyi and Akinin, 1985).

CONCLUSIONS

Thus, the studied radiolarian assemblages are of the Middle (Bajocian–Callovian), Middle–Late (Callovian–Oxfordian) and Late Jurassic (Kimmeridgian–Tithonian) age. Based on taxonomic composition and morphology of tests, the Bajocian–Callovian assemblage is attributed to the North Tethyan type, while the Callovian–Oxfordian and Kimmeridgian–Tithonian assemblages are of the Boreal affinity.

The new and formerly known dating results imply that rocks of the "Kingiveem" aspect originated mostly in the Middle–Late Jurassic time. Taking into consideration the Callovian–Oxfordian and Bathonian–Oxfordian dates, it is possible to suggest that tectonic delamination and accretion (apparently of recurrent style) destructed crust of an oceanic basin, which existed throughout the Middle and Late Jurassic. Judging from available data, silica accumulation in some basin areas commenced in the terminal Early Jurassic (Toarcian) and terminated in the Berriasian–Valanginian. It is obvious as well that relict areas of older (Late Permian–Triassic) oceanic crust represented in places the basement for silica accumulation.

PALEONTOLOGICAL DESCRIPTION OF JURASSIC RADIOLARIANS FROM THE POVOROTNYI CAPE AREA

CLASS Radiolaria Muller, 1858

SUBCLASS Euradiolaria Lamerere, 1931

SUPERORDER Polycystina Ehrenberg, 1838, emend. Riedel, 1967

ORDER Spummellaria Ehrenberg, 1875

FAMILY Praeconocaryommidae Pessagno, 1976

Genus *Praeconocaryomma* Pessagno, 1976

Type species: *Praeconocaryomma universa* Pessagno, 1976; Upper Cretaceous (Coniacian); the United States, California; Great Valley sequence.

Age and distribution: the Lower–Middle Jurassic of Northeastern Asia and Atlantic Ocean (Site 534); The Cretaceous of Sakhalin, Koryak Upland, North America (California), Japan, and China.

Praeconocaryomma immodica Pessagno et Poison

Plate I, figs. 1–3

Praeconocaryomma immodica Pessagno et Poison, 1981, p. 57, pl. 7, figs. 2–9.

Praeconocaryomma magnimamma (Rüst) Pessagno 1977a, p. 77, pl. 5, figs.14–16; pl. 6, fig. l.

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Povorotnyi Cape (Taigonos Peninsula).

Description. Spherical tuberculate test consists of four lattice shells. Outer shell is decorated by numerous, regularly spaced tubercles, which are connected by massive rods with the first medullary shell. Not all radial needles taking origin in tubercles are preserved. Spherical medullary shells lacking tubercles are connected with each other by short radial rods.

Dimensions: diameter 150 (fig. 1) to 175–178 μm (figs. 2, 3).

Age and distribution: Jurassic (Toarcian–lower Tithonian/upper Kimmeridgian), ophiolites of Stanley Mountains and Franciscan Complex of California; North Fork terrane in Klamath Mountain of North America; Busuanga Island, Philippines; Taigonos Peninsula.

Praeconocaryomma sp.

Plate I, fig. 5

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Povorotnyi Cape (Taigonos Peninsula).

FAMILY Pantanellidae Pessagno, 1977b, emend. Pessagno et Blome, 1980

Genus *Pantanellium* Pessagno, 1977a

Type species: *Pantanellium riedeli* Pessagno, 1977a; Upper Jurassic; the United States, California, Great Valley sequence.

Age and distribution: Upper Triassic (Carnian ?, Norian)–Lower Cretaceous (upper Aptian/lower Albian); worldwide.

Pantanellium cf. *riedeli* Pessagno

Plate I, figs. 8, 9

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Povorotnyi Cape (Taigonos Peninsula).

Description. Ellipsoidal test consisting of two lattice shells has two costate bipolar spines set along one axis. Spines are of unequal length, but one is broken and its exact dimension is unknown. Thin radial secondary rods connecting external and internal shells are attached to nodes of pentagonal and hexagonal perforated plates at the test surface.

Dimensions: greater test diameter 76–78 μm; shorter one 56–61 μm; length of spine 78 μm (fig. 9).

Age and distribution: Middle–Upper Jurassic; worldwide.

FAMILY Hagiastridae Riedel, 1971; emend. Baumgartner, 1980

SUBFAMILY Hagiastrinae Riedel, 1971; emend. Baumgartner, 1980

Genus *Homoeoparonaella* Baumgartner, 1980

Type species: *Homoeoparonaella elegans* (Pessagno), 1979.

Age and distribution: Lower Jurassic (lower Toarcian)–lower Cretaceous (Aptian); worldwide.

Homoeoparonaella sp.

Plate III, fig. 3

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Povorotnyi Cape (Taigonos Peninsula).

SUBFAMILY Archaeohagiastrinae

Genus *Archaeohagiastrum* Baumgartner, 1984

Type species: *Archaeohagiastrum minitum* Baumgartner. 1984, p. 758.

Age: Sinemurian–Callovian.

Archaeohagiastrum sp.

Plate III, fig. 5

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Povorotnyi Cape (Taigonos Peninsula).

SUBFAMILY Higumastrinae Baumgartner, 1980

Genus *Higumastra* Baumgartner, 1980

Type species: *Higumastra inflata* Baumgartner, 1980; Upper Jurassic (Oxfordian–Tithonian); Peloponnesus, Greece (Argolis).

Age and distribution: Lower Jurassic (Sinemurian)–lower Cretaceous (Albian); Koryak Upland, Japan, the United States (California, eastern Oregon), Pacific Ocean (Site 463); Tethyan and Boreal provinces.

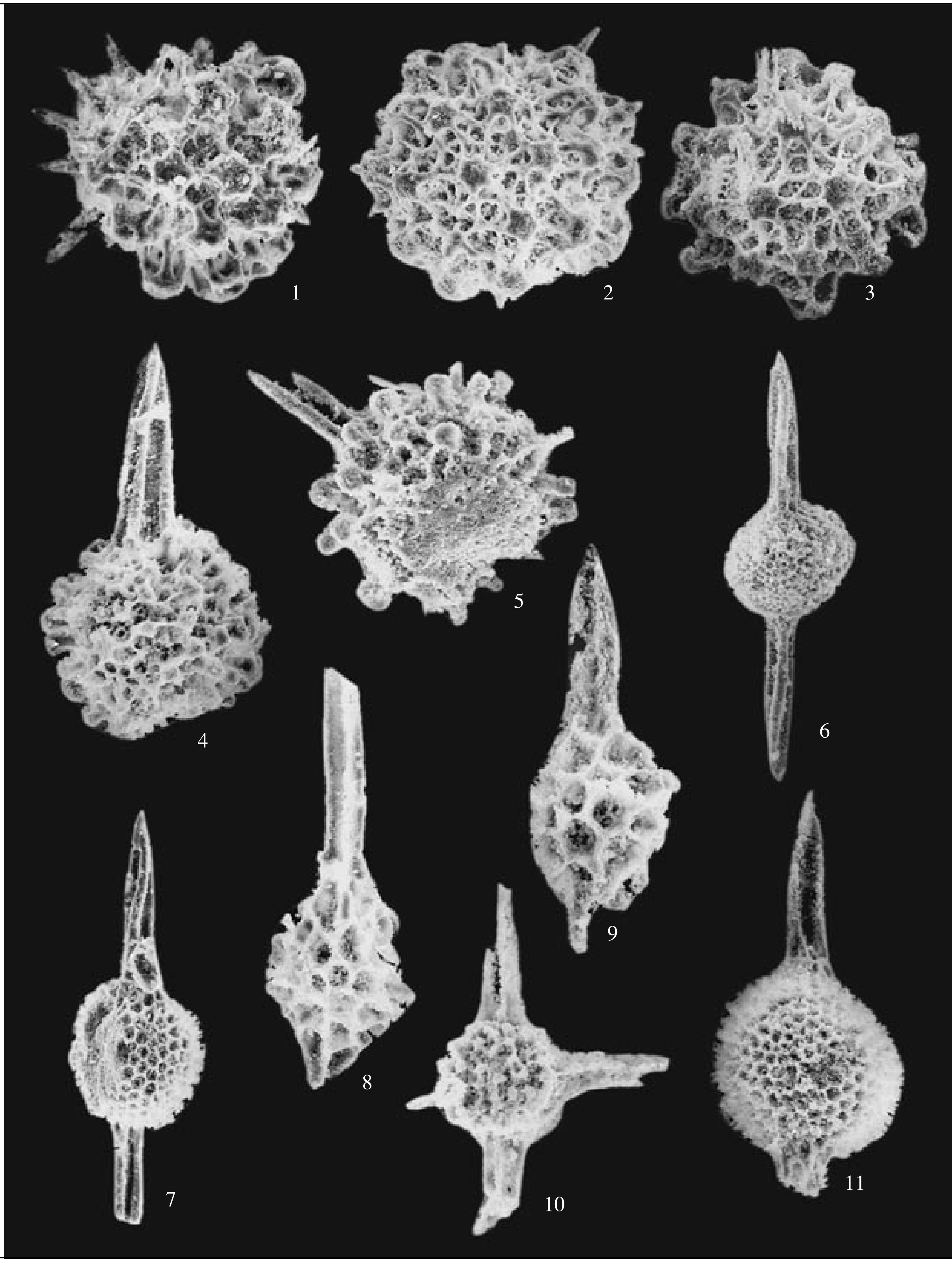
Higumastra inflata Baumgartner

Plate III, fig. 1

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Povorotnyi Cape (Taigonos Peninsula).

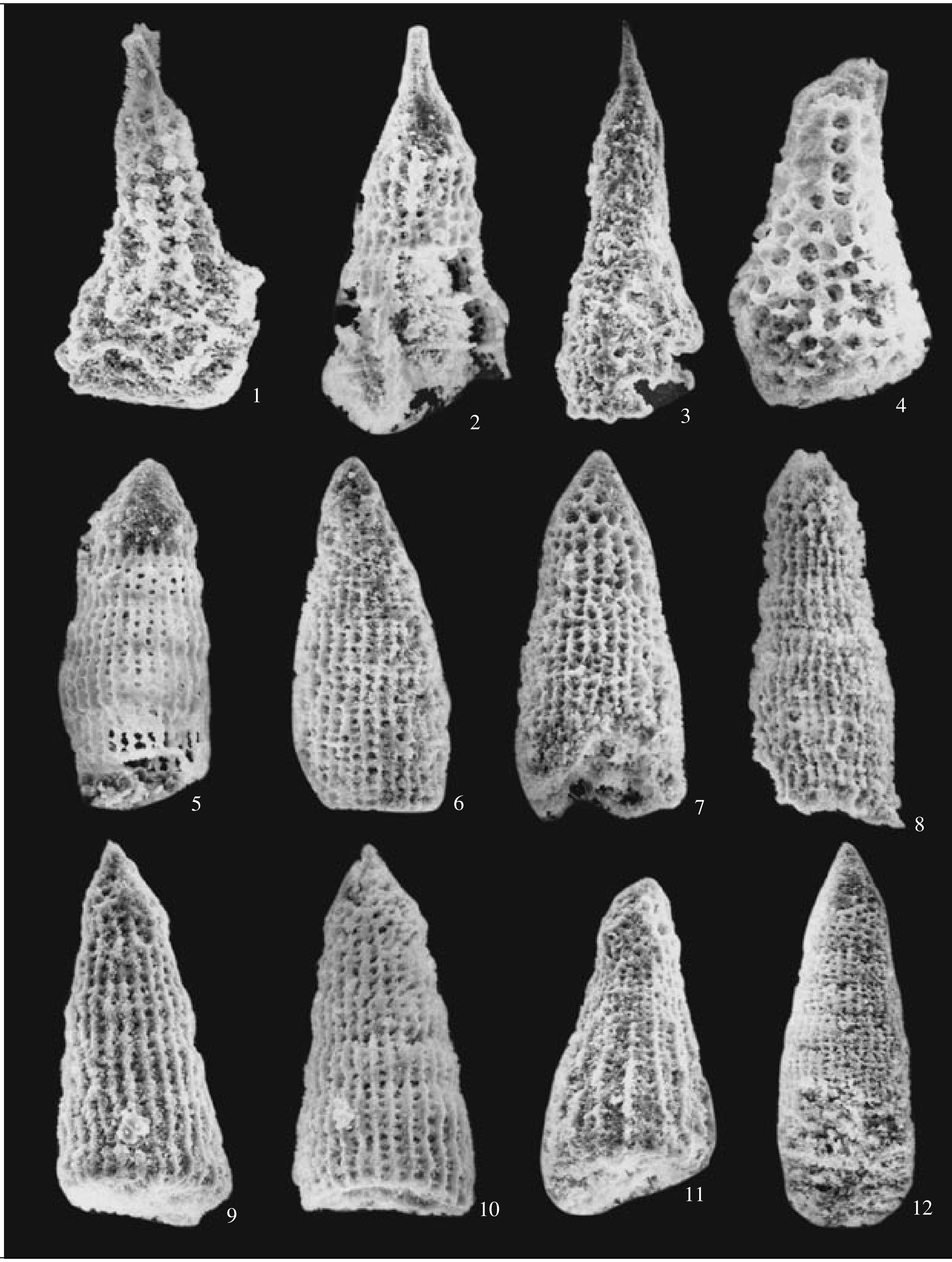
Description. Test with four arms oriented under right angles relative to each other is thin and perforated by frequent pores. Inner structure of arms and one–two medullary shells is visible under transmitted light. Cortical parts of arms are formed by longitudinal fibers with intervening rows of large round pores; three to five pore rows, the middle one most distinct, are visible on each side of the arms. Inside the arms, there are two large semicircular channels, the principal ones, and smaller accessory channels. Arms' cross-sections are round. Small fragments of central spine are retained at two arm ends.

Plate I



P l a t e I. Bajocian–Callovian radiolarians from the Povorotnyi Cape (Sample T123/1).
(1–3) *Praeconocaryomma immodica* Pessagno et Poison: (1) ×300, (2, 3) ×280; (4) *Pantanellium* sp., ×320; (5) *Praeconocaryomma* sp., ×300; (6, 7) *Xiphostylus* ex gr. *gasquetensis* Pessagno et Yang: (6) ×l94, (7) ×230; (8, 9) *Pantanellium* cf. *riedeli* Pessagno: (8) ×410, (9) ×450; (10) *Emiluvia* sp., ×320*; (*11*)* *Xiphostylus* sp., ×270.

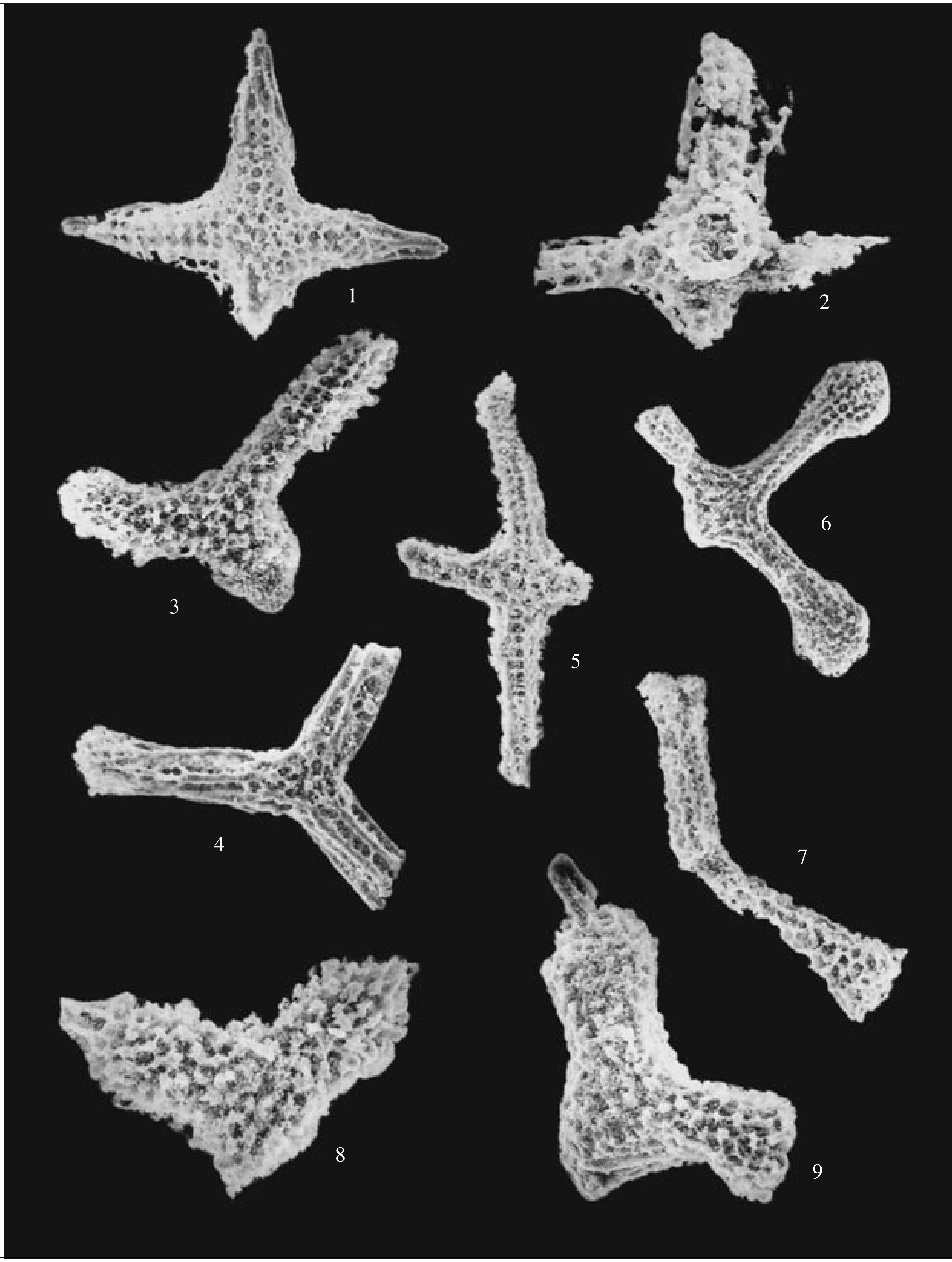
Plate II



P l a t e II. Bajocian-Callovian radiolarians from the Povorotnyi Cape (Sample T123/1).

(1) *Higumastra* sp., ×380; (2, 3) *Lupherium* sp.: (2) ×480, (3) ×300; (4) Hagiastridae Gen et sp. indet, ×530; (5) *Archaeodictyomitra* sp. C, ×500; (6) *Hsuum* sp. G, ×350; (7) *Lupherium* sp. C, ×420; (8) *Archaeodictyomitra* cf. *prisca* Kozur et Mostler, ×600; (9, 10) *Lupherium* ex gr. *officerense* Pessagno et Whalen: (9) ×510, (10) ×490; (11) *Hsuum* sp. cf. *H. busuangaense* Yeh et Cheng, ×300; (12) *Archaeodictyomitra* sp., ×300.

Plate III



P l a t e III. Bajocian-Callovian radiolarians from the Povorotnyi Cape (Sample T123/1).

(1) *Higumastra inflata* Baumgartner, ×210; (2) *Higumastra* ex gr. *devilsgapensis* Pessagno, Blome et Hull, ×430; (3) *Homoeoparonaella* sp., ×250; (4) *Tritrabs*, ×260; (5) *Archaeohagiastrum* sp., ×260; (6) *Tetraditryma* cf. *pseudoplena* Baumgartner, ×200; (7) *Angulobracchia* sp., ×240; (8, 9) *Paronaella* ex gr. *mulleri* Pessagno: (8) ×440, (9) ×420.

Plate IV

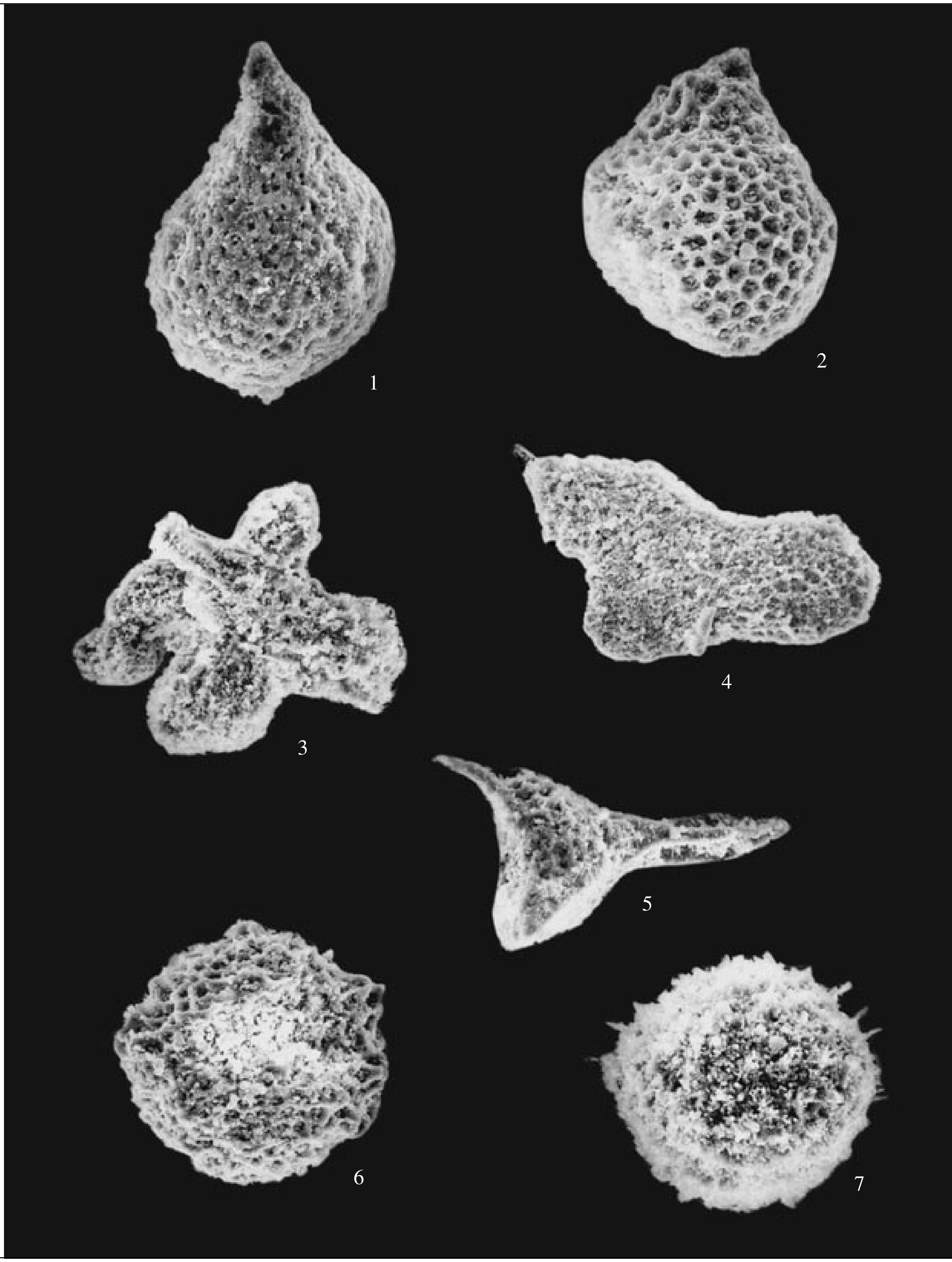
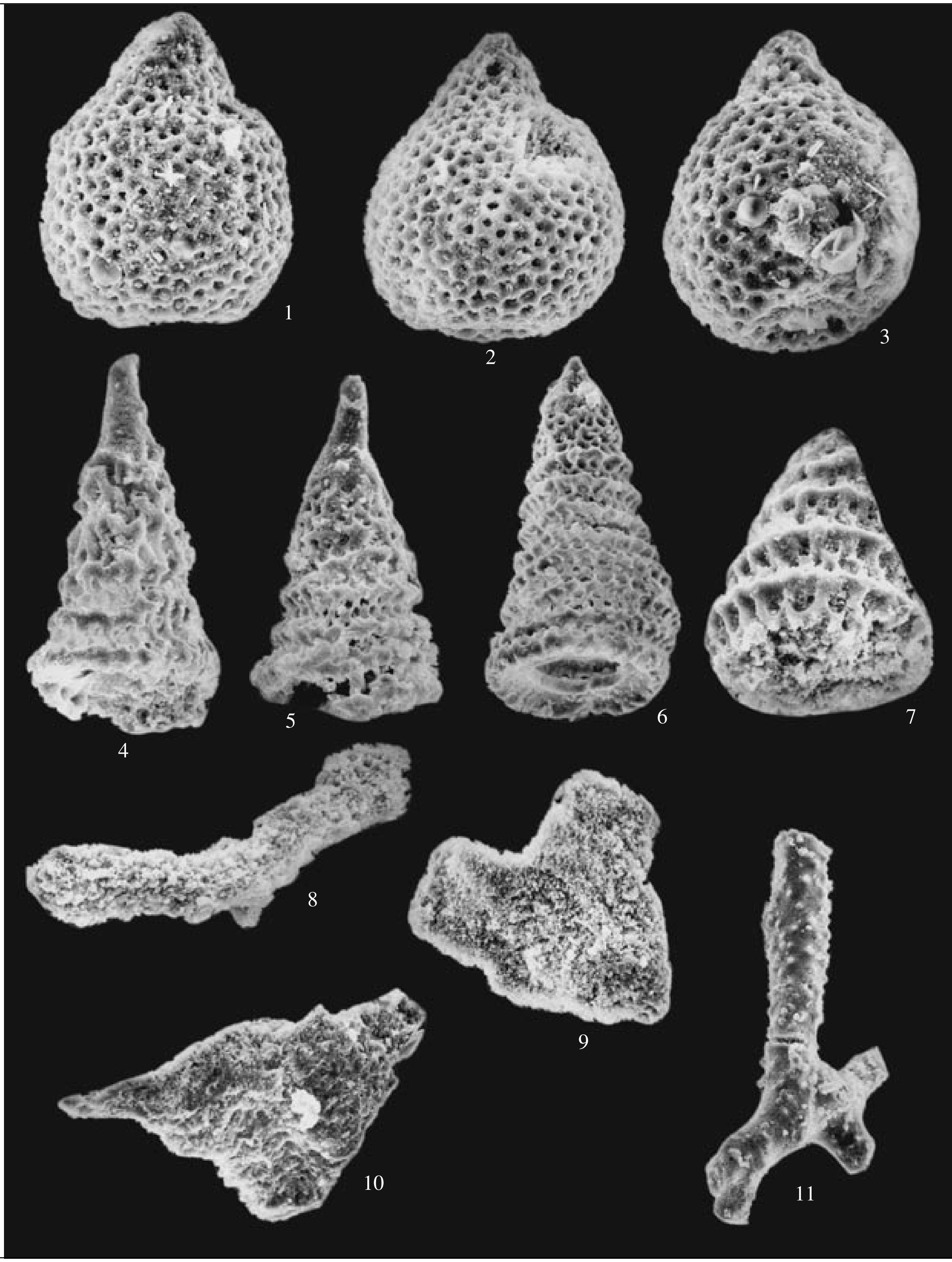


Plate IV. Bajocian-Callovian radiolarians from the Povorotnyi Cape (Sample T123/1).
(1) *Stichocapsa* aff. *convexa* Yao, ×550; (2) *Tricolocapsa* sp., ×480; (3, 4) Hagiastridae: (3) ×310, (4) ×300; (5) *Bernoullius ?* sp., ×450; (6, 7) *Actinomma ?* sp.: (6) ×320, (7) ×330.

Plate V



P l a t e V. Callovian–Oxfordian radiolarians from the Povorotnyi Cape, (1–7, 11) Sample T133/1, (8–10) Sample T134/1.
(1) *Tricolocapsa* sp., ×600; (2, 3) *Tricolocapsa* sp. A, Matsuoka et Yao: (2) ×550, (3) ×600; (4, 5) *Parvicingula* cf. *vera* Pessagno et Whalen: (4) ×470, (5) ×340; (6) *Parvicingula elegans* Pessagno et Whalen, ×690; (7) *Parvicingula* sp., ×550; (8, 9) *Paronaella ?* sp.: (8) ×280, (9) ×430; (10) Gen. et sp. indet., ×240; (11) sponge spicules, ×270.

Dimensions: arms are 165–170 μm long and 78–85 μm wide at the base.

Age and distribution: Lower Jurassic (Pliensbachian)–Lower Cretaceous (Barremian); worldwide.

Higumastra ex gr. *devilsgapensis* Pessagno, Blome et Hull

Plate III, fig. 2

Higumastra devilsgapensis Pessagno, Blome et Hull, 1993, p. 125, pl. 2, figs. 13, 17.

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Povorotnyi Cape (Taigonos Peninsula).

Age and distribution: Bajocian, the United States (Oregon), Bajocian–Callovian, Taigonos Peninsula; Oxfordian, northwestern California.

Higumastra sp.

Plate II, fig. 1

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Povorotnyi Cape (Taigonos Peninsula).

SUBFAMILY Tetraditryminae Baumgartner, 1980

Genus *Tetraditryma* Baumgartner, 1980

Type species: *Tetraditryma pseudoplena* Baumgartner, 1980.

Age and distribution: Lower Jurassic (upper Pliensbachian)–lower Cretaceous (Berriasian); worldwide.

Tetraditryma pseudoplena Baumgartner

Plate III, fig. 6

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Povorotnyi Cape (Taigonos Peninsula).

Description. Test with four transversely-spaced arms, one of which is broken. Rounded terminal parts of arms are swollen. Cortical parts of arms are formed by longitudinal fibers with intervening rows of large round pores; three to five pore rows are visible on each side of the arms.

Dimensions: arms are 165–170 μm long, 40 μm wide near the base, and up to 70 μm thick in swollen parts.

Age and distribution: Middle Jurassic (Bajocian)–lower Cretaceous (Berriasian); worldwide.

SUBFAMILY Patulibracchinae Pessagno, 1971; emend. Baumgartner, 1980

Genus *Paronaella* Pessagno, 1971

Type species: *Paronaella solanoensis* Pessagno, 1971. Upper Cretaceous (lower Coniacian); the United States, California, Great Valley sequence.

Age and distribution: Jurassic–Cretaceous; Koryak Upland, Japan, the United States (California), Pacific Ocean (Site 196), Mediterranean.

Paronaella ex gr. *mulleri* Pessagno

Plate III, figs. 8, 9

Paronaella mulleri Pessagno: Pessagno, 1977, p. 71, pl. 2, figs. 2, 3.

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Povorotnyi Cape (Taigonos Peninsula).

Description. Test with three equal or almost equal arms lacking brachiopyle; arms with a needle at their ends are ellipsoidal in cross-section. Spongy tissue with distinct nodes reveals parallel or almost parallel fabric.

Dimensions: arms are 68 to 71 μm long and 41 to 45 μm thick near the base.

Age and distribution: Upper Jurassic, California; Bajocian–Callovian, Taigonos Peninsula.

SUBFAMILY Tritrabiinae Baumgartner, 1980

Type genus *Tritrabs* Baumgartner, 1980, p.292.

Age and distribution: lower Toarcian–Lower Cretaceous (Hauterivian); Tethyan and Boreal provinces.

Tritrabs sp.

Plate III, fig. 4

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Povorotnyi Cape (Taigonos Peninsula).

SUBFAMILY Angulobracchinae Baumgartner, 1980

Type genus *Angulobracchia* Baumgartner, 1980.

Age and distribution: Middle Jurassic–Lower Cretaceous (Aptian); worldwide.

Angulobracchia sp.

Plate III, fig. 7

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Povorotnyi Cape (Taigonos Peninsula).

FAMILY Xiphostylidae Haeckel, 1881, emend. Pessagno et Yang, 1989

Type genus *Xiphostylus* Haeckel, 1881; emend. Pessagno et Yang, 1989

Age and distribution: Triassic–Cretaceous; widespread in the Tethyan and South Boreal provinces.

Type species: *Xiphostylus attenuatus* Rüst, 1885; emend. Campbell, 1954.

Age and distribution: Lower Jurassic (upper Pliensbachian)–Upper Jurassic (middle Oxfordian); worldwide.

Xiphostylus ex gr. *gasquetensis* Pessagno et Yang

Plate I, figs. 6, 7

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Povorotnyi Cape (Taigonos Peninsula).

Xiphostylus sp.

Plate I, fig. 11

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Povorotnyi Cape (Taigonos Peninsula).

ORDER Nassellaria Ehrenberg, 1875

FAMILY Hsuidae Pessagno et Whalen, 1982

Genus *Hsuum* Pessagno, 1977a

Type species: *Hsuum cuestaensis* Pessagno, 1977a. Upper Jurassic (upper Kimmeridgian–lower Tithonian); the United States, California, Great Valley sequence.

Age and distribution: Jurassic–Lower Cretaceous (upper Valanginian); worldwide.

Hsuum sp. cf. *H. busuangaense* Yeh et Cheng

Plate II, fig. 11

Hsuum busuangaense Yeh et Cheng, 1996, p. 110, pl. 3, figs. 5, 9, 13.

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Povorotnyi Cape (Taigonos Peninsula).

Age and distribution: ? Lower–Middle Jurassic, central Japan, Busuanga Island, Philippines; Bajocian–Callovian, Taigonos Peninsula.

Hsuum sp. G

Plate II, fig. 6

Hsuum sp. G, Kadiri, 1984, pl. 11, fig. 8.

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Povorotnyi Cape (Taigonos Peninsula).

Description. Multichamber test (8–10 chambers) conical in the upper and subcylindrical in the lower part; apical needle is missing. Pores chaotically perforated in initial to third chambers are set in rows between ribs on subsequent segments. Pores of unequal size form transverse and longitudinal rows. Ribs appear beginning since the third chamber (12 ribs per semicircle of the shell).

Dimensions: test is 186 μm high and as thick as 74 μm in the last segment, 45 μm in the third segment, and 22 μm at the cephalis base.

Age and distribution: Jurassic, northern Morocco, Bajocian–Callovian, Taigonos Peninsula.

Genus *Lupherium* Pessagno et Whalen, 1982

Type species: *Lupherium snowshoense* Pessagno et Whalen, 1982; Middle Jurassic (Bajocian); the United States, Oregon, Snowshoe Formation.

Age and distribution: Jurassic; North America, Japan, Lesser Caucasus, Yugoslavia.

Lupherium ex gr. *officerense* Pessagno et Whalen

Plate II, figs. 9, 10

Lupherium officerense Pessagno et Whalen, 1982, pp. 135–136, pl. 6, figs. 5, 13, 18; pl. 12, fig. 5.

Lupherium officerense Pessagno et Whalen; Grill and Kozur, 1986, pl. l, figs. 4, 5.

Parahsuum officerense (Pessagno et Whalen); Takemura, 1986, p. 48, pl. 4, figs. 16, 17.

? Parahsuum sp. Takemura, 1986, pl. 5, fig. 17.

Lupherium officerense Pessagno et Whalen; Hattori, 1987, pl. 17, fig. 3.

Lupherium officerense Pessagno et Whalen; Hattori and Sakamoto, 1989, pl. 18, figs. 1–3.

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Povorotnyi Cape (Taigonos Peninsula).

Description. High-conical test with 9–10 chambers but without apical needle; cephalis is very small. Chambers are getting wider toward distal end of the test, but their height is almost constant; 12 ribs per the test semicircle are counted. Pore frames of unequal size are almost square-shaped.

Dimensions: test is 135–137 μm high and 63–69 μm wide in the last segment; cephalis is 5 μm high and 6–7 μm wide.

Age and distribution: Middle Jurassic (lower–middle Bajocian); the United States (Oregon), Japan, northern Hungary.

Lupherium sp. C

Plate II, fig. 7

Lupherium sp. C: Yeh Kuei-yu, 1987, p. 68, pl. 17, figs. 2, 3, 8; Lower Toarcian, Hyde and Snowshoe formations, Oregon, the United States.

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Taigonos Peninsula.

Description. High-conical test with 8–10 chamber is lacking apical needle; 8–12 interrupted ribs per the test semicircle are counted. Transverse pore rows (one pore between ribs) can be detected. Pores of thorax and abdomen are 1.5–2 times larger than elsewhere in the test.

Dimensions: test is 160 μm high and 74 μm thick in the last segment; cephalis is 10 and 12 μm high and thick respectively.

Age and distribution: Lower Toarcian, Oregon, the United States, Tethyan province; Bajocian–Callovian, Taigonos Peninsula.

Lupherium sp.

Plate II, figs. 2, 3

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Povorotnyi Cape (Taigonos Peninsula).

Age and distribution: Jurassic; North America, Japan, Northeast Russia, Lesser Caucasus, Yugoslavia, Hungary.

FAMILY Archaeodictyomitridae Pessagno, 1976

Type genus *Archaeodictyomitra* Pessagno, 1976.

Age and distribution: Middle Jurassic–Cenozoic; worldwide.

Genus *Archaeodictyomitra* Pessagno, 1976

Type species: *Archaeodictyomitra squinaboli* Pessagno, 1976; Cretaceous (Albian–lower Campanian), California, Great Valley sequence.

Age and distribution: Middle Jurassic (Bajocian)–Cretaceous; worldwide.

Archaeodictyomitra cf. *apiara* (Rüst)

Plate VII, figs. 4, 5

Lithocampe apiarum Rüst: Rüst, 1885, p. 314, pl. 39 (14), fig. 8.

Dictyomitra apiarum (Rüst): Rüst, 1898, p. 58; not Foreman, 1975, p. 613, pl. 29, figs. 7, 8; Nakaseko et al., pl. 3, fig. 4, not 3; Schaaf, 1984, p. 92–93, figs. 1, 3a, 3b, 5a, 5b; not 2, 4a, 4b; Baumgartner, 1984, p. 758, pl. 2, figs. 5–6; not Murchey 1984, pl. 1, fig. 3; Pral'nikova et Vishnevskaya, 1996, p. 241, pl. 2, figs. h, m, n.

Archaeodictyomitra apiara (Rüst): Pessagno, 1977b, p. 41, pl. 6, figs. 6, 14; De Wever et Thiebault, 1981, p. 585; not Kanie et al., 1981, pl. 1, fig. 8; Nakaseko et Nishimura, 1981, p. l45, pl. 6, figs. 2–4; pl. 15, figs. 2, 6, not fig. 7; not Schaaf, 1981, p. 432, pl. 18, figs. 2a, 2b; Matsuyama et al., 1982, pl. 1, fig. 1; Aoki, 1982, pl. 2, figs. 11, ? 12; Matsuoka et Yao, 1985, pl. 2, fig. 4; Aita, 1987, p. 64; Wakita, 1988, pl. 4, fig. 1; Kiessling 1992, pl. 1, figs. 4–5.

Material: Specimen T101/4, GIN RAS; Kimmeridgian–Tithonian, Povorotnyi Cape (Taigonos Peninsula).

Description. Conical test with 8–10 segments is lacking apical horn. Cephalothorax is rounded-conical; other segments are almost cylindrical, having 26–30 massive ribs with intervening vertical pore rows. Transverse pore rows are also traceable.

Dimensions: test is 116–120 μm high and 70–80 μm thick.

Age and distribution: Upper Jurassic; worldwide.

Archaeodictyomitra cf. *prisca* Kozur et Mostler

Plate II, fig. 8

Archaeodictyomitra sp. Sashida et al. 1982, pl. 2, fig. 9.

Archaeodictyomitra gifuensis Takemura, 1986, pp. 51–52, pl. 6, figs. 3–5.

Archaeodictyomitra prisca Kozur et Mostler in Grill and Kozur, 1986, p. 258, pl. 8, figs. 3–6, pl. 9, fig. 1.

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Povorotnyi Cape (Taigonos Peninsula).

Age and distribution: Middle Jurassic (Bajocian); Japan, Hungary, Taigonos Peninsula.

Archaeodictyomitra (?) cf. *sixi* Yang

Plate VII, fig. 1

Archaeodictyomitra sixi Yang 1993, p. 112, pl. 19, figs. 3, 19; pl. 20, figs. 9–10, 19; Hull, 1997, p. 79, pl. 32, fig. 5.

Archaeodictyomitra (?) sixi Yang.; Kissling, 1999, p. 45, pl. 9, fig. 10.

Material: Specimen T101/4, GIN RAS; Kimmeridgian–Tithonian, Povorotnyi Cape (Taigonos Peninsula).

Age and distribution: Upper Kimmeridgian–basal upper Tithonian; eastern Mexico, southern Alps, Antarctica; Kimmeridgian–Tithonian, Taigonos Peninsula.

Archaeodictyomitra sp. A

Plate VII, figs. 2, 3

Material: Specimen T101/4, GIN RAS; Kimmeridgian–Tithonian, Povorotnyi Cape (Taigonos Peninsula).

Description. Multichamber test is sharply expanding toward the fourth chamber to be of cylindrical shape afterward. Distinct ribs extend throughout the test length (12 ribs per the test semicircle). Round-elliptical pores, one between neighboring ribs, form clear vertical pore rows.

Remark. A depression is visible on the third segment lateral side.

Dimensions: test 92 μm high is up to 77 μm thick in the fourth segment; thorax is 39 μm wide.

Age and distribution: Kimmeridgian–Tithonian, Taigonos Peninsula.

Archaeodictyomitra sp. C

Plate II, fig. 5

Archaeodictyomitra sp. C, Kishida et Sugano, 1981, p. 297, pl. 9, figs. 9, 10.

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Povorotnyi Cape (Taigonos Peninsula).

Age and distribution: terminal Lower–basal Middle Jurassic; southwestern Japan; Bajocian–Callovian, Taigonos Peninsula.

Archaeodictyomitra sp.

Plate II, fig. 12

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Povorotnyi Cape (Taigonos Peninsula).

Age and distribution: Jurassic–Cretaceous; worldwide.

Genus *Loopus* Yang, 1993

Type species: *Pseudodictyomitra primitiva* Matsuoka et Yao, 1985; Upper Jurassic, Torinosu Group, southwestern Japan.

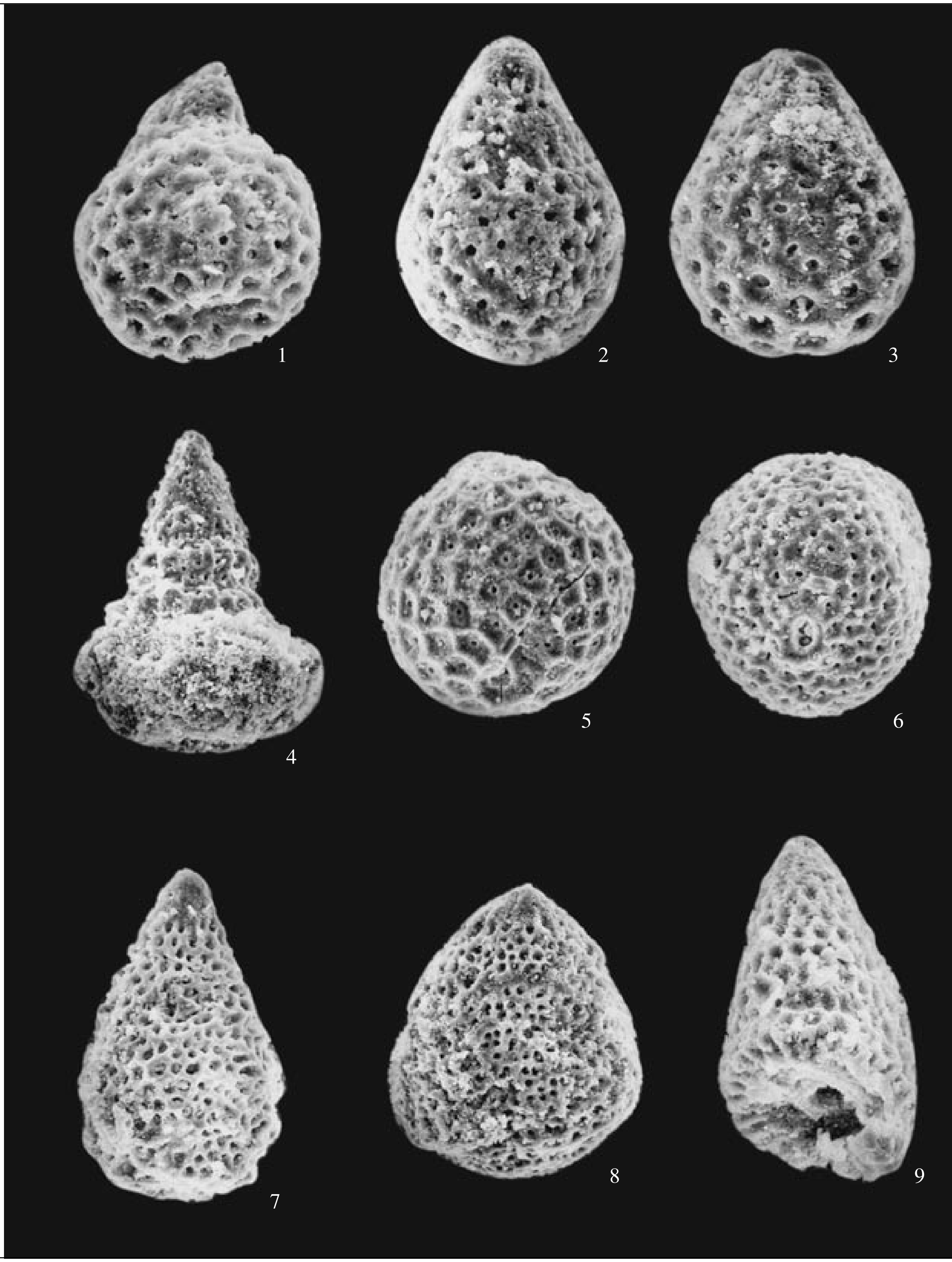
Age and distribution: Middle Jurassic (Bathonian–Callovian)–Upper Jurassic (Tithonian); worldwide.

Loopus ex gr. *primitivus* (Matsuoka et Yao)

Plate VII, figs. 7–10

Pseudodictyomitra primitiva Matsuoka et Yao, 1985, p. 131, pl. 1, figs. 1–6; pl. 3, figs. l–4; Gorican, 1994,

Plate VI



P l a t e VI. Kimmeridgian–Tithonian radiolarians from the Povorotnyi Cape (Sample T101/4).

(1) *Zhamoidellum* sp., ×660; (2, 3) *Stichocapsa convexa* Yao: (2) ×670, (3) ×530; (4) *Pseudoristola* sp., ×300; (5) *Gongylothorax favosus* Dumitrica, ×480; (6) *Gongylothorax* sp., ×480; (7) *Windalia* sp., ×330; (8) *Stichocapsa* sp. B, ×310; (9) *Stichomitra ?* sp., ×580.

Plate VII

P l a t e VII. Kimmeridgian–Tithonian radiolarians from the Povorotnyi Cape (Sample T101/4).

(1) *Archaeodictyomitra (?)* cf. *sixi* Yang, ×700; (2, 3) *Archaeodictyomitra* sp. A: (2) ×640; (3) ×560; (4, 5) *Archaeodictyomitra* cf. *apiara* (Rüst): (4) ×500, (5) ×470; (6) *Parvicingula* ex gr. *boesii* (Parona), ×430; (7–10) *Loopus* ex gr. *primitivus* (Matsuoka et Yao): (7) ×470, (8) ×480, (9) ×500, (10) ×370.

p. 84, pl. 22, fig. 16; Baumgartner et al., 1995, p. 454, pl. 3189, figs. 1–5 (with comprehensive synonymy).

Loopus primitivus (Matsuoka et Yao); Yang, 1993, p. 125, pl. 23, figs. 5, 6, 13, 21; Hull, 1997, p. 91, pl. 36, figs. 13,16.

Pseudodictyomitra cf. *primitiva* Matsuoka et Yao; Ozvoldova and Faupl, 1993, pl. 1, fig. 11.

Loopus primitivus (Matsuoka et Yao); Kiessling, 1999, p. 54, pl. 12, fig. 15.

Material: Specimen T101/4, GIN RAS; Kimmeridgian–Tithonian, Povorotnyi Cape (Taigonos Peninsula).

Age and distribution: Oxfordian–Tithonian; worldwide.

FAMILY Parvicingulidae Pessagno, 1977

Genus *Parvicingula* Pessagno, 1977

Type species: *Parvicingula santabarbaraensis* Pessagno, 1977; Jurassic (upper Kimmeridgian–Tithonian); the United States, California.

Age and distribution: Jurassic–Lower Cretaceous; worldwide.

Parvicingula cf. *vera* Pessagno et Whalen

Plate V, figs. 4, 5

Parvicingula vera Pessagno et Whalen; Pessagno and Whalen, 1982, p. 144, pl. 11, figs. 3–5, 11, 19; pl. 13, fig. 8.

Material: Specimen T133/1, GIN RAS; Callovian–Oxfordian, Povorotnyi Cape (Taigonos Peninsula).

Age and distribution: Middle Jurassic (Bathonian)–Upper Jurassic (Tithonian); eastern Oregon (the United States), eastern Mexico, Argentine, Antarctica, James Ross Island, Northeast Russia, Taigonos Peninsula.

Parvicingula elegans Pessagno et Whalen

Plate V, fig. 6

Parvicingula elegans Pessagno et Whalen: Pessagno and Whalen, 1982, p. 138, pl. 10, figs. 7, 16, 20; pl. 13, fig. 9.

Material: Specimen T133/1, GIN RAS; Callovian–Oxfordian, Povorotnyi Cape (Taigonos Peninsula).

Description. Multichamber turriculated test that lost apical needle. Below small conical cephalis, subsequent segments dilate gradually downward creating stepwise silhouette of the test distinctly divided into chambers. Transverse girdles between chambers are convex, projecting outward. Rare chaotic pores perforate cephalis and thorax, while two transverse pore rows are characteristic of the other chambers.

Dimensions: test is 83 μm high; cephalis is 3.5 μm wide and 4 μm high; last segment is 49 μm thick.

Age and distribution: Middle–Late Jurassic, California, Koryak Upland; (early Kimmeridgian) *Amoeboceras ravni* ammonite zone, Ukhta area, Pechora River, Komi, Russia, Taigonos Peninsula.

Parvicingula ex gr. *boesii* (Parona)

Plate VII, fig. 6

Dictyomitra boesii Parona; Parona, 1890, p. 170, pl. 6, fig. 9.

Ristola sp. aff. *R. boesii* (Parona); Pessagno et al., 1984, p. 29, pl. 3, figs. 16, 18, 23.

Parvicingula boesii (Parona); O'Dogherty, 1994, p. 111, pl. 8, fig. 16.

Parvicingula boesii gr. (Parona); Baumgartner et al., 1995, p. 402, pl. 3185, fig. 4.

Tethysetta boesii (Parona); Dumitrica et al., 1997, p. 48, pl. 10, fig. 19.

Material: Specimen T101/4, GIN RAS; Kimmeridgian–Tithonian, Povorotnyi Cape (Taigonos Peninsula).

Age and distribution: Middle Jurassic–Lower Cretaceous; worldwide.

Parvicingula sp.

Plate V, fig. 7

Material: Specimen T133/1, GIN RAS; Callovian–Oxfordian, Povorotnyi Cape (Taigonos Peninsula).

FAMILY Williriedellidae Dumitrica, 1970

Genus *Zhamoidellum* Dumitrica, 1970

Type species: *Zhamoidellum ventricosum* Dumitrica, 1970; Upper Jurassic (Callovian–Oxfordian); Romania, Pojorata area.

Age and distribution: Upper Jurassic–Cretaceous; worldwide.

Zhamoidellum sp.

Plate VI, fig. 1

Material: Specimen T101/4, GIN RAS; Kimmeridgian–Tithonian, Povorotnyi Cape (Taigonos Peninsula).

FAMILY Stichocapsidae Haeckel, 1881

Genus *Stichocapsa* Haeckel, 1881

Stichocapsa Haeckel, 1881, p. 439.

Type species: *Stichocapsa jaspidea* Rüst, 1885 (emend. Campbell, 1954, p. D143).

Age and distribution: Mesozoic–Cenozoic; worldwide.

Stichocapsa convexa Yao

Plate VI, figs. 2, 3

Stichocapsa convexa Yao, 1979, p. 35, pl. 6, figs. 1–7.

Material: Specimen T101/4, GIN RAS; Kimmeridgian–Tithonian, Povorotnyi Cape (Taigonos Peninsula).

Description. Multichamber conical test; relict pores are visible on cephalis with thickened walls. Round-ellipsoidal pores of unequal size regularly perforate smooth surface of the test. Aperture is invisible.

Dimensions: test is 91–105 μm high and up to 65–80 μm thick.

Age and distribution: Middle (Bathonian)–Upper Jurassic (Tithonian); Japan, the United States (Oregon), Northeast Russia, Taigonos Peninsula.

Stichocapsa aff. *convexa* Yao

Plate IV, fig.1

Material: Sample T123/1, GIN RAS; Bajocian–Callovian, Povorotnyi Cape (Taigonos Peninsula).

Stichocapsa sp. B

Plate VI, fig. 8

Stichocapsa sp. B; Aita and Sporli 1992, p. 112, pl. 6, fig. 2.

Material: Sample T101/4, GIN RAS; Kimmeridgian–Tithonian, Povorotnyi Cape (Taigonos Peninsula).

Age and distribution: Jurassic, New Zealand; Kimmeridgian–Tithonian, Taigonos Peninsula.

Genus *Tricolocapsa* Haeckel, 1881

Tricolocapsa Haeckel, 1881, p. 436.

Type species: *Tricolocapsa theophrasti* Haeckel, 1887 (emend. Campbell, 1954, p. D136).

Age and distribution: Jurassic–Cenozoic; worldwide.

Tricolocapsa sp. A

Plate V, figs. 2, 3

Tricolocapsa sp. A, Matsuoka et Yao, 1985.

Tricolocapsa sp. A, Matsuoka et Yao; Sano et al., 1992, p. 52, pl. II, fig. U.

Material: Specimen T133/1, GIN RAS; Callovian–Oxfordian, Povorotnyi Cape (Taigonos Peninsula).

Age and distribution: *Tricolocapsa yaoi* Matsuoka et Yao zone, Middle Jurassic (Bathonian)–Upper Jurassic (Kimmeridgian); Japan, Northeast Russia.

Tricolocapsa sp.

Plate IV, fig. 2; Plate V, fig. 1

Genus *Gongylothorax* Foreman, 1968, sensu Dumitrica, 1970

Gongylothorax Foreman, 1968, p. 19–20.

Gongylothorax Dumitrica, 1970, p. 56.

Type species: *Dicolocapsa verbeeki* Tan, 1927

Age and distribution: Middle Jurassic (Bajocian)–Upper Cretaceous (Campanian).

Gongylothorax favosus Dumitrica

Plate VI, fig. 5

Gongylothorax favosus Dumitrica, 1970, p. 56, pl. l, figs. 1a–1c, 2.

Gongylothorax favosus Dumitrica; Kissling and Zeiss, 1992, p. 190, pl. 2, figs. 11–13.

Gongylothorax favosus Dumitrica; Baumgartner et al. 1995, p. 230, pl. 6131, figs. 1–7.

Material: Specimen T101/4, GIN RAS; Kimmeridgian–Tithonian, Povorotnyi Cape (Taigonos Peninsula).

Age and distribution: middle Callovian–Tithonian; worldwide.

Gongylothorax sp.

Plate VI, fig. 6

Material: Specimen T101/4, GIN RAS; Kimmeridgian–Tithonian, Povorotnyi Cape (Taigonos Peninsula).

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