Bulletin of the Geological Survey of Japan, vol. 64 (5/6), p. 151 - 190, 2013

Report

Triassic to Middle Jurassic radiolarians from pelagic cherts in the Nanjō Mountains, Southwest Japan – Part 2. Kanmuri Yama district

Satoshi Nakae

Satoshi Nakae (2013) Triassic to Middle Jurassic radiolarians from pelagic cherts in the Nanjō Mountains, Southwest Japan – Part 2. Kanmuri Yama district. *Bull. Geol. Surv. Japan*, vol. 64 (5/6), p. 151-190, 3 figures, 2 tables, 8 plates.

Abstract: The Nanjō Mountains located in the central region of Fukui Prefecture, Southwest Japan, are chiefly underlain by the sedimentary complex of various rock-types such as basalt, limestone, chert, mudstone and sandstone. Among these rocks within the mountains, twenty-seven chert outcrops (localities) were explored for their radiolarian content. Twenty-six rock samples from seventeen localities in the studied Kanmuri Yama district yielded moderately- to poorly-preserved radiolarian remains as a result. Most of the samples contain Triassic to Middle Jurassic species, with Spumellaria and Entactinaria dominant among the Triassic faunas and with Nassellaria dominant among the Jurassic faunas. The description and faunal analysis of these radiolarians revealed that the cherts in the Kanmuri Yama district span a wide range of age from the Late Olenekian to Middle Bathonian stages.

Keywords: radiolaria, Triassic, Middle Jurassic, Nanjō Mountains, Mino belt, Kanmuri Yama district, Fukui Prefecture, Southwest Japan

1. Introduction

The Nanjō Mountains, which extend over an area of ca. 40 km x 20 km in the central region of Fukui Prefecture, are geotectonically divided into the Mino and Ultra-Tamba belts of the Inner Zone of Southwest Japan. The lithologic assemblages of each belt differ from one other; the accretionary complex of the Mino belt is regarded as one of the Jurassic accretionary complexes that formed along the eastern margin of the paleo-Asian continent (*e.g.*, Wakita, 1988), conversely the accretionary complex of the Ultra-Tamba belt is dominated by pale or greenish gray sandstone with subordinate chert and phyllitic mudstone of Permian age (Umeda *et al.*, 1996; Nakae, 2012). The Mino belt consists of thrust-bounded units of basalt and limestone of oceanic island/seamount origin, cherts of pelagic origin and terrigenous clastic rocks (Wakita, 1988; Nakae *et al.*, 2013). 1:50,000 scale maps of the "Imajō" and "Kanmuri Yama" districts almost cover the entire area of the Nanjō Mountains (Fig.1).

The age of the cherts in the Nanjō Mountains has so far been determined to be Triassic to Jurassic (*e.g.*, Hattori and Yoshimura, 1982; Takamura and Hayami, 1985; Taga, 1997; Umeda and Taga, 2003). Through this present study, additional extraction of radiolarians from the accretionary complex of the Mino belt in the Nanjō Mountains was therefore conducted for detailed age determination of its component rocks. Consequently, this study presents a systematic description of all radiolarian species extracted from the cherts in the Kanmuri Yama district as the second report. Those from the Imajō district have already been described in the first report by Nakae (2013).

2. Materials and Method

Through the course of this study, 530 samples were collected in the Nanjō Mountains (222 from the Imajō district, and 308 from the Kanmuri Yama district). The samples were undertaken using an usual technique for radiolarian extraction; briefly, the rock samples were individually soaked in dilute hydrofluoric acid (HF) solution (5%) for 10 to 15 hours, before being washed through a 62μm mesh sieve (235#). As a result, age-diagnostic radiolarians representative of Triassic to Middle Jurassic ages recovered from forty chert samples (from twenty-seven localities), twenty-six of which were from the Kanmuri Yama district. The residues of each processed sample were then examined under a stereomicroscope, and radiolarian remains were selected for examination by scanning electronic microscope (SEM). All figured specimens were deposited and registered with the Geological Museum, Geological Survey of Japan under catalogue numbers (GSJ F).

AIST, Geological Survey of Japan, Institute of Geology and Geoinformation
Author: S. NAKAE, Central 7, 1-1-1 Higashi, Tsukuba 305-8567, JAPAN. Email: nakae-satoshi@aist.go.jp

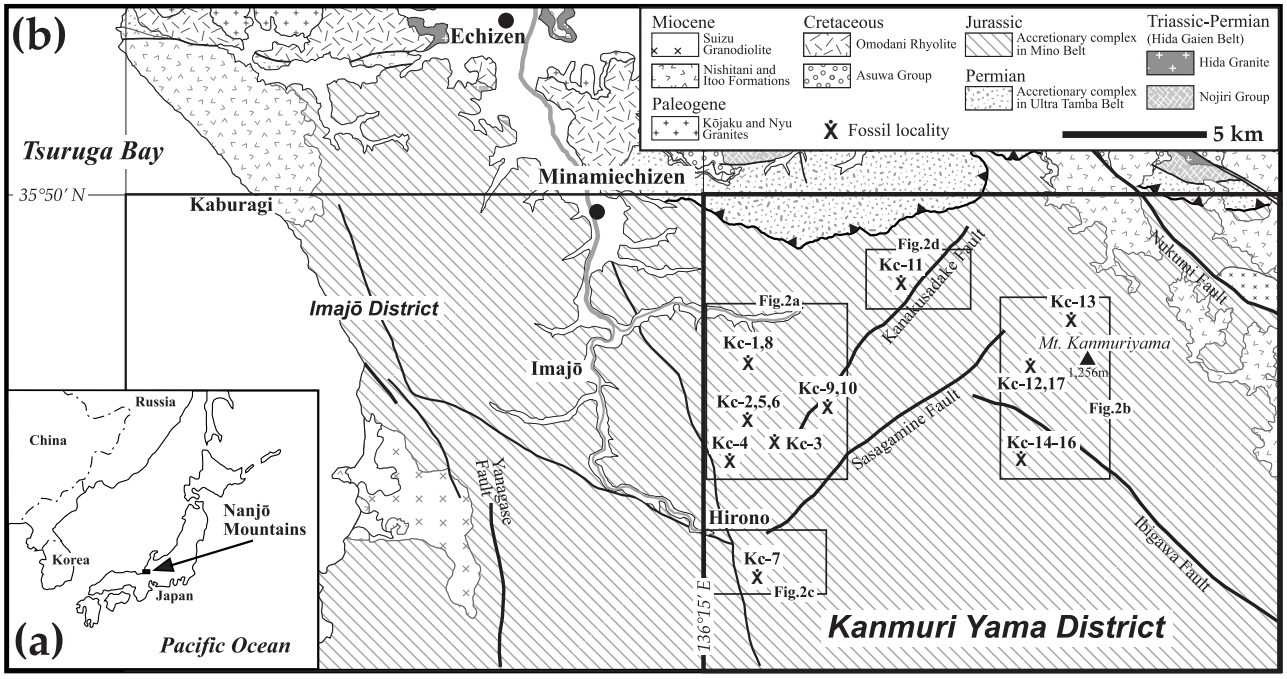


Fig. 1 Index map of the Kanmuri Yama district in Nanjō Mountains.
(a): The Nanjō Mountains are situated in a central part of Fukui Prefecture. (b): A simplified geological map of the mountains, most part of which geotectonically belongs to the Mino belt, Southwest Japan. The Kanmuri Yama district contains the eastern part of the Nanjō Mountains. Detailed radiolarian localities with symbols are given in Fig. 2.

3. Radiolarian locality and fauna

Twenty-six chert samples comprising part of a suite of 308 samples that were collected from the Kanmuri Yama district in the Nanjō Mountains yielded moderately- to poorly-preserved radiolarian faunas. Radiolarian localities (Kc-1 – Kc17) are shown in Figs. 1 and 2, and the identified species are listed in Table 1. Below is a detailed description of each locality investigated and their faunal contents.

(1) Locality Kc-1 (Fig. 2a)
Location: Tarumi-gawa, Minamiechizen Town.
(lat. 35º46’31.3” N, long. 136º16’57.4” E)
Sample number: KJ 0301.
Lithology: Thinly bedded light gray to pale gray chert.
Fauna: *Cryptostephanidium*? sp., *Palaeosaturnalis* sp., *Haeckelicyrtium*? spp. (Plate 1).
Age: Probably Carnian.

(2) Locality Kc-2 (Fig. 2a)
Location: Northeast of Masudani, Minamiechizen Town.
(lat. 35º45’23.8” N, long. 136º16’40.6” E)
Sample number: KJ 0402
Lithology: Thinly bedded light pale gray chert.
Fauna: *Eptingium nakasekoi* Kozur and Mostler, *Pseudostylosphaera japonica* (Nakaseko and Nishinura), *Pseudostylosphaera*? sp., *Triassocampe deweveri* (Nakaseko and Nishimura), *Triassocampe* spp., Poulpidae gen. et sp. indet., Spumellaria gen. et sp. indet. (Plate 1).
Age: Late Anisian.

Sample number: KJ 0403
Lithology: Thinly bedded light pale gray chert.
Fauna: *Pseudostylosphaera*? sp., *Triassocampe* sp. cf. *T. myterocorys* Sugiyama, *Multimonilis* sp. (Plate 1).
Age: Probably Ladinian – Early Carnian.

Sample number: KJ 0404
Lithology: Thinly bedded light pale gray chert.
Fauna: *Triassocampe deweveri* (Nakaseko and Nishimura), *Triassocampe* sp., Nassellaria gen. et sp. indet. (Plate 1).
Age: Late Anisian – middle Late Ladinian.

(3) Locality Kc-3 (Fig. 2a)
Location: East of Masudani, Minamiechizen Town.
(lat. 35º44’58.4” N, long. 136º17’9.1” E)
Sample number: KJ 0410c.
Lithology: Thinly bedded reddish brown chert.
Fauna: *Droltus* sp. cf. *D. hecatensis* Pessagno and Whalen, Entactinaria gen. et sp. indet., Nassellaria gen. et sp. indet. (Plate 1).
Age: Probably Hettangian – Early Pliensbachian.

(4) Locality Kc-4 (Fig. 2a)
Location: Masudani, Minamiechizen Town.
(lat. 35º44’28.5” N, long. 136º15’38.5” E)
Sample number: KJ 0810e.
Lithology: Thinly bedded gray chert.

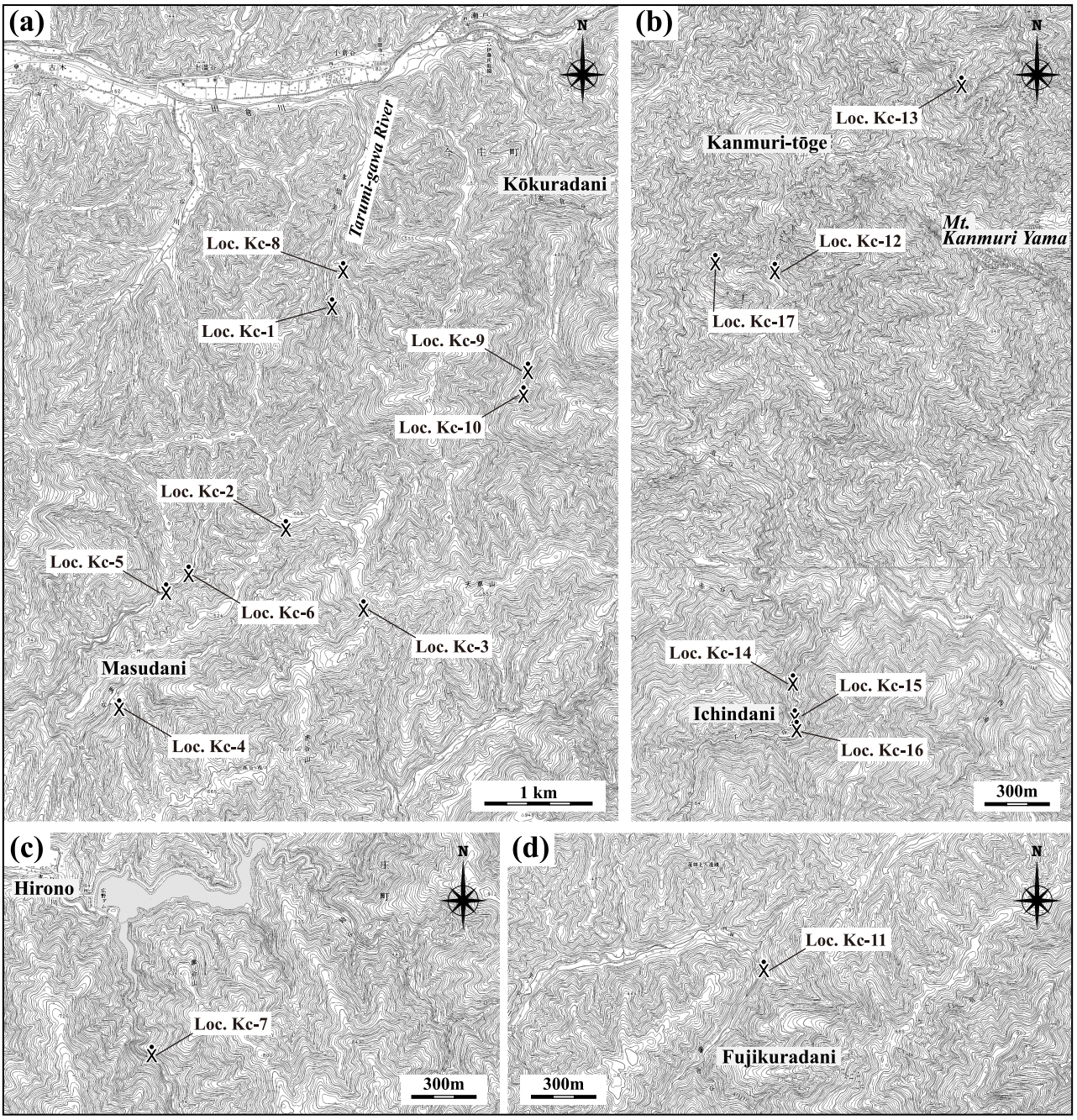


Fig. 2 Localities of chert samples yielding Triassic to Middle Jurassic radiolarians.
Parts of topographic maps of "Furuki" is used for figures (a) and (d), "Kanmuri Yama" and "Mino Tokuyama" for figure (b) and "Hirono" for figure (c). These maps are published from the Geospatial Information Authority of Japan.

Fauna: *Archaeocenosphaera*? sp., *Pseudostylosphaera*? spp., *Tirodella*? sp., *Celluronta* sp., Spumellaria gen. et sp. indet., Nassellaria gen. et sp. indet. (Plate 2).
Age: Early Anisian – Middle Anisian.

Sample number: KJ 0810f.
Lithology: Thinly bedded gray chert.
Fauna: *Eptingium*? sp., *Pseudostylosphaera* spp., Spumellaria gen. et sp. indet., Nassellaria gen. et sp. indet. (Plate 2).
Age: Probably Early Anisian – Early Carnian.

Sample number: KJ 0810g.
Lithology: Thinly bedded gray chert.
Fauna: *Cryptostephanidium*? sp., *Eptingium* sp., *Pseudostylosphaera compacta* (Nakaseko and Nishimura), *Parasepsagon* sp., *Triassocampe* spp., Spumellaria gen. et sp. indet., Entactinaria gen. et sp. indet., Nassellaria gen. et sp. indet. (Plate 2).
Age: Middle Anisian – Late Anisian.

Table. 1 List of radiolarian species detected from the Kanmuri Yama district in the Nanjō Maountains.

	Locality Number (Kc-)	1	2		3	4			5			6		7	8			9	10	11	12	13	14	15	16	17
	Sample Number	KJ 0301	KJ 0402	KJ 0403	KJ 0404	KJ 0410c	KJ 0810e	KJ 0810f	KJ 0810g	KJ 0904a	KJ 0904b	KJ 0904c	KJ 0905b	KJ 0905c	KJ 1904a	KJ 2206a	KJ 2206h	KJ 2206i	KJ 2412	KJ 2413	KJ 2902c	KJ 3701	KJ 3907	KJ 4401a	KJ 4405	KJ 4406a	KJ 5904
SPUMELLARIA	*Pantanellium*? *virgeum* Sashida														+											
	Pantanellium spp.																							+		+
	Zartus sp.																								+	
	Trillus elkhornensis Pessagno and Blome													+												
	Archaeocenosphaera? spp.						+			+	+															
	Udalia spp.															+										
	Protopsium spp.																				+					
	Spongoxystris? sp.																			+						
	Oertlispongus sp.																				+					
	Palaeosaturnalis sp.	+																					+			
	Praemesosaturnalis spp.																						+			
	Patulibracchiidae gen. et sp. indet.																								+	
	Spumellaria gen. et sp. indet.		+				+	+	+		+	+	+		+			+			+					
ENTACTINARIA	*Spongostephanidium* spp.																+				+					
	Cryptostephanidium? spp.	+							+								+		+							
	Eptingium nakasekoi Kozur and Mostler		+																			+				
	Eptingium spp.								+									+				+				
	Eptingium? spp.							+			+										+					
	Pentabelus sp. cf. *P. furutanii* Sugiyama																				+					
	Pseudostylosphaera compacta (Nakaseko and Nishimura)								+		+						+									
	Pseudostylosphaera helicata (Nakaseko and Nishimura)										+															
	Pseudostylosphaera japonica (Nakaseko and Nishimura)		+																	+			+			
	Pseudostylosphaera sp. aff. *P. tenuis* (Nakaseko and Nishimura)											+														
	Pseudostylosphaera spp.							+									+		+		+					
	Pseudostylosphaera? spp.		+	+			+								+			+	+							
	Parasepsagon sp.								+																	
	Hindeosphaera spinulosa (Nakaseko and Nishimura)																+									
	Hindeosphaera sp.																					+				
	Muelleritortis cochleata (Nakaseko and Nishimura)																			+						
	Monostylosphaera? spp.														+							+				
	Entactinaria gen. et sp. indet.				+				+				+		+			+	+		+				+	
NASSELLARIA	*Tirodella*? sp.						+																			
	Bipedis sp.																	+								
	Napora mitrata Pessagno, Whalen and Yeh															+										
	Napora sp.															+										
	Haeckelicyrtium? spp.	+																								
	Celluronta sp.						+																			
	Paratriassocampe sp.																+									
	Triassocampe deweveri (Nakaseko and Nishimura)		+		+						+						+									
	Triassocampe sp. cf. *T. myterocorys* Sugiyama			+																+						
	Triassocampe sp. aff. *T. diordinisi* Bragin sensu Sugiyama (1992)																		+							
	Triassocampe spp.		+		+				+	+	+						+		+	+		+				
	Eucyrtidiellum nagaiae Dumitrica, Goričan and Matsuoka															+										
	Droltus sp. cf. *D. hecatensis* Pessagno and Whalen				+																					
	Parahsuum simplum Yao															+										
	Parahsuum ovale Hori and Yao															+										
	Parahsuum izeense (Pessagno and Whalen)															+										
	Parahsuum longiconicum Sashida															+										
	Parahsuum sp. cf. *P. longiconicum* Sashida																							+		
	Parahsuum spp.													+		+						+				+
	Parahsuum? sp. A																									+
	Hsuum sp. cf. *H. mulleri* Pessagno and Whalen													+												
	Hsuum sp. sensu Matsuoka (2004)															+										
	Hsuum? sp.																					+				
	Conoptum sp. cf. *C. anulatum* Pessagno and Poisson																					+				
	Conoptum sp. cf. *C. rugosum* Pessagno and Poisson															+										
	Multimonilis sp.			+																						
	Praeparvicingula gigantocornis (Kishida and Hisada)																								+	
	Praeparvicingula sp. cf. *P. nanoconica* (Hori and Otsuka)																								+	
	Praeparvicingula spp.																							+	+	
	Parvicingula sp.																								+	
	Lantus obesus (Yeh)															+										
	Lantus intermedius Carter															+										+
	Lantus? sp.													+												
	Dictyomitrella? sp. cf. *D.*? *kamoensis* Mizutani and Kido																								+	
	Minocapsa globosa Matsuoka															+										
	Poulpidae gen. et sp. indet.		+																		+					
	Favosyringiinae gen. et sp. indet.													+								+				
	Nassellaria gen. et sp. indet.				+	+	+	+	+	+	+			+		+						+	+	+		

Table. 2 List of radiolarian genera and their biostratigraphic ranges.

Genus	Range
Pantanellium	upper Carnian — lower Aptian
Zartus	lower Pliensbachian — upper Bajocian
Trillus	lower Pliensbachian — lower Bathonian
Archaeocenosphaera	middle Anisian — upper Campanian
Udalia	lower Hettangian — lower Pliensbachian
Protopsium	upper Hettangian — lower Toarcian
Spongoxystris	middle Anisian — Ladinian
Oertlispongus	upper Anisian — lower Carnian
Palaeosaturnalis	lower Carnian — upper Pliensbachian
Praemesosaturnalis	upper Norian — upper Rhaetian
Pentabelus	upper Olenekian — lower Carnian
Monostylosphaera	lower Carnian — upper Carnian
Spongostephanidium	upper Olenekian — upper Carnian
Cryptostephanidium	lower Anisian — upper Carnian
Eptingium	lower Anisian — upper Rhaetian
Pseudostylosphaera	upper Olenekian — lower Carnian
Parasepsagon	middle Anisian — upper Anisian
Hindeosphaera	middle Anisian — middle Norian
Muelleritortis	Ladinian — lower Carnian
Hozmadia	upper Olenekian — upper Carnian
Tirodella	lower Carnian
Bipedis	upper Norian — upper Pliensbachian
Napora	upper Sinemurian — lower Turonian
Haecklicyrtium	lower Carnian — upper Pliensbachian
Celluronta	lower Anisian — middle Anisian
Paratriassocampe	middle Anisian — upper Anisian
Triassocampe	lower Anisian — lower Norian
Yeharaia	middle Anisian — lower Carnian
Eucyrtidiellum	lower Pliensbachian — upper Tithonian
Droltus	lower Hettangian — lower Bajocian
Parahsuum	lower Hettangian — upper Kimmeridgian
Hsuum	lower Pliensbachian — lower Cenomanian
Canoptum	Ladinian — upper Bajocian
Multimonilis	Ladinian — middle Norian
Praeparvicingula	middle Toarcian — upper Barremian
Parvicingula	upper Bathonian — upper Hauterivian
Lantus	lower Pliensbachian — lower Kimmeridgian
Minocapsa	lower Pliensbachian — lower Toarcian

(5) Locality Kc-5 (Fig. 2a)
Location: Northeast of Masudani, Minamiechizen Town. (lat. 35º45’4.9” N, long. 136º15’55.1” E)
Sample number: KJ 0904a.
Lithology: Thinly bedded pale gray chert.
Fauna: *Archaeocenosphaera*? spp., *Triassocampe* sp., Nassellaria gen. et sp. indet. (Plate 3).
Age: Probably Middle Anisian – Early Norian.

Sample number: KJ 0904b.
Lithology: Thinly bedded pale gray chert.
Fauna: *Archaeocenosphaera*? spp., *Eptingium*? sp., *Pseudostylosphaera compacta* (Nakaseko and Nishimura), *Pseudostylosphaera helicata* (Nakaseko and Nishimura), *Triassocampe deweveri* (Nakaseko and Nishimura), *Triassocampe* spp., Spumellaria gen. et sp. indet., Nassellaria gen. et sp. indet. (Plate 3).
Age: Late Anisian – middle Late Ladinian.

Sample number: KJ 0904c.
Lithology: Thinly bedded pale gray chert.
Fauna: *Pseudostylosphaera* sp. aff. *P. tenuis* (Nakaseko and Nishimura), Spumellaria gen. et sp. indet. (Plate 3).
Age: Probably Middle Anisian or younger.

(6) Locality Kc-6 (Fig. 2a)
Location: Northeast of Masudani, Minamiechizen Town. (lat. 35º45’7.6” N, long. 136º16’5.5” E)
Sample number: KJ 0905b.
Lithology: Thinly bedded dark gray chert.
Fauna: Entactinaria gen. et sp. indet., Spumellaria gen. et sp. indet. (Plate 3).
Age: Unknown.

Sample number: KJ 0905c.
Lithology: Thinly bedded dark gray chert.
Fauna: *Trillus elkhornensis* Pessagno and Blome, *Hsuum* sp. cf. *H. mulleri* Pessagno and Whalen, *Parahsuum* spp., *Lantus*? sp., Favosyringiinae gen. et sp. indet., Nassellaria gen. et sp. indet. (Plate 3).
Age: Early Pliensbachian – Middle Bajocian?

(7) Locality Kc-7 (Fig. 2c)
Location: Southeast of Hirono, Minamiechizen Town. (lat. 35º42’5.5” N, long. 136º15’45.6” E)
Sample number: KJ 1904a.
Lithology: Thinly bedded dark gray chert.
Fauna: *Pantanellium*? *virgeum* Sashida, *Pseudostylosphaera*? spp., *Monostylosphaera*? sp., Spumellaria gen. et sp. indet., Entactinaria gen. et sp. indet. (Plate 4).
Age: Late Olenekian – Middle Anisian.

(8) Locality Kc-8 (Fig. 2a)
Location: Tarumi-gawa, Minamiechizen Town. (lat. 35º46’42.5” N, long. 136º17’1.9” E)
Sample number: KJ 2206a.
Lithology: Thinly bedded gray chert.
Fauna: *Udalia* spp., *Napora mitrata* Pessagno, Whalen and Yeh, *Napora* sp., *Eucyrtidiellum nagaiae* Dumitrica, Goričan and Matsuoka, *Parahsuum simplum* Yao, *Parahsuum ovale* Hori and Yao, *Parahsuum izeense* (Pessagno and Whalen), *Parahsuum longiconicum* Sashida, *Parahsuum* spp., *Hsuum* sp. sensu Matsuoka 2004, *Canoptum* sp. cf. *C. rugosum* Pessagno and Poisson, *Lantus obesus* (Yeh), *Lantus intermedius* Carter, *Minocapsa globosa* Matsuoka, Nassellaria gen. et sp. indet. (Plate 4).
Age: Early Toarcian.

Sample number: KJ 2206h.
Lithology: Thinly bedded gray chert.
Fauna: *Spongostephanidium* sp., *Cryptostephanidium*?

sp., *Pseudostylosphaera compacta* (Nakaseko and Nishimura), *Pseudostylosphaera* spp., *Hindeosphaera spinulosa* (Nakaseko and Nishimura), *Triassocampe deweveri* (Nakaseko and Nishimura), *Triassocampe* spp., *Paratriassocampe* sp. (Plate 5).
Age: Late Anisian.

Sample number: KJ 2206i.
Lithology: Thinly bedded gray chert.
Fauna: *Eptingium* sp., *Pseudostylosphaera*? spp., *Bipedis* sp., Spumellaria gen. et sp. indet., Entactinaria gen. et sp. indet. (Plate 5).
Age: Probably Carnian – Late Norian.

(9) Locality Kc-9 (Fig. 2a)
Location: South of Kōkuradani, Minamiechizen Town.
(lat. 35º46'12.1" N, long. 136º18'12" E)
Sample number: KJ 2412.
Lithology: Thinly bedded light gray chert.
Fauna: *Cryptostephanidium*? sp., *Pseudostylosphaera* spp., *Pseudostylosphaera*? spp., *Triassocampe* sp. aff. *T. diordinis* Bragin sensu Sugiyama 1992, *Triassocampe* spp., Entactinaria gen. et sp. indet. (Plate 5).
Age: Middle Anisian.

(10) Locality Kc-10 (Fig. 2a)
Location: South of Kōkuradani, Minamiechizen Town.
(lat. 35º46'4" N, long. 136º18'8.2" E)
Sample number: KJ 2413.
Lithology: Thinly bedded greenish gray chert.
Fauna: *Spongoxystris*? sp., *Pseudostylosphaera japonica* (Nakaseko and Nishimura), *Muelleritortis cochleata* (Nakaseko and Nishimura), *Triassocampe* sp. cf. *T. myterocorys* Sugiyama, *Triassocampe* spp. (Plate 6).
Age: Late Ladinian – earliest Carnian.

(11) Locality Kc-11 (Fig. 2d)
Location: Fujikuradani, Minamiechizen Town.
(lat. 35º48'21.5" N, long. 136º20'23.2" E)
Sample number: KJ 2902c.
Lithology: Thinly bedded dark gray chert.
Fauna: *Protopsium* spp., *Oertlispongus* sp., *Spongostephanidium* spp., *Eptingium*? sp., *Pentabelus* sp. cf. *P. furutanii* Sugiyama, *Pseudostylosphaera* sp., Poulpidae gen. et sp. indet., Spumellaria gen. et sp. indet., Entactinaria gen. et sp. indet. (Plate 6).
Age: Probably Late Anisian – Early Carnian.

(12) Locality Kc-12 (Fig. 2b)
Location: South of Kanmuri-tōge, Ibigawa Town.
(lat. 35º46'40.1" N, long. 136º23'13.4" E)
Sample number: KJ 3701.
Lithology: Thinly bedded light dark gray chert.
Fauna: *Parahsuum* spp., *Hsuum*? sp., *Canoptum* sp. cf. *C. anulatum* Pessagno and Poisson, Favosyringiinae gen. et sp. indet., Nassellaria gen. et sp. indet. (Plate 7).
Age: Probably Early Pliensbachian – early Late Toarcian.

(13) Locality Kc-13 (Fig. 2b)
Location: Northeast of Kanmuri-tōge, Ikeda Town.
(lat. 35º47'37.2" N, long. 136º24'23.3" E)
Sample number: KJ 3907.
Lithology: Thinly bedded light pale gray chert.
Fauna: *Eptingium nakasekoi* Kozur and Mostler, *Eptingium* sp., *Pseudostylosphaera japonica* (Nakaseko and Nishimura), *Hindeosphaera* sp., *Monostylosphaera*? sp. *Triassocampe* spp., Nassellaria gen. et sp. indet. (Plate 7).
Age: Middle Anisian – Late Anisian.

(14) Locality Kc-14 (Fig. 2b)
Location: Ichindani, Ibigawa Town.
(lat. 35º44'36.4" N, long. 136º23'20.2" E)
Sample number: KJ 4401a.
Lithology: Thinly bedded pale gray chert.
Fauna: *Palaeosaturnalis* sp., *Praemesosaturnalis* spp., Nassellaria gen. et sp. indet. (Plate 7).
Age: Late Norian – Late Rhaetian.

(15) Locality Kc-15 (Fig. 2b)
Location: Ichindani, Ibigawa Town.
(lat. 35º44'23.3" N, long. 136º23'21" E)
Sample number: KJ 4405
Lithology: Thinly bedded gray chert.
Fauna: *Pantanellium* spp., *Parahsuum* sp. cf. *P. longiconicum* Sashida, *Praeparvicingula* spp. (Plate 8).
Age: Probably Early Pliensbachian – Early Aalenian.

(16) Locality Kc-16 (Fig. 2b)
Location: Ichindani, Ibigawa Town.
(lat. 35º44'21.2" N, long. 136º23'21.3" E)
Sample number: KJ 4406a.
Lithology: Thinly bedded gray chert.
Fauna: *Zartus* sp., *Praeparvicingula gigantocornis* (Kishida and Hisada), *Praeparvicingula* sp. cf. *P. nanoconica* (Hori and Otsuka), *Praeparvicingula* spp., *Parvicingula* sp., *Dictyomitrella*? sp. cf. *D.*? *kamoensis* Mizutani and Kido, Patulibracchiidae gen. et sp. indet., Entactinaria gen. et sp. indet. (Plate 8).
Age: Late Toarcian – Bajocian.

(17) Locality Kc-17 (Fig. 2b)
Location: Southwest of Kanmuri-tōge, Ibigawa Town.
(lat. 35º46'44.2" N, long. 136º22'50" E)
Sample number: KJ 5904.
Lithology: Thinly bedded light gray chert.
Fauna: *Pantanellium* spp., *Parahsuum* spp., *Parahsuum*? sp. A, *Lantus intermedius* Carter (Plate 8).
Age: Latest Sinemurian – Early Toarcian.

4. Age determination

In order to determine the geological age of the radiolarian faunas detected from the chert samples of this report, the zonation schemes proposed by Sugiyama (1997) for Triassic (TR0 – TR8D), by Hori (1990) and Carter *et*

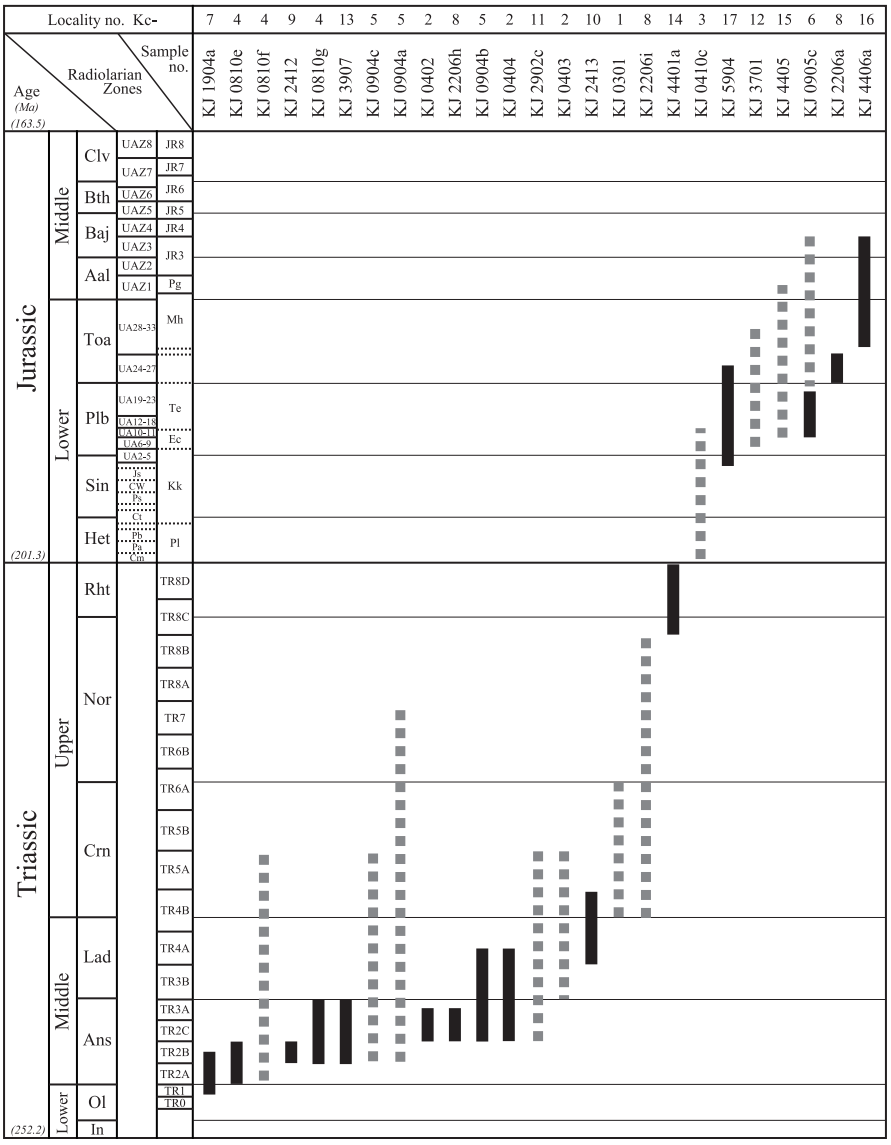


Fig. 3 Geologic age of each chert sample based on the detected radiolarians.
Radiolarian zonation schemes proposed by after-mentioned literatures are primarily adapted in this figure. These zones are arranged in ascending order: TR0 – TR8 for Triassic (Sugiyama, 1997); Pl, Kk, Ec, Te, Mh and Pg for Hettangian – lower Aalenian (Hori, 1990); Cm, Pa, Pb, Ct, Ps, CW, Js for Hettangian – Sinemurian (Carter *et al.*, 1998); UA2 – UA33 for uppermost Sinemurian – Toarcian (Carter *et al.*, 2010); JR3 – JR8 for Middle Jurassic (Matsuoka, 1995); UAZ1 – UAZ8 for Middle Jurassic (Baumgartner *et al.*, 1995b). Abbreviations are as follows. Pl: *Parahsuum aff. longiconicum*, Kk: *Katroma kurusuensis*, Ec: *Eucyrtidiellum*? sp. C, Te: *Trillus elkhornensis*, Mh: *Mesosaturnalis hexagonus*, Pg: *Parahsuum*? *grande*, Cm: *Canoptum merum*, Pa: *Protokatroma aquila*, Pb: *Pantanellium browni*, Ct: *Crucella hettangica*, Ps: *Parahsuum simplum*, CW: *Canutus rockfishensis* and *Wrangellium thurstonense*, Js: *Jacus*? *sandspitensis*, UAZ: Unitary Association Zone. Geologic time scale with ages (in Ma) is based on Gradstein *et al.* (2012).

al. (1998, 2010) for Lower Jurassic (UA1 – UA41), and by Baumgartner *et al.* (1995b) and Matsuoka (1995) for Middle Jurassic (UAZ1 – UAZ8), are primarily used. Biostratigraphic ranges of radiolarian genera fully and most-recently analyzed by O'Dogherty *et al.* (2009, 2010) are adapted to those of the radiolarian genera listed in Table 2. Furthermore, biostratigraphic ranges of the radiolarian species discussed below are partly based on Pessagno and Blome (1980), Pessagno and Whalen (1982), Sugiyama (1992), Sashida *et al.* (1993), Nishizono (1996), Yao (1997) and Matsuoka (2004), in addition to the above literatures.

4.1. Early – Middle Triassic

Ten samples (KJ0402, KJ0404, KJ0810e, KJ0810g, KJ0904b, KJ1904a, KJ2206h, KJ2412, KJ2413, and

KJ3907) taken from eight localities yielded Late Olenekian to Early Carnian (Early to Middle Triassic) radiolarian faunas; also five samples (KJ0403, KJ0810f, KJ0904a, KJ0904c and KJ2902c) contain faunas that have a much wider span ranging from the Anisian to Carnian or Norian ages.

Age-diagnostic species are rarely included in KJ0810e and KJ1904a, their ages however can be determined as follows; **KJ1904a** is assigned to TR1 – lower part of TR2B, ranging from the late Spathian (= late Late Olenekian) to Middle Anisian (Sugiyama, 1997), based on the presence of *Pantanellium*? *virgeum* Sashida, and **KJ0810e** is restricted in age to be the Early to Middle Anisian based on the occurrence of *Celluronta* sp.

Although the fauna is poorly preserved, the presence of *Triassocampe* sp. aff. *T. diordinis* Bragin sensu Sugiyama suggests that **KJ2412** is assigned to the Tc assemblage of Sugiyama (1992), indicating the Middle Anisian age. The presence of *Pseudostylosphaera compacta* (Nakaseko and Nishimura) and *Pseudostylosphaera japonica* (Nakaseko and Nishimura) suggests that **KJ0810g** and **KJ3907** are not older than the Middle Anisian (Sugiyama, 1992).

Moreover, the co-occurrence of *Parasepsagon* sp. in KJ0810g and *Eptingium nakasekoi* Kozur in KJ3907 supposed to be restricted to TR2A or TR2B – TR3A (Early or Middle Anisian – Late Anisian), were respectively found. Therefore, these samples are indicative of the Middle – Late Anisian age.

KJ0402 and **KJ2206h** are assigned to TR2C – lower part of TR3A (Late Anisian) based on the co-occurrence of following species: *Eptingium nakasekoi* Kozur and Mostler, *Pseudostylosphaera japonica* (Nakaseko and Nishinura) and *Triassocampe deweveri* (Nakaseko and Nishimura) in KJ0402; *Pseudostylosphaera compacta* (Nakaseko and Nishimura), *Triassocampe deweveri* (Nakaseko and Nishimura) and *Hindeosphaera spinulosa* (Nakaseko and Nishimura) in KJ2206h.

The fauna found in **KJ0904b** consists of *Pseudostylosphaera compacta* (Nakaseko and Nishimura), *Pseudostylosphaera helicata* (Nakaseko and Nishimura) and *Triassocampe deweveri* (Nakaseko and Nishimura). It is known that *Pseudostylosphaera helicata* (Nakaseko and Nishimura) had existed from T3 to lower part of T5 (Early Ladinian – Early Norian; Nishizono, 1996) or from Early Anisian to Late Ladinian (Sashida *et al.*, 1993), therefore KJ0904b is estimated to be a Late Anisian – middle Late Ladinian interval. *Triassocampe deweveri* (Nakaseko and Nishimura) is only an age-diagnostic species included in KJ0404, indicating a Late Anisian – middle Late Ladinian interval.

The fauna detected from **KJ2413** is characterized by the presence of *Muelleritortis cochleata* (Nakaseko and Nishimura) and *Pseudostylosphaera japonica* (Nakaseko and Nishimura), together with *Triassocampe* sp. cf. *T. myterocorys* Sugiyama. The former two co-existed during TR4A – TR4B (Late Ladinian and early Early Carnian), consequently suggesting that this sample is assigned to a Late Ladinian – earliest Carnian interval.

4.2. Late Triassic

Scarce and poorly preserved faunas were detected from Samples KJ0301, KJ2206i and K4401a. Ages of the former two samples are impossible to be determined precisely, due to the absence of age-diagnostic species. Remaining **KJ4401a** contains *Praemesosaturnalis* sp. and *Palaeosaturnalis* sp., therefore its age is estimated to be a Late Norian – Late Rhaetian interval.

4.3. Early – Middle Jurassic

Early to Middle Jurassic radiolarian faunas were found in seven samples (KJ0410c, KJ0905c, KJ2206a, KJ3701, KJ4405, KJ4406a and KJ5904).

A specimen comparable to *Droltus hecatensis* Pessagno and Whalen, ranging in age from Hettangian to Early Pliensbachian (Pessagno and Whalen, 1982), is an age-diagnostic species in **KJ0410c**. Thus, the inferred age-range probably is a Hettangian – Early Pliensbachian interval. **KJ5904** can be assigned to a latest Sinemurian – Early Toarcian interval (UA2 – UA26), based on the range of *Lantus intermedius* Carter.

Ages of **KJ3701** and **KJ4405** cannot be precisely determined because of their poorly preserved faunas. However, Early Pliensbachian – early Late Toarcian (UA6 – UA28) and Early Pliensbachian – Early Aalenian (UA10 – UA35) intervals are probably proposed respectively for the each age of KJ3701 and KJ4405, on the basis of the presence of *Canoptum* sp. cf. *C. anulatum* Pessagno and Poisson in KJ3701, and *Parahsuum* sp. cf. *P. longiconicum* Sashida in KJ4405.

KJ0905c contains *Trillus elkhornensis* Pessagno and Blome, which ranges from an Early or Late Pliensbachian to Middle Bajocian interval (Pessagno and Blome, 1980; Carter *et al.*, 2010). A specimen comparable to *Hsuum mulleri* Pessagno and Whalen is also included; its range is restricted in an interval of middle Early Pliensbachian – early Late Pliensbachian (UA10- UA20). For this sample, middle Early – early Late Pliensbachian age is indicated by the co-occurrence of the two species, although the maximum age may be extended up to the Middle Bajocian.

The fauna detected from **KJ2206a** is moderately preserved and relatively diverse. The co-occurrence of *Eucyrtidiellum nagaiae* Dumitrica, Goričan and Matsuoka and *Lantus intermedius* Carter suggests that this fauna compatible with an interval of Late Pliensbachian – Early Toarcian (UA19 – UA26). The presence of *Minocapsa globosa* Matsuoka, whose age-range is from Late Pliensbachian? – Early Toarcian (Yao, 1997; Matsuoka, 2004), is concordant with the age of the above co-occurrence. However, the range of *Napora mitrata* Pessagno, Whalen and Yeh is supposed to be restricted to the Early Toarcian age (Pessagno *et al.*, 1986), therefore the age of KJ2206a is within the Early Toarcian.

KJ4406a yielded poorly preserved fauna. On the basis of the presence of *Praeparvicingula gigantocornis* (Kishida and Hisada), together with *Praeparvicingula* sp. cf. *P. nanoconica* (Hori and Otsuka) and *Dictyomitrella*? sp. cf. *D.*? *kamoensis* Mizutani and Kido, an interval

between Late Toarcian and Middle Bajocian is inferred as the age of this sample.

5. Conclusion

The geological age inferred for all the twenty-six chert samples investigated in the Kanmuri Yama district, the Nanjō Mountains, spans a wide range from the Late Olenekian (Early Triassic) to Middle Bajocian (Middle Jurassic); age of one sample is still remain unknown (Fig. 3). This evidence strongly suggests that the cherts in this district records up to 80 m.y. of deposition.

6. Systematic Paleontology

Order **SPUMELLARIA** Ehrenberg 1875, *emend*. De Wever, Dumitrica, Caulet, Nigrini and Caridroit 2001
Family **Pantanelliidae** Pessagno 1977b

Genus ***Pantanellium*** Pessagno 1977a
Type species *Pantanellium riedeli* Pessagno 1977a

Pantanellium*? *virgeum Sashida 1991
(Plate 4, fig. 1)
1991 *Pantanellium*? *virgeum* n. sp.– Sashida, p.691-692, figs. 7.9-7.14.
1995 *Pantanellium*? *virgeum* Sashida – Kamata, figs. 6.6-6.7.
2010 *Pantanellium*? *virgeum* Sashida – Kuwahara, Sano, Ezaki and Yao, fig. 11.12.
Remarks: The illustrated specimen is characterized by a spherical shell and bipolar rod-like spines. The cortical shell, moderately-preserved, consists of large hexagonal pore frames that have rather high nodes at bars between pore frame vertices. The polar spines, longer and shorter ones, are circular in the axial section, but the proximal portion of the shorter spine is three-bladed. These diagnostic characters of this specimen are identical with those of *Pantanellium*? *virgeum* Sashida.
Range: Upper Olenekian – Middle Anisian (Sashida,1991; Sugiyama, 1997).

***Pantanellium* spp.**
(Plate 8, figs. 1-2, 17-19)
Remarks: Poorly- to moderately-preserved specimens were obtained. They consist of a spherical or ellipsoidal cortical shell with bipolar spines. Massive polygonal pore frames of the shell have small nodes at the vertices in the moderately-preserved specimens.

Genus ***Zartus*** Pessagno and Blome 1980
Type species *Zartus jonesi* Pessagno and Blome 1980

Zartus sp.
(Plate 8, fig. 9)
Remarks: A poorly-preserved specimen was obtained. It is similar to genus *Zartus* in having a spherical cortical shell with triradiate bipolar spines, and having secondary spines extended from raised median band.

Genus ***Trillus*** Pessagno and Blome 1980
Type species *Trillus seidersi* Pessagno and Blome 1980

Trillus elkhornensis Pessagno and Blome 1980
(Plate 3, fig. 26)
1980 *Trillus elkhornensis* n. sp. – Pessagno and Blome, p.249, pl.6, figs. 11-12, 16, 20, 25; pl.9, fig. 11.
1987 *Trillus elkhornensis* Pessagno and Blome – Yeh, p.37, pl.5, fig. 5.
1989 *Trillus elkhornensis* Pessagno and Blome – Hori and Otsuka, pl.4, fig. 15.
1990 *Trillus elkhornensis* Pessagno and Blome – Hori, fig. 8.30.
1992 *Trillus elkhornensis* Pessagno and Blome – Sashida, pl.2, figs. 21-22.
1996 *Trillus elkhornensis* Pessagno and Blome – Yeh and Cheng, p.98, pl.8, fig. 2.
1997 *Trillus elkhornensis* Pessagno and Blome – Yao, pl.3, fig. 147.
2004 *Trillus elkhornensis* Pessagno and Blome – Matsuoka, fig. 16.
Remarks: The examined specimen is moderately preserved, but is identical with *Trillus elkhornensis* Pessagno and Blome in having polygonal pore frames on the subspherical cortical shell and having triradiate bipolar spines.
Range: Lower Pliensbachian – Middle Bajocian (Pessagno and Blome, 1980; Carter *et al.*, 2010).

Family **Xiphostylidae** Haeckel 1881, *sensu* Pessagno and Yang *in* Pessagno, Six and Yang 1989, *emend*. De Wever, Dumitrica, Caulet, Nigrini and Caridroit 2001

Genus ***Archaeocenosphaera*** Pessagno and Yang *in* Pessagno, Six and Yang 1989
Type species *Archaeocenosphaera ruesti* Pessagno and Yang *in* Pessagno, Six and Yang 1989

***Archaeocenosphaera*? spp.**
(Plate 2, fig. 1; Plate 3, figs. 1-2, 5-6)
Remarks: The illustrated specimens are similar to genus *Archaeocenosphaera* in having a spherical shell and lacking spines. The outer lattice layer may be comprised of symmetrical polygonal pore frames, but it is not clear that two latticed layers are fused.

Family **Emiluviidae** Dumitrica 1995

Genus ***Udalia*** Whalen and Carter 1998
Type species *Udalia dennisoni* Whalen and Carter 1998

***Udalia* spp.**
(Plate 4, figs. 13-14)
Remarks: Overall form of the examined specimens is similar to those of genus *Udalia* in having a square spongy shell with four prominent spines, one of which is broken,

at each corner.

Family **Archaeospongoprunidae** Pessagno 1973

Genus ***Protopsium*** Pessagno and Poisson 1981
Type species *Protopsium ehrenbergi* Pessagno and Poisson 1981

***Protopsium* spp.**
(Plate 6, figs. 15-16)
Remarks: Overall form of the examined specimens is similar to those of genus *Protopsium* in having a subellipsoidal spongy shell and two rod-like polar spines.

Family **Spongotortilispinidae** Kozur and Mostler in Moix, Kozur, Stampfli and Mostler 2007

Genus ***Spongoxystris*** Sugiyama 1997
Type species *Spongoxystris hadra* Sugiyama 1997

***Spongoxystris*? sp.**
(Plate 6, fig. 2)
Remarks: The obtained specimen is similar to genus *Spongoxystris* in having two stout spines that are aligned in the major axis of the shell. However, it differs from the latter by the fact that a shorter spine dome-shaped.

Family **Oertlispongidae** Kozur and Mostler in Dumitrică, Kozur and Mostler 1980

Genus ***Oertlispongus*** Dumitrică, Kozur and Mostler 1980
Type species *Oertlispongus inaequispinosus* Dumitrică, Kozur and Mostler 1980

***Oertlispongus* sp.**
(Plate 6, fig. 21)
Remarks: The examined specimen is similar to genus *Oertlispongus* in general form and in having a subspherical shell with two long spines.

Family **Saturnalidae** Deflandre 1953, emend. Kozur and Mostler 1972

Genus ***Palaeosaturnalis*** Donofrio and Mostler 1978
Type species *Spongosaturnalis triassicus* Kozur and Mostler 1972

***Palaeosaturnalis* spp.**
(Plate 1, fig. 4; Plate 7, fig. 25)
Remarks: Two broken specimens were obtained. Their forms are characterized by a narrow and simple ring with radial spines of outside. Some of polar and radial spines lack due to poor preservation. However, they resemble genus *Palaeosaturnalis* in general form.

Genus ***Praemesosaturnalis*** Kozur and Mostler 1981
Type species *Spongosaturnalis bifidus* Kozur and Mostler 1972

***Praemesosaturnalis* spp.**
(Plate 7, figs. 23-24)
Remarks: These specimens are broken and composed of a wide ring and radial spines, which are short and massive, and therefore they belong to genus *Praemesosaturnalis*.

Order **ENTACTINARIA** Kozur and Mostler 1982

Family **Eptingiidae** Dumitrică 1978

Genus ***Spongostephanidium*** Dumitrică 1978
Type species *Spongostephanidium spongiosum* Dumitrică 1978

***Spongostephanidium* spp.**
(Plate 5, fig. 7, Plate 6, figs. 22-24)
Remarks: Moderately- to poorly-preserved specimens were examined. They resemble genus *Spongostephanidium* in general form, although one of the three rod-like horns is broken.

Genus ***Cryptostephanidium*** Dumitrică 1978
Type species *Cryptostephanidium cornigerum* Dumitrică 1978

***Cryptostephanidium*? spp.**
(Plate 1, fig. 5; Plate 2, figs. 24; Plate 5, figs. 8, 28)
Remarks: Moderately-preserved specimens were examined. They consist of a small subspherical shell and three spines. Thus, they are probably similar to genus *Cryptostephanidium* in general form.

Genus ***Eptingium*** Dumitrică 1978
Type species *Eptingium manfredi* Dumitrică 1978

Eptingium nakasekoi Kozur and Mostler 1994
(Plate 1, fig. 11; Plate 7, figs. 15-16)
1979 *Tripocyclia* sp. cf. *T. acythus* De Wever – Nakaseko and Nishimura, p.72-73, pl.4, fig. 2.
1994 *Eptingium nakasekoi* n. sp. – Kozur and Mostler, p.43, pl.1, fig. 5.
Remarks: Several moderately preserved specimens were examined. They consist of a cortical shell with three main spines. The shell is rounded subtriangular in lateral view, and its surface structure is characterized by large and irregular pore frames. The spines are stout and three-bladed in axial section. These features are quite similar to those of *Eptingium nakasekoi* Kozur and Mostler, although length of the spines are slightly shorter.
Range: Lower – Upper Anisian (Sugiyama, 1997).

***Eptingium* spp.**
(Plate 2, fig. 25; Plate 5, fig.20; Plate 7, fig. 17)
Remarks: Several poorly-preserved specimens were obtained. They are characterized by a rounded subtriangular cortical shell and three main spines that are three-bladed in axial section.

***Eptingium*? spp.**
(Plate 2, fig. 18; Plate 3, fig. 9; Plate 6, fig. 25)
Remarks: The illustrated specimens are broken due to poor preservation, but they are similar to *Eptingium* in having a rounded subtriangular shell and spines.

Family **Kungalariidae** Dumitrica and Carter 1999

Genus ***Pentabelus*** Sugiyama 1992
Type species *Pentabelus furutanii* Sugiyama 1992
Remarks: Sugiyama (1992) mentioned that the family assignment of genus *Pentabelus* is uncertain, and O'Dogherty *et al.* (2009) suggested that this genus belongs in Kungalariidae. In this report, *Pentabelus* is tentatively settled in Kungalariidae.

Pentabelus* sp. cf. *P. furutanii Sugiyama 1992
(Plate 6, fig. 17)
Remarks: Shell, primitive and spherical, is composed of coarse lattice work, with apical, primary lateral and secondary lateral spines. Thus, it is similar to *Pentabelus furutanii* Sugiyama.

Family **Hindeosphaeridae** Kozur and Mostler 1981

Genus ***Pseudostylosphaera*** Kozur and Mostler 1981
Type species *Pseudostylosphaera gracilis* Kozur and Mock in Kozur and Mostler 1981

Pseudostylosphaera compacta (Nakaseko and Nishimura) 1979
(Plate 2, fig. 22; Plate 3, fig. 8; Plate 5, fig. 1)
1979 *Archaeospongoprunum compactum* n. sp. – Nakaseko and Nishimura, p.68, pl.1, figs. 3, 7.
1981 *Pseudostylosphaera compacta* (Nakaseko and Nishimura) – Kozur and Mostler, p.30-31.
1990 *Pseudostylosphaera compacta* (Nakaseko and Nishimura) – Yeh, p.15, pl.4, figs. 3-4, 20.
1996 *Pseudostylosphaera compacta* (Nakaseko and Nishimura) – Nishizono, pl.3, fig. 6.
1996 *Pseudostylosphaera compacta* (Nakaseko and Nishimura) – Kozur, Krainer and Mostler, p.212, pl.6, fig. 17.
2001 *Pseudostylosphaera compacta* (Nakaseko and Nishimura) – Feng, Zhang and Ye, p.188-189, pl.5, figs. 7-12.
2011 *Pseudostylosphaera compacta* (Nakaseko and Nishimura) – Thassanapak, Feng, Grant-Mackie, Chonglakmani and Thanee, p.194, figs. 6O, 6Q.
Remarks: The illustrated specimens are not well preserved, but differ from *Pseudostylosphaera japonica* (Nakaseko and Nishinura) by having longer and slender polar spines. Then, they are identified with *Pseudostylosphaera compacta* (Nakaseko and Nishimura).
Range: Middle Anisian – Ladinian (Tumanda, 1991; Sugiyama,1992).

Pseudostylosphaera helicata (Nakaseko and Nishimura) 1979
(Plate 3. fig. 7)
1979 *Archaeospongoprunum helicatum* n. sp. – Nakaseko and Nishimura, p.68, pl.2, figs. 1-2; pl.12, fig. 3.
1981 *Pseudostylosphaera helicata* (Nakaseko and Nishimura) – Kozur and Mostler, p.30-31.
1992 *Pseudostylosphaera helicata* (Nakaseko and Nishimura) – Otsuka, Kajima and Hori, p.32, pl.3, figs. 3-4.
1992 *Pseudostylosphaera helicata* (Nakaseko and Nishimura) – Yeh, p.61, pl.7, fig. 1.
1993 *Pseudostylosphaera helicata* (Nakaseko and Nishimura) – Sashida, Nishimura, Igo, Kazama and Kamata, p.90, fig. 7.11.
1996 *Pseudostylosphaera helicata* (Nakaseko and Nishimura) – Nishizono, p.90, pl.3, fig. 7.
Remarks: The illustrated specimen possesses a subspherical shell and two opposite polar spines. The spines are slightly shorter than those of the type species, but are twisted in their distal part.
Range: Ladinian – Carnian or earliest Norian (Nishizono, 1996).

Pseudostylosphaera japonica (Nakaseko and Nishinura) 1979
(Plate 1, figs. 8-9; Plate 6, fig. 1; Plate 7, figs. 8-12)
1979 *Archaeospongoprunum japonicum* n. sp. – Nakaseko and Nishimura, p.67-68, pl.1, figs. 2, 4, 9.
1981 *Pseudostylosphaera japonica* (Nakaseko and Nishimura) – Kozur and Mostler, p.30-31.
1990 *Pseudostylosphaera japonica* (Nakaseko and Nishimura) – Yeh, p.15, pl.4, figs. 5-7.
1993 *Pseudostylosphaera japonica* (Nakaseko and Nishimura) – Sashida, Nishimura, Igo, Kazama and Kamata, p.89-90, figs. 7.9, 7.15
1996 *Pseudostylosphaera compacta* (Nakaseko and Nishimura) – Nishizono, pl.3, fig. 9.
1996 *Pseudostylosphaera japonica* (Nakaseko and Nishimura) – Kozur, Krainer and Mostler, p.212, pl.6, fig. 15.
1997 *Pseudostylosphaera japonica* (Nakaseko and Nishimura) – Sugiyama, p.186, fig. 48.15.
2001 *Pseudostylosphaera japonica* (Nakaseko and Nishimura) – Feng, Zhang and Ye, p.188, pl.5, figs. 1-6.
2011 *Pseudostylosphaera japonica* (Nakaseko and Nishimura) – Thassanapak, Feng, Grant-Mackie, Chonglakmani and Thanee, p.195, figs. 6P, 6S.
Remarks: The illustrated specimens are characterized by a globular shell with two polar spines. The spines are moderately long, massive and three-bladed in axial section. Their width slightly increase toward a distal direction and decrease near the terminus. Surface of the shell is rough and its spongy meshwork is indistinct due to poor preservation.
Range: Middle Anisian – Lower Carnian (Sugiyama,1997).

Pseudostylosphaera* sp. aff. *P. tenuis (Nakaseko and Nishimura) 1979
(Plate 3, fig. 19)
Remarks: The examined specimen is similar to *Pseudostylosphaera tenuis* (Nakaseko and Nishimura) in having a spherical shell and two polar spines that are unequal in length. However, length of the longer spine of the examined specimen is shorter than that of the type species (Nakaseko and Nishimura, 1979).

***Pseudostylosphaera* spp.**
(Plate 2, figs. 11-17; Plate 5, figs. 2-3, 23-24; Plate 6, fig. 14)
Remarks: The examined specimens seem to belong to genus *Pseudostylosphaera* on the basis of a subspherical shell with spongy meshwork and two polar spines although some of the specimens lack polar spines.

***Pseudostylosphaera*? spp.**
(Plate 1, figs. 10, 19; Plate 2, figs. 3-4; Plate 4, figs. 7, 12; Plate 5, figs. 17-18, 25-27)
Remarks: One of two polar spines of the examined specimens is lack or broken due to poor preservation. Therefore, it is questionable that they belong to genus *Pseudostylosphaera*.

Genus ***Parasepsagon*** Dumitrică, Kozur and Mostler 1980
Type species *Parasepsagon tetracanthus* Dumitrică, Kozur and Mostler 1980

***Parasepsagon* sp.**
(Plate 2, fig. 26)
Remarks: The examined specimen is not well preserved. It has a subspherical shell and four spines, one of which is broken. Outer shell consists of triangular meshes with small nodes at vertices. The spines are three-bladed and slightly twisted in distal part. This appearance is identical with genus *Parasepsagon*.

Genus ***Hindeosphaera*** Kozur and Mostler 1979
Type species *Hindeosphaera foremanae* Kozur and Mostler 1979

Hindeosphaera spinulosa (Nakaseko and Nishimura) 1979
(Plate 5, figs. 4-6)
1979 *Archaeospongoprunum spinulosum* n. sp. – Nakaseko and Nishimura, p.69, pl.2, figs. 3-4, 6.
1989 *Pseudostylosphaera* sp. cf. *P. spinulosa* (Nakaseko and Nishimura) – Cheng, p.143, pl.6, fig. 2; pl.7, figs. 8-9.
1989 *Hindeosphaera spinulosa* (Nakaseko and Nishimura) – Martini, De Wever, Zaninetti, Denelian and Kito, p.150, pl.3, fig. 8.
1990 *Pseudostylosphaera spinulosa* (Nakaseko and Nishimura) – Yeh, p.15, pl.4, fig. 14.
1993 *Pseudostylosphaera spinulosa* (Nakaseko and Nishimura) – Sashida, Nishimura, Igo, Kazama and Kamata, p.92, figs. 7.16-7.17.
1995 *Hindeosphaera*? *spinulosa* (Nakaseko and Nishimura) – Ramovš and Goričan, p.185, pl.3, figs. 6-8.
1996 *Pseudostylosphaera spinulosa* (Nakaseko and Nishimura) – Nishizono, pl.3, figs. 10-12.
1996 *Hindeosphaera spinulosa* (Nakaseko and Nishimura) – Kozur, Krainer and Mostler, p.210, pl.4, figs. 4, 8.
2001 *Hindeosphaera spinulosa* (Nakaseko and Nishimura) – Feng, Zhang and Ye, p.190, pl.5, figs. 15, 21.
2011 *Hindeosphaera spinulosa* (Nakaseko and Nishimura) – Thassanapak, Feng, Grant-Mackie, Chonglakmani and Thanee, p.194, fig. 6K.
Remarks: The illustrated specimens possess an ellipsoidal shell and two polar spines. One spine is broad and three-bladed, and is considerably larger than the opposite spine.
Range: Lower – Upper Anisian (Sugiyama, 1997).

***Hindeosphaera* sp.**
(Plate 7, fig. 14)
Remarks: This specimen consists of a spherical shell with spongy meshwork and spikes. One massive and stout spike, which is not spirally rotated as in other species of genus *Hindeosphaera*, is quite longer than the others.

Family **Muelleritortiidae** Kozur 1988

Genus ***Muelleritortis*** Kozur 1988
Type species *Emiluvia*? *cochleata* Nakaseko and Nishimura 1979

Muelleritortis cochleata (Nakaseko and Nishimura) 1979
(Plate 6, figs. 3-10)
1979 *Emiluvia*? *cochleata* n. sp. – Nakaseko and Nishimura, p.70, pl.3, figs. 2-4, 6.
1979 *Staurocontium minoense* n. sp. – Nakaseko and Nishimura, p.71, pl.2, figs. 7, 9-10; pl.12, fig. 4.
1988 *Muelleritortis cochleata cochleata* (Nakaseko and Nishimura) – Kozur, p.53, pl.l, figs. 1-8; pl.2, figs. 1-2; pl.3, fig. 1.
1993 *Emiluvia*? *cochleata* Nakaseko and Nishimura – Sashida, Nishimura, Igo, Kazama and Kamata, p.93, figs. 8.5-8.6, 8.8, 8.15-8.16.
1996 *Plafkerium cochleatum* (Nakaseko and Nishimura) – Nishizono, pl.3, figs. 20-21.
Remarks: The examined specimens are grouped into two types; one has four main spines, and the other has two spines. Based on Kozur and Mostler (1996), the latter type is included into genus *Ditortis*, but it is not clear whether two of four spines were lacked or not. These examined specimens consist of a spherical to subellipsoidal shell and four or two main spines. The outer shell structures are indistinct due to poor preservation, but polygonal pore frames are observed in the case of moderately-preserved specimen. One of the main spines straightly extends, whereas the remaining three or one spines are strongly

twisted. These characters are identical with those of *Muelleritortis cochleata* (Nakaseko and Nishimura).
Range: Upper Ladinian – lowest Carnian (Sugiyama, 1997).

ENTACTINARIA *Incertae sedis*

Genus ***Monostylosphaera*** Xu 1992
Type species *Monostylosphaera sinensis* Xu 1992

***Monostylosphaera*? spp.**
(Plate 4, figs. 11; Plate 7, fig. 13)
Remarks: The illustrated specimens are similar to genus *Monostylosphaera* in having a spherical shell with one polar spine, but it is unclear that the spine is three-bladed in the axial section, due to poor preservation.

Order **NASSELLARIA** Ehrenberg 1875

Family **Ultranaporidae** Pessagno 1977b

Genus ***Tirodella*** Kozur and Mostler 1981
Type species *Tirodella goestlingensis* Kozur and Mostler 1981

***Tirodella*? sp.**
(Plate 2, fig. 7)
Remarks: This poorly-preserved specimen lacks its apical horn, but resembles genus *Tirodella* in having thin thoracic feet that connect to strong ribs on the wall of the very large thorax. However, other diagnostic features of this specimen are unclear, due to poor preservation.

Genus ***Bipedis*** De Wever 1982
Type species *Bipedis calvabovis* De Wever 1982

***Bipedis* sp.**
(Plate 5, fig. 21)
Remarks: The examined specimen is similar to genus *Bipedis* in having a two-segmented small test with strong apical horn and two feet, one of which is lost.

Genus ***Napora*** Pessagno 1977a, *emend*. Pessagno, Whalen and Yeh 1986
Type species *Napora bukryi* Pessagno 1977a

Napora mitrata Pessagno, Whalen and Yeh 1986
(Plate 4, fig. 16)
1986 *Napora mitrata* n. sp. – Pessagno, Whalen and Yeh, p.42-43, pl.5, figs. 8, 15; pl.11, figs. 11-12.
1987 *Napora mitrata* Pessagno, Whalen and Yeh – Yeh, pl.13, figs. 6, 11.
Remarks: The figured specimen consists of a two-segmented test, cephalis and thorax, with an apical horn and three feet, two of which are lost. Cephalis is small and imperforate. The apical horn is bladed in axial section with three ridges alternating with three grooves. It terminates with moderately long subsidiary spines. Thorax is hemispherical in outline and is composed of pentagonal and hexagonal pore frames. The remaining foot occurs at the base of thorax and is triradiate in axial section with alternating three ridges and grooves.
Range: Lower Toarcian (Pessagno, Whalen and Yeh 1986)

***Napora* sp.**
(Plate 4, fig. 17)
Remarks: A strongly broken specimen was obtained and is composed of cephalis and thorax with a three-bladed apical horn. It seems to belong to genus *Napora* on the basis of the above morphologic features.

Family **Deflandrecyrtiidae** Kozur and Mostler 1979

Genus ***Haeckelicyrtium*** Kozur and Mostler 1979, *emend*. Carter 1993
Type species *Haeckelicyrtium austriacum* Kozur and Mostler 1979

***Haeckelicyrtium*? spp.**
(Plate 1, figs. 1-3)
Remarks: Genus *Haeckelicyrtium* consists of hot-shaped shell with three segments and skirt (Kozur and Mostler, 1979). Preservation of the detected specimens is extremely poor; they are a fragment of the skirt which has subcircular or subhexagonal pores. Therefore, it is doubtful that these specimens belong to genus *Haeckelicyrtium*.

Family **Acropyramididae** Haeckel 1881

Genus ***Celluronta*** Sugiyama 1997
Type species *Celluronta donax* Sugiyama 1997

***Celluronta* sp.**
(Plate 2, fig. 8)
Remarks: The illustrated specimen possesses a long test probably consisting of more than seven segments. Pores on the lower part of the test are large in size and subcircular in shape. These characters are identical with those of genus *Celluronta*.

Family **Ruesticyrtiidae** Kozur and Mostler 1979

Genus ***Paratriassocampe*** Kozur and Mostler 1994
Type species *Paratriassocampe gaetanii* Kozur and Mostler 1994

***Paratriassocampe* sp.**
(Plate 5, fig. 15)
Remarks: Genus *Paratriassocampe* is similar to genus *Triassocampe* in general shape of their test, but the former differs from the latter by having two rings of pores on the well-developed circumferential ridges. The illustrated specimen is characterized by the above two rings of pores.

Genus ***Triassocampe*** Dumitrică, Kozur and Mostler 1980
Type species *Triassocampe scalaris* Dumitrică, Kozur and

Mostler 1980

Triassocampe deweveri (Nakaseko and Nishimura) 1979
(Plate 1, figs. 14, 22; Plate 3, fig. 12; Plate 5, figs. 9-12)
1979 *Dictyomitrella deweveri* n. sp. – Nakaseko and Nishimura, p.77, pl.10, figs. 8-9.
1982 *Triassocampe deweveri* (Nakaseko and Nishimura) – Yao, pl.1, figs. 1-3.
1989 *Triassocampe deweveri* (Nakaseko and Nishimura) – Cheng, p.148, pl.6, figs. 13-14; pl.7, figs. 10-11.
1990 *Triassocampe deweveri* (Nakaseko and Nishimura) – Yeh, p.28-29, pl.7, figs. 7, 18, 20; pl.11, figs. 2-3, 7-8, 13-14.
1993 *Triassocampe deweveri* (Nakaseko and Nishimura) – Sashida, Nishimura, Igo, Kazama and Kamata, p.86, figs. 5.3-5.7.
2001 *Triassocampe deweveri* (Nakaseko and Nishimura) – Feng, Zhang and Ye, p.182, pl.3, figs. 1-6.
2011 *Triassocampe deweveri* (Nakaseko and Nishimura) – Thassanapak, Feng, Grant-Mackie, Chonglakmani and Thanee, p.198, figs. 8I, 8J, 8L.
Remarks: The examined specimens are characterized by dome-shaped cephalis without an apical horn and by well-developed circumferential ridges. One row of small knobs and two or three rows of circular pores are arranged respectively on and below each circumferential ridge. These specimens are identical with the type specimen reported by Nakaseko and Nishimura (1979).
Range: Upper Anisian – middle Upper Ladinian (Sugiyama, 1997).

Triassocampe* sp. cf. *T. myterocorys Sugiyama 1992
(Plate 1, fig. 20; Plate 6, fig. 11)
Remarks: The main character of the examined specimens is two rows of large pores that are aligned below a strong circumferential ridge on each post-abdominal segment. However, it differs from *Triassocampe myterocorys* Sugiyama by having a conical test.

Triassocampe* sp. aff. *T. diordinis Bragin 1991 sensu Sugiyama 1992
(Plate 5, fig. 37)
1992 *Triassocampe* sp. aff. *T. diordinis* Bragin 1991 – Sugiyama, p.1199, figs. 11.7-11.8.
Remarks: The examined specimen is quite poorly-preserved. But it is similar to *Triassocampe* sp. aff. *T. diordinis* Bragin described by Sugiyama (1992) in having a single row of pores, which are indistinct, just beneath the poorly developed circumferential ridges.
Range: Middle Anisian (Sugiyama, 1992).

***Triassocampe* spp.**
(Plate 1, figs. 15-18, 23; Plate 2, figs. 28-30; Plate 3, figs. 3, 13-16; Plate 5, figs. 13-14, 16, 31-36; Plate 6, figs. 12-13; Plate 7, figs. 18-20)
Remarks: Preservation of most specimens obtained is so poor that diagnostic features characterizing genus *Triassocampe* are not identified. However, they consist of a long and slightly conical to subcyrindrical multisegmented shell without an apical horn. This appearance is similar to that of *Triassocampe*.

Family **Eucyrtidiellidae** Takemura 1986

Genus ***Eucyrtidiellum*** Baumgartner 1984
Type species *Eucyrtidium*? *unumaensis* Yao 1979

Eucyrtidiellum nagaiae Dumitrica, Goričan and Matsuoka in Goričan, Carter, Dumitrică, Whalen, Hori, De Wever, O'Dogherty, Matsuoka and Guex 2006
(Plate 4, figs. 18-19)
1986 *Eucyrtidiellum* sp. C group – Nagai, p.12, pl.2, figs. 11-12.
1987 *Eucyrtidiellum* sp. C_2 – Hattori, pl.12, fig. 12.
1990 *Eucyrtidiellum* sp. C_2 – Nagai, pl.4, figs. 1a-1c.
1995 *Eucyrtidiellum* sp. C_2 – Nagai, p.12, pl.4, figs. 7-8.
2004 *Eucyrtidiellum* – Matsuoka, fig. 2-8.179.
2006 *Eucyrtidiellum nagaiae* Dumitrica, Goričan and Matsuoka n. sp. – Goričan, Carter, Dumitrică, Whalen, Hori, De Wever, O'Dogherty, Matsuoka and Guex, p.158, pl.EUC06.
Remarks: The figured specimens are composed of three segments and characterized by a stout apical horn and strong longitudinal costae on their abdominal surfaces. Cephalis is imperforate and is incorporated into the apical horn. Thorax is perforated with polygonal pore frames. Abdomen is inflated and porous, and is ornamented with the continuous vertical costae.
Range: Upper Pliensbachian – Upper Toarcian (Carter *et al.*, 2010).

Family **Bagotidae** Pessagno and Whalen 1982

Genus ***Droltus*** Pessagno and Whalen 1982
Type species *Droltus lyellensis* Pessagno and Whalen 1982

Droltus* sp. cf. *D. hecatensis Pessagno and Whalen 1982
(Plate 1, fig. 30)
Remarks: The examined specimen is poorly-preserved, but is similar to *Droltus hecatensis* Pessagno and Whalen in having a conical test and in the state of pore frames. Pore frames of the upper portion of the test including abdomen and first several post-abdominal segments are irregular in size and shape; tetragonal pore frames of the lower portion are more uniform in size and aligned in longitudinal rows.

Family **Hsuidae** Pessagno and Whalen 1982

Genus ***Parahsuum*** Yao 1982
Type species *Parahsuum simplum* Yao 1982

Parahsuum simplum Yao 1982
(Plate 4, figs. 24-26)
1982 *Parahsuum simplum* n. sp. – Yao, p.61, pl.4, figs.

1-8.
1990 *Parahsuum simplum* Yao – Kozur and Mostler, p.222, pl.17, fig. 2.
1991 *Parahsuum simplum* Yao – Tumanda, pl.7, fig. 20; pl.8, fig. 5.
1994 *Parahsuum simplum* Yao – Goričan, p.79, pl.17, figs. 9-10, 12.
1998 *Parahsuum simplum* Yao – Whalen and Carter, p.67, pl.16, fig. 6.
1998 *Parahsuum simplum* Yao – Yeh and Cheng, p.26, pl.4, fig. 14.
2002 *Parahsuum simplum* Yao – Whalen and Carter, p.126, pl.12, figs. 3-4, 12-13; pl.17, figs. 14-15.
2002 *Parahsuum simplum* Yao – Tekin, p.189, pl.4, fig. 3.
2004 *Parahsuum simplum* Yao – Ishida, Shimakawa, Kozai, and Yao, pl.5, figs. 1-2.

Remarks: Considerable variation in overall form and size has been recognized in *Parahsuum simplum* Yao (Hori and Yao, 1988). The illustrated specimens, lacking an apical horn, are short in length rather than the type species, but resemble *Parahsuum simplum* Yao in having an elongate conical shell with six or more segments, and also having continuous costae.
Range: Hettangian – Lower Aalenian (Hori, 1990; Carter *et al.*, 2010).

Parahsuum ovale Hori and Yao 1988
(Plate 4, figs. 27-28)
1982 *Parahsuum* sp. C – Yao, pl.4, figs. 9-11.
1988 *Parahsuum ovale* n. sp. – Hori and Yao, p.51, pl.1, figs. 3a-3e.
1988 *Parahsuum takarazawaense* n. sp. – Sashida, p.19, pl.1, figs. 6-13, 18-19.
1990 *Parahsuum ovale* Hori and Yao – Hori, fig. 8.16.
1994 *Parahsuum ovale* Hori and Yao – Goričan, p.79, pl.17, fig. 13.
2010 *Parahsuum ovale* Hori and Yao – Uchino and Hori, figs. 5.3-5.4.

Remarks: The examined specimens are characterized by an oval-shaped shell. Cephalis is slightly flattened conical in shape without an apical horn. Based on these characters, they are identical with *Parahsuum ovale* Hori and Yao.
Range: Sinemurian – Upper Toarcian (Hori 1990).

Parahsuum izeense (Pessagno and Whalen) 1982
(Plate 4, fig. 30)
1982 *Canutus izeensis* n.sp. – Pessagno and Whalen, p.129, pl.6, figs. 8, 10, 15.
1982 *Canutus giganteus* n.sp. – Pessagno and Whalen, p.127, pl.4, figs. 5, 13.
1995a *Parahsuum izeense* (Pessagno and Whalen) – Baumgartner *et al.*, p.378, pl.2012, figs. 1-2.
2003 *Parahsuum izeense* (Pessagno and Whalen) – Goričan, Šmuc and Baumgartner, p.296, pl.5, figs. 18-19.

Remarks: Shell of each specimen obtained is short and inflated conical in shape. The last two segments slightly decrease in width. Based on these characters, it is identical with *Parahsuum izeense* (Pessagno and Whalen).
Range: Lower Pliensbachian – Bajocian (Carter *et al.*, 2010).

Parahsuum longiconicum Sashida 1988
(Plate 4, fig. 31-33)
1988 *Parahsuum longiconicum* n. sp. – Sashida, p.20, pl.2, figs. 1-4, 16-17.
1996 *Parahsuum longiconicum* Sashida – Tumanda, Sashida and Igo, p.178, fig. 4.2.
2003 *Parahsuum longiconicum* Sashida – Goričan, Šmuc, and Baumgartner, p.296, pl.V, fig. 16.
2004 *Parahsuum longiconicum* Sashida – Ishida, Shimakawa, Kozai and Yao, figs. 5.3-5.4.

Remarks: The illustrated specimens are characterized by a conical test that consists of eight to ten segments, and by a massive conical horn on the cephalis with wide and deep grooves at the base of the horn. Longitudinal continuous edged costae and weak circumferential ridges are visible on the outer layer of these specimens. Based on the above, they are identical with *Parahsuum longiconicum* Sashida.
Range: Lower Pliensbachian – Lower Aalenian (Carter *et al.*, 2010).

Parahsuum* sp. cf. *P. longiconicum Sashida 1988
(Plate 8, fig. 3)
Remarks: The examined specimen is similar to *Parahsuum longiconicum* Sashida in general shell shape. However, the apical horn is broken and the grooves at the base of the horn are not visible.

***Parahsuum* spp.**
(Plate 3, fig. 29-31; Plate 4, figs. 29, 34; Plate 7, figs. 2-4; Plate 8, figs. 20-27)
Remarks: As originally described by Yao (1982), conical to spindle-shaped multisegmented Nassellaria lacking well-developed strictures and having continuous edged costae is included into species of genus *Parahsuum*. A wide range in variation of the examined specimens is recognized.

***Parahsuum*? sp. A**
(Plate 8, fig. 28)
1997 *Parahsuum* sp. A – Yao, pl.14, fig. 658.
2004 *Archaeodictyomitra*? sp. – Hori, pl.1, fig. 55.

Description: Test is elongate and conical with probably six post-abdominal segments, lacking well-developed strictures. Pore frames of post-abdominal segments are square in shape with circular pores. Cephalis, without a horn, is dome-shaped and remaining segments are trapezoidal in outline, increasing moderately in width and more rapidly in length as added. Thin circumferential ridges present at joints between post-abdominal segments. Pore frames on post-abdominal segments are aligned in a transverse and vertical directions; three or four rows of pore frames are transversally arranged between the ridges, and single row of pore frames is longitudinally arranged

between the costae. Costae are not continuous, due to development of the ridges.
Remarks: *Parahsuum*? sp. A is questionably assigned to genus *Parahsuum*, because it is different from the latter by having thin circumferential ridges although it has single row of pore frames that is arranged between costae. This species resembles *Parahsuum* sp. A of Yao (1997) and *Archaeodictyomitra*? sp. of Hori (2004) in having the same diagnostic features.

Genus ***Hsuum*** Pessagno 1977a, *emend*. Takemura 1986
Type species *Hsuum cuestaense* Pessagno 1977a

Hsuum* sp. cf. *H. mulleri Pessagno and Whalen 1982
(Plate 3, fig. 32)
Remarks: The illustrated specimen has an elongate conical test with discontinuous costae. The costae which indicate few branches laterally and are developed over the abdomen and post-abdominal segments. This appearance is similar to that of *Hsuum mulleri* Pessagno and Whalen, but an apical horn is not developed in this specimen.

***Hsuum* sp.** sensu Matsuoka 2004
(Plate 4, fig. 23)
2004 *Hsuum* sp. – Matsuoka, p.77, fig. 2-9.224.
Remarks: Test of the examined specimen is elongated conical in shape and much wider than other species of genus *Hsuum*. Relatively thin costae developed over the test are continuous, and are inserted between rows of pore frames.
Range: Toarcian (Matsuoka, 2004).

***Hsuum*? sp.**
(Plate 7, fig. 6)
Remarks: Test of the examined specimen is an inflated conical in shape with probably five segments. These segments are separated by strictures and rapidly increase in width. Cephalis is dome-shaped without an apical horn. The test is composed of polygonal pore frames with circular pores and with continuous costae. The costae extend throughout the test. Two rows of pores are arranged between two adjacent costae. This specimen is questionably assigned to genus *Hsuum*, due to strictures between segments.

Family **Canoptidae** Pessagno in Pessagno, Finch and Abbott 1979, *emend*. Yeh 1987

Genus ***Canoptum*** Pessagno in Pessagno, Finch and Abbott 1979
Type species *Canoptum poissoni* Pessagno in Pessagno, Finch and Abbott 1979

Canoptum* sp. cf. *C. anulatum Pessagno and Poisson 1981
(Plate 7, fig. 7)
Remarks: As originally described by Pessagno and Poisson (1981), *Canoptum anulatum* has a slender and more elongate test with closely spaced post-abdominal segments; post-abdominal segments are eleven to fifteen in number with short and discontinuous costae. These costae are visible on each circumferential ridge. The obtained specimen is poorly-preserved, but it is similar to *Canoptum anulatum* Pessagno and Poisson in slender and elongate outer form. Discontinuous costae are slightly recognized.

Canoptum* sp. cf. *C. rugosum Pessagno and Poisson 1981
(Plate 4, fig. 35)
Remarks: *Canoptum rugosum* Pessagno and Poisson is characterized by having a short and broad test that is ornamented by circumferential ridges between post-abdominal segments, and also having post-abdominal segments with a rugose surface. Nevertheless, the rugose surface is indistinct in the examined specimen, because of its poor preservation.

Genus ***Multimonilis*** Yeh 1989
Type species *Multimonilis pulcher* Yeh 1989

***Multimonilis* sp.**
(Plate 1, fig. 21)
Remarks: The examined specimen is similar to genus *Multimonilis* in overall form that consists of a conical and multicyrtid test. Especially, this specimen possesses narrow elevated circumferential ridges that modified by well-developed nodes. According to Yeh (1989), this is a characteristic feature of genus *Multimonilis*.

Family **Parvicingulidae** Pessagno 1977a, *emend*. Pessagno and Whalen 1982

Genus ***Praeparvicingula*** Pessagno, Blome and Hull in Pessagno, Blome, Hull and Six 1993
Type species *Parvicingula profunda* Pessagno and Whalen 1982

Praeparvicingula gigantocornis (Kishida and Hisada) 1985
(Plate 8, fig. 13)
1982 *Parvicingula* sp. A – Kishida and Sugano, pl.7, fig. 8.
1985 *Parvicingula gigantocornis* n. sp. – Kishida and Hisada, p.118, pl.4, figs. 1-5.
1988 *Parvicingula gigantocornis* Kishida and Hisada – Sashida, p.22, pl.2, figs. 5, 10-12, 20-21; pl.3, figs. 4-5.
2001 *Praeparvicingula gigantocornis* (Kishida and Hisada) – Kashiwagi, fig. 6.6.
2004 *Parvicingula gigantocornis* Kishida and Hisada – Ishida, Shimakawa, Kozai and Yao, pl.5, fig. 14.
Remarks: The illustrated specimen is characterized by a slightly slender conical test with a long massive apical horn. Moreover, Each circumferential ridge is widely spaced and separated by three rows of small pores; center row of pores is poorly developed. Based on these features,

it is identical with *Praeparvicingula gigantocornis* (Kishida and Hisada).
Range: Upper Toarcian – Bajocian (Carter *et al.*, 2010).

Praeparvicingula* sp. cf. *P. nanoconica (Hori and Otsuka) 1989
(Plate 8, fig. 12)
Remarks: The illustrated specimen is similar to *Praeparvicingula nanoconica* (Hori and Otsuka) in general shape and especially having a long apical horn. However, it is not clear that this specimen is identical with *Praeparvicingula nanoconica* (Hori and Otsuka), because of its poorly preservation.

***Praeparvicingula* spp.**
(Plate 8, figs. 4-7, 14-15)
Remarks: The illustrated specimens are moderately- to poorly-preserved. They are characterized by a conical- to subcylindrical-shaped test. Their final post-abdominal segments lack narrow terminal tube.

Genus ***Parvicingula*** Pessagno 1977a, *emend*. Pessagno, Blome, Hull and Six 1993
Type species *Parvicingula santabarbarensisa* Pessagno 1977a

***Parvicingula* sp.**
(Plate 8, fig. 16)
Remarks: The poorly-preserved specimen was obtained. It is characterized by a spindle-shaped test and final post-abdominal segment terminates in a narrow tube.

NASSELLARIA *Incertae sedis*

Genus ***Lantus*** Yeh 1987
Type species *Lantus sixi* Yeh 1987

Lantus obesus (Yeh) 1987
(Plate 4, fig. 21)
1987 *Pseudoristola obesa* n. sp. – Yeh, p.96-97, pl. 14, figs. 11-12.
1997 *Pseudoristola obesa* Yeh – Yao, pl. 15, fig. 724.
2001 *Stichocapsa obesa* (Yeh) – Gawlick, Suzuki and Missoni, fig. 5.6.
2006 *Lantus obesus* (Yeh) – Goričan, Carter, Dumitrică, Whalen, Hori, De Wever, O'Dogherty, Matsuoka and Guex, p.234, pl. LAN01, figs. 1-10.
2010 *Lantus obesus* (Yeh) – Uchino and Hori, figs. 5.16-5.17.
Remarks: Moderately preserved specimen was obtained. Its test is conical with a large bulbous expansion, and without circumferential ridges. It is not clear that cephalis is perforate, but thorax, abdomen and post-abdominal segments are perforate; post-abdominal segments consist of pentagonal or hexagonal pore frames.
Range: Uppermost Simenurian – Upper Toarcian (Carter *et al.*, 2010).

Lantus intermedius Carter in Goričan, Carter, Dumitrică, Whalen, Hori, De Wever, O'Dogherty, Matsuoka and Guex 2006
(Plate 4, fig. 22; Plate 8, fig. 29)
1988 *Hemicryptocephalis dengqensis* n. sp. – Li, p.327, p.330, pl. 1, figs. 5-6.
1997 *Parahsuum* sp. NB – Yao, pl. 13, fig. 642.
2006 *Lantus intermedius* n. sp. – Goričan, Carter, Dumitrică, Whalen, Hori, De Wever, O'Dogherty, Matsuoka and Guex, p.232, pl. LAN05, figs. 1-7.
Remarks: The obtained specimens are identical with *Lantus intermedius* Carter on the basis of general shape of their conical tests. Post-abdominal segments increase in width as added, and the final segment is closed with an ellipsoidal cap. These specimens possess weakly circumferential ridges, which are recognized between segments.
Range: Uppermost Simenurian – Lower Toarcian (Carter *et al.*, 2010).

***Lantus*? sp.**
(Plate 3, fig. 33)
Remarks: Because of extremely poor preservation, the examined specimen questionably belongs to genus *Lantus*.

Genus ***Dictyomitrella*** Haeckel 1887
Type species *Eucyrtidium articulatum* Ehrenberg 1873

Dictyomitrella*? sp. cf. *D.*? *kamoensis Mizutani and Kido 1983
(Plate 8, fig. 11)
Remarks: Poorly-preserved specimen was obtained. It consists of a test that is conical at the upper portion and subcylindrical at the lower portion. Post-abdominal segments are separated by nodose circumferential ridges; each one row of pores are faintly observed below and above the ridges, but tetragonally-arranged two rows of circular pits are indistinct on the abdomen and post-abdominal segments. This specimen is similar to *Dictyomitrella*? *kamoensis* Mizutani and Kido in possessing each one row of pores below and above the nodose circumferential ridges, but is different by the absence of two rows of circular pits.

Genus ***Minocapsa*** Matsuoka 1991
Type species *Minocapsa cylindrica* Matsuoka 1991

Minocapsa globosa Matsuoka 1991
(Plate 4, fig. 20)
1991 *Minocapsa globosa* n. sp. – Matsuoka, p.736, figs. 11.1a-11.4b.
1997 *Minocapsa globosa* Matsuoka – Yao, pl.10, fig. 451.
2004 *Minocapsa globosa* Matsuoka – Matsuoka, fig. 90.
Remarks: The obtained specimen has a pyriform test consisting of four segments; proximal part including cephalis, thorax and abdomen is conical, and distal part composed of fourth segment is large and subspherical

without aperture. Circular pores are set in pentagonal to hexagonal pore frames and arranged irregularly rather than longitudinally. This specimen is slightly slender; change in contour from the conical proximal part to subspherical distal part is not rapid than the type species of *Minocapsa globosa* Matsuoka.

Range: Upper Pliensbachian? – Lower Toarcian (Yao, 1997; Matsuoka, 2004).

Acknowledgements: This report is based on results of the study "Geology of the Kanmuri Yama district" which has been conducted by the Geological Survey of Japan, AIST. Thanks are extended to Dr. M. Saito (GSJ) for his comments on the radiolarian identification. Associate Prof. Y. Kamata (Univ. Tsukuba) is gratefully acknowledged for thorough review of the manuscript.

References

Baumgartner, P.O. (1984) A Middle Jurassic–Early Cretaceous low-latitude radiolarian zonation based on Unitary Associations and age of Tethyan radiolarites. *Eclogae Geologicae Helvetiae*, **77**, 729-837.

Baumgartner, P.O., O'Dogherty, L., Gorican, S., Dumitrica-Jud, R., Dumitrica, P., Pillevuit, A. Urquhart, E., Matsuoka, A., and Danelian, T. (1995a) Radiolarian catalogue and systematics of Middle Jurassic to Early Cretaceous Tethyan genera and species. *In* Baumgartner, P. O., O'Dogherty, L., Gorican, S., Urquhart, E., Pillevuit, A. and De Wever, P. eds., *Middle Jurassic to Early Cretaceous Radiolaria of Tethys: occurrence, systematics, biochronology. Mémoires de Géologie (Lausanne)*, no.23, Institut de Géologie et Paléontologie, Université de Lausanne, Switzerland, 37-688.

Baumgartner, P.O., Bartolini, A., Carter, E.S., Conti, M., Cortese, G., Danelian, T., De Wever, P., Dumitrica, P., Dumitrica-Jud, R., Gorican, S., Guex, J., Hull, D.M., Kito, N., Marcucci, M., Matsuoka, A., Murchey, B., O'Dogherty, L., Savary, J., Vishnevskaya, V., Widz, D. and Yao, A. (1995b) Middle Jurassic to Early Cretaceous radiolarian biochronology of Tethys based on Unitary Association. *In* Baumgartner, P. O., O'Dogherty, L., Gorican, S., Urquhart, E., Pillevuit, A. and De Wever, P. eds., *Middle Jurassic to Early Cretaceous Radiolaria of Tethys: occurrence, systematics, biochronology. Mémoires de Géologie (Lausanne)*, no.23, Institut de Géologie et Paléontologie, Université de Lausanne, Switzerland, 1013-1048.

Bragin, N.Yu. (1991) Ралиолярии и Нижнемезозойские Толщи Востока СССР. Доклады Академии Наук, *СССР*, **469**, 1-122.

Carter, E.S. (1993) Biochronology and paleontology of uppermost Triassic (Rhaetian) radiolarians, Queen Charlotte Islands, British Columbia, Canada. *Mémoires de Géologie (Lausanne)*, no.11, Institut de Géologie et Paléontologie, Université de Lausanne, Switzerland, 1-175.

Carter, E.S., Whalen, P.A. and Guex, J. (1998) Biochronology and paleontology of Lower Jurassic (Hettangian and Sinemurian) radiolarians, Queen Charlotte Islands, British Columbia. *Geol. Surv. Canada Bull*., no.496, 1-162.

Carter, E.S., Goričan, Š., Guex, J., O'Dogherty, L., De Wever, P., Dumitrica, P., Hori, R.S., Matsuoka, A and Whalen, P.A. (2010) Global radiolarian zonation for the Pliensbachian, Toarcian and Aalenian. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **297**, 401-419.

Cheng, Y-N. (1989) Upper Paleozoic and Lower Mesozoic radiolarian assemblages from the Busuanga Islands, North Palawan block, Philippines. *Bull. National Museum of Natural Science, Taiwan*, no.1, 129-175.

Deflandre, G. (1953) Radiolaires fossils. *In* Grassé, P.P. ed., *Traite de zoologie*. Masson, Paris, 389-436.

De Wever, P. (1981) Une nouvelle sous-famille, les Poulpinae, et quatre nouvelles espèces de *Saitoum* radiolarires mésozoïques téthysiens. *Géobios*, **14**, 5-15.

De Wever, P. (1982) Nassellaria (Radiolarires polycystines) du Lias de Turquie, *Revue de Micropaléontologie*, **24**, 189-232.

De Wever, P., Dumitrica, P., Caulet, J.P., Nigrini, C. and Caridroit, M. (2001) *Radiolarians in the sedimentary record*. Gordon and Breach Science Publishers, 533p.

Donofrio, D. and Mostler, H. (1978) Zur Verbreitung der Saturnalidae (Radiolaria) im Mesozoikum der Nordlichen Kalkalpan und Sudalpen. *Geologisch Pläontologische mitteilungen Innsbruck*, **7**, 1-55.

Dumitrică, P. (1978) Family Eptingiidae n. fam., extinct Nassellaria (Radiolaria) with sagittal ring. *Deri di Seama ale sedintelor, Institutul de Geologie si Geofizica, Bucuresti*, **64**, 27-38.

Dumitrica, P. (1995) Upper Jurassic and Lower Cretaceous radiolarians at Svinita (Romania). *In* Baumgartner, P.O., O'Dogherty, L., Gorican, S., Urquhart, E., Pillevuit, A. and De Wever, P. eds., *Middle Jurassic to Early Cretaceous Radiolaria of Tethys: occurrence, systematics, biochronology. Mémoires de Géologie (Lausanne)*, no.23, Lausanne, Switzerland, 897-905.

Dumitrica, P. and Carter, E.S. (1999) Family Kungalariidae, n. fam., new Mesozoic entactinarian Radiolaria with a nassellarian-type initial spicule. *Micropaleontology*, **45**, 418-428.

Dumitrică, P., Kozur, H. and Mostler, H. (1980) Contribution to the radiolarian fauna of the Middle Triassic of the Southern Alps. *Geologisch Pläontologische mitteilungen Innsbruck*, **10**, 1-46.

Ehrenberg, C.G. (1873) Grössere Felsproben des Polycystine – Mergels von Barbados mit weiteren Erläuterungen. *Monatsberichte der Königlichen Preussischen Akademie der Wissenschaften zu Berlin*, 213-263.

Ehrenberg, C.G. (1875) Fortsetzung der mikrogeologischen Studien als Gesammt-Ubersichtder mikroskopischen

Palaontologie gleichartig analysirter Gebirgsarten der Erde, mit specieller Rucksicht auf den Polycystinen-Mergel von Barbados. *Abhandlungen der Königlichen Preussischen Akademie der Wissenschaften zu Berlin*, Abhandlungen, Jahre 1875, 1-225.

Feng, Q., Zhang, Z. and Ye, M. (2001) Middle Triassic radiolarian fauna from southwest Yunnan, China. *Micropaleontology*, **47**, 173-204.

Gawlick, H.-J., Suzuki, H. and Missoni, S. (2001) Nachweis von unterliassischen Beckensedimenten in Hallstätter Fazies (Dürrnberg-Formation) im Bereich der Hallein-Berchtesgadener Hallstätter Zone und des Lammer Beckens (Hettangium – Sinemurium). *Mitteilungen der Gesellschaft der Geologie und Bergbaustudenten in Österreich*, **45**, 39-55. (in German with English abstract)

Goričan, Š. (1994) Jurassic and Cretaceous radiolarian biostratigraphy and sedimentary evolution of the Budva zone (Dinarides, Montenegro). *Mémoires de Géologie (Lausanne)*, no.18, Institut de Géologie et Paléontologie, Université de Lausanne, Switzerland, 177p.

Goričan, Š., Šmuc, A. and Baumgartner, P.O. (2003) Toarcian Radiolaria from Mt. Mangart (Slovenian – Italian border) and their paleoecological implications. *Marine Micropaleontology*, **49**, 275-301.

Goričan, Š., Carter, E. S., Dumitrică, P., Whalen, P. A., Hori, R.S., De Wever, P., O'Dogherty, L., Matsuoka, A. and Guex, J. (2006) *Catalogue and systematics of Pliensbachian, Toarcian and Aalenian radiolarian genera and species*. Založba ZRC/ZRC Publishing, ZRC SAZU, Ljubljana, 446p.

Gradstein, F. M., Ogg, J. G., Schmitz, M. and Ogg. G. (2012) *The Geologic Time Scale 2012*. Elsevier.

Haeckel, E. (1881) Entwurf eines Radiolarien–Systems auf Grund von Studien der Challenger–Radiolarien. *Jenaische Zeitschrift für Naturwissenschaft*, **15**, 418-472.

Haeckel, E. (1887) Report on the Radiolaria collected by H.M.S. Challenger during the years 1873-1876. *Report on the Scientific Results of the Voyage of the H.M.S. Challenger, Zoology*, **18**, 1803p.

Hattori, I. (1987) Jurassic radiolarian fossils from the Nanjo massif, Fukui Prefecture, central Japan. *Bull. Fukui Municipal Museum of Natural History*, no.34, 29-101. (in Japanese with English abstract)

Hattori, I. and Yoshimura, M. (1982) Lithofacies distribution and radiolarian fossils in the Nanjo area in Fukui Prefecture, central Japan. *News of Osaka Micropaleontologists, spec. vol*., no.5, 103-116. (in Japanese with English abstract)

Hori, N. (2004) Jurassic radiolarians from chert and clastic rocks of the Chichibu belt in the Toyohashi district, Aichi Prefecture, Southwest Japan. *Bull. Geological Survey of Japan*, **55**, 335-388. (in Japanese with English abstract)

Hori, R. (1990) Lower Jurassic radiolarian zones of SW Japan. *Trans. Proc. Paleont. Soc. Japan. New series*, no.159, 562-586.

Hori, R. and Otsuka, T. (1989) Early Jurassic radiolarians from the Mt. Norikuradake area, Mino terrane, central Japan. *Jour. Geosciences, Osaka City Univ*., **32**, 175-199.

Hori, R. and Yao, A. (1988) *Parahsuum* (Radiolaria) from the Lower Jurassic of the Inuyama area, central Japan. *Jour. Geosciences, Osaka City Univ*., **31**, 47-61.

Ishida, K., Shimakawa, M., Kozai, T. and Yao, A. (2004) Oceanic-plate stratigraphy and radiolarian zonation of the Hegawa section in northern South Chichibu belt (Kurano subbelt), east Shikoku. *News of Osaka Micropaleontologists, spec. vol*., no.13, 181-195. (in Japanese with English abstract)

Kamata, Y. (1995) Early Triassic radiolarians from black siliceous shale and black chert in the Kuzu area of the Ashio terrane, central Japan. *FOSSILS*, **59**, 23-31. (in Japanese with English abstract)

Kashiwagi, K. (2001) The Inumodorikyo Complex of the Chichibu terrane, eastern Kii Peninsula, Southwest Japan: Jurassic accretionary complex as characterized by chert–clastics sequence. *Jour. Geological Society of Japan*, **107**, 640-658. (in Japanese with English abstract)

Kishida, Y. and Hisada, K. (1985) Late Triassic to Early Jurassic radiolarian assemblages from the Ueno-mura area, Kanto Mountains, central Japan. *Mem. Osaka Kyoiku Univ., ser. III (Natural Science)*, **34**, 103-129. (in Japanese with English abstract)

Kishida, Y. and Sugano, K. (1982) Radiolarian zonation of Triassic and Jurassic in outer side of Southwest Japan. *News of Osaka Micropaleontologists, spec. vol*., no.5, 271-300. (in Japanese with English abstract)

Kozur, H. (1988) Muelleritortiidae n. fam., eine charakteristische longobardische (oberladinische) Radiolarienfamilie, Teil I. *Freiberger Forschungshefte, Geowissenschaften-Paläontologie*, **C419**, 51-61.

Kozur, H. and Mostler, H. (1972) Beiträge zur Erforschung der mesozoischen Radiolarien. Teil I: Revision der Oberfamilie Coccodiscacea Haeckel 1862 emend. und Beschreibung ihrer triassischen Vertreter. *Geologisch Pläontologische mitteilungen Innsbruck*, **2**, 1-60.

Kozur, H. and Mostler, H. (1979) Beiträge zur Erforschung der mesozoischen Radiolarien. Teil III: Die Oberfamilien Actinommacea Haeckel 1862 emend., Artiscacea Haeckel 1882, Multiarcusellacea nov. der Spumelllaria und triassische Nassellaria. *Geologisch Pläontologische mitteilungen Innsbruck*, **9**, 1-132.

Kozur, H. and Mostler, H. (1981) Beiträge zur Erforschung der mesozoischen Radiolarien. Teil IV: Thalassosphaeracea Hackel, 1862, Hexastylacea Haeckel, 1882 emend. Petruševskaja, 1979, Sponguracea Haeckel, 1862 emend. und weitere triassische Lithocycliacea, Trematodiscacea, Actinommacea und Nassellaria. *Geologisch Pläontologische mitteilungen Innsbruck, Sonderband*, 1-208.

Kozur, H. and Mostler, H. (1982) Entactinaria subordo

Nov., a new radiolarian suborder. *Geologisch Pläontologische mitteilungen Innsbruck*, **11**, 399-414.
Kozur, H. and Mostler, H. (1990) Saturnaliacea Deflandre and some other stratigraphically important Radiolaria from the Hattangian of Lenggries/Isar (Bavaria, Northern Calcareous Alps). *Geologisch Pläontologische mitteilungen Innsbruck*, **17**, 179-248.
Kozur, H. and Mostler, H. (1994) Anisian to Middle Carnian radiolarian zonation and description of some stratigraphically important radiolarians. *Geologisch Pläontologische mitteilungen Innsbruck, Sonderband*, **3**, 39-255.
Kozur, H. and Mostler, H. (1996) Longobardian (Late Ladinian) Muelleritortiidae (Radiolaria) from the Repablic of Bosnia-Hercegowina. *Geologisch Pläontologische mitteilungen Innsbruck, Sonderband*, **4**, 83-103.
Kozur, H., Krainer, K. and Mostler, H. (1996) Radiolarians and facies of the Middle Triassic Loibl Formation, South Alpine Karawanken Mountains (Carpathia, Austria). *Geologisch Pläontologische mitteilungen Innsbruck, Sonderband*, **4**, 195-269.
Kuwahara, K., Sano, H., Ezaki, Y. and Yao, A. (2010) Discovery of Triassic siliceous rocks within a large Permian oceanic-rock mass in the Mt. Funafuse-yama area, western Mino terrane, and geologic implication. *Jour. Geological Society of Japan*, **116**, 159-173. (in Japanese with English abstract)
Li, Hong-shen (1988) Early Jurassic (Late Pliensbachian) Radiolaria from the Dengqen area, Xizang (Tibet). *Acta Micropalaeontologica Sinica*, **5**, 323-330. (in Chinese with English abstract)
Martini, R., De Wever, P., Zaninetti, L., Denelian, T. and Kito, N. (1989) Les radiolarites triasiques de la Formation du Monte Facito *Auct*. (Bassin de Lagonegro, Italieméridionale). *Revue de Paléobiologie*, **8**, 143-161.
Matsuoka, A. (1991) Early Jurassic radiolarians from the Nanjo massif in the Mino terrane, central Japan. *Trans. Proc. Paleont. Soc. Japan. New series*, no.161, 720-738.
Matsuoka, A. (1995) Middle Jurassic – Lower Cretaceous radiolarian zonation in Japan and the western Pacific, and age assignments based on the Unitary Associations method. *In* Baumgartner, P. O., O'Dogherty, L., Gorican, S., Urquhart, E., Pillevuit, A. and De Wever, P. eds., *Middle Jurassic to Early Cretaceous Radiolaria of Tethys: occurrence, systematics, biochronology. Mémoires de Géologie (Lausanne)*, no.23, Lausanne, Switzerland, 1049-1057.
Matsuoka, A. (2004) Toarcian (Early Jurassic) radiolarian fauna from the Nanjo massif in the Mino terrane, central Japan. *News of Osaka Micropaleontologists, spec. vol*., no.13, 69-87.
Mizutani, S. and Kido, S. (1983) Radiolarians in Middle Jurassic siliceous shale from Kamiaso, Gifu Prefecture, central Japan. *Trans. Proc. Paleont. Soc. Japan. New series*, no.132, 253-262.
Moix, P., Kozur, H.W., Stampfli, G.M. and Mostler, H. (2007) New paleontological, biostratigraphic and paleographic results from the Triassic of the Mersin Melange, SE Turkey. *In* Lucas, S.G. and Spielmann, J.A. eds., *Bull. New Mexico Museum of Natural History and Science*, New Mexico, **41**, 282-305.
Nagai, H. (1986) Jurassic *Eucyrtidiellum* (Radiolaria) from central Japan. *Bull. Nagoya Univ. Museum*, no.2, 1-22.
Nagai, H. (1990) Jurassic (Lower Toarcian) radiolarians from the Hyde Formation, central Oregon, North America. *Bull. Nagoya Univ. Museum*, no.6, 1-7. (in Japanese with English abstract)
Nagai, H. (1995) History and significance of radiolarian biostratigraphic study on the Mesozoic of Mino terrane. *Bull. Nagoya Univ. Furukawa Museum, special report*, no.4, 89p. (in Japanese with English abstract)
Nakae, S. (2012) Geology of the Permian Higashimata Complex in the Nanjō Mountains, Fukui Prefecture, Southwest Japan. *Bull. Geological Survey of Japan*, **63**, 269-281.
Nakae, S. (2013) Triassic to Middle Jurassic radiolarians from pelagic cherts in the Nanjō Mountains, Southwest Japan – Part 1. Imajō district. *Bull. Geological Survey of Japan*, **64**, 85-112.
Nakae, S., Komatsubara, T. Takahashi, Y. and Yoshikawa, T. (2013) *Geology of the Imajō and Takenami district*. Quadrangle Series, 1:50000, Geological Survey of Japan, AIST, 110p. (in Japanese with English abstract, 4p.)
Nakaseko, K. and Nishimura, A. (1979) Upper Triassic Radiolaria from Southwest Japan. *Sci. Rep., Col. Educ., Osaka Univ*., **28**, 61-109.
Nishizono, Y. (1996) Mesozoic convergent process of the Southern Chichibu terrane in West Kyushu, Japan, on the basis of Triassic to Early Cretaceous radiolarian biostratigraphy. *Kumamoto Jour. Science (Earth Sciences)*, **14**, 45-226. (in Japanese with English abstract)
O'Dogherty, L., Carter, E.S., Dumitrica, P., Goričan, Š. and De Wever, P. (2009) An illustrated and revised catalogue of Mesozoic radiolarian genera – objectives, concepts and guide for users. *Geodiversitas*, **31**, 191-356.
O'Dogherty, L., Carter, E.S., Gorican, S. and Dumitrica, P. (2010) Triassic radiolarian biostratigraphy. *In* Licas, S.G. ed., *The Triassic timescale*. Geol. Soc. London, Special publications, **334**, 163-200.
Otsuka, T., Kajima, M. and Hori, R. (1992) The Batinah olistostrome of the Oman Mountains and Mesozoic radiolarians. *News of Osaka Micropaleontologist, Special Volume*, no.8, 21-34. (in Japanese with English abstract)
Pessagno, E.A. (1973) Upper Cretaceous Spumellariina from the Great Valley Sequence, California Coast Ranges. *Bull. American Paleontology*, **63**, 49-102.
Pessagno, E.A. (1977a) Upper Jurassic Radiolaria and

radiolarian biostratigraphy of the California Coast Ranges. *Micropaleontology*, **23**, 56-113.

Pessagno, E.A. (1977b) Lower Cretaceous radiolarian biostratigraphy of the Great Valley Sequence and Franciscan Complex, California Coast Ranges. *Cushman Foundation for Foraminiferal Research, Special publication*, no.15, 87p.

Pessagno, E.A. and Blome, C.D. (1980) Upper Triassic and Jurassic Pantanelliinae from California, Oregon and British Columbia. *Micropaleontology*, **26**, 225-273.

Pessagno, E.A. and Poisson, A. (1981) Lower Jurassic Radiolaria from the Gümüşlü Allochton of southwestern Turkey (Taurides occidentals). *Bull. Mineral Research and Exploration Inst. Turkey*, **92**, 47-69.

Pessagno, E.A. and Whalen, P.A. (1982) Lower and Middle Jurassic Radiolaria (multicyrtid Nassellariina) from California, east-central Oregon and the Queen Charlotte Islands, B.C.. *Micropaleontology*, **28**, 111-169.

Pessagno, E.A., Finch, W. and Abbott, P.L. (1979) Upper Triassic Radiolaria from the San Hipólito Formation, Baja California. *Micropaleontology*, **25**, 160-197.

Pessagno, E.A., Whalen, P.A. and Yeh, K.-Y. (1986) Jurassic Nassellariina (Radiolaria) from North American geologic terranes. *Bulletins of American paleontology*, **91**, 5-75.

Pessagno, E.A., Six, W.M. and Yang, Q. (1989) The Xiphostylidae Haeckel and Parvivaccidae, n. fam. (Radiolaria) from the North America Jurassic. *Micropaleontology*, **35**, 138-255.

Pessagno, E.A., Blome, C.D., Hull, D.M. and Six, W.M. (1993) Jurassic Radiolaria from the Josephine ophiolite and overlying strata, Smith River subterrane (Klamath Mountains), northwestern California and southwestern Oregon. *Micropaleontology*, **39**, 93-166.

Ramovš, A. and Goričan, Š. (1995) Late Anisian-Early Ladinian radiolarians and conodonts from Šmarma Gora near Ljublana, Slovenia. *Razprave IV. Razreda SAZU*, **36**, 179-221.

Sashida, K. (1988) Lower Jurassic multisegmented Nassellaria from the Itsukaichi area, western part of Tokyo Prefecture, central Japan. *Science Report, Institute of Geosciences, University of Tsukuba, sec.B*, **9**, 1-27.

Sashida, K. (1991) Early Triassic radiolarians from the Ogamata Formation, Kanto Mountains, central Japan. Part 2. *Trans. Proc. Paleont. Soc. Japan. New series*, no.161, 681-696.

Sashida, K. (1992) Early Jurassic radiolarians from the Shomaru Pass–Higashiagano area, Hanno City, Saitama Prefecture, central Japan. *News of Osaka Micropaleontologists, spec. vol*., no.8, 35-46. (in Japanese with English abstract)

Sashida, K., Nishimura, H., Igo, H., Kazama, S. and Kamata, Y. (1993) Triassic radiolarian faunas from Kiso-fukushima, Kiso Mountains, central Japan. *Science Report, Institute of Geosciences, Univ. Tsukuba, sec.B*, **14**, 77-97.

Sugiyama, K. (1992) Lower and Middle Triassic radiolarians from Mt. Kinkazan, Gifu Prefecture, central Japan. *Trans. Proc. Paleont. Soc. Japan. New series*, no.167, 1180-1223.

Sugiyama, K. (1997) Triassic and Lower Jurassic radiolarians biostratigraphy in the siliceous claystone and bedded chert units of the southeastern Mino Terrane, central Japan. *Bull. Mizunami Fossil Museum*, no.24, 79-193.

Taga, H. (1997) Paleozoic and Mesozoic radiolarian fossils found in chert of the Nanjo massif, central Japan. *Bull. Fukui City Museum of Natural History*, no.44, 35-55. (in Japanese)

Takamura, Y. and Hayami, T. (1985) On the Paleozoic and Mesozoic strata in the eastern area of Imajo-cho, Fukui Prefecture, central Japan. *Bull. Fukui City Museum of Natural History*, no.31, 1-16. (in Japanese)

Takemura, A. (1986) Classification of Jurassic nassellarians (Radiolaria). *Palaeontographica. Abteilung A: Palaeozoologie-Stratigraphie*, **195**, 29-74.

Tekin, U.K. (2002) Lower Jurassic (Hettangian-Sinemurian) radiolarians from the Antaya Nappes, central Taurids, Southern Turkey. *Micropaleontology*, **48**, 177-205.

Thassanapak, H., Feng, Q.-L., Grant-Mackie, J., Chonglakmani, C. and Thanee, N. (2011) Middle Triassic radiolarian faunas from Chiang Dao, Northern Thailand. *Palaeoworld*, **20**, 179-202.

Tumanda, F. (1991) Radiolarian biostratigraphy in central Busuanga Island, Palawan, Philippines. *Jour. Geological Society of Philippines*, **46**, 49–104.

Tumanda, F.M., Sashida, K. and Igo, H. (1996) Some Jurassic radiolarians from Busuanga Island, Calamian Island Group, Palawan, Philippines. *In* Noda, H. and Sashida, K. eds., *Professor Hisayashi Igo Commemorative volume on Geology and Paleontology of Japan and Southeast Asia*, 165-192.

Uchino, T. and Hori, R.S. (2010) Early Jurassic radiolarian fossils from mudstone of the Ashio terrane in the Kambara Mountains, Niigata Prefecture, Japan. *Jour. Geological Society of Japan*, **116**, 441-446. (in Japanese with English abstract)

Umeda, M. and Taga, H. (2003) Note of occerrence of radiolarian fossils in the Nanjo massif, Fukui Prefecture, central Japan – No. 7 – Takura-gawa area. *Bull. Fukui City Museum of Natural History*, no.50, 27-36. (in Japanese)

Umeda, M., Taga, H. and Hattori, I. (1996) Discovery and its geologic significance of Permian radiolarians from clastic rocks at the northern margin of the Nanjo massif, Fukui Prefecture, central Japan. *Jour. Geological Society of Japan*, **102**, 635-638. (in Japanese with English abstract)

Wakita, K. (1988) Origin of chaotically mixed rock bodies in the Early Jurassic to Early Cretaceuos sedimentary

complex of the Mino terrane, central Japan. *Bull. Geological Survey of Japan*, **39**, 675-757.

Whalen, P.A. and Carter, E.S. (1998) Part II. Systematic paleontplogy. *In* Carter, E. S., Whalen, P. A. and Guex, J. eds., Biochronology and paleontology of Lower Jurassic (Hettangian and Sinemurian) radiolarians, Queen Charlotte Islands, British Columbua. *Geological Survey of Canada Bull*., no.496, 36-162.

Whalen, P.A. and Carter, E.S. (2002) Pliensbachian (Lower Jurassic) Radiolaria from Baja Californian Sur, Mexico. *Micropaleontology*, **48**, 97-151.

Xu, X. (1992) Triassic faunas and stratigraphic subdivision and correlation of Qinling and neibouring areas. 1. Triassic marine faunas and stratigraphic subdivision and correlation of Qinling region. 1. Triassic faunas and fossil zonations. (6). Radiolarians. *In* Yin, H., Yang, F., Huang, Q., Yang, H. and Lai, X. eds., *The Triassic of Qinling Mountains and neibouring area*. Press of the China University of Geosciences, 68-69.

Yao, A. (1979) Radiolarian fauna from the Mino belt in the northern part of the Inuyama area, central Japan. Part II: Nassellaria 1. *Jour. Geosci., Osaka City Univ*., **22**, 21-72.

Yao, A. (1982) Middle Triassic to Early Jurassic radiolarians from the Inuyama area, central Japan. *Jour. Geosci., Osaka City Univ*., **25**, 53-70.

Yao, A. (1997) Faunal change of Early – Middle Jurassic radiolarians. *News of Osaka Micropaleontologists, spec. vol*., no.10, 155-182. (in Japanese with English abstract)

Yeh, K.-Y. (1987) Taxonomic studies of Lower Jurassic Radiolaria from east–central Oregon. *Special Publication, National Museum of Natural Science, Taiwan*, no.2, 169p.

Yeh, K.-Y. (1989) Studies of Radiolaria from the Fields Creek Formation, east-central Oregon, U.S.A.. *Bull. National Museum of Natural Science, Taiwan*, no.1, 43-109.

Yeh, K.-Y. (1990) Taxonomic studies of Triassic Radiolaria from Busuanga Island, Philippines. *Bull. National Museum of Natural Science, Taiwan*, no.2, 1-63.

Yeh, K.-Y. (1992) Triassic Radiolaria from Uson Island, Philippines. *Bull. National Museum of Natural Science, Taiwan*, no.3, 51-91.

Yeh, K.-Y. and Cheng, Y.-N. (1996) Jurassic radiolarians from the northwest coast of the Busuanga Island, North Palawan block, Philippines. *Micropaleontology*, **42**, 93-124.

Yeh, K.-Y. and Cheng, Y.-N. (1998) Radiolarians from the Lower Jurassic of the Busuanga Island, Philippines. *Bull. National Museum of Natural Science, Taiwan*, no.11, 1-65.

Received May 13, 2013
Accepted August 21, 2013

Plate

Plate 1 SEM images of Triassic to Middle Jurassic radiolarians from the Kanmuri Yama district.

KJ0301 (Locality Kc-1: Tarumi-gawa)
1-3: *Haeckelicyrtium*? sp. (1: GSJ F18132-002, 2: -003, 3: -001)
4: *Palaeosaturnalis* sp. (GSJ F18132-005)
5: *Cryptostephanidium*? sp. (GSJ F18132-004)

KJ0402 (Locality Kc-2: Northeast of Masudani)
6-7: Spumellaria gen. et sp. indet. (6: GSJ F18136-013, 7: -014)
8-9: *Pseudostylosphaera japonica* (Nakaseko and Nishinura) (8: GSJ F18136-011, 9: -010)
10: *Pseudostylosphaera*? sp. (GSJ F18136-012)
11: *Eptingium nakasekoi* Kozur and Mostler (GSJ F18136-009)
12-13: Poulpidae gen. et sp. indet. (12: GSJ F18136-006, 13: -008)
14: *Triassocampe deweveri* (Nakaseko and Nishimura) (GSJ F18136-003)
15-18: *Triassocampe* sp. (15: GSJ F18136-002, 16: -001, 17: -004, 18: -005)

KJ0403 (Locality Kc-2: Northeast of Masudani)
19: *Pseudostylosphaera*? sp. (GSJ F18137-003)
20: *Triassocampe* sp. cf. *T. myterocorys* Sugiyama (GSJ F18137-002)
21: *Multimonilis* sp. (GSJ F18137-01)

KJ0404 (Locality Kc-2: Northeast of Masudani)
22: *Triassocampe deweveri* (Nakaseko and Nishimura) (GSJ F18138-008)
23: *Triassocampe* sp. (GSJ F18138-001)
24-28: Nassellaria gen. et sp. indet. (24: F18138-002, 25: -003, 26: -004, 27: -005, 28: -007)

KJ0410c (Locality Kc-3: East of Masudani)
29: Entactinaria gen. et sp. indet. (GSJ F18139-003)
30: *Droltus* sp. cf. *D. hecatensis* Pessagno and Whalen (GSJ F18139-001)
31: Nassellaria gen. et sp. indet. (GSJ F18139-002)

All scale bars equal to 0.1 mm.

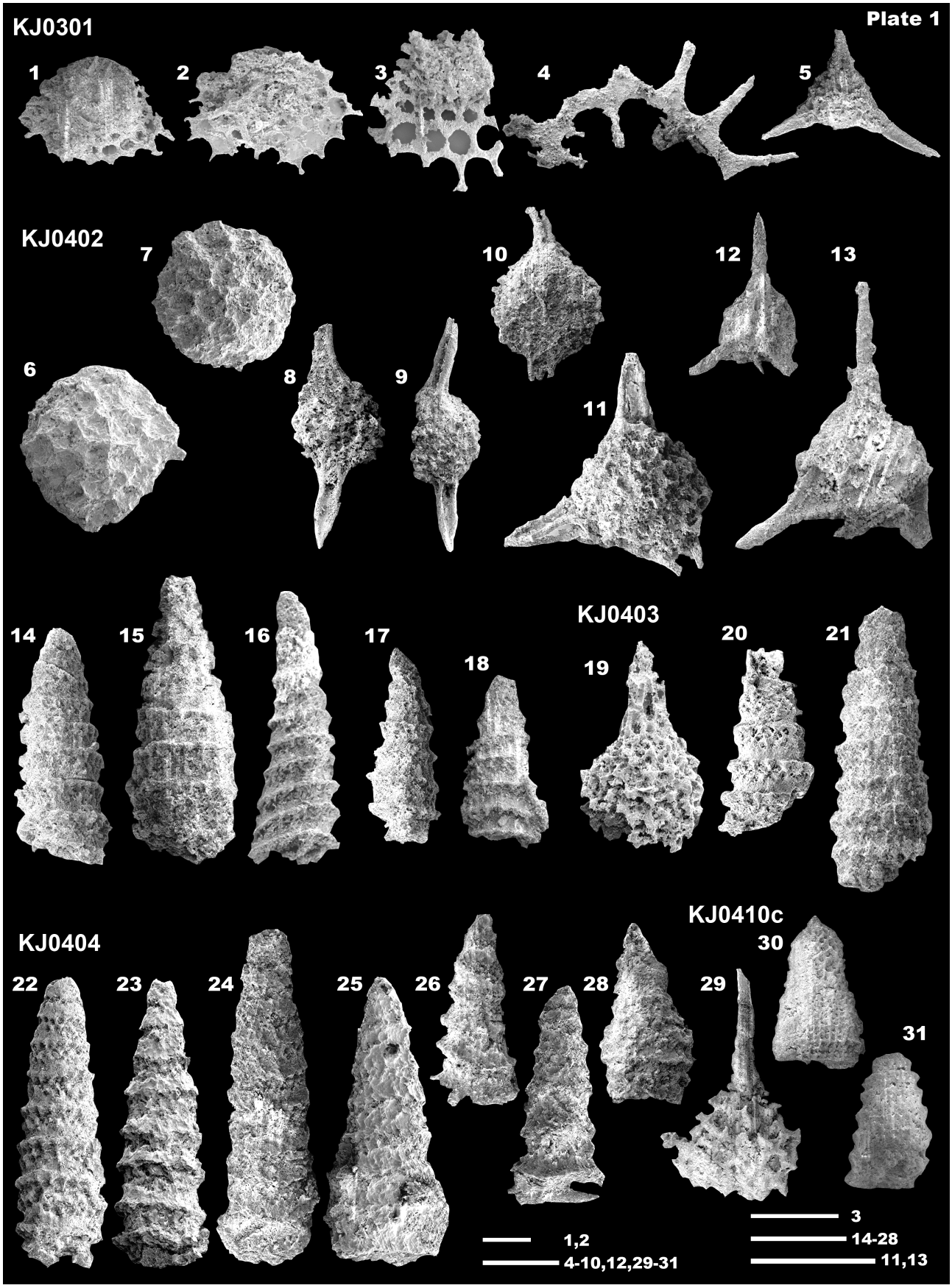


Plate 1
KJ0301
1
2
3
4
5
KJ0402
6
7
8
9
10
11
12
13
KJ0403
14
15
16
17
18
19
20
21
KJ0404
22
23
24
25
26
27
28
KJ0410c
29
30
31
1,2
4-10,12,29-31
3
14-28
11,13

Plate 2 SEM images of Triassic to Middle Jurassic radiolarians from the Kanmuri Yama district.

KJ0810e (Locality Kc-4: Masudani)
1: *Archaeocenosphaera*? sp. (GSJ F18141-008)
2: Spumellaria gen. et sp. indet. (GSJ F18141-009)
3-4: *Pseudostylosphaera*? sp. (3: GSJ F18141-006, 4: -005)
5-6: Spumellaria gen. et sp. indet. (GSJ F18141-003, 6: -004)
7: *Tirodella*? sp. (GSJ F18141-007)
8: *Celluronta* sp. (GSJ F18141-001)
9: Nassellaria gen. et sp. indet. (GSJ F18141-002)

KJ0810f (Locality Kc-4: Masudani)
10: Spumellaria gen. et sp. indet. (GSJ F18142-013)
11-17: *Pseudostylosphaera* sp. (11: GSJ F18142-008, 12: -011, 13: -005, 14: -010, 15: -009, 16: -007, 17: -012)
18: *Eptingium*? sp. (GSJ F18142-006)
19-20: Spumellaria gen. et sp. indet. (19: GSJ F18142-004, 20: -003)
21: Nassellaria gen. et sp. indet. (GSJ F18142-002)

KJ0810g (Locality Kc-4: Masudani)
22: *Pseudostylosphaera compacta* (Nakaseko and Nishimura) (GSJ F18143-010)
23: Spumellaria gen. et sp. indet. (GSJ F18143-005)
24: *Cryptostephanidium*? sp. (GSJ F18143-008)
25: *Eptingium* sp. (GSJ F18143-007)
26: *Parasepsagon* sp. (GSJ F18143-009)
27: Entactinaria gen. et sp. indet. (GSJ F18143-006)
28-30: *Triassocampe* sp. (28: GSJ F18143-003, 29: -002, 30: -001)
31: Nassellaria gen. et sp. indet. (GSJ F18143-004)

All scale bars equal to 0.1 mm.

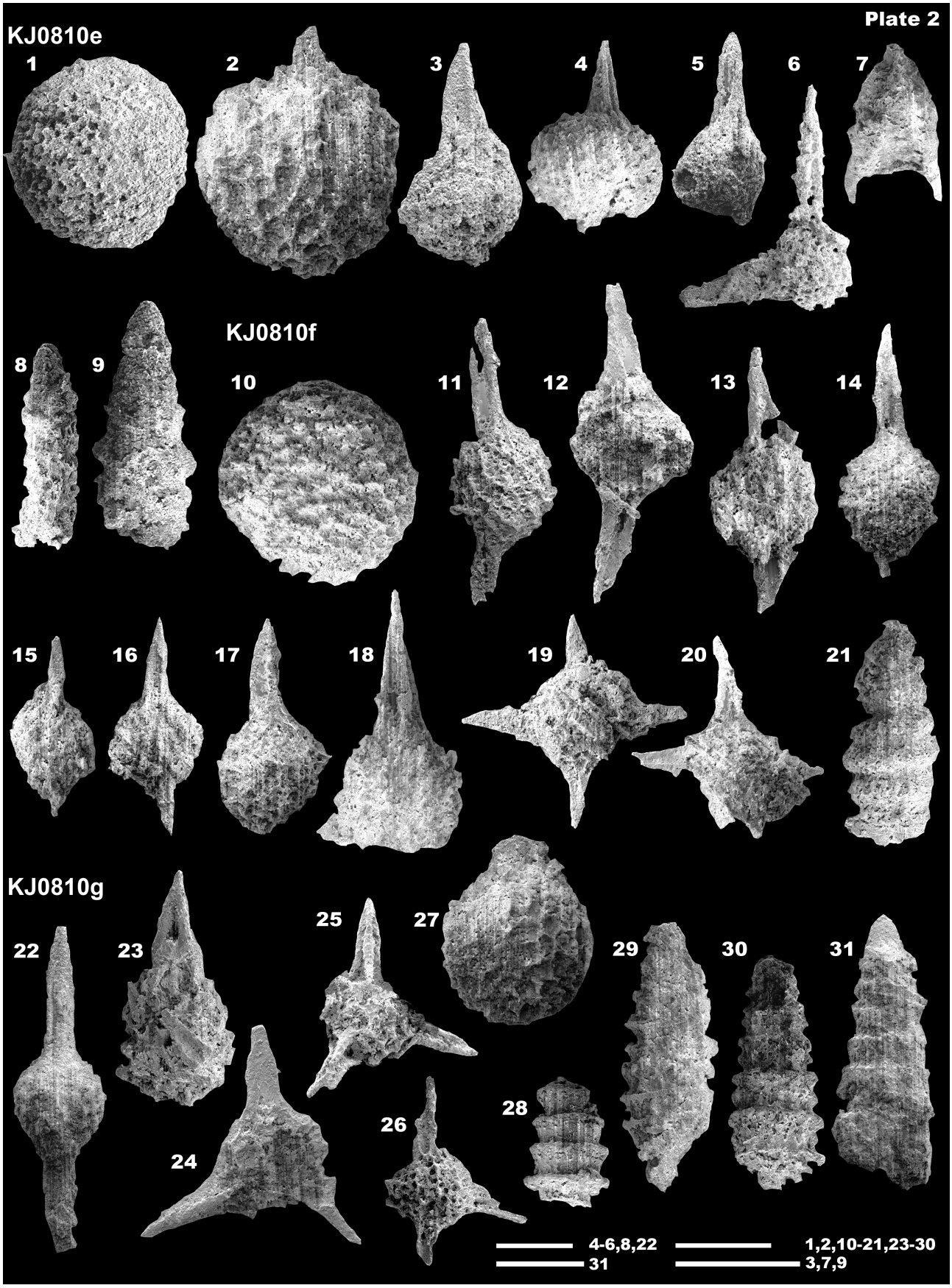


Plate 2
KJ0810e
1
2
3
4
5
6
7
KJ0810f
8
9
10
11
12
13
14
15
16
17
18
19
20
21
KJ0810g
22
23
24
25
26
27
28
29
30
31
4-6,8,22
31
1,2,10-21,23-30
3,7,9

Plate 3 SEM images of Triassic to Middle Jurassic radiolarians from the Kanmuri Yama district.

KJ0904a (Locality Kc-5: Northeast of Masudani)
1-2: *Archaeocenosphaera*? sp. (1: GSJ F18144-004, 2: -005)
3: *Triassocampe* sp. (GSJ F18144-001)
4: Nassellaria gen. et sp. indet. (GSJ F18144-002)

KJ0904b (Locality Kc-5: Northeast of Masudani)
5-6: *Archaeocenosphaera*? sp. (5: GSJ F18145-013, 6: -012)
7: *Pseudostylosphaera helicata* (Nakaseko and Nishimura) (GSJ F18145-008)
8: *Pseudostylosphaera compacta* (Nakaseko and Nishimura) (GSJ F18145-011)
9: *Eptinguium*? sp. (GSJ F18145-010)
10: Spumellaria gen. et sp. indet. (GSJ F18145-009)
11: Nassellaria gen. et sp. indet. (GSJ F18145-007)
12: *Triassocampe deweveri* (Nakaseko and Nishimura) (GSJ F18145-003)
13-16: *Triassocampe* sp. (13: GSJ F18145-004, 14: -002, 15: -001, 16: -005)

KJ0904c (Locality Kc-5: Northeast of Masudani)
17-18: Spumellaria gen. et sp. indet. (17: GSJ F18146-009, 18: -003)
19: *Pseudostylosphaera* sp. aff. *P. tenuis* (Nakaseko and Nishimura) (GSJ F18146-004)
20-23: Spumellaria gen. et sp. indet. (20: GSJ F18146-001, 21: -007, 22: -002, 23: -008)

KJ0905b (Locality Kc-6: Northeast of Masudani)
24: Entactinaria gen. et sp. indet. (GSJ F18147-001)
25: Spumellaria gen. et sp. indet. (GSJ F18147-002)

KJ0905c (Locality Kc-6: Northeast of Masudani)
26: *Trillus elkhornensis* Pessagno and Blome (GSJ F18148-008)
27: Favosyringiinae gen. et sp. indet. (GSJ F18148-006)
28: Nassellaria gen. et sp. indet. (GSJ F18148-007)
29-31: *Parahsuum* sp. (29: GSJ F18148-003, 30: -005, 31: -001)
32: *Hsuum* sp. cf. *H. mulleri* Pessagno and Whalen (GSJ F18148-004)
33: *Lantus*? sp. (GSJ F18148-002)

All scale bars equal to 0.1 mm.

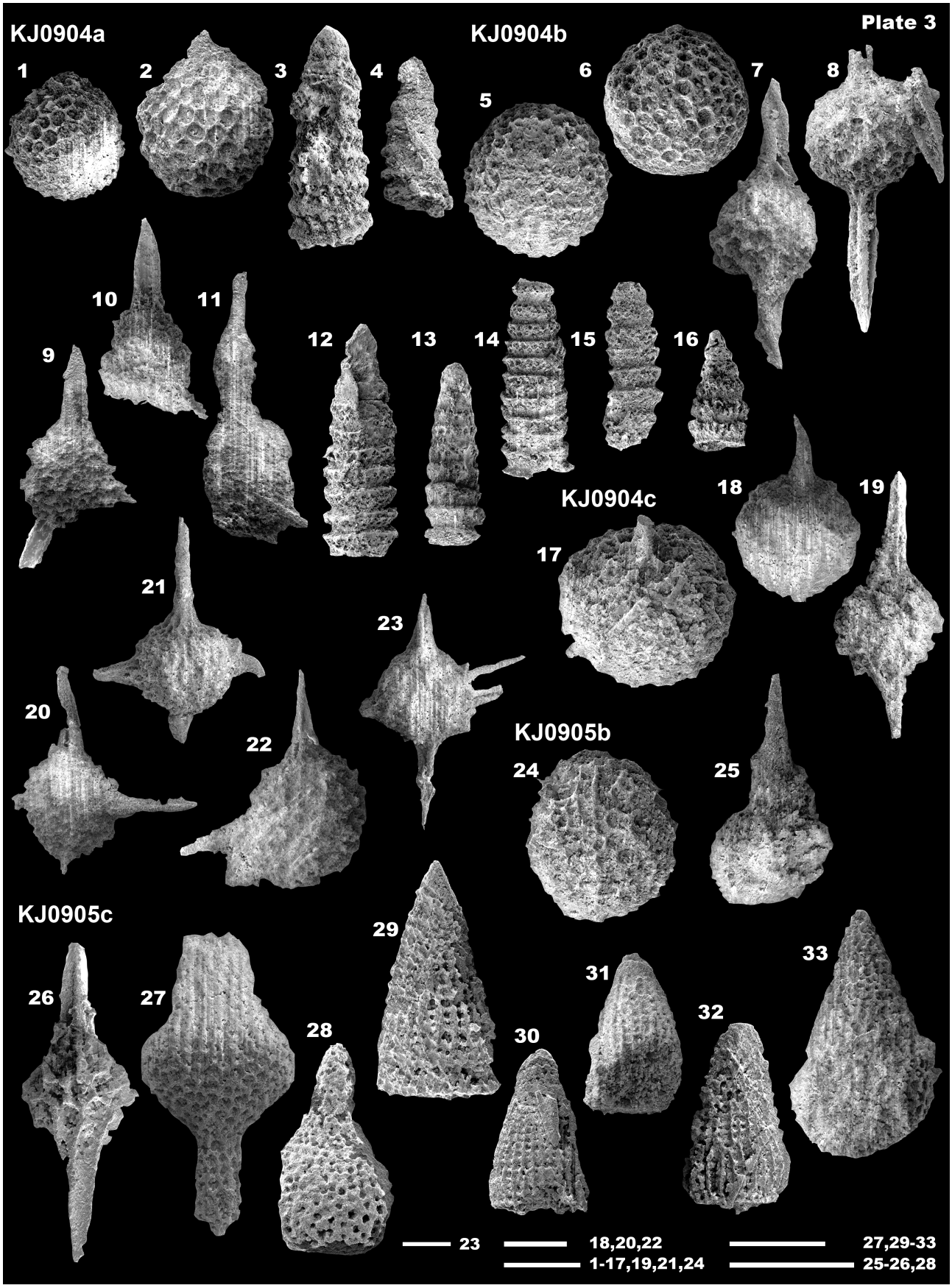


Plate 3
KJ0904a
KJ0904b
KJ0904c
KJ0905b
KJ0905c
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
23
18,20,22
1-17,19,21,24
27,29-33
25-26,28

Plate 4 SEM images of Triassic to Middle Jurassic radiolarians from the Kanmuri Yama district.

KJ1904a (Locality Kc-7: Southeast of Hirono)
1: *Pantanellium*? *virgeum* Sashida (GSJ F18157-014)
2-6: Spumellaria gen. et sp. indet. (2: GSJ F18157-009, 3: -017, 4: -004, 5: -003, 6: -012)
7: *Pseudostylosphaera*? sp. (GSJ F18157-007)
8-10: Entactinaria gen. et sp. indet. (8: GSJ F18157-008, 9: -005, 10: -013)
11: *Monostylosphaera*? sp. (GSJ F18157-002)
12: *Pseudostylosphaera*? sp. (GSJ F18157-001)

KJ2206a (Locality Kc-8: Tarumi-gawa)
13-14: *Udalia* sp. (13: GSJ F18159-038, 14: -039)
15: Nassellaria gen. et sp. indet. (GSJ F18159-028)
16: *Napora mitrata* Pessagno, Whalen and Yeh (GSJ F18159-037)
17: *Napora* sp. (GSJ F18159-034)
18-19: *Eucyrtidiellum nagaiae* Dumitrica, Goričan and Matsuoka (18: GSJ F18159-030, 19: -031)
20: *Minocapsa globosa* Matsuoka (GSJ F18159-025)
21: *Lantus obesus* (Yeh) (GSJ F18159-026)
22: *Lantus intermedius* Carter (GSJ F18159-015)
23: *Hsuum* sp. sensu Matsuoka 2004 (GSJ F18159-012)
24-26: *Parahsuum simplum* Yao (24: GSJ F18159-006, 25: -018, 26: -013)
27-28: *Parahsuum ovale* Hori and Yao (27: GSJ F18159-009, 28: -023)
29: *Parahsuum* sp. (GSJ F18159-021)
30: *Parahsuum izeense* (Pessagno and Whalen) (GSJ F18159-011)
31-33: *Parahsuum longiconicum* Sashida (31: GSJ F18159-002, 32: -007, 33: -020)
34: *Parahsuum* sp. (GSJ F18159-001)
35: *Canoptum* sp. cf. *C. rugosum* Pessagno and Poisson (GSJ F18159-019)

All scale bars equal to 0.1 mm.

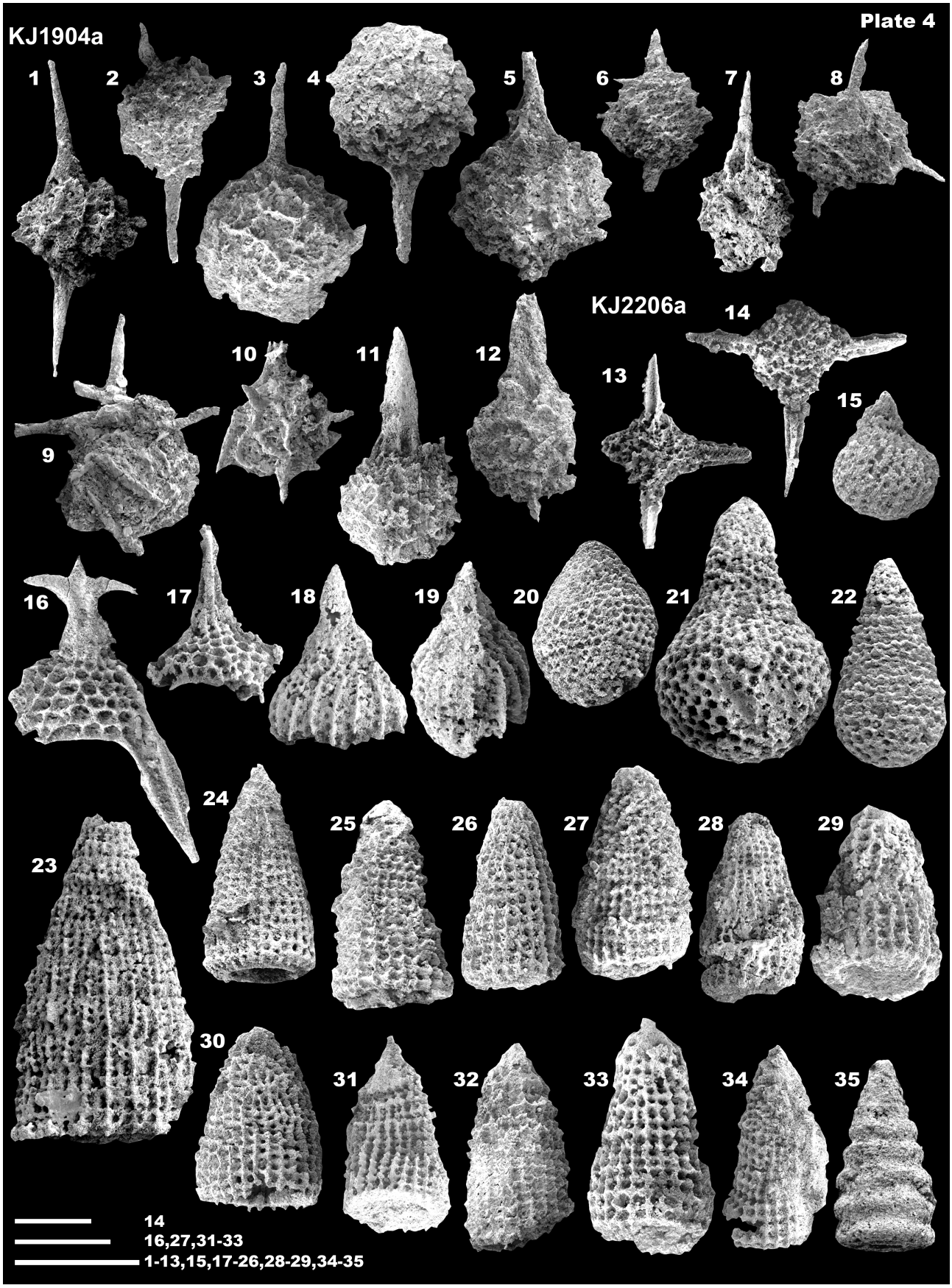


Plate 4
KJ1904a
KJ2206a
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
14
16,27,31-33
1-13,15,17-26,28-29,34-35

Plate 5 SEM images of Triassic to Middle Jurassic radiolarians from the Kanmuri Yama district.

KJ2206h (Locality Kc-8: Tarumi-gawa)
1: *Pseudostylosphaera compacta* (Nakaseko and Nishimura) (GSJ F18160-011)
2-3: *Pseudostylosphaera* sp. (2: GSJ F18160-010, 3: -015)
4-6: *Hindeosphaera spinulosa* (Nakaseko and Nishimura) (4: GSJ F18160-014, 5: -017, 6: -016)
7: *Spongostephanidium* sp. (GSJ F18160-018)
8: *Cryptostephanidium*? sp. (GSJ F18160-021)
9-12: *Triassocampe deweveri* (Nakaseko and Nishimura) (9: GSJ F18160-004, 10: -005, 11: -003, 12: -008)
13-14: *Triassocampe* sp. (13: GSJ F18160-007, 14: -001)
15: *Paratriassocampe* sp. (GSJ F18160-006)
16: *Triassocampe* sp. (GSJ F18160-002)

KJ2206i (Locality Kc-8: Tarumi-gawa)
17-18: *Pseudostylosphaera*? sp. (17: GSJ F18161-006, 18: -005)
19: Entactinaria gen. et sp. indet. (GSJ F18161-007)
20: *Eptingium* sp. (GSJ F18161-001)
21: *Bipedis* sp. (GSJ F18161-004)
22: Spumellaria gen. et sp. indet. (GSJ F18161-002)

KJ2412 (Locality Kc-9: South of Kōkuradani)
23-24: *Pseudostylosphaera* sp. (23: GSJ F18167-009, 24: -014)
25-27: *Pseudostylosphaera*? sp. (25: GSJ F18167-013, 26: -010, 27: -008)
28: *Cryptostephanidium*? sp. (GSJ F18167-018)
29-30: Entactinaria gen. et sp. indet. (29: GSJ F18167-017, 30: -016)
31-36: *Triassocampe* sp. (31: GSJ F18167-001, 32: -002, 33: -003, 34: -004, 35: -005, 36: -007)
37: *Triassocampe* sp. aff. *T. diordinis* Bragin sensu Sugiyama 1992 (GSJ F18167-006)

All scale bars equal to 0.1 mm.

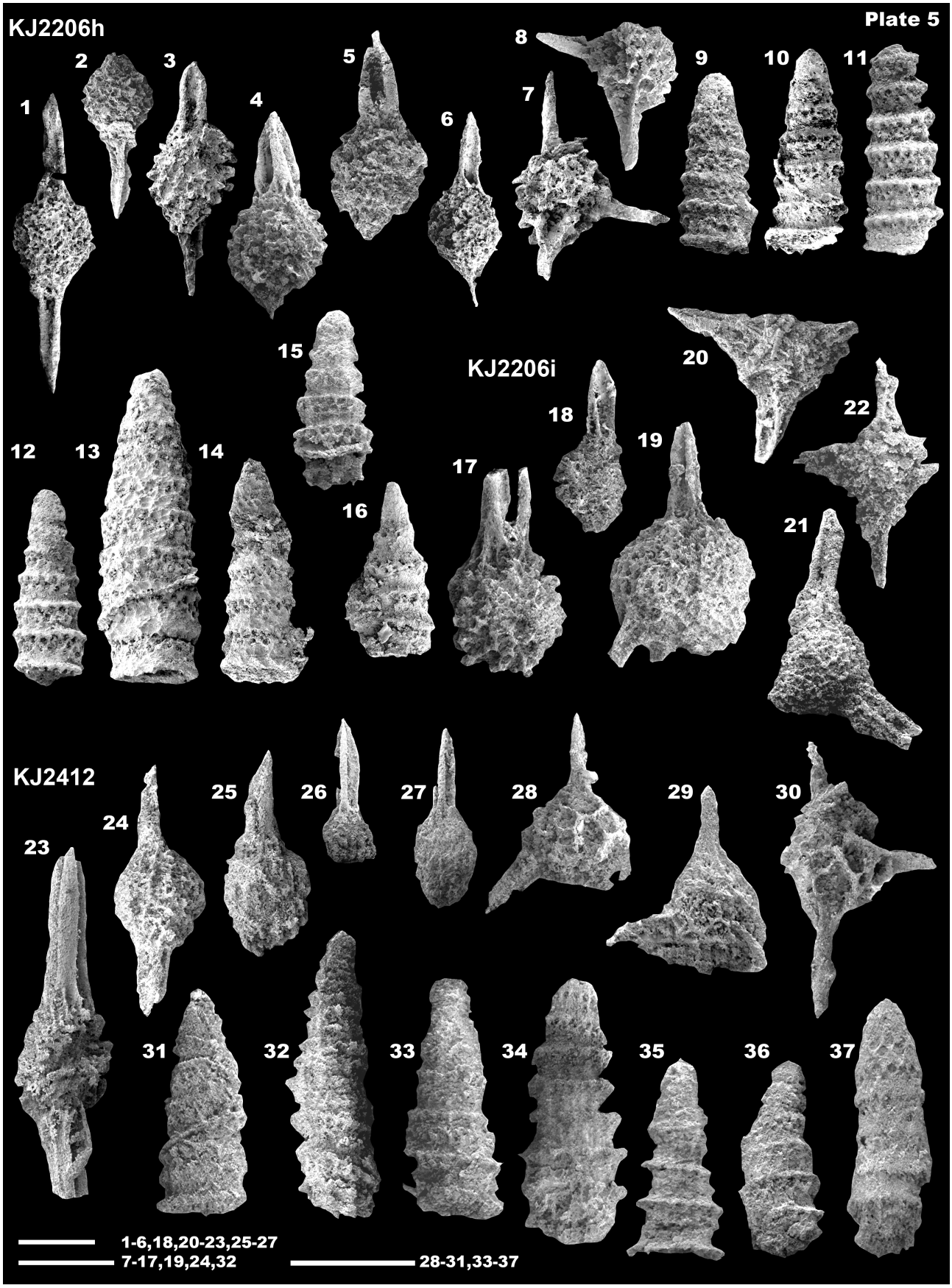

KJ2206h
Plate 5
1
2
3
4
5
6
7
8
9
10
11
KJ2206i
12
13
14
15
16
17
18
19
20
21
22
KJ2412
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
1-6,18,20-23,25-27
7-17,19,24,32
28-31,33-37

Plate 6 SEM images of Triassic to Middle Jurassic radiolarians from the Kanmuri Yama district.

KJ2413 (Locality Kc-10: South of Kōkuradani)
1: *Pseudostylosphaera japonica* (Nakaseko and Nishimura) (GSJ F18168-005)
2: *Spongoxystris*? sp. (GSJ F18168-009)
3-10: *Muelleritortis cochleata* (Nakaseko and Nishimura) (3: GSJ F18168-014, 4: -012, 5: -016, 6: -013, 7: -012, 8: -008, 9: -006, 10: -011)
11: *Triassocampe* sp. cf. *T. myterocorys* Sugiyama (GSJ F18168-003)
12-13: *Triassocampe* sp. (12: GSJ F18168-004, 13: -001)

KJ2902c (Locality Kc-11: Fujikuradani)
14: *Pseudostylosphaera* sp. (GSJ F18173-034)
15-16: *Protopsium* sp. (15: GSJ F18173-012, 16: -040)
17: *Pentabelus* sp. cf. *P. furutanii* Sugiyama (GSJ F18173-011)
18: Spumellaria gen. et sp. indet. (GSJ F18173-007)
19: Entactinaria gen. et sp. indet. (GSJ F18173-008)
20: Spumellaria gen. et sp. indet. (GSJ F18173-039)
21: *Oertlispongus* sp. (GSJ F18173-031)
22-24: *Spongostephanidium* sp. (22: GSJ F18173-003, 23: -001, 24: -023)
25: *Eptingium*? sp. (GSJ F18173-005)
26: Entactinaria gen. et sp. indet. (GSJ F18173-029)
27: Poulpidae gen. et sp. indet. (GSJ F18173-044)
28: Entactinaria gen. et sp. indet. (GSJ F18173-013)

All scale bars equal to 0.1 mm.

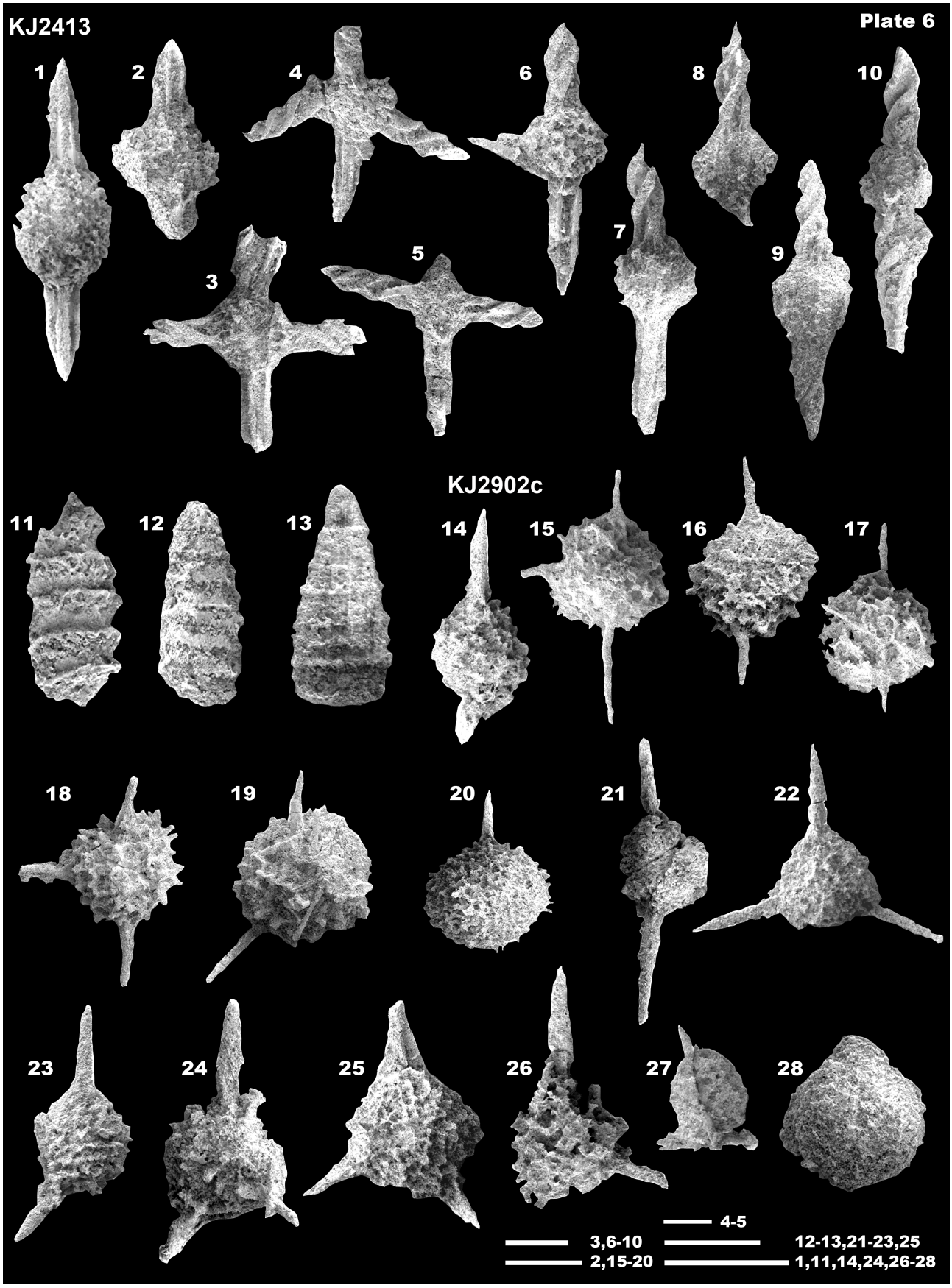

KJ2413
Plate 6
1
2
4
6
8
10
3
5
7
9
KJ2902c
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
4-5
3,6-10
12-13,21-23,25
2,15-20
1,11,14,24,26-28

Plate 7 SEM images of Triassic to Middle Jurassic radiolarians from the Kanmuri Yama district.

KJ3701 (Locality Kc-12: South of Kanmuri-tōge)
1: Favosyringiinae gen. et sp. indet. (GSJ F18177-011)
2-4: *Parahsuum* sp. (2: GSJ F18177-004, 3: -001, 4: -006)
5: Nassellaria gen. et sp. indet. (GSJ F18177-005)
6: *Hsuum*? sp. (GSJ F18177-009)
7: *Canoptum* sp. cf. *C. anulatum* Pessagno and Poisson (GSJ F18177-002)

KJ3907 (Locality Kc-13: Northeast of Kanmuri-tōge)
8-12: *Pseudostylosphaera japonica* (Nakaseko and Nishimura) (8: GSJ F18178-007, 9: -008, 10: -009, 11: -010, 12: -011)
13: *Monostylosphaera*? sp. (GSJ F18178-012)
14: *Hindeosphaera* sp. (GSJ F18178-014)
15-16: *Eptingium nakasekoi* Kozur and Mostler (15: GSJ F18178-013, 16: -017)
17: *Eptingium* sp. (GSJ F18178-015)
18-20: *Triassocampe* sp. (18: GSJ F18178-004, 19: -005, 20: -006)
21-22: Nassellaria gen. et sp. indet. (21: GSJ F18178-001, 22: -003)

KJ4401a (Locality Kc-14: Ichindani)
23-24: *Praemesosaturnalis* sp. (GSJ F18194-005, 24: -004)
25: *Palaeosaturnalis* sp. (GSJ F18194-006)
26-28: Nassellaria gen. et sp. indet. (26: GSJ F18194-001, 27: -002, 28: -003)

All scale bars equal to 0.1 mm.

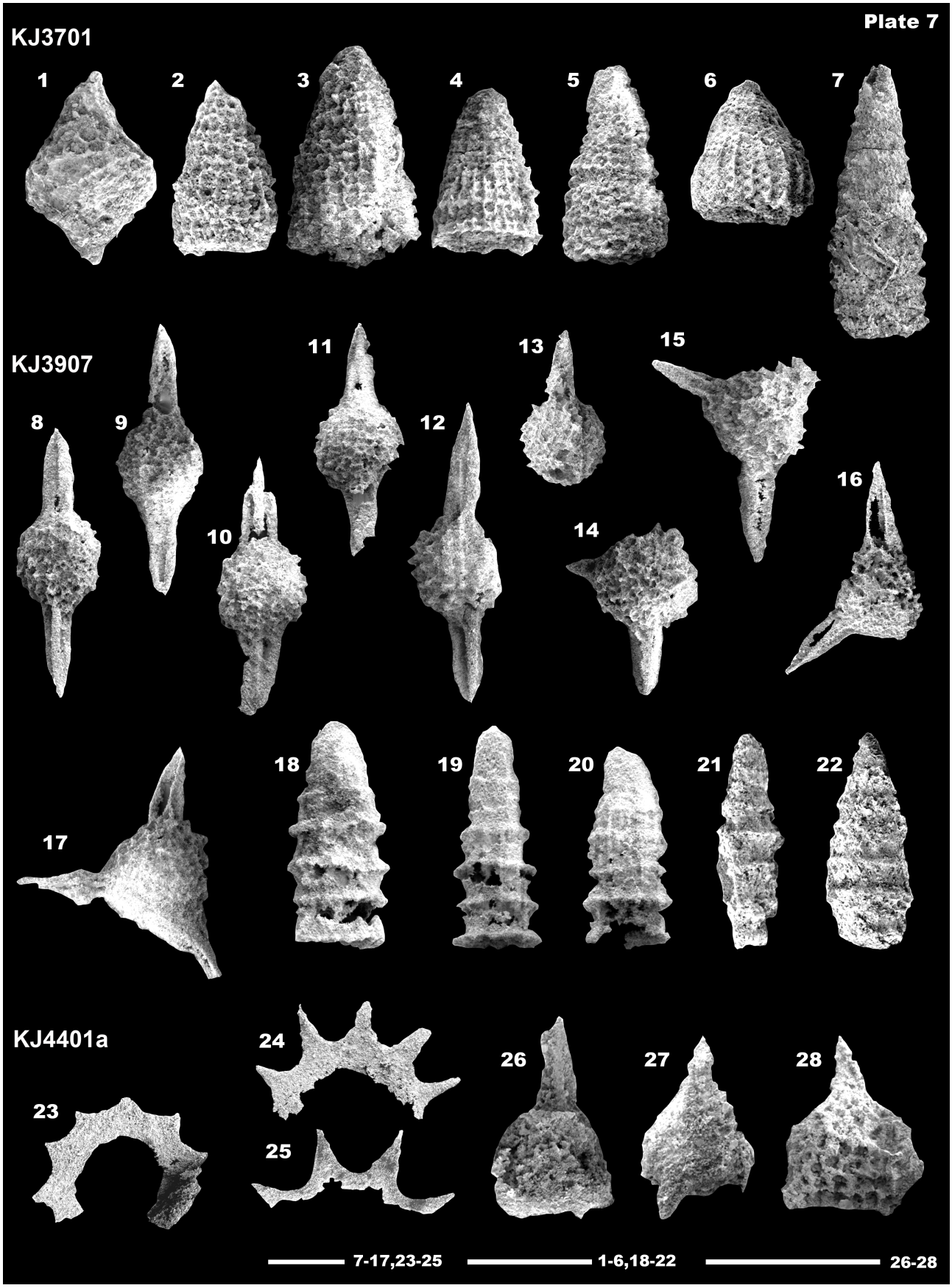


Plate 7
KJ3701
1
2
3
4
5
6
7
KJ3907
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
KJ4401a
23
24
25
26
27
28
7-17,23-25
1-6,18-22
26-28

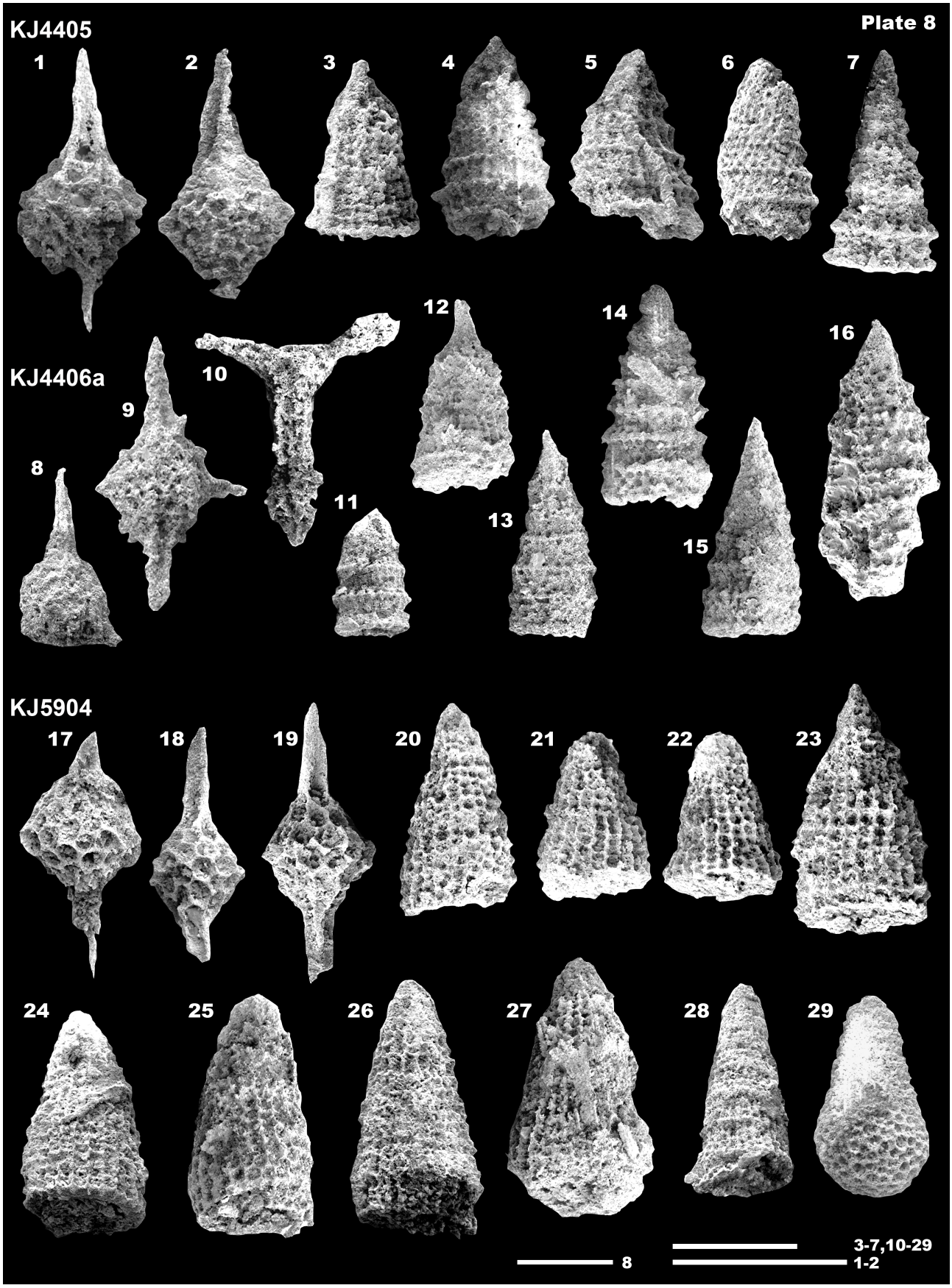
Plate 8 SEM images of Triassic to Middle Jurassic radiolarians from the Kanmuri Yama district.

KJ4405 (Locality Kc-15: Ichindani)
1-2: *Pantanellium* sp. (1: GSJ F18195-013, 2: -009)
3: *Parahsuum* sp. cf. *P. longiconicum* Sashida (GSJ F18195-007)
4-7: *Praeparvicingula* sp. (4: GSJ F18195-004, 5: -006, 6: -005, 7: 001)

KJ4406a (Locality Kc-16: Ichindani)
8: Entactinaria gen. et sp. indet. (GSJ F18196-015)
9: *Zartus* sp. (GSJ F18196-012)
10: Patulibracchiidae gen. et sp. indet. (GSJ F18196-013)
11: *Dictyomitrella*? sp. cf. *D.*? *kamoensis* Mizutani and Kido (GSJ F18196-007)
12: *Praeparvicingula* sp. cf. *P. nanoconica* (Hori and Otsuka) (GSJ F18196-004)
13: *Praeparvicingula gigantocornis* (Kishida and Hisada) (GSJ F18196-006)
14-15: *Praeparvicingula* sp. (14: GSJ F18196-002, 15: -001)
16: *Parvicingula* sp. (GSJ F18196-008)

KJ5904 (Locality Kc-17: Southwest of of Kanmuri-tōge)
17-19: *Pantanellium* sp. (17: GSJ F18215-015, 18: -019, 19: -016)
20-27: *Parahsuum* sp. (20: GSJ F18215-009, 21: -005, 22: -008, 23: -007, 24:-002, 25: -003, 26: -006, 27: -004)
28: *Parahsuum*? sp. A (GSJ F18215-011)
29: *Lantus intermedius* Carter (GSJ F18215-012)

All scale bars equal to 0.1 mm.


KJ4405
Plate 8
1
2
3
4
5
6
7
KJ4406a
8
9
10
11
12
13
14
15
16
KJ5904
17
18
19
20
21
22
23
24
25
26
27
28
29
8
3-7,10-29
1-2

西南日本南条山地における遠洋性チャートから産出した三畳紀–中期ジュラ紀放散虫 ー 第２部．冠山地域

中江　訓

要　旨

西南日本福井県中央部に位置する南条山地の主要域には，玄武岩・石灰岩・チャート・泥岩・砂岩などの多様な岩石から構成される堆積岩複合岩体が分布する．南条山地におけるこれらの岩石のうち 27 地点の露頭から採取したチャートについて，含有される放散虫化石の検討を行った．その結果，冠山地域では 17 地点 26 試料から Spumellaria 目ならびに Entactinaria 目が卓越する三畳紀群集と Nassellaria 目が卓越するジュラ紀群集が産出した．本報告ではこれらの放散虫化石群集を記載するとともに，その種構成に基づき冠山地域に分布するチャートの地質時代は前期三畳紀（Olenekian）～中期ジュラ紀（Bajocian）に至ると結論した．

難読・重要地名

Fujikuradani：藤倉谷，Fukui：福井，Hirono：広野，Ichindani：イチン谷，Imajō：今庄，Kanmuri-tōge：冠峠，Kanmuri Yama：冠山，Kōkuradani：高倉谷，Masudani：桝谷，Minamiechizen：南越前，Mino：美濃，Tarumi-gawa：多留美川．