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Middle Jurassic Radiolarians from the Western Pacific

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Abstract: Middle Jurassic radiolarians have been recovered from the western Pacific for the first time. The oldest faunas are assigned to the middle and upper *Tricolocapsa conexa* Zone, indicating a Bathonian/Callovian age. The faunas contain more than 30 species and are characterized by an abundance of small nassellarians with a constricted distal end. The faunas compare well with Tethyan faunas, and are especially similar to Japanese faunas.

Introduction

Jurassic sediments have been recovered for the first time beneath the deep western Pacific Ocean by Leg 129 of the Ocean Drilling Program (ODP) (Shipboard Scientific Party of Leg 129, 1990a, 1990b; Lancelot, Larson *et al.*, 1990). The Jurassic sediments are composed chiefly of radiolarite associated with pelagic claystone. They contain abundant radiolarians and rare calcareous nannofossils, but are barren of foraminifers and dinoflagellates. Age of samples from the sedimentary section is based largely on comparison of the radiolarian faunas of known age. This paper presents the oldest radiolarian faunas obtained just above the basaltic basement in the western Pacific, discusses their age assignment and compares their composition with contemporaneous radiolarian faunas from other regions.

Material Studied

Jurassic sediments were recovered from ODP Site 801 of the central Pigafetta Basin in the western Pacific (Figure 1). Site 801 (18°38.54'N, 156°21.58'E, water depth 5682m) is located on a magnetic quiet zone southeast of, and presumably older than, the M25-M37 magnetic lineation sequence. Three holes (A, B and C) were drilled in Site 801. Figure 2 shows the lithostratigraphy of Site 801.

The basal sedimentary unit (Unit V) is composed of alternating beds of red radiolarite and claystone, and covers a basaltic basement including intrusive and pillow units. Two radiolarite samples (129-801B-37R-1, 16-20 cm and 129-801B-35R-3, 24-26 cm) of different stratigraphic levels in the lower part of Unit V were examined in this study. Radiolarian tests were extracted from the rock samples by the HF method. Radiolarian preservation is better in Sample 129-801B-35R-3, 24-26 cm than in Sample 129-801B-37R-1, 16-20 cm. In both samples, well preserved radiolarians can be identified to the species level.

Radiolarian Fauna

Table 1 lists radiolarian fossils from the two samples examined. Some of them are illustrated in Plates 1 and 2. Twenty-seven species are identified in Sample 129-801B-37R-1, 16-20 cm and 31 species are present in Sample 129-801B-35R-3, 24-26 cm. The difference in species diversity between the two samples seems to be partly reflected by difference in preservation of radiolarian tests.

Age assignment

Sample 129-801B-37R-1, 16-20 cm contains *Tricolocapsa conexa* Matsuoka and *Guexella nudata* (Kocher), but lacks *Stylocapsa tecta* Matsuoka and *Stylocapsa catenarum* Matsuoka. This faunal combination indicates the middle part of the *Tricolocapsa conexa* Zone (Matsuoka, 1983). Sample 129-801B-35R-3, 24-26 cm yields *T. conexa* and *S. tecta*, but lacks *Stylocapsa* (?) *spiralis* Matsuoka whose occurrence is diagnostic for the next younger *Stylocapsa* (?) *spiralis* Zone (Matsuoka, 1983). *S.* (?) *spiralis* is actually obtained from several horizons higher than this level in Site 801. These data show the fauna indicates the upper part of the *Tricolocapsa conexa* Zone.

Because the faunal composition of these samples is very similar to that of Japanese faunas, the samples can be easily placed in the framework of Jurassic radiolarian zonation (Matsuoka, 1983;

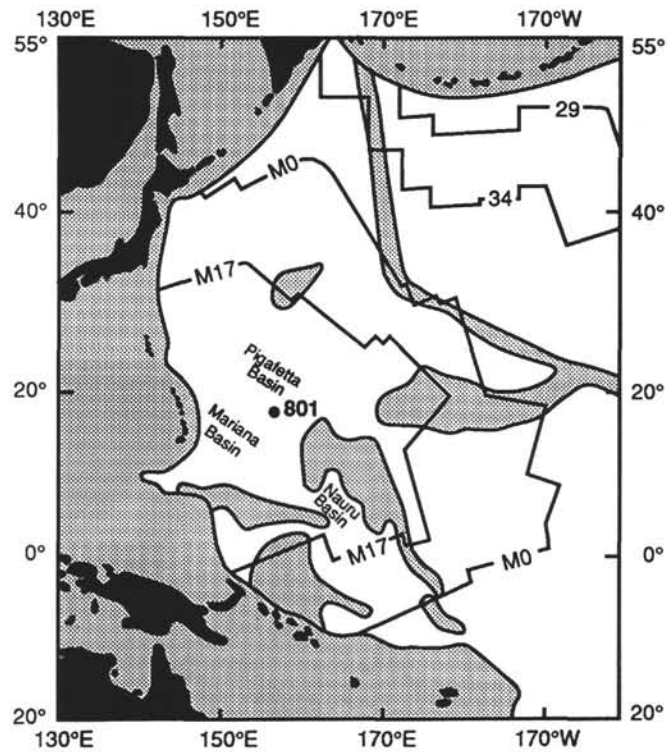

Figure 1. Coring site location for ODP Leg 129, Site 801. White portions represent areas of normal ocean crustal thickness and water depth on the Pacific plate, and gray areas represent volcanic edifices with thickened crustal sections, as well as the younger areas beyond the Pacific subduction zones. Magnetic lineation isochrons correspond to the following geologic boundaries; M17 = Jurassic/Cretaceous, M0 = Barremian/Aptian, 34 = Santonian/Campanian, and 29 = Cretaceous/Tertiary. Modified from Shipboard Scientific Party of Leg 129 (1990a).

Matsuoka and Yao, 1986) in Japan. However, age assignment for Japanese radiolarian zones of a Jurassic interval is still tentative because they are not sufficiently dated by other age diagnostic fossils. Age assignment depends largely on the correlation of Matsuoka and Yao's (1986) zonation with the zonation proposed by Baumgartner (1984, 1987) (Figure 3). Baumgartner's zonation was based primarily on his research in the central Atlantic and Mediterranean Tethys regions where radiolarian-bearing sequences contain other age diagnostic fossils. Based on this correlation, the middle and upper *T. conexa* Zone of Matsuoka and Yao (1986) is assigned to a Bathonian/Callovian age. Further study is required to give a more precise age.

Faunal comparison

In both samples, the radiolarian fauna is rich in small nassellarian species with a constricted distal end which belong to the following genera; *Stylocapsa, Tricolocapsa, Stichocapsa, Theocapsomma* and *Guexella.* Large multisegmented nassellarians and spumellarians are fewer than the small nassellarians.

The fauna contains many species originally described from Japanese materials. These are *Archaeodictyomitra* (?) *amabilis* Aita, *Dictyomitrella* (?) *kamoensis* Mizutani and Kido, *Eucyrtidiellum nodosum* Wakita, *Eucyrtidiellum unumaense* (Yao), *Protunuma* (?) *ochiensis* Matsuoka, *Stichocapsa robusta* Matsuoka, *Stylocapsa catenarum* Matsuoka, *Stylocapsa lacrimalis* Matsuoka, *Stylocapsa tecta* Matsuoka, *Tricolocapsa conexa* Matsuoka and *Acanthocircus oblongus* (Yao).

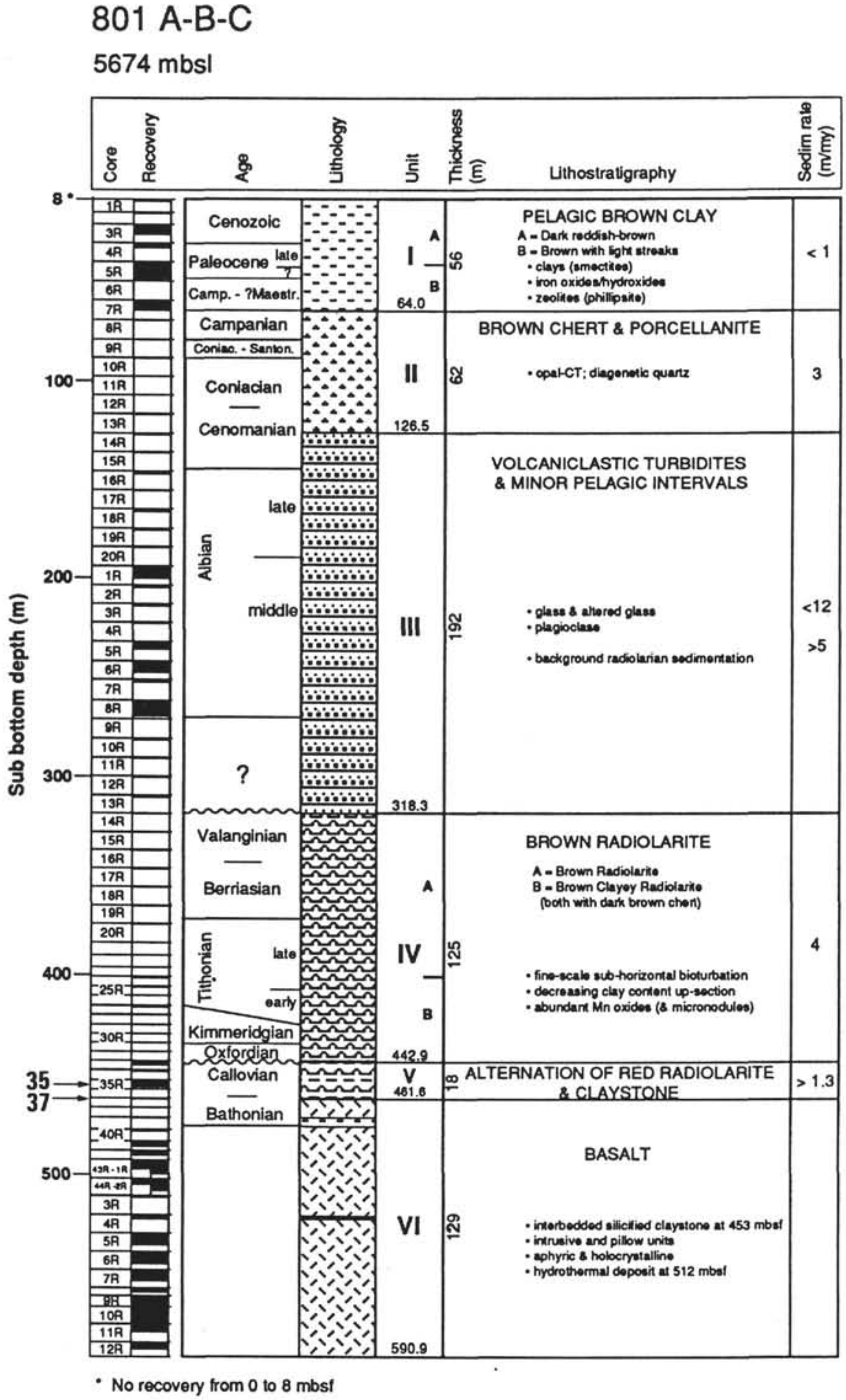

Figure 2. Stratigraphy of Holes 801A, 801B, and 801C. After Lancelot, Larson *et al.* (1990). Arrows with number (37 and 35) indicate the horizons of Sample 129-801B-37R-1, 16-20 cm (37) and 129-801B-35R-3, 24-26 cm (35).

AGE			Baumgartner (1984, 1987)	Matsuoka and Yao (1986)
JURASSIC	Late	Tithonian	C2	*P. primitiva*
		Kimmeridgian	C1	
		Oxfordian	B	*C. carpatica*
			A2	*S.(?) spiralis*
	Middle	Callovian	A1	*T. conexa*
		Bathonian	A0	
		Bajocian		*T. plicarum*

Figure 3. Correlation of Middle-Late Jurassic radiolarian zonation by Matsuoka and Yao (1986) with Baumgartner's (1984, 1987) zonation and age assignment.

Most of the above species have also reported from the central Atlantic (Baumgartner, 1984; Yamamoto *et al.,* 1985) and Mediterranean Tethys regions (*e.g.* Baumgartner, 1984) together with *Gorgansium pulchrum* Kocher, *Guexella nudata* (Kocher), *Parvicingula* (?) *dhimenaensis* Baumgartner, *Stylocapsa oblongula* Kocher and *Theocapsomma cordis* Kocher. However, the occurrence of *Stylocapsa lacrimalis* and *Stylocapsa tecta* is restricted to Japan and sometimes Sikhote Alin of the USSR as far as known.

The western Pacific assemblage is quite different from contemporaneous radiolarian faunas in North America. For example, Alaskan and Oregon faunas of Callovian age (Blome, 1984) are characterized by diverse parvicingulids, whereas the Bathonian/Callovian western Pacific fauna contains no parvicingulids. The Alaskan fauna is regarded as the Boreal one (Pessagno and Blome, 1986).

Therefore, it is concluded that the Bathonian/Callovian radiolarian fauna from the western Pacific is comparable with the Tethyan fauna, and is especially similar to the Japanese fauna.

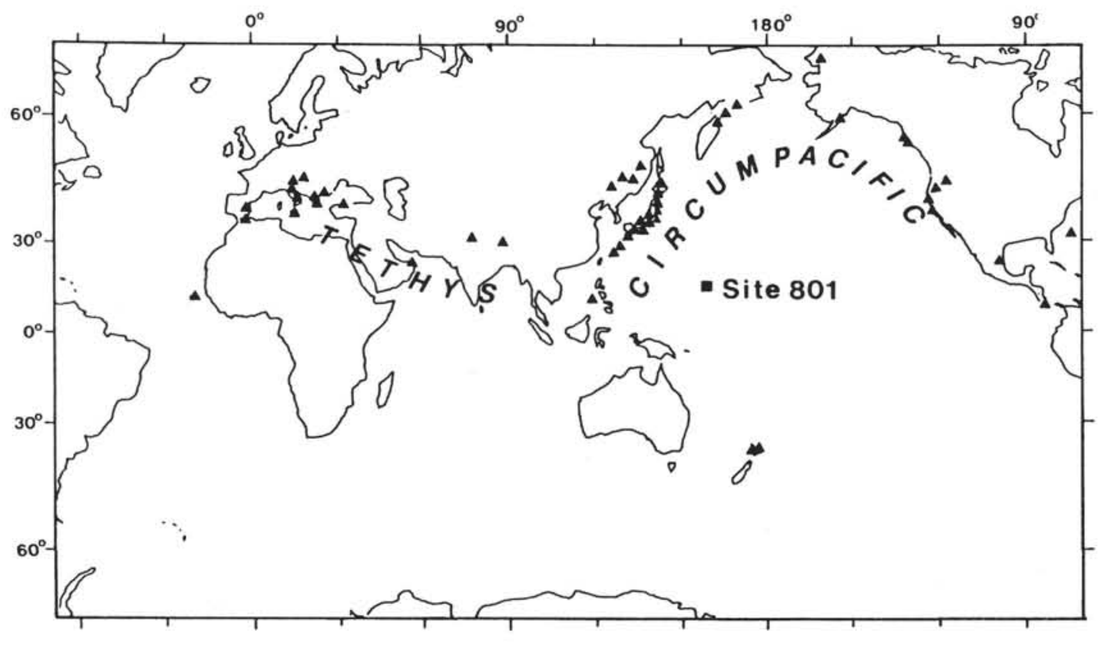

Figure 4. Geographical distribution of Jurassic radiolarians.

Radiolarian Fauna from the Western Pacific

Table 1. Radiolarians from Sample 129-801B-37R-1, 16-20 cm (37) and 129-801B-35R-3, 24-26 cm (35).

RADIOLARIAN SPECIES	SAMPLE 37	SAMPLE 35
NASSELLARIA		
Andromeda sp.	+	
Archaeodictyomitra(?) amabilis Aita	+	
Archaeodictyomitra sp.	+	+
Cyrtocalpis sp.		+
Dictyomitrella(?) kamoensis Mizutani & Kido	+	+
Eucyrtidiellum unumaense (Yao)	+	+
Eucyrtidiellum nodosum Wakita		+
Guexella nudata (Kocher)	+	+
Guexella sp. aff. G. nudata (Kocher)		+
Hsuum brevicostatum (Ozvoldova)		+
Hsuum maxwelli Pessagno	+	
Jacus(?) sp.	+	
Mirifusus sp. cf. M. fragilis Baumgartner		+
Napora sp.	+	+
Parahsuum sp.	+	+
Parvicingula(?) dhimenaensis Baumgartner	+	
Perispyridium sp.		+
Protunuma(?) ochiensis Matsuoka		+
Protunuma sp. cf. P. turbo Matsuoka	+	
Ristola sp.	+	
Ristola(?) sp.	+	+
Saitoum sp.	+	+
Spongocapsula sp.		+
Stichocapsa robusta Matsuoka	+	
Stichocapsa sp.		+
Stylocapsa catenarum Matsuoka		+
Stylocapsa lacrimalis Matsuoka		+
Stylocapsa oblongula Kocher		+
Stylocapsa tecta Matsuoka		+
Syringocapsa sp.	+	
Theocapsomma cordis Kocher		+
Tricolocapsa conexa Matsuoka	+	+
Tricolocapsa sp. aff. T.(?) fusiformis Yao	+	
Tricolocapsa sp.	+	+
Unuma sp.	+	
SPUMELLARIA		
Acanthocircus suboblongus (Yao)	+	
Archaeohagiastrum sp.	+	
Archaeospongoprunum sp.	+	+
Gorgansium pulchrum Kocher		+
Haliodictya(?) hojnosi Riedel & Sanfilippo		+
Haliodictya(?) sp.	+	+
Pantanellium sp.	+	+
Paronaella mulleri Pessagno		+
Praeconocarryoma(?) sp. cf. P.(?) hexacubica Baumgartner	+	
Praeconocaryomma sp.		+

Remarks on Paleobiogeography of Jurassic Radiolarians

Knowledge of Jurassic radiolarians has rapidly accumulated in this decade. Japanese radiolarists have obtained Jurassic radiolarians from many localities throughout Japan (*e.g.* Nakaseko *et al.*, 1983; Yao, 1990). Researchers in the Soviet Union also reported Jurassic radiolarian fossils from the Far East and Koryak regions in the USSR (*e.g.* Tikhomirova, 1988; Vishnevskaya, 1988). European workers showed radiolarian faunas from the central Atlantic, Mediterranean Tethys regions and their eastern extension (*e.g.* Baumgartner, 1984; De Wever *et al.*, 1986). Pessagno and his colleagues have described radiolarian faunas from North America including Alaska, the California Coast Range of the United States, and Queen Charlotte Islands, Canada (*e.g.* Pessagno and Blome, 1982; Pessagno and Whalen, 1982). Recently Jurassic radiolarian assemblages were reported in New Zealand (Spörli *et al.*, 1989), north Palawan of Philippines (Isozaki *et al.*, 1988), Nicoya Complex of Costa Rica (Steinberg, 1988) and southern Tibet of China (Wu, 1988; Yang and Wang, 1990). In spite of extensive research, Jurassic radiolarian faunas are not fully understood yet due to their extremely diverse nature. Thus, it is difficult to establish the paleobiogeography of Jurassic radiolarians, although a preliminary model has been already proposed by Pessagno and Blome (1986).

Fossil localities of Jurassic radiolarians can be categorized into two regions (Figure 4); one is the Circumpacific region including Costa Rica-the North American Cordillera-Alaska-Koryak-Sikhote Alin-Japan-North Palawan-New Zealand and the other is the Tethys region running from the central Atlantic through the Mediterranean Tethys and southern Tibet to Japan. The ODP Site 801 reported here is located at a unique position which is far from both the Circumpacific and Tethys regions mentioned above. Paleomagnetic data show that this site stayed within low latitudes during Jurassic time. The Jurassic radiolarian fauna from this site, partly presented herein, is regarded as representative of low latitude faunas. Further study of this material will provide important data for paleoceanic reconstruction including the Tethys-Pacific connection in Jurassic time.

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Plate 1

All figures are scanning electron micrographs of Bathonian/Callovian radiolarians from Sample 129-801B-37R-1, 16-20 cm. Figs. 7, 11-12, X180; Figs. 2-6, 9-10, 15, X250; Figs. 1, 8, 13-14, X380.

1. *Tricolocapsa* (?) sp. aff. *T.* (?) *fusiformis* Yao
2. *Tricolocapsa* sp.
3. *Tricolocapsa* sp.
4. *Protunuma* sp. cf. *P. turbo* Matsuoka
5. *Archaeodictyomitra* (?) *amabilis* Aita
6. *Dictyomitrella* (?) *kamoensis* Mizutani and Kido
7. *Parvicingula* (?) *dhimenaensis* Baumgartner
8. *Eucyrtidiellum unumaense* (Yao)
9. *Guexella nudata* (Kocher)
10. *Stichocapsa robusta* Matsuoka
11. *Ristola* sp.
12. *Hsuum maxwelli* Pessagno
13. *Tricolocapsa conexa* Matsuoka
14. *Jacus* (?) sp.
15. *Praeconocaryomma* (?) sp. cf. *P.* (?) *hexacubica* Baumgartner

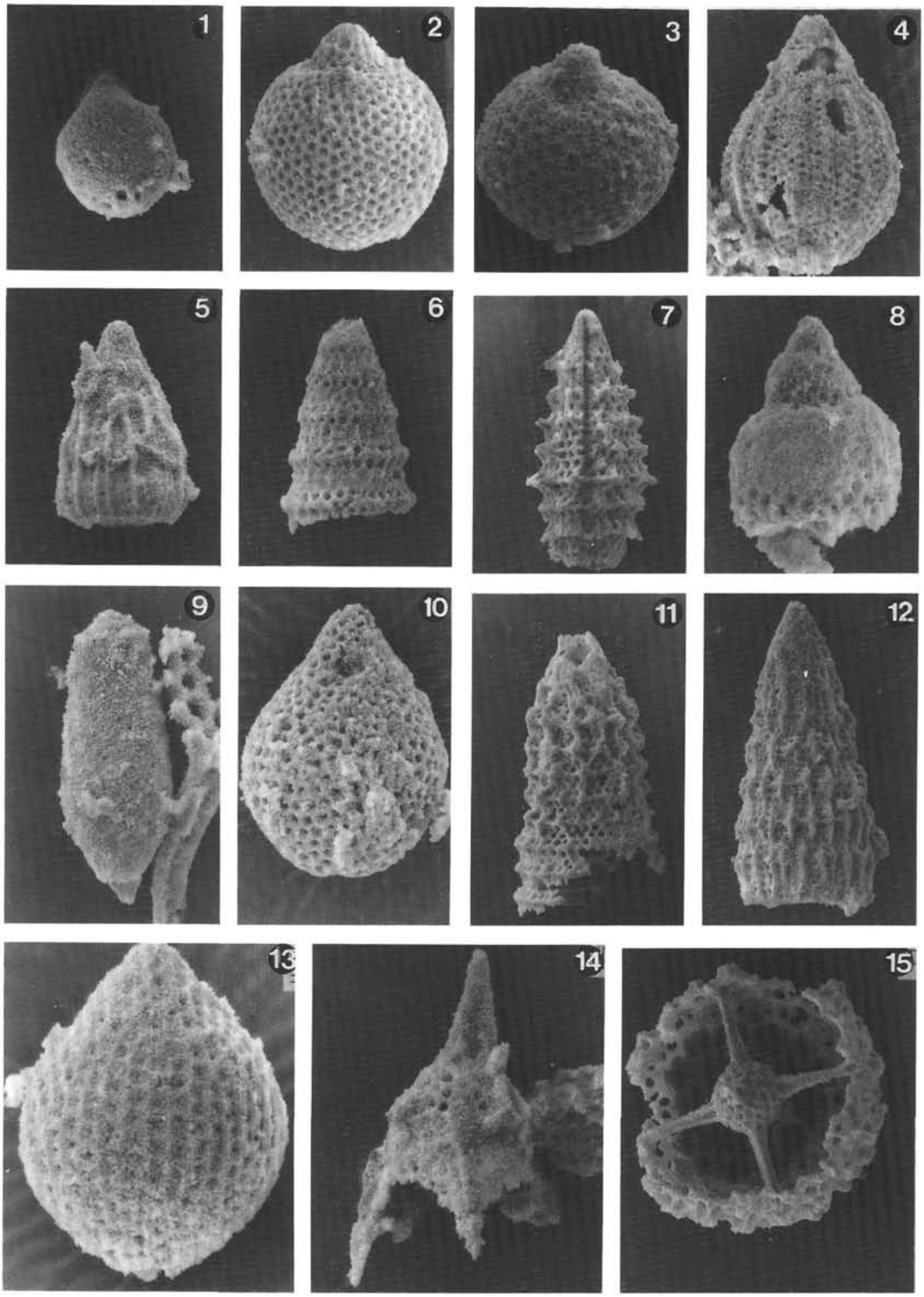
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Plate 2

All figures are scanning electron micrographs of Bathonian/Callovian radiolarians from Sample 129-801B-35R-3, 24-26 cm. Figs. 2, 14-15, X180; figs. 1, 5, 12, X500; figs. 3-4, 6-11, 13, X380.

1. *Stylocapsa oblongula* Kocher
2. *Hsuum brevicostatum* (Ozvoldova)
2. *Theocapsomma cordis* Kocher
4. *Stylocapsa catenarum* Matsuoka
5. *Gorgansium pulchrum* Kocher
6. *Haliodictya* (?) sp.
7. *Eucyrtidiellum unumaense* (Yao)
8. *Eucyrtidiellum nodosum* Wakita
9. *Stylocapsa tecta* Matsuoka
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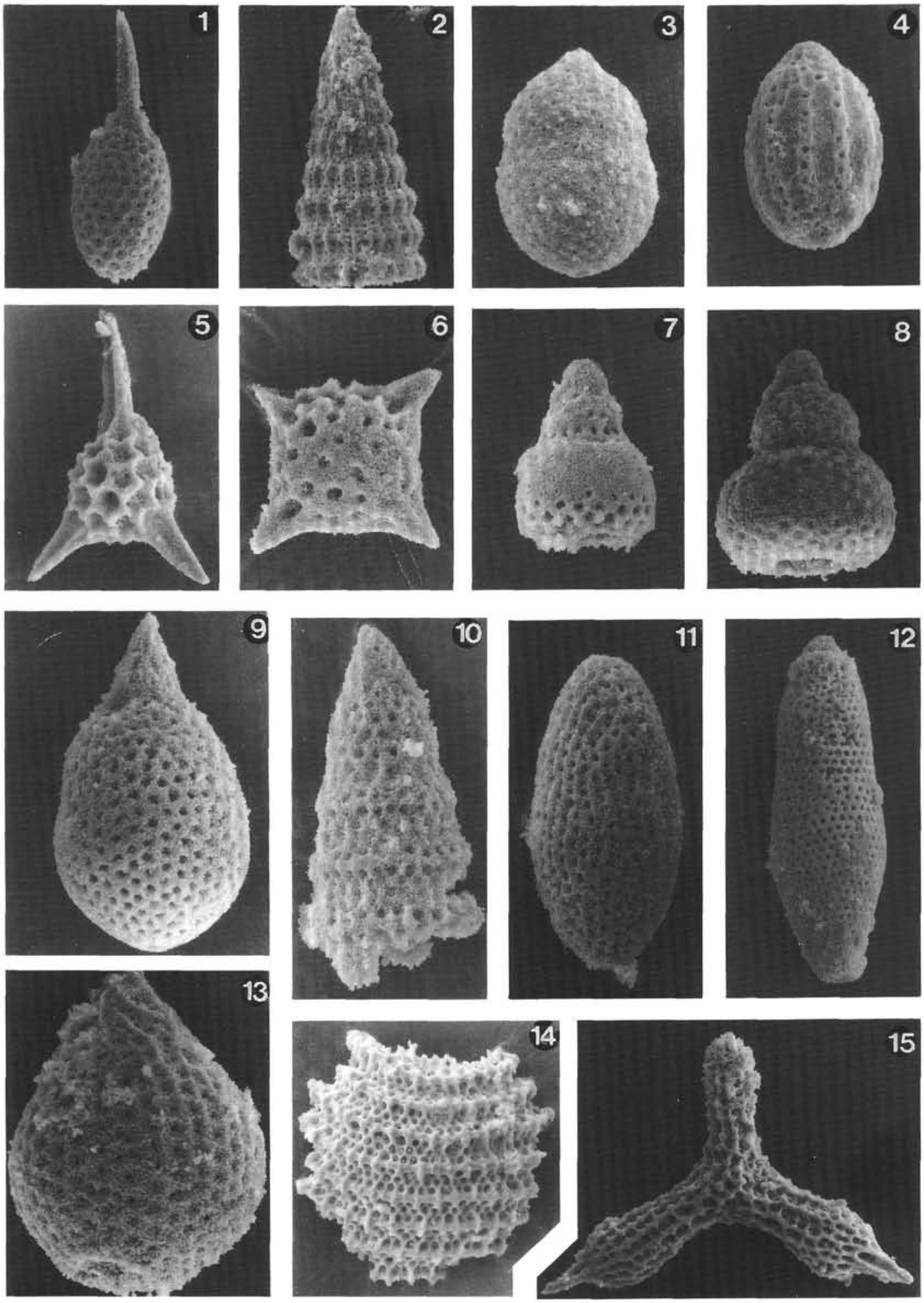
11. *Stichocapsa* sp.
12. *Guexella* sp. aff. *G. nudata* (Kocher)
13. *Tricolocapsa conexa* Matsuoka
14. *Mirifusus* sp. cf. *M. fragilis* Baumgartner
15. *Paronaella mulleri* Pessagno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