

Late Jurassic radiolarian fauna from the Ikenohara Formation of the Kurosegawa Belt in the Toyo - Izumi area, Kumamoto Prefecture, Kyushu, Japan

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Nobuharu Hori, Makoto Saito and Seiichi Toshimitsu (2002) Late Jurassic radiolarian fauna from the Ikenohara Formation of the Kurosegawa Belt in the Toyo - Izumi area, Kumamoto Prefecture, Kyushu, Japan. *Bull. Geol. Surv. Japan*, vol. 53(9/10), p.689-724, 2 figs, 1 Appendix, 12 Plates.

Abstract: Abundant well-preserved radiolarians were obtained from the Kurosegawa Belt in the Toyo - Izumi Area, Kumamoto Prefecture, Kyushu. Radiolarian-bearing rocks were collected from the Upper Jurassic Ikenohara Formation, which is composed mainly of mudstone. The samples GSJ R76489 and GSJ R76490 include 330 and 329 radiolarian species, respectively. The radiolarian faunas of both samples are very similar in composition. Based on the radiolarian zonation of Matsuoka (1995a), the radiolarian fauna represents the *Kilinora spiralis* Zone and is assigned to Oxfordian in age. This radiolarian fauna includes greater numbers of spumellarians and quite differs from radiolarian faunas reported from the Jurassic accretionary complex of Japan. This evidence may imply that the depositional environment of the Ikenohara Formation is different from that of the Jurassic accretionary complex, and the Ikenohara Formation possibly deposited in a trench slope environment.

Keywords: Jurassic, Radiolaria, Ikenohara Formation, Kurosegawa Belt, Tomochi, Kumamoto

1. Introduction

Jurassic system composed mainly of clastic sediments is distributed around Toyo and Izumi Villages, Yatsushiro County, Kumamoto Prefecture. Recently, Nakamura *et al.* (1998) and Miyamoto *et al.* (2001) reported the occurrences of rich radiolarian faunas from the Jurassic in the area including the above two villages. Miyamoto *et al.* (2001) further mentioned the relationship between Middle to Upper Jurassic formation in this area and the Sakamoto Formation distributed south of this area. They pointed out the necessity of quantitative treatment of their radiolarian faunal composition because the lithology and radiolarian age of these two formations are similar. However, they neither listed nor showed the faunal composition, only nassellarian species were described. We tried to recover more spumellarian species than those reported by Nakamura *et al.* (1998) and Miyamoto *et al.* (2001).

The latter two authors of this paper are studying "the geology of the Tomochi district" in the 1: 50,000 mapping project of the Geological Survey of Japan. Through this study, we extracted abundant late Jurassic radiolarians from black mudstones of the Ikenohara Formation exposed at the boundary between Toyo and Izumi Villages. The radiolarian fauna obtained from the Ikenohara Formation is quite different from that in

accretionary complexes of the same age. In this paper, we will report the detailed faunal composition of the obtained radiolarians and discuss their age. We will also propose a brief summary of the depositional environment of the Ikenohara Formation.

2. Geologic framework

The Kurosegawa Belt in the Kyushu Island contains Paleozoic rocks (granitic, metamorphic and ultramafic rocks), Silurian to Cretaceous coherent strata and Jurassic accretionary complexes (Fig. 1). They are bounded by faults. The coherent strata have a synclinorium with an ENE trending axis. In the coherent strata, Permian to Cretaceous strata are composed of the Upper Permian Kuma Formation (Kanmera, 1953), Upper Triassic Miyamadani Formation (Miyamoto *et al.*, 2001), Lower Jurassic "Nishinoiwa Formation" (Miyamoto and Kuwazuru, 1994), Middle Jurassic Bisho Formation (Hirano and Sano, 1977), Upper Jurassic Ikenohara Formation (Yokota and Sano, 1984) and Lower Cretaceous Kawaguchi Formation (Matsumoto and Kanmera, 1949) in ascending order. These formations contact with faults.

The Kuma Formation consists dominantly of sandstone and mudstone with a small amount of conglomerate. The Miyamadani Formation is composed of

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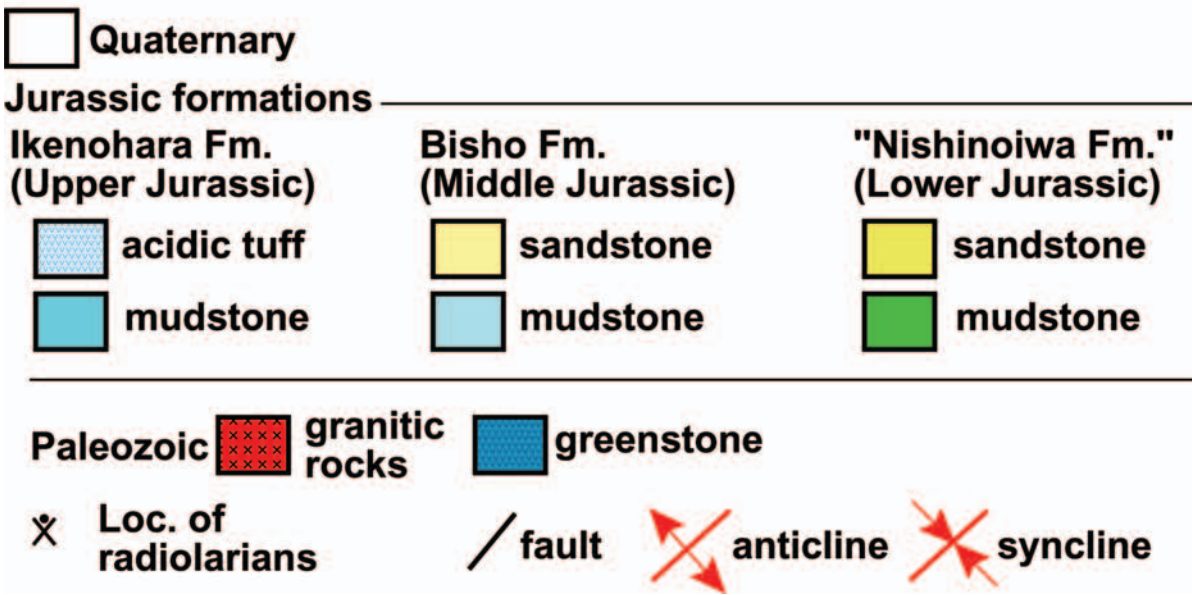
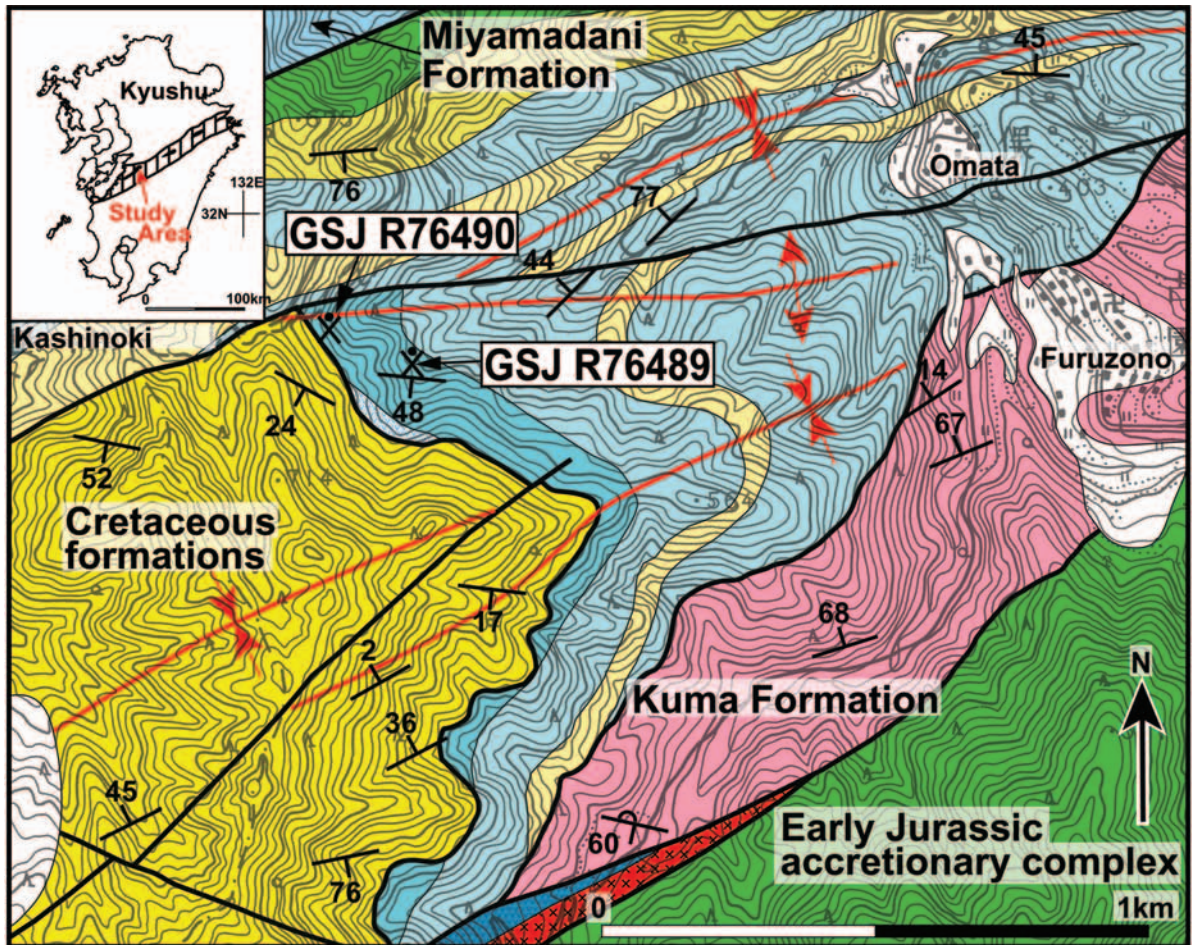


Fig. 1 Index map (upper left) and geologic map of the study area. Hatched and solid black areas of the index map indicate the Chichibu and Kurosegawa Belts, respectively. The base map of the geologic map is adopted from the 1: 25,000 topographic map "Kakizako" published by the Geographical Survey Institute of Japan.

interbedded sandstone and mudstone with sandstone and mudstone. The “Nishinoiwa Formation” is composed of mudstone at the lower part and sandstone at the upper part. The Bisho Formation consists of mudstone that is intercalated with sandstone interbeds. The Ikenohara Formation is composed mainly of mudstone, which is interbedded with acidic tuff at upper part.

Around the studied Toyo - Izumi area, the existence of Middle Jurassic strata was first reported by Sano (1977). Hirano and Sano (1977) called these strata the Bisho Formation. Yokota and Sano (1984) discovered Middle Jurassic radiolarians of the *Unuma echinatus* Assemblage (Yao et al., 1980) from the Bisho Formation and late Jurassic radiolarians. They newly called the Ikenohara Formation for this upper Jurassic strata (Yokota and Sano, 1984). On the other hand, a comprehensive study of the Permian to Jurassic stratigraphy and geologic structure in this area was undertaken by Miyamoto and Kuwazuru (1993). Miyamoto et al. (1997) called the Jurassic strata the Kawamata Group in this area. Recently, Nakamura et al. (1998) and Miyamoto et al. (2001) reported the occurrence of rich radiolarian fauna from this Jurassic strata in the area.

3. Radiolarian fauna of the Ikenohara Formation

Abundant well-preserved radiolarians were obtained from two rock samples (sample numbers GSJ R76489

and GSJ R76490) of black mudstone collected from the upper part of the Ikenohara Formation. In the laboratory, the collected rock samples were soaked in a dilute HF solution (about 5%) for 16 to 24 hours. The samples were sieved through 200#, and the residue was dried with oven. After this procedure, radiolarians were picked up and photographed by a scanning electron microscope (SEM). The radiolarian species from these samples are listed in Appendix 1, and their photomicrographs are presented in Plates 1 to 12.

From the sample GSJ R76489, 36 genera and 174 species of spumellarians are differentiated. About the nassellarians, 37 genera and 156 species were discriminated. They are *Tricolocapsa plicarum* Yao, *Tricolocapsa conexa* Matsuoka, *Kilinora spiralis* Matsuoka, *Transhsuum maxwelli* (Pessagno), *Loopus primitivus* (Matsuoka and Yao) and other nassellarians.

Sample GSJ R76490 includes 35 genera and 168 species of spumellarians with a composition similar to that from sample GSJ R76489. Nassellarians of 33 genera and 161 species are obtained from this sample. They include age diagnostic radiolarians such as *Tricolocapsa plicarum* Yao, *Tricolocapsa conexa* Matsuoka, *Kilinora spiralis* (Matsuoka), *Transhsuum maxwelli* (Pessagno) and *Loopus primitivus* (Matsuoka and Yao).

The radiolarian faunas of both the samples are very similar in their composition. Thus, we will call them the ‘Ikenohara Fauna’ for convenience.

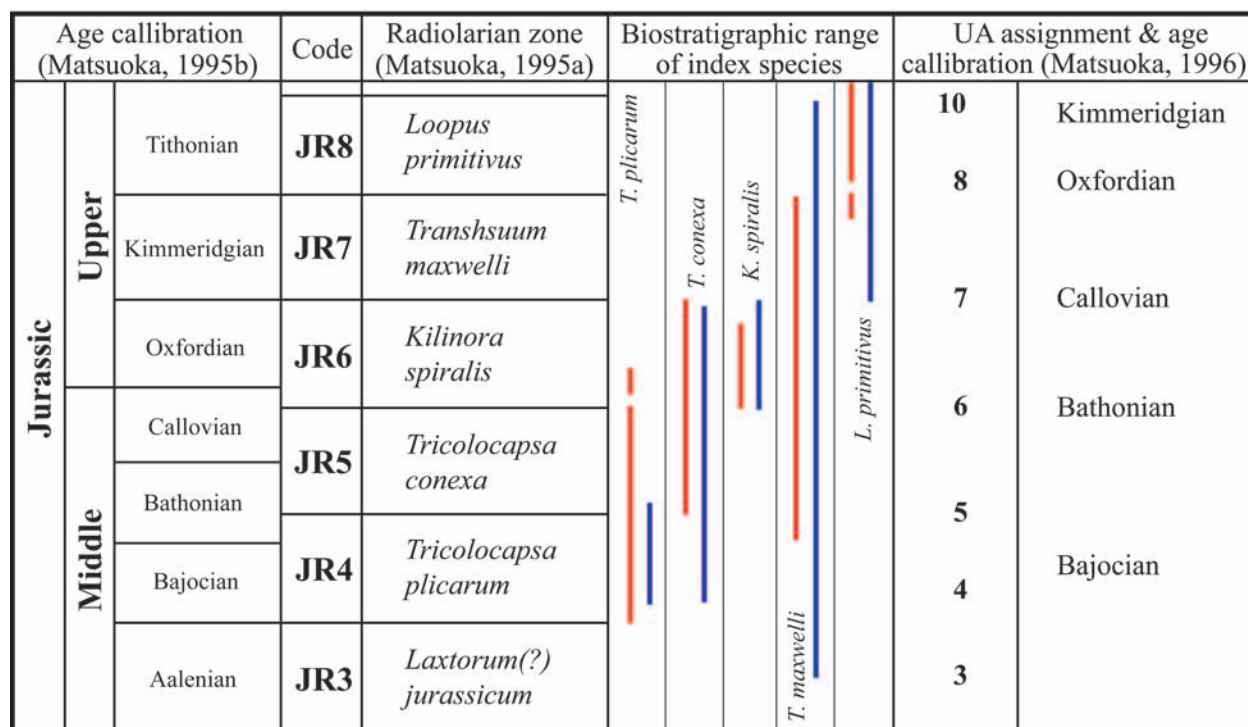


Fig. 2 Radiolarian zonation in Japan and the western Pacific (Matsuoka, 1995a) and its correlation with the UA Zone 95 (Baumgartner et al., 1995b). Correlation of radiolarian zones is after Matsuoka (1996). The biostratigraphic range of each index species based on data from Matsuoka (1995a, b) and Baumgartner et al. (1995a, b) are also shown with red and blue lines, respectively.

4. Discussion

4.1. Radiolarian age determination

Index species for the Japanese Jurassic, especially middle to late Jurassic, were first proposed by Matsuoka and Yao (1986). Matsuoka (1995a, b) revised the radiolarian zonation of Matsuoka and Yao (1986) and presented the biostratigraphical data for the zonation. In the above papers, *Tricolocapsa plicarum* Yao, *Tricolocapsa conexa* Matsuoka, *Kilinora spiralis* (Matsuoka), *Transhsuum maxwelli* (Pessagno) and *Loopus primitivus* (Matsuoka and Yao) were nominated for biostratigraphically important species for age determination.

Radiolarian zones established by Matsuoka (1995a) and their correlation with the UA Zone of Baumgartner *et al.* (1995b) are shown in Fig. 2. *Tricolocapsa plicarum* Yao was described by Yao (1979) from the Mino Terrane, central Japan. Its first occurrence biohorizon (FOB) defines the base of the *Tricolocapsa plicarum* Zone (Matsuoka, 1995a), But its last occurrence biohorizon (LOB) is uncertain. On the contrary, Nishizono *et al.* (1997) investigated the Jurassic radiolarian biostratigraphy in the Chichibu Terrane, western Kyushu. Their range chart shows that *Tricolocapsa plicarum* Yao occurs from the *Tricolocapsa plicarum* Zone to the *Cinguloturris carpatica* Zone (equal to the upper part of the *Kilinora spiralis* Zone of Matsuoka, 1995a). Matsuoka (1995b) also shows the co-occurrence of *Tricolocapsa plicarum* Yao and *Kilinora spiralis* (Matsuoka). Therefore, the LOB of *Tricolocapsa plicarum* Yao can be fixed within the *Kilinora spiralis* Zone or higher.

The FOB and LOB of *Tricolocapsa conexa* Matsuoka, which was described by Matsuoka (1983), define the base of the *Tricolocapsa conexa* Zone and top of the *Kilinora spiralis* Zone, respectively.

The base of the *Kilinora spiralis* Zone is defined by the FOB of *Kilinora spiralis* (Matsuoka). *Tricolocapsa plicarum* Yao, *Tricolocapsa conexa* Matsuoka and *Transhsuum maxwelli* (Pessagno) occur within the *Kilinora spiralis* Zone.

Transhsuum maxwelli (Pessagno) occurs from the *Tricolocapsa plicarum* Zone to the *Transhsuum maxwelli* Zone (Matsuoka, 1995a), and its LOB defines the base of the *Loopus primitivus* Zone. *Loopus primitivus* (Matsuoka and Yao) occurs from the *Transhsuum maxwelli* Zone to the overlying *Loopus primitivus* Zone (Matsuoka, 1995a; Yang and Matsuoka, 1997).

The obtained 'Ikenohara Fauna' yields the above-mentioned species. The co-occurrence of *Tricolocapsa plicarum* Yao, *Tricolocapsa conexa* Matsuoka, *Kilinora spiralis* (Matsuoka) and *Transhsuum maxwelli* (Pessagno) strongly suggests that this fauna is correlative with the *Kilinora spiralis* Zone (Oxfordian). This

fauna actually contains *Loopus primitivus* (Matsuoka and Yao) contrary to Matsuoka's data. Therefore, its FOB maybe is lower within the *Kilinora spiralis* Zone.

In the UA Zone 95, which was established by Baumgartner *et al.* (1995b), the Middle to Late Jurassic is subdivided into 13 radiolarian zones. The range chart of Baumgartner *et al.* (1995b) shows the biostratigraphic ranges of *Tricolocapsa plicarum* Yao, *Tricolocapsa conexa* Matsuoka, *Kilinora spiralis* (Matsuoka), *Transhsuum maxwelli* (Pessagno) and *Loopus primitivus* (Matsuoka and Yao). According to this chart, these species have the following biostratigraphic range (Fig. 2): *Tricolocapsa plicarum* Yao: UA Zones 4-5 (late Bajocian to latest Bajocian-early Bathonian), *Tricolocapsa conexa* Matsuoka: UA Zones 4-7 (late Bajocian to late Bathonian-early Callovian), *Kilinora spiralis* (Matsuoka): UA Zones 6-7 (middle Bathonian to late Bathonian-early Callovian), *Transhsuum maxwelli* (Pessagno): UA Zones 3-10 (early-middle Bajocian to late Oxfordian-early Kimmeridgian) and *Loopus primitivus* (Matsuoka and Yao): and UA Zones 7-12 (late Bathonian-early Callovian to early-early late Tithonian).

Based on the biostratigraphic data of Baumgartner *et al.* (1995b), the co-occurrence of *Tricolocapsa plicarum* Yao, *Tricolocapsa conexa* Matsuoka, *Kilinora spiralis* (Matsuoka) and *Transhsuum maxwelli* (Pessagno) in the 'Ikenohara Fauna' probably suggests that this fauna corresponds to the horizon around the boundary between UA Zones 5 and 6 (early or middle Bathonian).

Matsuoka (1996) pointed out that age assignments of Matsuoka (1995a) and Baumgartner *et al.* (1995b) are quite different. For example, *Kilinora spiralis* Zone, which is considered to be Oxfordian in age (Matsuoka, 1995a), is correlated to UA Zones 6 to 7 (Matsuoka, 1996), on the basis of the range of *Kilinora spiralis* (Matsuoka). Baumgartner *et al.* (1995b) assigned the age of UA Zones 6 to 7 to middle Bathonian to early Callovian (Fig. 2). There is a time gap longer than one stage between the zonation of Matsuoka and Baumgartner (Matsuoka, 1996). Radiolarian biostratigraphy of Matsuoka (1995a) was established by using the data both from sections of surface outcrops in Japan and core samples from the Western Pacific through the Ocean Drilling Program. These materials can be regarded as the sediments in Panthalassa based on the paleogeography and plate motions at that time (e.g. Engebretson *et al.*, 1985; Rowley, 1992). On the other hand, a large amount of basic data of UA Zone 95 came from the Tethyan region. The difference in water mass between Panthalassa and Tethys may influence the FOB or LOB of radiolarian species in both areas. Based on the above-mentioned literatures, our mudstone samples from the Ikenohara Formation can be regarded as deposits under Panthalassa. Therefore, we adopt the zo-

nation of Matsuoka (1995a). As a result, the 'Ikenohara Fauna' indicates Oxfordian (early Late Jurassic) in age.

4.2. Brief comment on the depositional environment of the Ikenohara Formation

Okamura and Matsugi (1986) studied radiolarian fauna from time equivalent formations of the Cretaceous arc-trench system in Shikoku, southwest Japan. Examined radiolarians were collected from the Yamanouchi Formation of intra-arc deposits (Izumi Group), Kajisako Formation of fore-arc deposits ("Sotoizumi" Group) and Shimotsui Formation of accretionary complex (Shimanto Belt). Radiolarian density and diversity increase from the Izumi Group through the "Sotoizumi" Group to the Shimanto Belt (Okamura and Matsugi, 1986). For example, the whole residue obtained by HF treatment of the mudstone of the Izumi Group includes rare individuals of radiolarians; there were about 200. In contrast with the density and diversity, the ratio of spumellarians to nassellarians (S/N) increases from the Shimanto Belt to the Izumi Group (Okamura and Matsugi, 1986).

One of the remarkable characteristics of the 'Ikenohara Fauna' is that the number of spumellarians is greater than that of nassellarian species. It is well known that there are more nassellarians than spumellarians in the radiolarian fauna from fine-grained clastic rocks of Japanese accretionary complexes (e.g. Hori, 1999).

The Middle Jurassic ammonite-bearing Bisho Formation (Sano, 1977), which is considered to conformably underlie the Upper Jurassic Ikenohara Formation, is composed mainly of shallow marine clastic rocks (Toyohara, *et al.* 1998). Therefore, the Ikenohara Formation may have been deposited between shallow marine and trench environments. The S/N obtained from this study and accretionary complexes is different; high S/N in the former, low S/N in the latter. This compositional difference may reflect the difference of the depositional environment. The radiolarian density and S/N of our sample may imply that the black mudstone of the Ikenohara Formation was deposited under a trench slope environment.

5. Conclusion

Well-preserved radiolarians of late Jurassic were obtained from the black mudstone of the Ikenohara Formation, a member of the Kurosegawa Belt, distributed in the Toyo - Izumi area, Kumamoto Prefecture. Based on the radiolarian zonation of Matsuoka (1995a), the age of the obtained radiolarian fauna is assigned to Oxfordian.

On the examined radiolarian fauna, the ratio of spumellarians to nassellarians (S/N) is higher in comparison with S/N in Jurassic accretionary complexes.

From this evidence, it is thought that the depositional environment of the Ikenohara Formation differed from that of Jurassic accretionary complexes.

Acknowledgment

We would like to thank Drs. Chikao Kurimoto and Satoshi Nakae for their valuable suggestions and critical reading of the manuscript.

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* in Japanese with English abstract.

** in Japanese.

難読・重要地名

Kurosegawa: 黒瀬川, Tomochi: 砥用, Toyo: 東陽, Izumi: 泉, Ikenohara: 池原, Bisho: 美生, Yatsushiro: 八代, Omata: 小俣, Furuzono: 古園

Received May 7, 2002

Accepted September 5, 2002

Appendix 1 List of Late Jurassic radiolarians obtained from the Ikenohara Formation. (1)

Species name	GSJ R 76489	GSJ R 76490	Species name	GSJ R 76489	GSJ R 76490
<i>Archaeocenosphaera</i> sp. 1	+	+	<i>Pantanellium</i> sp. 6	+	+
<i>Archaeocenosphaera</i> sp. 2	+		<i>Pantanellium</i> sp. 7		+
<i>Archaeocenosphaera</i> sp. 3	+	+	<i>Pantanellium</i> sp. 8		+
<i>Archaeocenosphaera</i> sp. 4	+		<i>Pantanellium</i> sp. 9		+
<i>Archaeocenosphaera</i> (?) sp. 5	+	+	<i>Pantanellium</i> sp. 10	+	+
<i>Archaeocenosphaera</i> (?) sp. 6	+	+	<i>Pantanellium</i> sp. 11	+	+
<i>Archaeoceansphaera</i> (?) sp. 7	+	+	<i>Pantanellium</i> (?) sp. 12	+	+
<i>Triactoma mexicana</i> Pessagno and Yang	+		<i>Pantanellium</i> (?) sp. 13	+	+
<i>Triactoma</i> sp. 1	+		<i>Gorgansium</i> sp. 1	+	+
<i>Triactoma</i> sp. 2	+	+	<i>Gorgansium</i> sp. 2	+	+
<i>Triactoma</i> sp. 3	+		<i>Gorgansium</i> sp. 3	+	+
<i>Triactoma</i> sp. 4	+		<i>Emiluvia chica</i> Foreman	+	+
<i>Triactoma</i> sp. 5	+	+	<i>Emiluvia</i> aff. <i>chica</i> Foreman	+	+
<i>Triactoma</i> sp. 6		+	<i>Emiluvia orea</i> Baumgartner	+	
<i>Triactoma</i> sp. 7		+	<i>Emiluvia premyogii</i> Baumgartner	+	+
<i>Triactoma</i> sp. 8	+	+	<i>Emiluvia</i> aff. <i>premyogii</i> Baumgartner	+	+
<i>Triactoma</i> (?) sp. 9	+		<i>Emiluvia</i> sp. 1	+	+
<i>Zanola cornuta</i> (Baumgartner)		+	<i>Emiluvia</i> (?) sp. 2	+	+
<i>Praeconosphaera</i> cf. <i>sphaeraconus</i> (Rüst)	+	+	<i>Emiluvia</i> (?) sp. 3	+	
<i>Praeconosphaera</i> sp. 1	+	+	<i>Emiluvia</i> (?) sp. 4	+	+
<i>Praeconosphaera</i> sp. 2	+		<i>Spongurus</i> sp. 1	+	
<i>Acaeniotyle umbilicata</i> Foreman		+	<i>Spongurus</i> sp. 2	+	
<i>Acaeniotyle</i> aff. <i>umbilicata</i> Foreman		+	<i>Archicapsa</i> (?) sp. 1	+	+
<i>Acatea diaphorogona</i> (Foreman)	+	+	<i>Archicapsa</i> (?) sp. 2	+	+
<i>Acatea</i> aff. <i>diaphorogona</i> (Foreman)	+	+	<i>Archicapsa</i> (?) sp. 3	+	+
<i>Novitripus varius</i> Hull	+		<i>Archaeospongoprunum imlayi</i> Pessagno	+	+
<i>Praeconocaryomma</i> sp. 1	+	+	<i>Archaeospongoprunum</i> sp. 1	+	
<i>Praeconocaryomma</i> sp. 2	+	+	<i>Archaeospongoprunum</i> sp. 2	+	+
<i>Praeconocaryomma</i> sp. 3	+		<i>Archaeospongoprunum</i> sp. 3	+	+
<i>Praeconocaryomma</i> sp. 4	+	+	<i>Archaeospongoprunum</i> sp. 4	+	
<i>Praeconocaryomma</i> sp. 5	+	+	<i>Archaeospongoprunum</i> sp. 5	+	+
<i>Praeconocaryomma</i> sp. 6	+	+	<i>Archaeospongoprunum</i> (?) sp. 6	+	+
<i>Praeconocaryomma</i> sp. 7	+	+	<i>Archaeospongoprunum</i> (?) sp. 7	+	+
<i>Praeconocaryomma</i> sp. 8	+	+	<i>Archaeospongoprunum</i> (?) sp. 8	+	+
<i>Praeconocaryomma</i> sp. 9		+	<i>Archaeospongoprunum</i> (?) sp. 9	+	+
<i>Praeconocaryomma</i> (?) sp. 10	+		<i>Archaeospongoprunum</i> (?) sp. 10	+	+
<i>Praeconocaryomma</i> (?) sp. 11	+	+	<i>Acanthocircus suboblongus</i> (Yao)		+
<i>Haliomma</i> (?) sp. 1	+	+	<i>Acanthocircus trizonalis trizonalis</i> (Rüst)	+	
<i>Haliomma</i> (?) sp. 2	+	+	<i>Bernoullius dicera</i> (Baumgartner)	+	+
<i>Haliomma</i> (?) sp. 3	+	+	<i>Bernoullius rectispinus delnortensis</i> Pessagno, Blome and Hull	+	
<i>Haliomma</i> (?) sp. 4	+		<i>Bernoullius</i> sp. 1	+	+
<i>Haliomma</i> (?) sp. 5	+		<i>Bernoullius</i> sp. 2	+	+
<i>Haliomma</i> (?) sp. 6	+		<i>Bernoullius</i> sp. 3	+	+
<i>Trilonche</i> (?) sp. 1	+		<i>Bernoullius</i> sp. 4	+	
<i>Acaeniotylopsis</i> sp. 1	+		<i>Bernoullius</i> (?) sp. 5		+
<i>Staurolonche</i> sp. 1	+	+	<i>Bernoullius</i> (?) sp. 6	+	+
<i>Staurolonche</i> (?) sp. 2	+	+	<i>Spongotripus</i> sp. 1	+	+
<i>Staurolonche</i> (?) sp. 3	+		<i>Spongotripus</i> sp. B of Yao (1997)	+	+
<i>Hexalonche</i> (?) sp. 1	+		<i>Spongotripus</i> sp. 2	+	+
<i>Hexalonche</i> (?) sp. 2		+	<i>Spongotripus</i> sp. 3	+	
<i>Pantanellium riedeli</i> Pessagno	+		<i>Spongotripus</i> sp. 4	+	
<i>Pantanellium</i> sp. 1		+	<i>Spongotripus</i> sp. 5		+
<i>Pantanellium</i> sp. 2	+	+	<i>Spongotripus</i> sp. 6		+
<i>Pantanellium</i> sp. 3	+	+	<i>Spongotripus</i> (?) sp. 7		+
<i>Pantanellium</i> sp. 4	+	+	<i>Spongotripus</i> (?) sp. 8	+	+
<i>Pantanellium</i> sp. 5	+	+			

Appendix 1 List of Late Jurassic radiolarians obtained from the Ikenohara Formation. (2)

Species name	GSJ R 76489	GSJ R 76490	Species name	GSJ R 76489	GSJ R 76490
<i>Spongotropus</i> (?) sp. 9	+	+	<i>Paronaella pygmaea</i> Baumgartner		+
<i>Spongotropus</i> (?) sp. 10	+	+	<i>Paronaella</i> sp. 1	+	
<i>Orbiculiforma monticelloensis</i> Pessagno	+	+	<i>Paronaella</i> sp. 2		+
<i>Orbiculiforma</i> sp. 2	+	+	<i>Paronaella</i> sp. 3	+	+
<i>Orbiculiforma</i> (?) <i>plana</i> Hori	+	+	<i>Paronaella</i> sp. 4		+
<i>Orbiculiforma</i> (?) aff. <i>plana</i> Hori	+	+	<i>Paronaella</i> sp. 5		+
<i>Orbiculiforma</i> sp. 3	+	+	<i>Paronaella</i> sp. 6		+
<i>Orbiculiforma</i> sp. 4	+	+	<i>Deviatus diamphidius diamphidius</i> (Foreman)	+	+
<i>Orbiculiforma</i> (?) sp. 5	+	+	<i>Deviatus diamphidius hipposidericus</i> (Foreman)	+	+
<i>Orbiculiforma</i> (?) sp. 6	+		<i>Deviatus</i> aff. <i>diamphidius hipposidericus</i> (Foreman)	+	+
<i>Orbiculiforma</i> (?) sp. 7	+	+	<i>Higumastra inflata</i> Baumgartner	+	+
<i>Dactylodiscus</i> sp. 1	+	+	<i>Higumastra coronaria</i> Ozvoldova	+	
<i>Dactylodiscus</i> sp. 2	+	+	<i>Higumastra</i> sp. 1	+	+
<i>Spongotrochus</i> sp. 1	+	+	<i>Higumastra</i> sp. 2	+	
<i>Spongotrochus</i> sp. B of Yao (1997)	+	+	<i>Higumastra</i> sp. 3	+	
<i>Spongotrochus</i> sp. 2	+	+	<i>Tetrarabs bulbosa</i> Baumgartner	+	
<i>Bistarkum irazuense</i> (Aita)	+	+	<i>Tetrarabs zealis</i> (Ozvoldova)	+	+
<i>Bistarkum</i> sp. 1	+	+	<i>Tetrarabs</i> sp. 1	+	
<i>Bistarkum</i> sp. 2	+	+	<i>Tetraditryma pseudoplana</i> Baumgartner	+	+
<i>Bistarkum</i> sp. 3	+		<i>Tetraditryma corralitosensis</i> (Pessagno)		+
<i>Bistarkum</i> sp. 4	+		<i>Pseudocrucella</i> sp. A of Baumgartner (1980)	+	+
<i>Bistarkum</i> sp. 5		+	<i>Pseudocrucella</i> sp. C of Baumgartner (1980)	+	+
<i>Bistarkum</i> sp. 6		+	<i>Crucella theokaftensis</i> Baumgartner	+	+
<i>Bistarkum</i> sp. 7		+	<i>Crucella</i> aff. <i>theokaftensis</i> Baumgartner	+	
<i>Bistarkum</i> sp. 8		+	<i>Crucella</i> (?) sp. 1		+
<i>Bistarkum</i> sp. 9	+	+	Hagiastriids gen. et sp. indet. 1	+	+
<i>Homoeoparonaella elegans</i> (Pessagno)	+	+	Hagiastriids gen. et sp. indet. 2	+	
<i>Homoeoparonaella</i> sp. 1	+	+	Hagiastriids gen. et sp. indet. 3	+	
<i>Homoeoparonaella</i> (?) sp. 2	+		Hagiastriids gen. et sp. indet. 4	+	
<i>Monotrabs</i> sp. 1		+	Hagiastriids gen. et sp. indet. 5		+
<i>Tritrabs casmaliaensis</i> (Pessagno)	+	+	Hagiastriids gen. et sp. indet. 6		+
<i>Tritrabs</i> aff. <i>casmaliaensis</i> (Pessagno)		+	<i>Haliodictya</i> (?) <i>hojnosi</i> Riedel and Sanfilippo	+	+
<i>Tritrabs ewingi ewingi</i> (Pessagno)	+		<i>Haliodictya</i> (?) aff. <i>hojnosi</i> Riedel and Sanfilippo	+	+
<i>Tritrabs ewingi worzeli</i> (Pessagno)	+	+	<i>Haliodictya</i> (?) sp. 1	+	+
<i>Tritrabs exotica</i> (Pessagno)	+	+	<i>Phantum insperatum</i> Hull	+	+
<i>Tritrabs</i> aff. <i>exotica</i> (Pessagno)		+	Spumellaria gen. et sp. indet. 1	+	+
<i>Tritrabs rhododactylus</i> Baumgartner	+	+	Spumellaria gen. et sp. indet. 2	+	+
<i>Tritrabs</i> aff. <i>rhododactylus</i> Baumgartner		+	Spumellaria gen. et sp. indet. 3	+	+
<i>Tritrabs</i> sp. 1	+	+	Spumellaria gen. et sp. indet. 4	+	
<i>Tritrabs</i> sp. 2	+	+	Spumellaria gen. et sp. indet. 5	+	+
<i>Tritrabs</i> sp. 3	+	+	Spumellaria gen. et sp. indet. 6		+
<i>Tritrabs</i> sp. 4	+		Spumellaria gen. et sp. indet. 7	+	+
<i>Tritrabs</i> sp. 5	+	+	Spumellaria gen. et sp. indet. 8	+	+
<i>Tritrabs</i> sp. 6		+	Spumellaria gen. et sp. indet. 9	+	+
<i>Tritrabs</i> sp. 7	+	+	Spumellaria gen. et sp. indet. 10	+	+
<i>Tritrabs</i> sp. 8		+	Spumellaria gen. et sp. indet. 11	+	+
<i>Angulobracchia</i> sp. 1	+	+	Spumellaria gen. et sp. indet. 12		+
<i>Angulobracchia</i> sp. 2	+		Spumellaria gen. et sp. indet. 13		+
<i>Angulobracchia</i> sp. 3		+	Spumellaria gen. et sp. indet. 14	+	+
<i>Angulobracchia</i> sp. 4		+	Spumellaria gen. et sp. indet. 15		+
<i>Paronaella bandyi</i> Pessagno		+	<i>Poulpus</i> sp. 1	+	+
<i>Paronaella denudata</i> (Rüst)	+		<i>Saitoum</i> sp. 1		+
<i>Paronaella kotura</i> Baumgartner	+	+	<i>Napora</i> sp. 1	+	+
<i>Paronaella mulleri</i> Pessagno	+	+	<i>Napora</i> sp. 2	+	
<i>Paronaella</i> aff. <i>mulleri</i> Pessagno		+	<i>Napora</i> sp. 3	+	+
<i>Paronaella nipomoensis</i> Hull	+	+	<i>Napora</i> sp. 4	+	

Appendix 1 List of Late Jurassic radiolarians obtained from the Ikenohara Formation. (3)

Species name	GSJ R 76489	GSJ R 76490	Species name	GSJ R 76489	GSJ R 76490
<i>Palinandromeda crassa</i> (Baumgartner)	+		<i>Arcanicapsa</i> sp. 10	+	+
<i>Palinandromeda podobierensis</i> (Ozoldova)	+		<i>Arcanicapsa</i> sp. 11		+
<i>Gongylothorax favosus</i> Dumitrica	+	+	<i>Kilinora spiralis</i> (Matsuoka)	+	+
<i>Gongylothorax</i> sp. 1	+		<i>Kilinora</i> sp. 1		+
<i>Williriedellum carpathicum</i> Dumitrica	+	+	<i>Eucyrtidiellum nodosum</i> Wakita	+	+
<i>Williriedellum crystallinum</i> Dumitrica	+	+	<i>Eucyrtidiellum ptyctum</i> (Riedel and Sanfilippo)	+	+
<i>Williriedellum</i> sp. 1		+	<i>Protunuma japonicus</i> Matsuoka and Yao	+	+
<i>Williriedellum</i> (?) sp. 2		+	<i>Protunuma</i> aff. <i>japonicus</i> Matsuoka and Yao	+	+
<i>Complexapora</i> sp. 1	+	+	<i>Protunuma</i> (?) <i>ochiensis</i> Matsuoka		+
<i>Zhamoidellum ovum</i> Dumitrica	+	+	<i>Protunuma</i> sp. 1		+
<i>Zhamoidellum</i> aff. <i>ovum</i> Dumitrica		+	<i>Syringocapsa</i> sp. 1	+	+
<i>Zhamoidellum</i> sp. 1	+	+	<i>Syringocapsa</i> sp. 2		+
<i>Zhamoidellum</i> sp. 2	+		<i>Syringocapsa</i> sp. C of Yao (1997)	+	+
<i>Zhamoidellum</i> sp. 3	+		<i>Syringocapsa</i> (?) sp. 3		+
<i>Zhamoidellum</i> sp. 4	+	+	<i>Syringocapsa</i> (?) sp. 4		+
<i>Zhamoidellum</i> sp. 5		+	<i>Podobursa spinosa</i> (Ozoldova)	+	
<i>Zhamoidellum</i> (?) sp. 6		+	<i>Podobursa typica</i> (Rüst)	+	+
<i>Tricolocapsa conexa</i> Matsuoka	+	+	<i>Podobursa</i> sp. 1	+	+
<i>Tricolocapsa plicarum</i> Yao	+	+	<i>Podobursa</i> sp. 2		+
<i>Tricolocapsa</i> aff. <i>plicarum</i> Yao	+	+	<i>Podocapsa</i> (?) sp. 1		+
<i>Tricolocapsa</i> (?) sp. 1	+		<i>Thanarla</i> aff. <i>brouweri</i> (Tan)	+	
<i>Tricolocapsa</i> (?) sp. 2		+	<i>Archaeodictyomitra</i> aff. <i>apiarium</i> (Rüst)		+
<i>Tricolocapsa</i> sp. M of Baumgartner et al. (1995a)	+	+	<i>Archaeodictyomitra minoensis</i> (Mizutani)	+	+
<i>Hiscocapsa naradaniensis</i> (Matsuoka)	+	+	<i>Archaeodictyomitra</i> aff. <i>minoensis</i> (Mizutani)		+
<i>Hiscocapsa</i> (?) sp. 1	+		<i>Archaeodictyomitra</i> sp. 1	+	
<i>Hiscocapsa</i> (?) sp. 2	+		<i>Archaeodictyomitra</i> sp. 2	+	+
<i>Hiscocapsa</i> (?) sp. 3		+	<i>Archaeodictyomitra</i> sp. 3	+	+
<i>Hiscocapsa</i> (?) sp. 4		+	<i>Archaeodictyomitra</i> sp. 4	+	+
<i>Tetracapsa</i> sp. 1	+		<i>Archaeodictyomitra</i> sp. 5	+	+
<i>Tetracapsa</i> sp. 2	+	+	<i>Archaeodictyomitra</i> sp. 6	+	+
<i>Tetracapsa</i> sp. 3		+	<i>Archaeodictyomitra</i> sp. 7	+	+
<i>Tetracapsa</i> sp. 4		+	<i>Archaeodictyomitra</i> sp. 8	+	+
<i>Tetracapsa</i> sp. 5	+	+	<i>Archaeodictyomitra</i> sp. 9	+	
<i>Tetracapsa</i> sp. 6		+	<i>Archaeodictyomitra</i> sp. 10	+	+
<i>Tetracapsa</i> sp. 7		+	<i>Archaeodictyomitra</i> sp. 11		+
<i>Tetracapsa</i> sp. 8		+	<i>Archaeodictyomitra</i> (?) sp. 12		+
<i>Tetracapsa</i> sp. 9		+	<i>Canoptum</i> sp. 1	+	
<i>Tetracapsa</i> sp. 10		+	<i>Cinguloturris carpatica</i> Dumitrica	+	+
<i>Tetracapsa</i> (?) sp. 11		+	<i>Cinguloturris</i> aff. <i>carpatica</i> Dumitrica	+	+
<i>Sethocapsa funatoensis</i> Aita	+	+	<i>Dictyomitrella</i> (?) aff. <i>kamoensis</i> Mizutani and Kido	+	+
<i>Sethocapsa</i> aff. <i>funatoensis</i> Aita	+	+	<i>Dictyomitrella</i> (?) sp. 1	+	+
<i>Sethocapsa leiostraca</i> Foreman	+	+	<i>Xitus magnus</i> Baumgartner	+	+
<i>Sethocapsa</i> sp. 1	+	+	<i>Xitus singularis</i> Hull	+	+
<i>Sethocapsa</i> sp. 2	+		<i>Xitus</i> aff. <i>singularis</i> Hull		+
<i>Sethocapsa</i> sp. 3	+		<i>Xitus</i> sp. 1	+	
<i>Sethocapsa</i> sp. 4	+		<i>Xitus</i> sp. 2	+	+
<i>Sethocapsa</i> sp. 5		+	<i>Xitus</i> sp. 3		+
<i>Arcanicapsa</i> sp. 1	+	+	<i>Xitus</i> sp. 4		+
<i>Arcanicapsa</i> sp. 2	+	+	<i>Xitus</i> (?) sp. 5		+
<i>Arcanicapsa</i> sp. 3	+	+	<i>Parvicingula</i> sp. 1	+	+
<i>Arcanicapsa</i> sp. 4	+	+	<i>Parvicingula</i> sp. 2	+	
<i>Arcanicapsa</i> sp. 5	+	+	<i>Parvicingula</i> sp. 3	+	+
<i>Arcanicapsa</i> sp. 6	+		<i>Parvicingula</i> sp. 4	+	
<i>Arcanicapsa</i> sp. 7	+	+	<i>Parvicingula</i> sp. 5	+	
<i>Arcanicapsa</i> sp. 8	+	+	<i>Parvicingula</i> sp. 6	+	
<i>Arcanicapsa</i> sp. 9	+	+	<i>Parvicingula</i> sp. 7	+	

Appendix 1 List of Late Jurassic radiolarians obtained from the Ikenohara Formation. (4)

Species name	GSJ R 76489	GSJ R 76490	Species name	GSJ R 76489	GSJ R 76490
<i>Parvicingula</i> sp. 8	+		<i>Anisicyrtis</i> sp. 1	+	
<i>Parvicingula</i> sp. 9	+		<i>Loopus primitivus</i> (Matsuoka and Yao)	+	+
<i>Parvicingula</i> sp. 10	+		<i>Loopus</i> aff. <i>primitivus</i> (Matsuoka and Yao)	+	+
<i>Parvicingula</i> sp. 11	+		<i>Loopus</i> (?) sp. 1	+	
<i>Parvicingula</i> sp. 12	+		<i>Loopus</i> (?) sp. 2	+	+
<i>Parvicingula</i> sp. 13	+	+	<i>Loopus</i> (?) sp. 3		+
<i>Parvicingula</i> sp. 14	+	+	<i>Loopus</i> (?) sp. 4		+
<i>Parvicingula</i> sp. 15	+		<i>Pseudoeucyrtis</i> sp. J of Baumgartner <i>et al.</i> (1995a)		+
<i>Parvicingula</i> sp. 16	+		<i>Pseudoeucyrtis</i> sp. 1	+	
<i>Parvicingula</i> sp. 17		+	<i>Pseudodictyomitra</i> (?) sp. 1	+	+
<i>Parvicingula</i> sp. 18		+	<i>Pseudodictyomitra</i> (?) sp. 2	+	
<i>Parvicingula</i> sp. 19		+	<i>Pseudodictyomitra</i> (?) sp. 3	+	+
<i>Parvicingula</i> sp. 20		+	<i>Pseudodictyomitra</i> (?) sp. 4		+
<i>Parvicingula</i> (?) sp. 21		+	Multisegmented nassellaria gen. et sp. indet. 1	+	+
<i>Tethysetta dhimenaensis</i> (Baumgartner)	+	+	Multisegmented nassellaria gen. et sp. indet. 2	+	+
<i>Tethysetta mashitaensis</i> (Mizutani)	+	+	Multisegmented nassellaria gen. et sp. indet. 3	+	+
<i>Tethysetta</i> sp. 1		+	Multisegmented nassellaria gen. et sp. indet. 4	+	
<i>Mirifusus chenodes</i> (Renz)	+	+	Multisegmented nassellaria gen. et sp. indet. 5	+	
<i>Mirifusus diana</i> e (Karrer)	+	+	Multisegmented nassellaria gen. et sp. indet. 6	+	+
<i>Mirifusus guadalupensis</i> Pessagno	+		Multisegmented nassellaria gen. et sp. indet. 7	+	
<i>Ristola altissima</i> (Rüst)	+		Multisegmented nassellaria gen. et sp. indet. 8	+	+
<i>Ristola</i> sp. 1	+	+	Multisegmented nassellaria gen. et sp. indet. 9	+	
<i>Ristola</i> sp. 2	+		Multisegmented nassellaria gen. et sp. indet. 10	+	
<i>Ristola</i> sp. 3	+		Multisegmented nassellaria gen. et sp. indet. 11	+	
<i>Parahsuum</i> sp. S of Matsuoka (1986)	+	+	Multisegmented nassellaria gen. et sp. indet. 12	+	
<i>Parahsuum</i> sp. 1	+	+	Multisegmented nassellaria gen. et sp. indet. 13	+	+
<i>Parahsuum</i> sp. 2	+	+	Multisegmented nassellaria gen. et sp. indet. 14	+	
<i>Hsuum</i> sp. 1	+		Multisegmented nassellaria gen. et sp. indet. 15		+
<i>Hsuum</i> sp. 2	+	+	Multisegmented nassellaria gen. et sp. indet. 16		+
<i>Hsuum</i> sp. 3		+	Multisegmented nassellaria gen. et sp. indet. 17		+
<i>Hsuum</i> sp. 4	+	+	Multisegmented nassellaria gen. et sp. indet. 18		+
<i>Hsuum</i> sp. 5		+	Multisegmented nassellaria gen. et sp. indet. 19		+
<i>Hsuum</i> sp. 6		+	Multisegmented nassellaria gen. et sp. indet. 20		+
<i>Transhsuum brevicostatum</i> (Ozoldova)	+	+	Multisegmented nassellaria gen. et sp. indet. 21		+
<i>Transhsuum</i> aff. <i>brevicostatum</i> (Ozoldova)	+		Multisegmented nassellaria gen. et sp. indet. 22		+
<i>Transhsuum maxwelli</i> (Pessagno)	+	+	Multisegmented nassellaria gen. et sp. indet. 23	+	+
<i>Transhsuum</i> sp. 1	+		Multisegmented nassellaria gen. et sp. indet. 24		+
<i>Transhsuum</i> sp. 2	+		Multisegmented nassellaria gen. et sp. indet. 25		+
<i>Transhsuum</i> sp. 3	+	+	Multisegmented nassellaria gen. et sp. indet. 26		+
<i>Perispyridium ordinarium</i> (Pessagno)	+	+	Multisegmented nassellaria gen. et sp. indet. 27	+	+
<i>Perispyridium</i> sp. 1	+		Multisegmented nassellaria gen. et sp. indet. 28		+
<i>Perispyridium</i> sp. 2	+	+	Multisegmented nassellaria gen. et sp. indet. 29		+
<i>Spongocapsula palmerae</i> Pessagno	+	+	Multisegmented nassellaria gen. et sp. indet. 30		+
<i>Spongocapsula perampla</i> (Rüst)	+	+	Multisegmented nassellaria gen. et sp. indet. 31		+
<i>Spongocapsula</i> sp. 1	+		Multisegmented nassellaria gen. et sp. indet. 32		+
<i>Spongocapsula</i> sp. 2	+		Multisegmented nassellaria gen. et sp. indet. 33	+	+
<i>Spongocapsula</i> sp. 3	+	+	Multisegmented nassellaria gen. et sp. indet. 34		+
<i>Spongocapsula</i> sp. 4	+		Nassellaria gen. et sp. indet. 35		+
<i>Spongocapsula</i> sp. 5	+	+	Nassellaria gen. et sp. indet. 36		+
<i>Spongocapsula</i> sp. 6	+		Nassellaria gen. et sp. indet. 37		+
<i>Spongocapsula</i> sp. 7	+				
<i>Spongocapsula</i> sp. 8	+				
<i>Spongocapsula</i> sp. 9	+	+			
<i>Spongocapsula</i> sp. 10	+				
<i>Obesacapsula morroensis</i> Pessagno	+				
<i>Obesacapsula</i> (?) sp. C of Hull (1997)	+				

Plate 1~12

Plate 1

1. *Archaeocenosphaera* sp. 1. IGUT-NH1995, GSJ R76489, scale C.
2. *Archaeocenosphaera* sp. 2. IGUT-NH2350, GSJ R76489, scale A.
3. *Archaeocenosphaera* sp. 3. IGUT-NH2136, GSJ R76489, scale C.
4. *Archaeocenosphaera* sp. 4. IGUT-NH1966, GSJ R76489, scale A.
5. *Archaeocenosphaera* (?) sp. 5. IGUT-NH2462, GSJ R76489, scale C.
6. *Archaeocenosphaera* (?) sp. 6. IGUT-NH2729, GSJ R76489, scale C.
7. *Archaeocenosphaera* (?) sp. 7. GSJ-NH0981, GSJ R76490, scale F.
8. *Triactoma mexicana* Pessagno and Yang. IGUT-NH2278, GSJ R76489, scale A.
9. *Triactoma* sp. 1. IGUT-NH2200, GSJ R76489, scale C.
10. *Triactoma* sp. 2. IGUT-NH2806, GSJ R76489, scale A.
11. *Triactoma* sp. 3. IGUT-NH2581, GSJ R76489, scale C.
12. *Triactoma* sp. 4. IGUT-NH2881, GSJ R76489, scale A.
13. *Triactoma* sp. 5. GSJ-NH0854, GSJ R76490, scale C.
14. *Triactoma* sp. 6. GSJ-NH0902, GSJ R76490, scale B.
15. *Triactoma* sp. 7. GSJ-NH0840, GSJ R76490, scale A.
16. *Triactoma* sp. 8. GSJ-NH0878, GSJ R76490, scale B.
17. *Triactoma* (?) sp. 9. IGUT-NH2515, GSJ R76489, scale C.
18. *Zanora cornuta* (Baumgartner). IGUT-NH3069, GSJ R76490, scale A.
19. *Praeconosphaera* sp. cf. *P. sphaeraconus* (Rüst). IGUT-NH2056, GSJ R76489, scale C.
20. *Praeconosphaera* sp. 1. IGUT-NH1904, GSJ R76489, scale C.
21. *Praeconosphaera* sp. 2. IGUT-NH2494, GSJ R76489, scale C.
22. *Acaeniotyle umbilicata* Foreman. GSJ-NH1086, GSJ R76490, scale B.
23. *Acaeniotyle* aff. *umbilicata* Foreman. IGUT-NH3019, GSJ R76490, scale E.
24. *Acastea diaphorogona* (Foreman). GSJ-NH0767, GSJ R76490, scale C.
25. *Acastea* aff. *diaphorogona* (Foreman). GSJ-NH0913, GSJ R76490, scale F.
26. *Novitripus varius* Hull. IGUT-NH2658, GSJ R76489, scale C.
27. *Praeconocaryomma* sp. 1. IGUT-NH1956, GSJ R76489, scale E.
28. *Praeconocaryomma* sp. 2. IGUT-NH1896, GSJ R76489, scale E.
29. *Praeconocaryomma* sp. 3. IGUT-NH1940, GSJ R76489, scale C.
30. *Praeconocaryomma* sp. 4. GSJ-NH0885, GSJ R76490, scale G.
31. *Praeconocaryomma* sp. 5. IGUT-NH1902, GSJ R76489, scale E.
32. *Praeconocaryomma* sp. 6. GSJ-NH0678, GSJ R76490, scale F.
33. *Praeconocaryomma* sp. 7. GSJ-NH0806, GSJ R76490, scale F.
34. *Praeconocaryomma* sp. 8. GSJ-NH0978, GSJ R76490, scale F.
35. *Praeconocaryomma* sp. 9. GSJ-NH1028, GSJ R76490, scale D.

All scale bars indicate 0.1 mm.

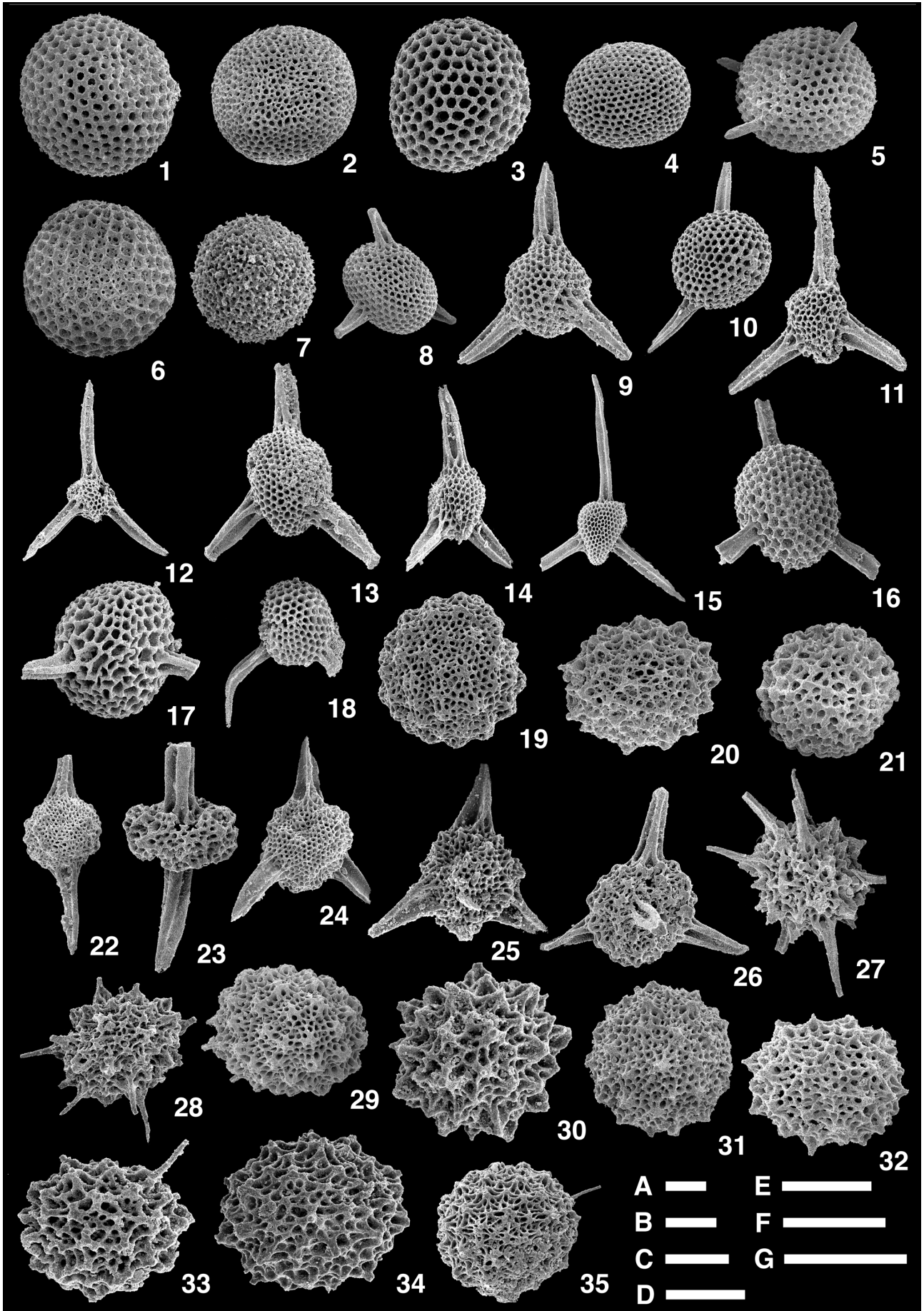


Plate 2

1. *Praeconocaryomma* (?) sp. 10. IGUT-NH2446, GSJ R76489, scale B.
2. *Praeconocaryomma* (?) sp. 11. IGUT-NH2279, GSJ R76489, scale C.
3. *Haliomma* (?) sp. 1. IGUT-NH2201, GSJ R76489, scale D.
4. *Haliomma* (?) sp. 2. IGUT-NH2262, GSJ R76489, scale D.
5. *Haliomma* (?) sp. 3. IGUT-NH2290, GSJ R76489, scale C.
6. *Haliomma* (?) sp. 4. IGUT-NH2406, GSJ R76489, scale C.
7. *Haliomma* (?) sp. 5. IGUT-NH1817, GSJ R76489, scale D.
8. *Haliomma* (?) sp. 6. IGUT-NH2157, GSJ R76489, scale A.
9. *Trilonche* (?) sp. 1. IGUT-NH2088, GSJ R76489, scale B.
10. *Acaeniotylopsis* sp. 1. IGUT-NH2477, GSJ R76489, scale B.
11. *Staurolonche* sp. 1. IGUT-NH2825, GSJ R76489, scale B.
12. *Staurolonche* (?) sp. 2. IGUT-NH2726, GSJ R76489, scale C.
13. *Staurolonche* (?) sp. 3. IGUT-NH2689, GSJ R76489, scale B.
14. *Hexalonche* (?) sp. 1. IGUT-NH2547, GSJ R76489, scale C.
15. *Hexalonche* (?) sp. 2. GSJ-NH1070, GSJ R76490, scale E.
16. *Pantanellium riedeli* Pessagno. IGUT-NH2784, GSJ R76489, scale F.
17. *Pantanellium* sp. 1. GSJ-NH0832, GSJ R76490, scale E.
18. *Pantanellium* sp. 2. IGUT-NH2571, GSJ R76489, scale D.
19. *Pantanellium* sp. 3. IGUT-NH2639, GSJ R76489, scale F.
20. *Pantanellium* sp. 4. GSJ-NH0861, GSJ R76490, scale F.
21. *Pantanellium* sp. 5. GSJ-NH0688, GSJ R76490, scale F.
22. *Pantanellium* sp. 6. IGUT-NH1945, GSJ R76489, scale C.
23. *Pantanellium* sp. 7. GSJ-NH0754, GSJ R76490, scale F.
24. *Pantanellium* sp. 8. GSJ-NH0672, GSJ R76490, scale G.
25. *Pantanellium* sp. 9. GSJ-NH0952, GSJ R76490, scale E.
26. *Pantanellium* sp. 10. GSJ-NH1025, GSJ R76490, scale G.
27. *Pantanellium* sp. 11. GSJ-NH0905, GSJ R76490, scale G.
28. *Pantanellium* (?) sp. 12. GSJ-NH1080, GSJ R76490, scale H.
29. *Pantanellium* (?) sp. 13. GSJ-NH0757, GSJ R76490, scale F.
30. *Gorgansium* sp. 1. IGUT-NH2815, GSJ R76489, scale F.
31. *Gorgansium* sp. 2. IGUT-NH3275, GSJ R76490, scale F.
32. *Gorgansium* sp. 3. GSJ-NH0824, GSJ R76490, scale F.
33. *Emiluvia chica* Foreman. IGUT-NH2561, GSJ R76489, scale C.
34. *Emiluvia* aff. *chica* Foreman. GSJ-NH0909, GSJ R76490, scale B.
35. *Emiluvia orea* Baumgartner. IGUT-NH1929, GSJ R76489, scale C.

All scale bars indicate 0.1 mm.

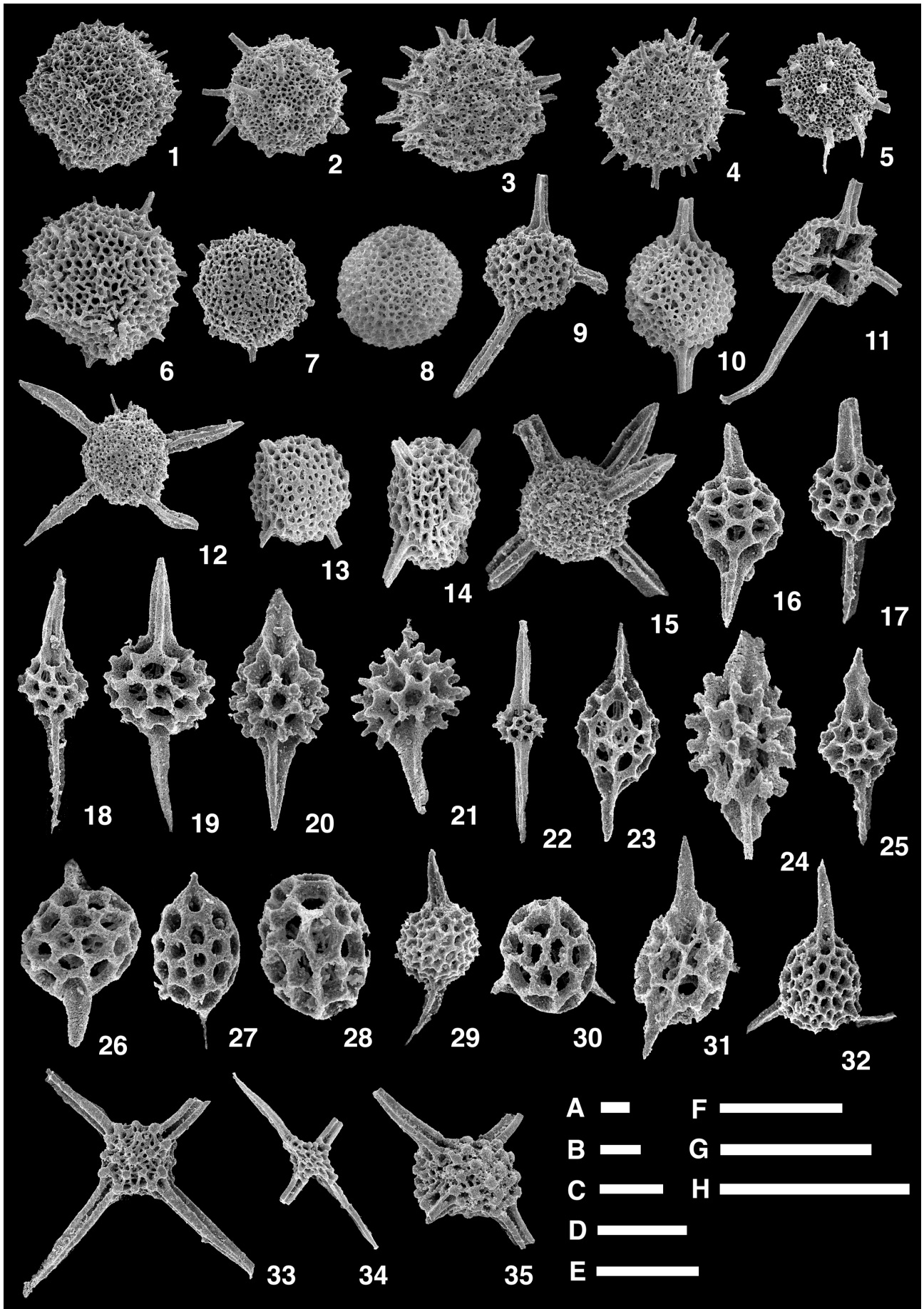


Plate 3

1. *Emiluvia premyogii* Baumgartner. IGUT-NH2344, GSJ R76489, scale D.
2. *Emiluvia* aff. *premyogii* Baumgartner. IGUT-NH3029, GSJ R76490, scale A.
3. *Emiluvia* sp. 1. IGUT-NH2314, GSJ R76489, scale A.
4. *Emiluvia* (?) sp. 2. IGUT-NH2004, GSJ R76489, scale B.
5. *Emiluvia* (?) sp. 3. IGUT-NH2260, GSJ R76489, scale A.
6. *Emiluvia* (?) sp. 4. GSJ-NH1041, GSJ R76490, scale C.
7. *Spongurus* sp. 1. IGUT-NH2338, GSJ R76489, scale B.
8. *Spongurus* sp. 2. IGUT-NH1840, GSJ R76489, scale B.
9. *Archicapsa* (?) sp. 1. GSJ-NH0777, GSJ R76490, scale E.
10. *Archicapsa* (?) sp. 2. GSJ-NH1084, GSJ R76490, scale E.
11. *Archicapsa* (?) sp. 3. GSJ-NH0788, GSJ R76490, scale E.
12. *Archaeospongoprunum imlayi* Pessagno. IGUT-NH2754, GSJ R76489, scale B.
13. *Archaeospongoprunum* sp. 1. IGUT-NH2762, GSJ R76489, scale B.
14. *Archaeospongoprunum* sp. 2. IGUT-NH2267, GSJ R76489, scale B.
15. *Archaeospongoprunum* sp. 3. IGUT-NH1907, GSJ R76489, scale B.
16. *Archaeospongoprunum* sp. 4. IGUT-NH2291, GSJ R76489, scale B.
17. *Archaeospongoprunum* (?) sp. 5. IGUT-NH2013, GSJ R76489, scale D.
18. *Archaeospongoprunum* (?) sp. 6. IGUT-NH2217, GSJ R76489, scale D.
19. *Archaeospongoprunum* (?) sp. 7. IGUT-NH3264, GSJ R76490, scale B.
20. *Archaeospongoprunum* (?) sp. 8. GSJ-NH0982, GSJ R76490, scale B.
21. *Archaeospongoprunum* (?) sp. 9. GSJ-NH0848, GSJ R76490, scale C.
22. *Archaeospongoprunum* (?) sp. 10. GSJ-NH0929, GSJ R76490, scale C.
23. *Acanthocircus suboblongus* (Yao). IGUT-NH3159, GSJ R76490, scale B.
24. *Acanthocircus trizonalis trizonalis* (Rüst). IGUT-NH1802, GSJ R76489, scale B.
25. *Bernoullius dicera* (Baumgartner). IGUT-NH2679, GSJ R76489, scale B.
26. *Bernoullius rectispinus delnortensis* Pessagno, Blome and Hull. IGUT-NH2315, GSJ R76489, scale D.
27. *Bernoullius* sp. 1. IGUT-NH2424, GSJ R76489, scale B.
28. *Bernoullius* sp. 2. IGUT-NH2676, GSJ R76489, scale D.
29. *Bernoullius* sp. 3. IGUT-NH2904, GSJ R76489, scale B.
30. *Bernoullius* sp. 4. IGUT-NH1998, GSJ R76489, scale D.
31. *Bernoullius* (?) sp. 5. GSJ-NH0828, GSJ R76490, scale E.
32. *Bernoullius* (?) sp. 6. IGUT-NH3203, GSJ R76490, scale D.
33. *Spongotropis* sp. B of Yao (1997). IGUT-NH2712, GSJ R76489, scale D.
34. *Spongotropis* sp. 1. IGUT-NH2442, GSJ R76489, scale B.
35. *Spongotropis* sp. 2. IGUT-NH2175, GSJ R76489, scale B.

All scale bars indicate 0.1 mm.

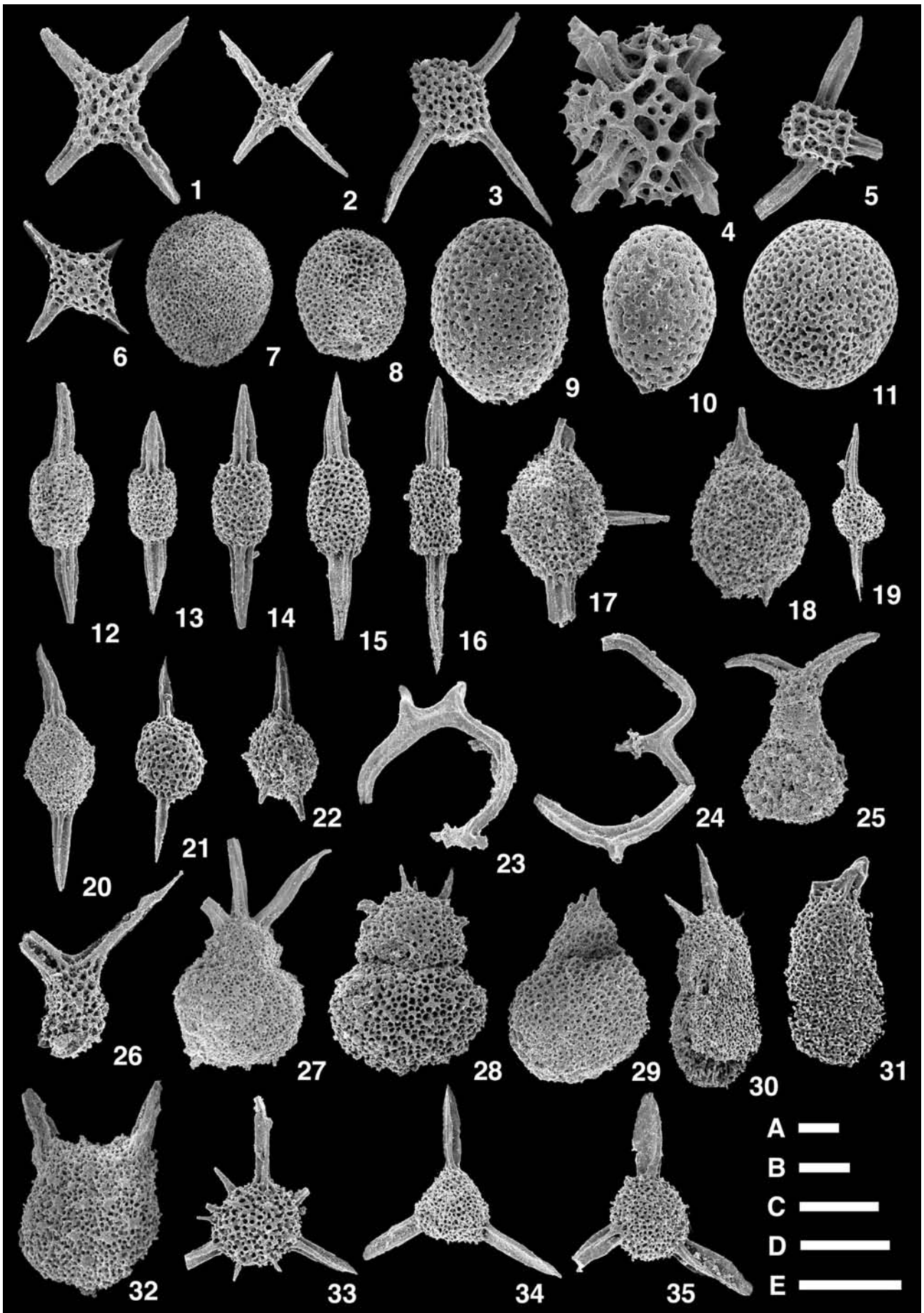


Plate 4

1. *Spongotripus* sp. 3. IGUT-NH1847, GSJ R76489, scale E.
2. *Spongotripus* sp. 4. IGUT-NH2800, GSJ R76489, scale C.
3. *Spongotripus* sp. 5. IGUT-NH3147, GSJ R76490, scale C.
4. *Spongotripus* sp. 6. IGUT-NH3239, GSJ R76490, scale E.
5. *Spongotripus* (?) sp. 7. IGUT-NH3284, GSJ R76490, scale C.
6. *Spongotripus* (?) sp. 8. GSJ-NH0695, GSJ R76490, scale D.
7. *Spongotripus* (?) sp. 9. GSJ-NH0825, GSJ R76490, scale D.
8. *Spongotripus* (?) sp. 10. GSJ-NH0882, GSJ R76490, scale G.
9. *Orbiculiforma* (?) *plana* Hori. IGUT-NH2700, GSJ R76489, scale C.
10. *Orbiculiforma* (?) aff. *plana* Hori. IGUT-NH1991, GSJ R76489, scale E.
11. *Orbiculiforma monticelloensis* Pessagno. IGUT-NH2483, GSJ R76489, scale C.
12. *Orbiculiforma* sp. 2. IGUT-NH2617, GSJ R76489, scale C.
13. *Orbiculiforma* sp. 3. IGUT-NH3084, GSJ R76490, scale C.
14. *Orbiculiforma* sp. 4. IGUT-NH3197, GSJ R76490, scale A.
15. *Orbiculiforma* (?) sp. 5. IGUT-NH1856, GSJ R76489, scale C.
16. *Orbiculiforma* (?) sp. 6. IGUT-NH2775, GSJ R76489, scale C.
17. *Orbiculiforma* (?) sp. 7. GSJ-NH1095, GSJ R76490, scale F.
18. *Dactyliodiscus* sp. 1. IGUT-NH2298, GSJ R76489, scale C.
19. *Dactyliodiscus* sp. 2. IGUT-NH2277, GSJ R76489, scale C.
20. *Spongotrochus* sp. B of Yao (1997). IGUT-NH2552, GSJ R76489, scale E.
21. *Spongotrochus* sp. 1. IGUT-NH2678, GSJ R76489, scale E.
22. *Spongotrochus* sp. 2. GSJ-NH1113, GSJ R76490, scale D.
23. *Bistarkum irazuense* (Aita). IGUT-NH1805, GSJ R76489, scale C.
24. *Bistarkum* sp. 1. IGUT-NH2326, GSJ R76489, scale A.
25. *Bistarkum* sp. 2. GSJ-NH0899, GSJ R76490, scale D.
26. *Bistarkum* sp. 3. IGUT-NH2751, GSJ R76489, scale A.
27. *Bistarkum* sp. 4. IGUT-NH1846, GSJ R76489, scale A.
28. *Bistarkum* sp. 5. GSJ-NH1146, GSJ R76490, scale F.
29. *Bistarkum* sp. 6. GSJ-NH0882, GSJ R76490, scale B.
30. *Bistarkum* sp. 7. GSJ-NH0668, GSJ R76490, scale G.
31. *Bistarkum* sp. 8. GSJ-NH0879, GSJ R76490, scale C.
32. *Bistarkum* sp. 9. GSJ-NH0749, GSJ R76490, scale C.
33. *Homoeoparonaella elegans* (Pessagno). GSJ-NH0699, GSJ R76490, scale A.
34. *Homoeoparonaella* sp. 1. IGUT-NH2876, GSJ R76489, scale C.
35. *Homoeoparonaella* sp. 1. GSJ-NH0815, GSJ R76490, scale B.
36. *Homoeoparonaella* (?) sp. 2. IGUT-NH2361, GSJ R76489, scale C.

All scale bars indicate 0.1 mm.

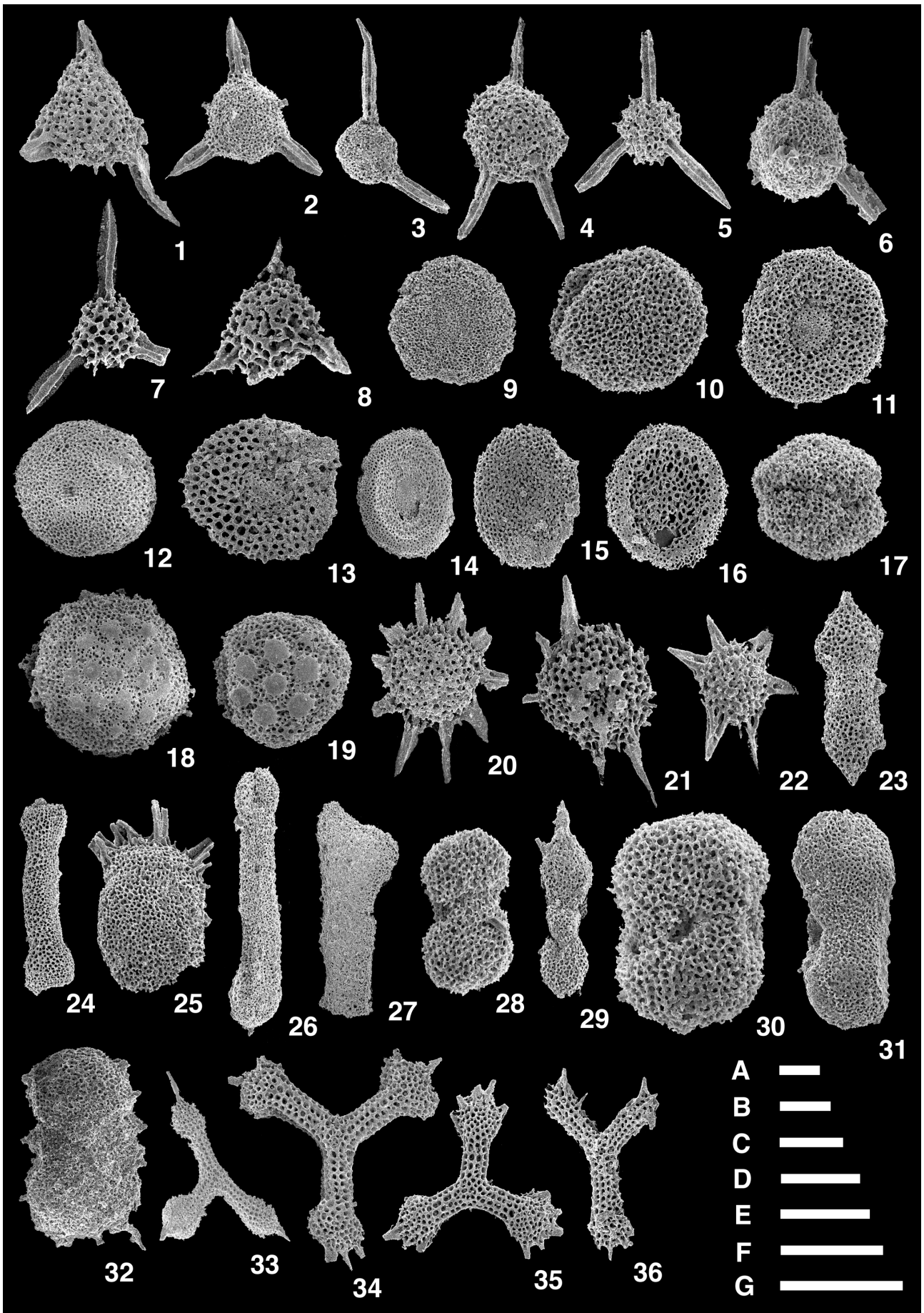


Plate 5

1. *Monotrabs* sp. 1. GSJ-NH0708, GSJ R76490, scale B.
2. *Tritrabs casmaliaensis* (Pessagno). IGUT-NH2479, GSJ R76489, scale B.
3. *Tritrabs* aff. *casmaliaensis* (Pessagno). IGUT-NH3295, GSJ R76490, scale D.
4. *Tritrabs ewingi ewingi* (Pessagno). IGUT-NH2321, GSJ R76489, scale A.
5. *Tritrabs ewingi worzeli* (Pessagno). IGUT-NH2573, GSJ R76489, scale B.
6. *Tritrabs exotica* (Pessagno). GSJ-NH0937, GSJ R76490, scale C.
7. *Tritrabs* aff. *exotica* (Pessagno). IGUT-NH3033, GSJ R76490, scale B.
8. *Tritrabs rhododactylus* Baumgartner. IGUT-NH2190, GSJ R76489, scale D.
9. *Tritrabs* aff. *rhododactylus* Baumgartner. GSJ-NH0960, GSJ R76490, scale C.
10. *Tritrabs* sp. 1. IGUT-NH2302, GSJ R76489, scale D.
11. *Tritrabs* sp. 2. IGUT-NH2460, GSJ R76489, scale D.
12. *Tritrabs* sp. 3. IGUT-NH2082, GSJ R76489, scale D.
13. *Tritrabs* sp. 4. IGUT-NH2008, GSJ R76489, scale F.
14. *Tritrabs* sp. 5. IGUT-NH2852, GSJ R76489, scale D.
15. *Tritrabs* sp. 6. IGUT-NH2979, GSJ R76490, scale D.
16. *Tritrabs* sp. 7. GSJ-NH0833, GSJ R76490, scale C.
17. *Tritrabs* sp. 8. IGUT-NH3071, GSJ R76490, scale D.
18. *Angulobraccia* sp. 1. IGUT-NH2294, GSJ R76489, scale B.
19. *Angulobraccia* sp. 2. IGUT-NH2399, GSJ R76489, scale B.
20. *Angulobraccia* sp. 3. IGUT-NH3210, GSJ R76490, scale D.
21. *Angulobraccia* sp. 4. GSJ-NH0941, GSJ R76490, scale C.
22. *Paronaella bandyi* Pessagno. IGUT-NH3100, GSJ R76490, scale D.
23. *Paronaella denudata* (Rüst). IGUT-NH2715, GSJ R76489, scale D.
24. *Paronaella kotura* Baumgartner. IGUT-NH2124, GSJ R76489, scale B.
25. *Paronaella mulleri* Pessagno. IGUT-NH2390, GSJ R76489, scale D.
26. *Paronaella* aff. *mulleri* Pessagno. GSJ-NH0746, GSJ R76490, scale C.
27. *Paronaella nipomoensis* Hull. IGUT-NH2866, GSJ R76489, scale D.
28. *Paronaella pygmaea* Baumgartner. GSJ-NH1130, GSJ R76490, scale E.
29. *Paronaella* sp. 1. IGUT-NH2259, GSJ R76489, scale A.
30. *Paronaella* sp. 2. IGUT-NH2982, GSJ R76490, scale F.
31. *Paronaella* sp. 3. GSJ-NH0963, GSJ R76490, scale E.
32. *Paronaella* sp. 4. IGUT-NH3272, GSJ R76490, scale F.
33. *Paronaella* sp. 5. GSJ-NH0948, GSJ R76490, scale B.
34. *Paronaella* sp. 6. GSJ-NH0783, GSJ R76490, scale D.
35. *Devitatus diamphidius diamphidius* (Foreman). GSJ-NH0821, GSJ R76490, scale E.

All scale bars indicate 0.1 mm.

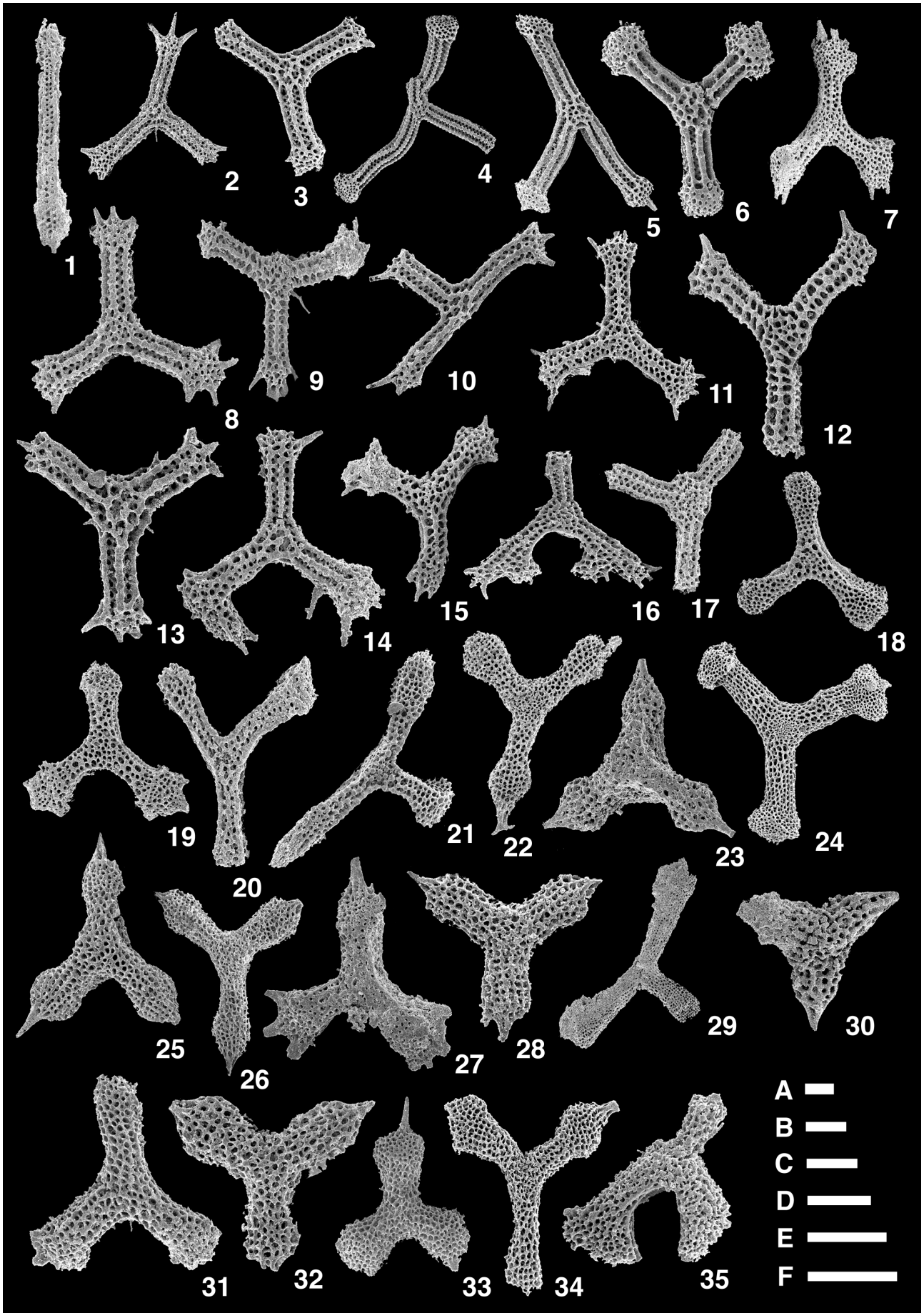


Plate 6

1. *Deviatus diamphidius hipposidericus* (Foreman). GSJ-NH1152, GSJ R76490, scale F.
2. *Deviatus* aff. *diamphidius hipposidericus* (Foreman). GSJ-NH0901, GSJ R76490, scale D.
3. *Higumastra inflata* Baumgartner. GSJ-NH1128, GSJ R76490, scale C.
4. *Higumastra coronaria* Ozvoldova. IGUT-NH2244, GSJ R76489, scale B.
5. *Higumastra* sp. 1. IGUT-NH2195, GSJ R76489, scale E.
6. *Higumastra* sp. 2. IGUT-NH2914, GSJ R76489, scale G.
7. *Higumastra* sp. 3. IGUT-NH2778, GSJ R76489, scale E.
8. *Tetratrabs bulbosa* Baumgartner. IGUT-NH2670, scale A.
9. *Tetratrabs zealis* (Ozvoldova). IGUT-NH2814, GSJ R76489, scale B.
10. *Tetratrabs* sp. 1. IGUT-NH2864, GSJ R76489, scale E.
11. *Tetraditryma pseudoplena* Baumgartner. IGUT-NH2492, GSJ R76489, scale E.
12. *Tetraditryma corralitosensis* (Pessagno). GSJ-NH0765, GSJ R76490, scale E.
13. *Pseudocrucella* sp. A of Baumgartner (1980). IGUT-NH2123, GSJ R76489, scale C.
14. *Pseudocrucella* sp. C of Baumgartner (1980). IGUT-NH2582, GSJ R76489, scale E.
15. *Crucella theokaftensis* Baumgartner. IGUT-NH2882, GSJ R76489, scale E.
16. *Crucella* aff. *theokaftensis* Baumgartner. IGUT-NH2473, GSJ R76489, scale E.
17. *Crucella* (?) sp. 1. IGUT-NH3046, GSJ R76490, scale G.
18. Hagiastriids gen. et sp. indet. 1. GSJ-NH1075, GSJ R76490, scale E.
19. Hagiastriids gen. et sp. indet. 2. IGUT-NH2735, GSJ R76489, scale E.
20. Hagiastriids gen. et sp. indet. 3. IGUT-NH2694, GSJ R76489, scale C.
21. Hagiastriids gen. et sp. indet. 4. IGUT-NH2655, GSJ R76489, scale E.
22. Hagiastriids gen. et sp. indet. 5. GSJ-NH0750, GSJ R76490, scale F.
23. Hagiastriids gen. et sp. indet. 6. GSJ-NH0769, GSJ R76490, scale H.
24. *Haliodictya* (?) *hojnosi* Riedel and Sanfilippo. IGUT-NH3274, GSJ R76490, scale G.
25. *Haliodictya* (?) aff. *hojnosi* Riedel and Sanfilippo. GSJ-NH0954, GSJ R76490, scale H.
26. *Haliodictya* (?) sp. 1. GSJ-NH0907, GSJ R76490, scale H.
27. *Phantum insperatum* Hull. IGUT-NH2867, GSJ R76489, scale G.
28. Spumellaria gen. et sp. indet. 1. IGUT-NH2759, GSJ R76489, scale G.
29. Spumellaria gen. et sp. indet. 2. IGUT-NH2176, GSJ R76489, scale E.
30. Spumellaria gen. et sp. indet. 3. IGUT-NH2023, GSJ R76489, scale G.
31. Spumellaria gen. et sp. indet. 4. IGUT-NH2045, GSJ R76489, scale E.
32. Spumellaria gen. et sp. indet. 5. IGUT-NH1828, GSJ R76489, scale E.
33. Spumellaria gen. et sp. indet. 6. IGUT-NH3051, GSJ R76490, scale E.
34. Spumellaria gen. et sp. indet. 7. GSJ-NH1055, GSJ R76490, scale H.
35. Spumellaria gen. et sp. indet. 8. IGUT-NH3228, GSJ R76490, scale G.
36. Spumellaria gen. et sp. indet. 9. GSJ-NH0865, GSJ R76490, scale I.

All scale bars indicate 0.1 mm.

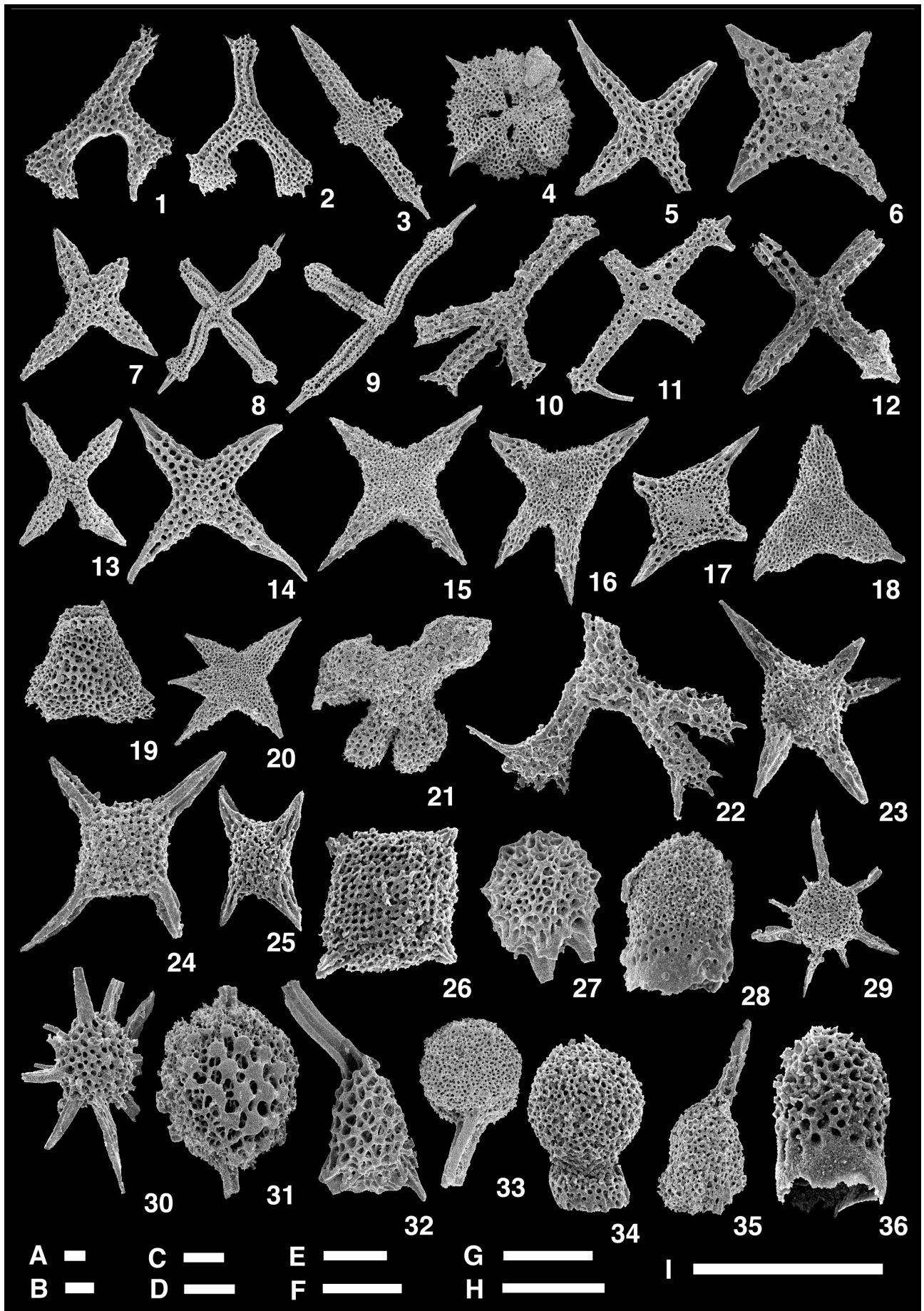


Plate 7

1. *Spumellaria* gen. et sp. indet. 10. GSJ-NH0916, GSJ R76490, scale F.
2. *Spumellaria* gen. et sp. indet. 11. GSJ-NH1043, GSJ R76490, scale F.
3. *Spumellaria* gen. et sp. indet. 12. GSJ-NH0795, GSJ R76490, scale D.
4. *Spumellaria* gen. et sp. indet. 13. GSJ-NH1081, GSJ R76490, scale H.
5. *Spumellaria* gen. et sp. indet. 14. GSJ-NH0712, GSJ R76490, scale G.
6. *Spumellaria* gen. et sp. indet. 15. GSJ-NH1087, GSJ R76490, scale F.
7. *Poulpus* sp. 1. GSJ-NH0761, GSJ R76490, scale F.
8. *Saitoum* sp. 1. IGUT-NH3271, GSJ R76490, scale E.
9. *Napora* sp. 1. IGUT-NH2373, GSJ R76489, scale C.
10. *Napora* sp. 2. IGUT-NH2799, GSJ R76489, scale C.
11. *Napora* sp. 3. GSJ-NH0938, GSJ R76490, scale B.
12. *Napora* sp. 4. IGUT-NH2426, GSJ R76489, scale E.
13. *Palinandromeda crassa* (Baumgartner). IGUT-NH2461, GSJ R76489, scale A.
14. *Palinandromeda podobierensis* (Ozvodova). IGUT-NH2851, GSJ R76489, scale C.
15. *Gongylothorax favosus* Dumitrica. GSJ-NH1094, GSJ R76490, scale G.
16. *Gongylothorax* sp. 1. IGUT-NH2040, GSJ R76489, scale E.
17. *Gongylothorax* sp. 1. GSJ-NH1147, GSJ R76490, scale F.
18. *Williriedellum carpathicum* Dumitrica. GSJ-NH0664, GSJ R76490, scale H.
19. *Williriedellum crystallinum* Dumitrica. GSJ-NH0850, GSJ R76490, scale G.
20. *Williriedellum* sp. 1. IGUT-NH3000, GSJ R76490, scale G.
21. *Williriedellum* (?) sp. 2. GSJ-NH0860, GSJ R76490, scale H.
22. *Complexapora* sp. 1. IGUT-NH2233, GSJ R76489, scale E.
23. *Zhamoidellum ovum* Dumitrica. GSJ-NH0949, GSJ R76490, scale G.
24. *Zhamoidellum* aff. *ovum* Dumitrica. IGUT-NH3260, GSJ R76490, scale E.
25. *Zhamoidellum* sp. 1. IGUT-NH2708, GSJ R76489, scale C.
26. *Zhamoidellum* sp. 2. IGUT-NH2913, GSJ R76489, scale E.
27. *Zhamoidellum* sp. 3. IGUT-NH2808, GSJ R76489, scale C.
28. *Zhamoidellum* sp. 4. GSJ-NH0928, GSJ R76490, scale H.
29. *Zhamoidellum* sp. 5. IGUT-NH3127, GSJ R76490, scale E.
30. *Zhamoidellum* (?) sp. 6. IGUT-NH2975, GSJ R76490, scale G.
31. *Tricolocapsa conexa* (Matsuoka). GSJ-NH1001, GSJ R76490, scale F.
32. *Tricolocapsa plicarum* (Yao). GSJ-NH0894, GSJ R76490, scale G.
33. *Tricolocapsa* aff. *plicarum* (Yao). GSJ-NH0808, GSJ R76490, scale H.
34. *Tricolocapsa* (?) sp. 1. IGUT-NH2429, GSJ R76489, scale G.
35. *Tricolocapsa* (?) sp. 2. IGUT-NH3110, GSJ R76490, scale G.
36. *Tricolocapsa* sp. M of Baumgartner et al. (1995). GSJ-NH0716, GSJ R76490, scale H.
37. *Hiscocapsa naradaniensis* (Matsuoka). GSJ-NH0918, GSJ R76490, scale G.
38. *Hiscocapsa* (?) sp. 1. IGUT-NH2336, GSJ R76489, scale G.

All scale bars indicate 0.1 mm.

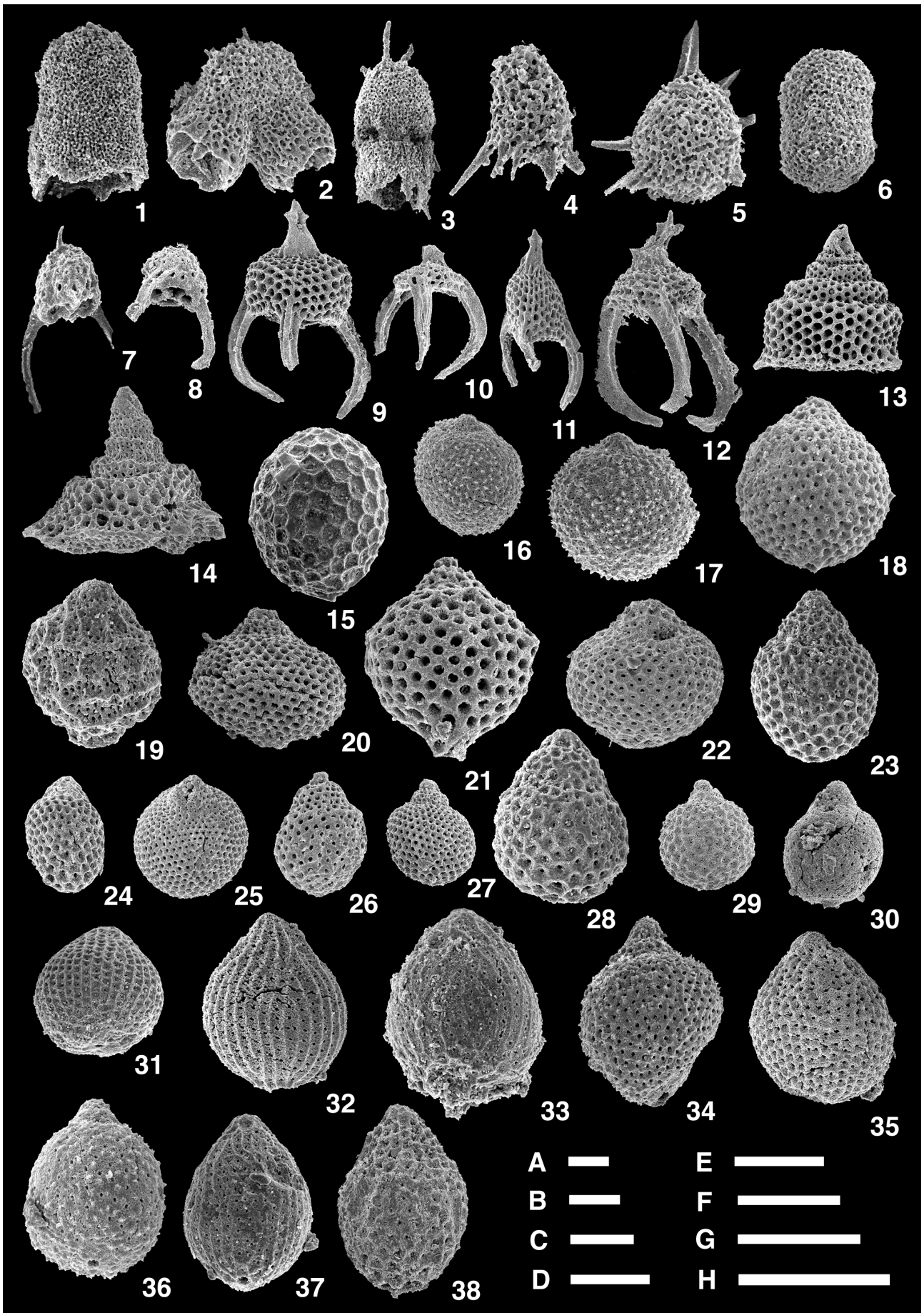


Plate 8

1. *Hiscocapsa* (?) sp. 2. IGUT-NH2047, GSJ R76489, scale E.
2. *Hiscocapsa* (?) sp. 3. GSJ-NH0951, GSJ R76490, scale E.
3. *Hiscocapsa* (?) sp. 4. GSJ-NH1031, GSJ R76490, scale F.
4. *Tetracapsa* sp. 1. IGUT-NH1864, GSJ R76489, scale E.
5. *Tetracapsa* sp. 2. IGUT-NH2580, GSJ R76489, scale C.
6. *Tetracapsa* sp. 3. IGUT-NH3070, GSJ R76490, scale E.
7. *Tetracapsa* sp. 4. IGUT-NH3212, GSJ R76490, scale C.
8. *Tetracapsa* sp. 5. GSJ-NH0931, GSJ R76490, scale F.
9. *Tetracapsa* sp. 6. GSJ-NH1073, GSJ R76490, scale E.
10. *Tetracapsa* sp. 7. GSJ-NH0893, GSJ R76490, scale E.
11. *Tetracapsa* sp. 8. GSJ-NH1069, GSJ R76490, scale D.
12. *Tetracapsa* sp. 9. GSJ-NH0830, GSJ R76490, scale D.
13. *Tetracapsa* sp. 10. GSJ-NH1091, GSJ R76490, scale D.
14. *Tetracapsa* (?) sp. 11. GSJ-NH1074, GSJ R76490, scale D.
15. *Sethocapsa funatoensis* Aita. GSJ-NH0999, GSJ R76490, scale D.
16. *Sethocapsa* aff. *funatoensis* Aita. GSJ-NH0985, GSJ R76490, scale E.
17. *Sethocapsa leiostraca* Foreman. IGUT-NH2793, GSJ R76489, scale C.
18. *Sethocapsa* sp. 1. IGUT-NH2327, GSJ R76489, scale A.
19. *Sethocapsa* sp. 2. IGUT-NH2521, GSJ R76489, scale A.
20. *Sethocapsa* sp. 3. IGUT-NH2551, GSJ R76489, scale A.
21. *Sethocapsa* sp. 4. IGUT-NH2618, GSJ R76489, scale B.
22. *Sethocapsa* sp. 5. IGUT-NH3106, GSJ R76490, scale C.
23. *Areanicapsa* sp. 1. GSJ-NH0924, GSJ R76490, scale E.
24. *Areanicapsa* sp. 2. IGUT-NH2106, GSJ R76489, scale C.
25. *Areanicapsa* sp. 3. IGUT-NH2485, GSJ R76489, scale C.
26. *Areanicapsa* sp. 4. IGUT-NH2160, GSJ R76489, scale C.
27. *Areanicapsa* sp. 5. IGUT-NH2343, GSJ R76489, scale C.
28. *Areanicapsa* sp. 6. IGUT-NH2125, GSJ R76489, scale E.
29. *Areanicapsa* sp. 7. IGUT-NH2628, GSJ R76489, scale C.
30. *Areanicapsa* sp. 8. IGUT-NH2820, GSJ R76489, scale E.
31. *Areanicapsa* sp. 9. IGUT-NH2767, GSJ R76489, scale C.
32. *Areanicapsa* sp. 10. GSJ-NH1063, GSJ R76490, scale D.
33. *Areanicapsa* sp. 11. IGUT-NH2980, GSJ R76490, scale C.
34. *Kilinora spiralis* (Matsuoka). GSJ-NH0732, GSJ R76490, scale D.
35. *Kilinora* sp. 1. GSJ-NH0979, GSJ R76490, scale E.
36. *Eucyrtidiellum nodosum* Wakita. GSJ-NH0759, GSJ R76490, scale G.
37. *Eucyrtidiellum ptyctum* (Riedel and Sanfilippo). GSJ-NH1000, GSJ R76490, scale E.
38. *Protunuma japonicus* Matsuoka and Yao. GSJ-NH0864, GSJ R76490, scale F.

All scale bars indicate 0.1 mm.

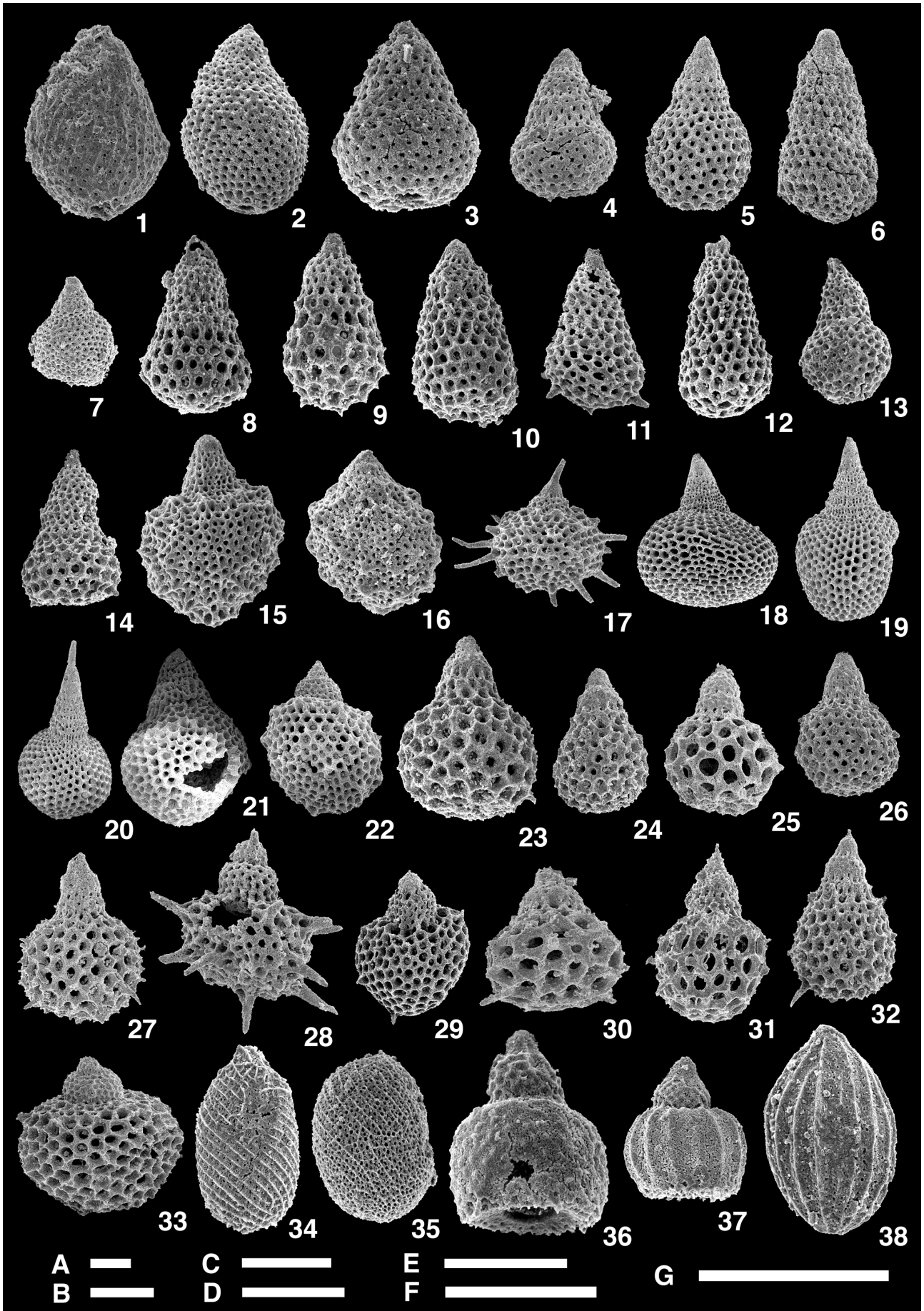


Plate 9

1. *Protunuma* aff. *japonicus* Matsuoka and Yao. GSJ-NH1153, GSJ R76490, scale G.
2. *Protunuma* (?) *ochiensis* Matsuoka. GSJ-NH1156, GSJ R76490, scale F.
3. *Protunuma* sp. 1. GSJ-NH1076, GSJ R76490, scale F.
4. *Syringocapsa* sp. C of Yao (1997). IGUT-NH2400, GSJ R76489, scale A.
5. *Syringocapsa* sp. 1. GSJ-NH0770, GSJ R76490, scale C.
6. *Syringocapsa* sp. 2. IGUT-NH2988, GSJ R76490, scale E.
7. *Syringocapsa* (?) sp. 3. GSJ-NH0782, GSJ R76490, scale B.
8. *Syringocapsa* (?) sp. 4. GSJ-NH0873, GSJ R76490, scale D.
9. *Podobursa spinosa* (Ozvodova). IGUT-NH2906, GSJ R76489, scale C.
10. *Podobursa typica* (Rüst). IGUT-NH2601, GSJ R76489, scale C.
11. *Podobursa* sp. 1. GSJ-NH0713, GSJ R76490, scale D.
12. *Podobursa* sp. 2. GSJ-NH0939, GSJ R76490, scale D.
13. *Podocapsa* (?) sp. 1. GSJ-NH1112, GSJ R76490, scale C.
14. *Thanarla* aff. *brouweri* (Tan). IGUT-NH2823, GSJ R76489, scale G.
15. *Archaeodictyomitra* aff. *apiarium* (Rüst). GSJ-NH0919, GSJ R76490, scale G.
16. *Archaeodictyomitra minoensis* (Mizutani). GSJ-NH0989, GSJ R76490, scale F.
17. *Archaeodictyomitra* aff. *minoensis* (Mizutani). IGUT-NH3178, GSJ R76490, scale E.
18. *Archaeodictyomitra* sp. 1. IGUT-NH1797, GSJ R76489, scale G.
19. *Archaeodictyomitra* sp. 2. GSJ-NH0764, GSJ R76490, scale G.
20. *Archaeodictyomitra* sp. 3. IGUT-NH1818, GSJ R76489, scale G.
21. *Archaeodictyomitra* sp. 4. IGUT-NH1884, GSJ R76489, scale E.
22. *Archaeodictyomitra* sp. 5. IGUT-NH2029, GSJ R76489, scale G.
23. *Archaeodictyomitra* sp. 6. IGUT-NH2151, GSJ R76489, scale E.
24. *Archaeodictyomitra* sp. 7. IGUT-NH2431, GSJ R76489, scale E.
25. *Archaeodictyomitra* sp. 8. GSJ-NH1123, GSJ R76490, scale G.
26. *Archaeodictyomitra* sp. 9. IGUT-NH2761, GSJ R76489, scale E.
27. *Archaeodictyomitra* sp. 10. IGUT-NH2843, GSJ R76489, scale E.
28. *Archaeodictyomitra* sp. 11. GSJ-NH1022, GSJ R76490, scale G.
29. *Archaeodictyomitra* (?) sp. 12. GSJ-NH0816, GSJ R76490, scale H.
30. *Canoptum* sp. 1. IGUT-NH2525, GSJ R76489, scale C.
31. *Cinguloturris carpatica* Dumitrica. GSJ-NH1048, GSJ R76490, scale C.
32. *Cinguloturris* aff. *carpatica* Dumitrica. GSJ-NH0689, GSJ R76490, scale H.
33. *Dictyomitrella* (?) aff. *kamoensis* Mizutani and Kido. GSJ-NH1067, GSJ R76490, scale D.
34. *Dictyomitrella* (?) sp. 1. GSJ-NH0945, GSJ R76490, scale D.
35. *Xitus magnus* Baumgartner. IGUT-NH2025, GSJ R76489, scale C.
36. *Xitus singularis* Hull. IGUT-NH3031, GSJ R76490, scale E.
37. *Xitus* aff. *singularis* Hull. IGUT-NH3140, GSJ R76490, scale E.
38. *Xitus* sp. 1. IGUT-NH1826, GSJ R76489, scale E.
39. *Xitus* sp. 2. IGUT-NH3201, GSJ R76490, scale E.
40. *Xitus* sp. 3. GSJ-NH0799, GSJ R76490, scale F.
41. *Xitus* sp. 4. GSJ-NH1017, GSJ R76490, scale F.

All scale bars indicate 0.1 mm.

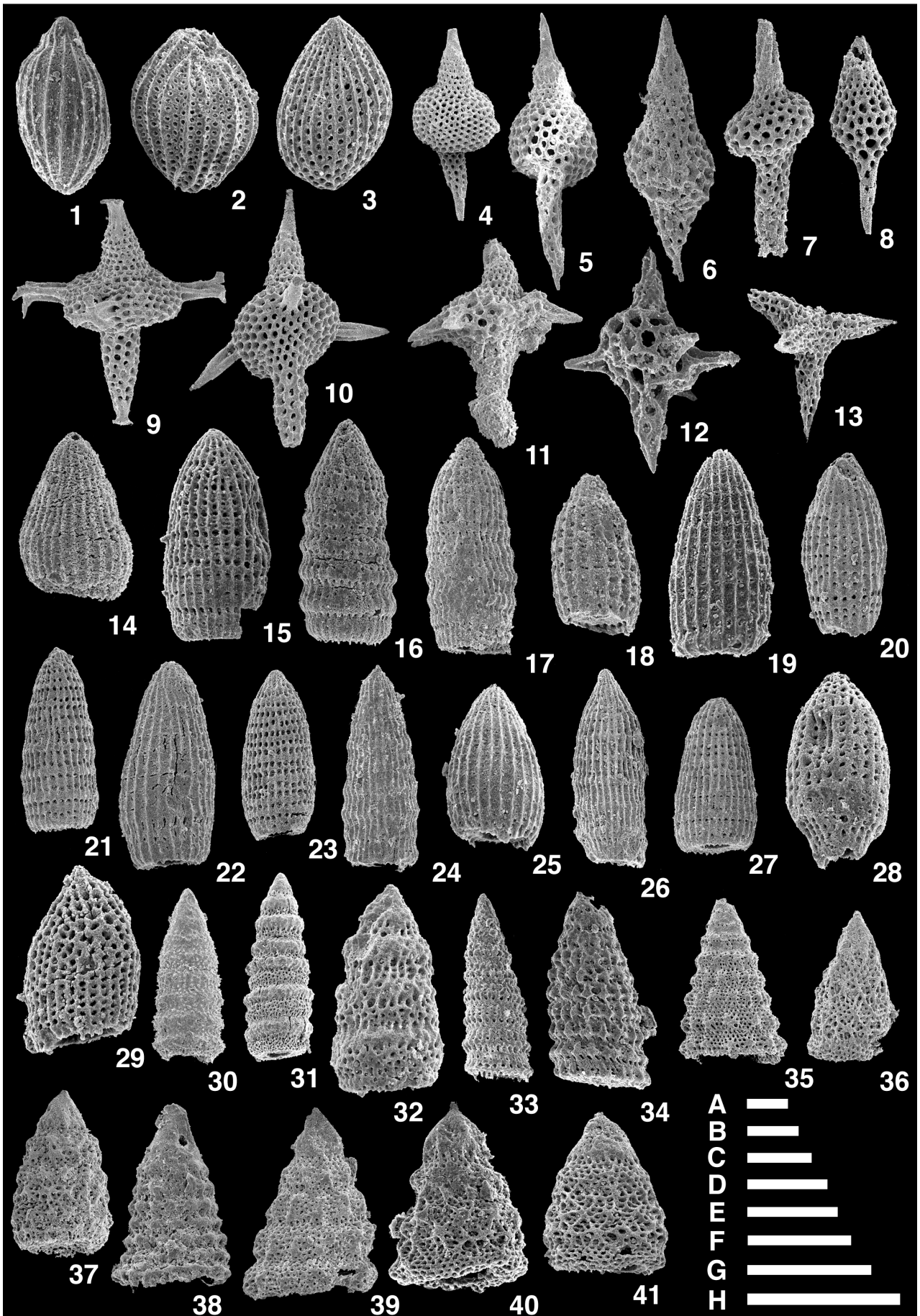


Plate 10

1. *Xitus* (?) sp. 5. IGUT-NH3158, GSJ R76490, scale D.
2. *Parvicingula* sp. 1. IGUT-NH2265, GSJ R76489, scale D.
3. *Parvicingula* sp. 2. IGUT-NH1824, GSJ R76489, scale D.
4. *Parvicingula* sp. 3. IGUT-NH3130, GSJ R76490, scale B.
5. *Parvicingula* sp. 4. IGUT-NH2465, GSJ R76489, scale D.
6. *Parvicingula* sp. 5. IGUT-NH2562, GSJ R76489, scale D.
7. *Parvicingula* sp. 6. IGUT-NH1875, GSJ R76489, scale D.
8. *Parvicingula* sp. 7. IGUT-NH1922, GSJ R76489, scale B.
9. *Parvicingula* sp. 8. IGUT-NH1961, GSJ R76489, scale D.
10. *Parvicingula* sp. 9. IGUT-NH2102, GSJ R76489, scale B.
11. *Parvicingula* sp. 10. IGUT-NH2198, GSJ R76489, scale D.
12. *Parvicingula* sp. 11. IGUT-NH2705, GSJ R76489, scale D.
13. *Parvicingula* sp. 12. IGUT-NH2892, GSJ R76489, scale D.
14. *Parvicingula* sp. 13. IGUT-NH2613, GSJ R76489, scale D.
15. *Parvicingula* sp. 14. GSJ-NH1144, GSJ R76490, scale E.
16. *Parvicingula* sp. 15. IGUT-NH1897, GSJ R76489, scale B.
17. *Parvicingula* sp. 16. IGUT-NH2779, GSJ R76489, scale B.
18. *Parvicingula* sp. 17. IGUT-NH3105, GSJ R76490, scale D.
19. *Parvicingula* sp. 18. IGUT-NH3283, GSJ R76490, scale F.
20. *Parvicingula* sp. 19. GSJ-NH0687, GSJ R76490, scale G.
21. *Parvicingula* sp. 20. GSJ-NH1059, GSJ R76490, scale C.
22. *Parvicingula* (?) sp. 21. GSJ-NH0785, GSJ R76490, scale C.
23. *Tethysetta dhimenaensis* (Baumgartner). GSJ-NH0851, GSJ R76490, scale E.
24. *Tethysetta mashitaensis* (Mizutani). IGUT-NH2172, GSJ R76489, scale B.
25. *Tethysetta* sp. 1. GSJ-NH0740, GSJ R76490, scale G.
26. *Mirifusus chenodes* (Renz). GSJ-NH0787, GSJ R76490, scale C.
27. *Mirifusus diana* (Karrer). IGUT-NH2591, GSJ R76489, scale A.
28. *Mirifusus guadalupensis* Pessagno. IGUT-NH2341, GSJ R76489, scale A.
29. *Ristola altissima* (Rüst). IGUT-NH2507, GSJ R76489, scale A.
30. *Ristola* sp. 1. IGUT-NH2727, GSJ R76489, scale B.
31. *Ristola* sp. 2. IGUT-NH2634, GSJ R76489, scale A.
32. *Ristola* sp. 3. IGUT-NH1951, GSJ R76489, scale B.
33. *Parahsuum* sp. S of Matsuoka (1986). GSJ-NH0898, GSJ R76490, scale E.
34. *Parahsuum* sp. 1. GSJ-NH0804, GSJ R76490, scale C.
35. *Parahsuum* sp. 2. GSJ-NH0853, GSJ R76490, scale E.
36. *Hsuum* sp. 1. IGUT-NH1798, GSJ R76489, scale D.
37. *Hsuum* sp. 2. IGUT-NH2360, GSJ R76489, scale D.
38. *Hsuum* sp. 3. IGUT-NH3017, GSJ R76490, scale D.
39. *Hsuum* sp. 4. IGUT-NH3047, GSJ R76490, scale D.
40. *Hsuum* sp. 5. GSJ-NH1127, GSJ R76490, scale B.
41. *Hsuum* sp. 6. GSJ-NH0776, GSJ R76490, scale C.

All scale bars indicate 0.1 mm.

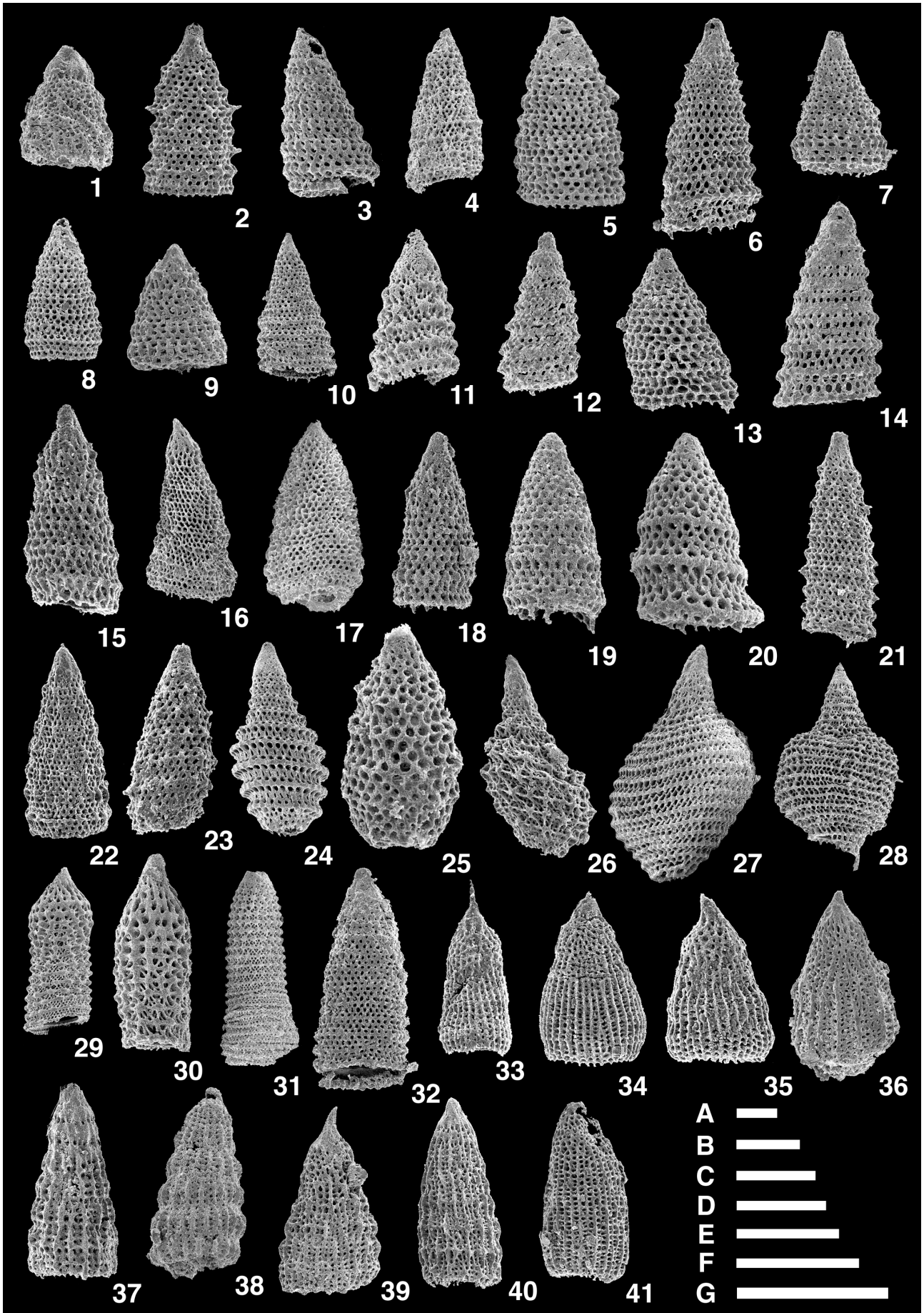


Plate 11

1. *Transhsuum brevicostatum* (Ozvoldova). GSJ-NH0844, GSJ R76490, scale C.
2. *Transhsuum* aff. *brevicostatum* (Ozvoldova). IGUT-NH2281, GSJ R76489, scale B.
3. *Transhsuum maxwelli* (Pessagno). IGUT-NH2046, GSJ R76489, scale B.
4. *Transhsuum* sp. 1. IGUT-NH2273, GSJ R76489, scale D.
5. *Transhsuum* sp. 2. IGUT-NH2743, GSJ R76489, scale B.
6. *Transhsuum* sp. 3. IGUT-NH3240, GSJ R76490, scale D.
7. *Perispyridium ordinarium* (Pessagno). IGUT-NH2055, GSJ R76489, scale B.
8. *Perispyridium* sp. 1. IGUT-NH2284, GSJ R76489, scale D.
9. *Perispyridium* sp. 2. IGUT-NH2135, GSJ R76489, scale B.
10. *Spongocapsula palmerae* Pessagno. IGUT-NH2611, GSJ R76489, scale A.
11. *Spongocapsula perampla* (Rüst). IGUT-NH2204, GSJ R76489, scale B.
12. *Spongocapsula* sp. 1. IGUT-NH2895, GSJ R76489, scale A.
13. *Spongocapsula* sp. 2. IGUT-NH2513, GSJ R76489, scale A.
14. *Spongocapsula* sp. 3. IGUT-NH2351, GSJ R76489, scale A.
15. *Spongocapsula* sp. 4. IGUT-NH2018, GSJ R76489, scale B.
16. *Spongocapsula* sp. 5. IGUT-NH2137, GSJ R76489, scale B.
17. *Spongocapsula* sp. 6. IGUT-NH2812, GSJ R76489, scale A.
18. *Spongocapsula* sp. 7. IGUT-NH2237, GSJ R76489, scale B.
19. *Spongocapsula* sp. 8. IGUT-NH2441, GSJ R76489, scale B.
20. *Spongocapsula* sp. 9. GSJ-NH0891, GSJ R76490, scale C.
21. *Spongocapsula* sp. 10. IGUT-NH2405, GSJ R76489, scale A.
22. *Obesacapsula morroensis* Pessagno. IGUT-NH2892, GSJ R76489, scale A.
23. *Obesacapsula* (?) sp. C of Hull (1997). IGUT-NH2652, GSJ R76489, scale B.
24. *Anisicyrtis* sp. 1. IGUT-NH2746, GSJ R76489, scale F.
25. *Loopus primitivus* (Matsuoka and Yao). IGUT-NH3101, GSJ R76490, scale F.
26. *Loopus* aff. *primitivus* (Matsuoka and Yao). GSJ-NH1014, GSJ R76490, scale E.
27. *Loopus* (?) sp. 1. IGUT-NH1932, GSJ R76489, scale F.
28. *Loopus* (?) sp. 2. IGUT-NH2717, GSJ R76489, scale D.
29. *Loopus* (?) sp. 3. IGUT-NH3248, GSJ R76490, scale D.
30. *Loopus* (?) sp. 4. GSJ-NH0961, GSJ R76490, scale E.
31. *Pseudoeucyrtis* sp. J of Baumgartner et al. (1995). GSJ-NH1044, GSJ R76490, scale C.
32. *Pseudoeucyrtis* sp. 1. IGUT-NH2861, GSJ R76489, scale D.
33. *Pseudodictyomitra* (?) sp. 1. IGUT-NH2220, GSJ R76489, scale F.
34. *Pseudodictyomitra* (?) sp. 2. IGUT-NH2146, GSJ R76489, scale D.
35. *Pseudodictyomitra* (?) sp. 3. IGUT-NH1782, GSJ R76489, scale D.
36. *Pseudodictyomitra* (?) sp. 4. IGUT-NH3011, GSJ R76490, scale F.

All scale bars indicate 0.1 mm.

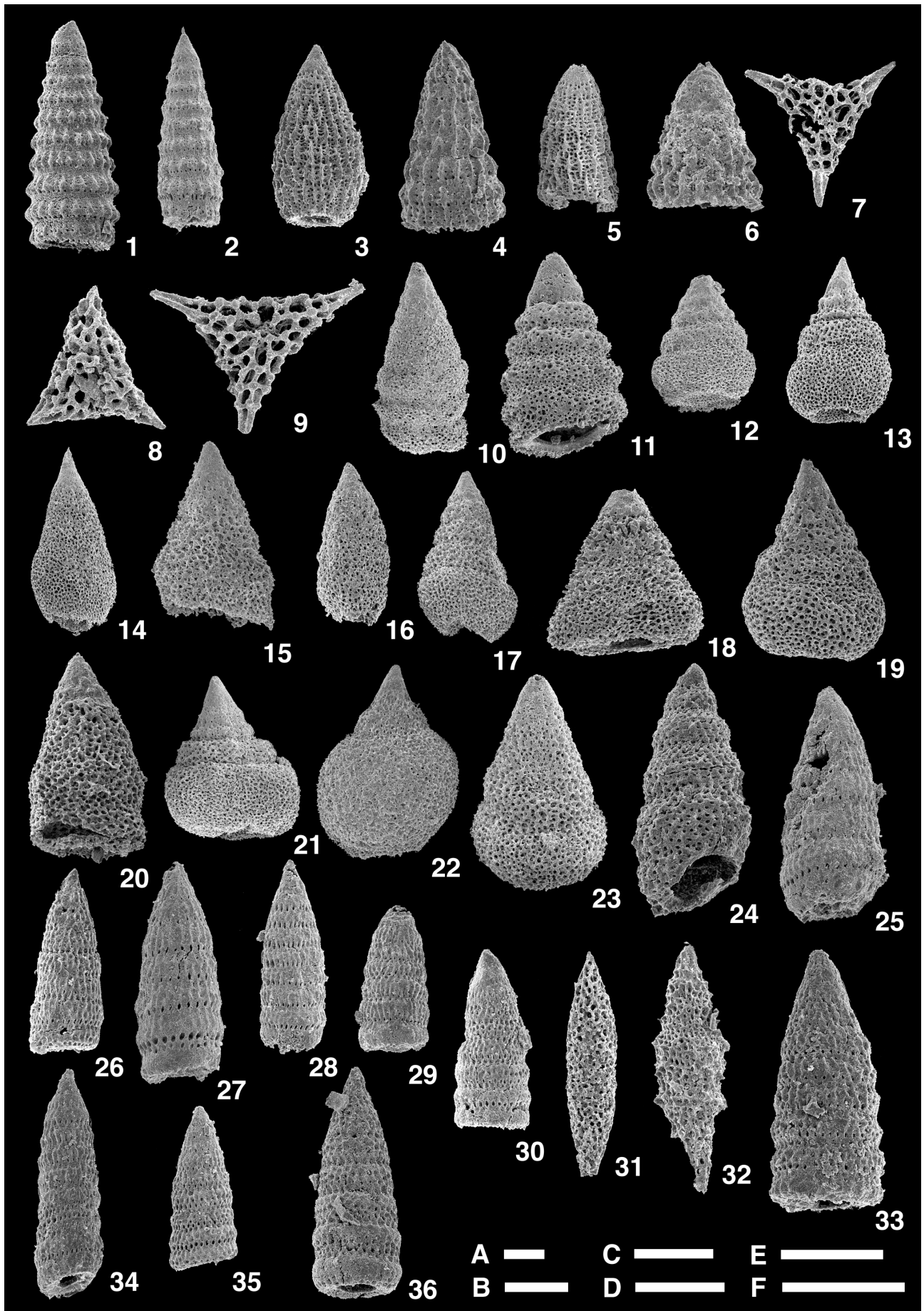
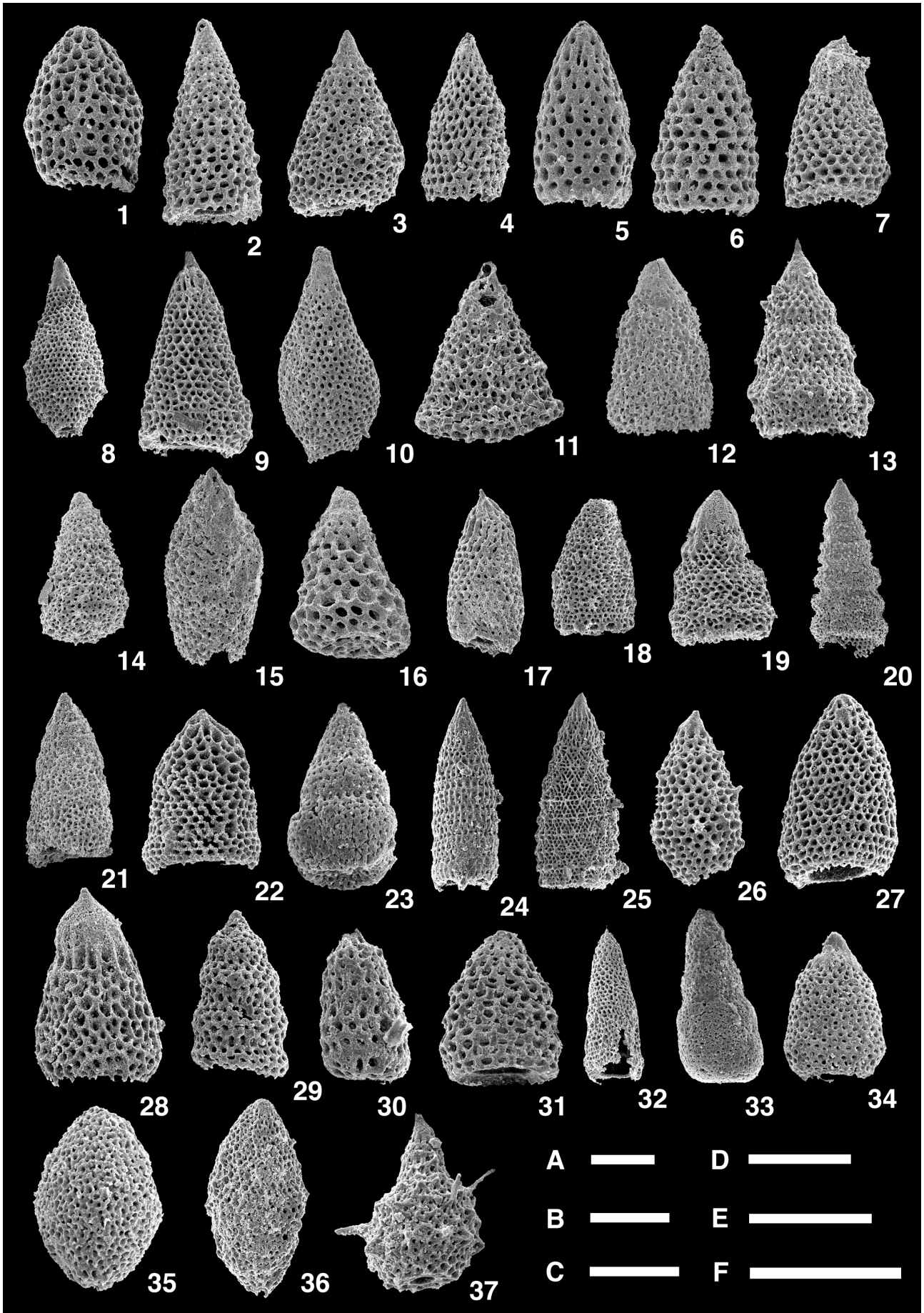


Plate 12

1. Multisegmented nassellaria gen. et sp. indet. 1. IGUT-NH2301, GSJ R76489, scale E.
2. Multisegmented nassellaria gen. et sp. indet. 2. IGUT-NH2319, GSJ R76489, scale C.
3. Multisegmented nassellaria gen. et sp. indet. 3. IGUT-NH2177, GSJ R76489, scale C.
4. Multisegmented nassellaria gen. et sp. indet. 4. IGUT-NH2060, GSJ R76489, scale C.
5. Multisegmented nassellaria gen. et sp. indet. 5. IGUT-NH2683, GSJ R76489, scale E.
6. Multisegmented nassellaria gen. et sp. indet. 6. IGUT-NH2821, GSJ R76489, scale E.
7. Multisegmented nassellaria gen. et sp. indet. 7. IGUT-NH2205, GSJ R76489, scale C.
8. Multisegmented nassellaria gen. et sp. indet. 8. GSJ-NH0920, GSJ R76490, scale A.
9. Multisegmented nassellaria gen. et sp. indet. 9. IGUT-NH2100, GSJ R76489, scale C.
10. Multisegmented nassellaria gen. et sp. indet. 10. IGUT-NH2196, GSJ R76489, scale C.
11. Multisegmented nassellaria gen. et sp. indet. 11. IGUT-NH2076, GSJ R76489, scale C.
12. Multisegmented nassellaria gen. et sp. indet. 12. IGUT-NH2905, GSJ R76489, scale C.
13. Multisegmented nassellaria gen. et sp. indet. 13. GSJ-NH0859, GSJ R76490, scale E.
14. Multisegmented nassellaria gen. et sp. indet. 14. IGUT-NH2731, GSJ R76489, scale C.
15. Multisegmented nassellaria gen. et sp. indet. 15. IGUT-NH2976, GSJ R76490, scale C.
16. Multisegmented nassellaria gen. et sp. indet. 16. IGUT-NH2985, GSJ R76490, scale E.
17. Multisegmented nassellaria gen. et sp. indet. 17. IGUT-NH3115, GSJ R76490, scale C.
18. Multisegmented nassellaria gen. et sp. indet. 18. IGUT-NH3156, GSJ R76490, scale C.
19. Multisegmented nassellaria gen. et sp. indet. 19. IGUT-NH3166, GSJ R76490, scale C.
20. Multisegmented nassellaria gen. et sp. indet. 20. IGUT-NH3169, GSJ R76490, scale A.
21. Multisegmented nassellaria gen. et sp. indet. 21. IGUT-NH3205, GSJ R76490, scale A.
22. Multisegmented nassellaria gen. et sp. indet. 22. GSJ-NH1010, GSJ R76490, scale E.
23. Multisegmented nassellaria gen. et sp. indet. 23. GSJ-NH1005, GSJ R76490, scale F.
24. Multisegmented nassellaria gen. et sp. indet. 24. GSJ-NH0895, GSJ R76490, scale D.
25. Multisegmented nassellaria gen. et sp. indet. 25. GSJ-NH0911, GSJ R76490, scale A.
26. Multisegmented nassellaria gen. et sp. indet. 26. GSJ-NH1019, GSJ R76490, scale D.
27. Multisegmented nassellaria gen. et sp. indet. 27. GSJ-NH0798, GSJ R76490, scale E.
28. Multisegmented nassellaria gen. et sp. indet. 28. GSJ-NH0845, GSJ R76490, scale E.
29. Multisegmented nassellaria gen. et sp. indet. 29. GSJ-NH0856, GSJ R76490, scale E.
30. Multisegmented nassellaria gen. et sp. indet. 30. GSJ-NH1082, GSJ R76490, scale E.
31. Multisegmented nassellaria gen. et sp. indet. 31. GSJ-NH1038, GSJ R76490, scale E.
32. Multisegmented nassellaria gen. et sp. indet. 32. GSJ-NH1004, GSJ R76490, scale A.
33. Multisegmented nassellaria gen. et sp. indet. 33. GSJ-NH1121, GSJ R76490, scale E.
34. Multisegmented nassellaria gen. et sp. indet. 34. GSJ-NH1090, GSJ R76490, scale D.
35. Nassellaria gen. et sp. indet. 35. GSJ-NH0698, GSJ R76490, scale F.
36. Nassellaria gen. et sp. indet. 36. GSJ-NH0793, GSJ R76490, scale B.
37. Nassellaria gen. et sp. indet. 37. GSJ-NH0943, GSJ R76490, scale E.

All scale bars indicate 0.1 mm.



熊本県東陽-泉地域の黒瀬川帯池原層から産出する後期ジュラ紀放散虫化石群集

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要 旨

熊本県中央部の東陽-泉地域に分布する黒瀬川帯から保存良好な後期ジュラ紀を示す放散虫化石が産出した。泥岩を主体とする上部ジュラ系池原層において採取された2試料(GSJ R76489およびGSJ R76490)からはそれぞれ330種および329種の放散虫種が識別された。それぞれの試料中の放散虫群集は非常に類似しており、松岡(1995a)の年代論に基づけば、本放散虫群集はOxfordianの年代を示す。本試料からの放散虫群集は、多量のSpumellariaを含む点で、同時代の付加体中の放散虫群集と異なる。これは池原層の堆積場が付加体とは異なる可能性を示しており、池原層はtrench slopeの環境下で堆積した可能性が示唆される。