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Notes and Comments

A report of Permian, Triassic, and Jurassic radiolarian occurrences from the Ashio terrane in the Hachioji Hills, eastern Gunma Prefecture, central Japan

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Abstract: The Ashio terrane, which is a Jurassic accretionary complex, is exposed in the Hachioji Hills, eastern Gunma Prefecture, central Japan. The Ashio terrane in the Hachioji Hills mainly comprises chert and muddy mixed rock with siliceous mudstone and sandstone. Early Permian (Sakmarian, Cisuralian), Late Triassic (Carnian–Norian), and Jurassic radiolarians occurred in the chert, whereas Middle Jurassic (Bajocian–Bathonian) radiolarians occurred in the siliceous mudstone.

Keywords: radiolaria, Permian, Triassic, Jurassic, Ashio terrane, Hachioji Hills, Kiryu, Ohta, Gunma Prefecture, Japan

1. Introduction

Mid-Mesozoic accretionary complexes, including the Tamba–Mino–Ashio and Chichibu composite terranes, are exposed in central Japan (e.g. Matsuoka *et al,* 1998; Nakae, 2000) (Fig. 1). The Ashio terrane is distributed over the Ashio Mountains and its adjacent regions. Many researchers have reported the presence of several fossil types, such as selachoid, brachiopod, fusulinid, conodont, radiolarian, and ammonoid, from the terrane (e.g. Yabe, 1903; Morikawa and Horiguchi, 1956; Hayashi, 1963; Aono, 1985; Kamata, 1996; Muto *et al.*, 2018).

The Hachioji Hills in the eastern Gunma Prefecture are geographically separated from the Ashio Mountains. The Ashio terrane is exposed on the northeastern side of the hills. As aforementioned, numerous fossil occurrences have been reported from the Ashio Mountains. Suzuki (1898a, b) first noted the presence of radiolarian remains within the siliceous rocks found within the Ashio Copper Mine of the Ashio Mountains. Since the 1960s, radiolarians and conodonts have been extracted from the Ashio terrane in the Ashio Mountains. However, despite numerous fossil occurrences in the Ashio Mountains, only a few brief reports have been written about the Ashio terrane in the Hachioji Hills. Masuda (1989) reported on the discovery of Middle Jurassic radiolarians from chert and manganese nodules within mudstone. Meanwhile, Hayashi *et al.* (1990) reported some possibly Triassic radiolarians from chert.

The author obtained Permian, Triassic, and Jurassic radiolarian assemblages from the Ashio terrane in the Hachioji Hills. This article aims to briefly report the geology of the Ashio terrane in the Hachioji Hills with the radiolarian occurrences.

2. Brief research history of the Ashio terrane in the Ashio Mountains

Several researchers have investigated the Ashio terrane in the Ashio Mountains, and some geologic maps of the mountains have been presented (e.g. Harada, 1886; Kawada and Ozawa, 1955; Yoshida, 1956, 1957; Watanabe *et al.*, 1957; Fujimoto, 1961; Hatori, 1965; Yanagimoto, 1973; Igo *et al.*, 1976; Aono, 1985; Sato and Aono, 1985; Kamata, 1996). However, a few geologic maps have depicted the area of the mountains comprehensively (Hayashi and Hasegawa, 1981; Sudo *et al.*, 1991) because the Ashio Mountains they are distributed over a broad area surrounding both the Gunma and Tochigi prefectures. Figure 2 displays a simplified geologic map of the Ashio Mountains. Major previous studies with their geological divisions are summarized in Fig. 3.

The Ashio terrane had been considered a member of the Chichibu Paleozoic strata until the 1970s. Although Hayashi (1963, 1964, 1968a, b, 1971) discovered Triassic conodonts from the “Chichibu Paleozoic strata,” he considered the possibility that the Triassic-type conodonts had appeared in the Permian. Koike *et al.* (1970, 1971,

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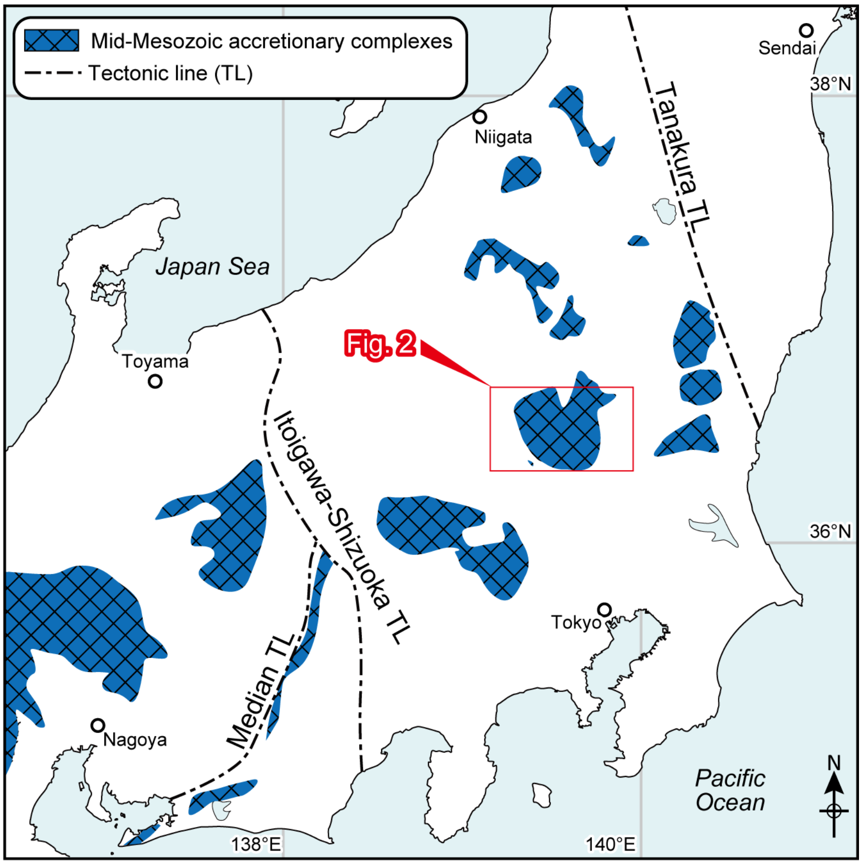

Fig. 1 Index map of the study area with distribution of mid-Mesozoic accretionary complexes in Kanto District, central Japan (based on Matsuoka *et al.*, 1998; Nakae, 2000).

1974) and Conodont Research Group (1972, 1974) similarly pondered whether or not the "Chichibu Paleozoic strata" contains Triassic strata based on the discovery of the Triassic conodonts. Hayashi and Hasegawa (1981) showed the geologic maps of the Ashio terrane in the Ashio Mountains and estimated their age to be Permian to Triassic.

From the viewpoint of an accretionary complex geology based on the plate tectonics, Aono (1985) surveyed the Ashio terrane in the southeast Ashio Mountains and obtained Triassic conodonts as well as Triassic and Jurassic radiolarians. Kamata (1996) later investigated a wide area of the south–southwest Ashio Mountains and defined three tectonostratigraphic units, namely the Omama, Kurohone–Kiryu, and Kuzu complexes. The former two complexes are characterized by mixed facies including some kind of blocks, such as chert, limestone, and sandstone. The Omama Complex contains large amounts of basalt and limestone, whereas the Kurohone–Kiryu Complex contains small amounts of such rocks. The Kuzu Complex is characterized by coherent facies, composed mainly of repeated chert-clastic sequences with basaltic-limestone blocks. Kamata (1997) subdivided the Kuzu Complex into three units.

3. Geologic outline of the Hachioji Hills

In the Hachioji Hills, the Ashio terrane is exposed in the northeastern side of the hills (Fig. 4). The Ashio terrane in the Hachioji Hills consists mainly of chert and muddy mixed rock with siliceous mudstone and sandstone.

The chert is mostly gray, dark-gray, and bright-gray in color (Fig. 5A). Red chert, which yielded Permian radiolarians, is observed at only one outcrop (Fig. 5B). The chert is generally well-bedded (bed thickness: 3–10 cm) (Figs. 5A, 5B) and is composed mainly of siliceous microfossils (possibly radiolarian remains) and cryptocrystalline quartz with a few clay minerals (Fig. 6A).

The siliceous mudstone is dark-gray (Fig. 5C) and weakly-bedded (bed thickness: 3–10 cm). Most siliceous mudstone occurs within the muddy mixed rock (Fig. 5D). The siliceous mudstone comprises scattered microfossils (possibly radiolarian remains) with clay materials (Fig. 6B).

The sandstone is medium to fine-grained, gray or brown lithic arenite (Fig. 6C). The sandstone is generally included within muddy mixed rocks as blocks.

The muddy mixed rock comprises a dark-gray mudstone

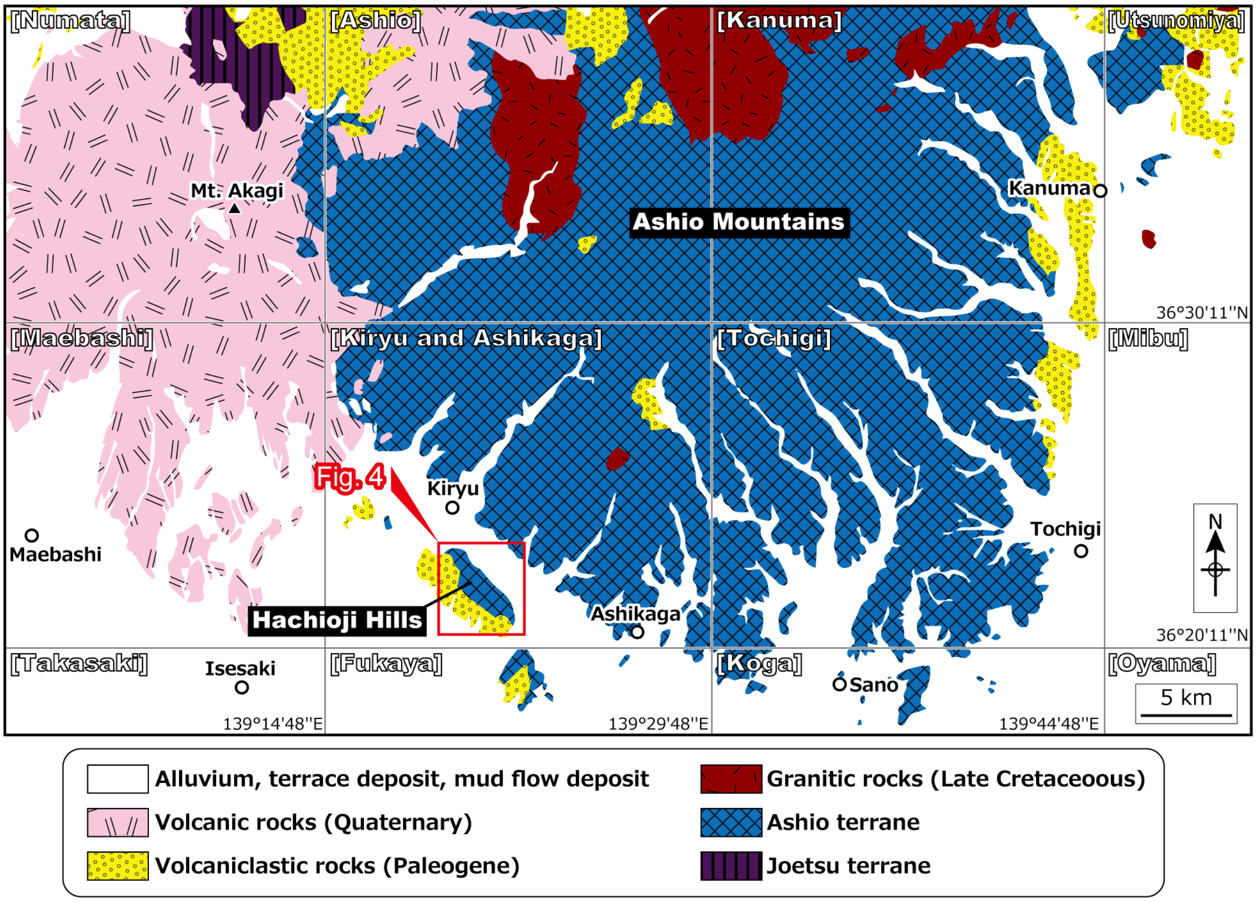

Fig. 2 Simplified geologic map of the Ashio Mountains (modified after from Sudo *et al.*, 1991; Geological Survey of Japan, AIST, 2018). Geographical names in brackets indicate 1:50,000 topographic maps published by Geospatial Information Authority of Japan.

Kawada & Ozawa (1955)	Yoshida (1956, 1957)	Hatori (1965)	Watanabe *et al.* (1957)	Fujimoto (1961)	Koike *et al.* (1971) Yanagimoto (1973)	Hayashi & Hasegawa (1981)	Aono (1985) Sato & Aono (1985)	Sudo *et al.* (1991)	Kamata (1996)	Kamata (1997)
	Permian	Permian: Aso Group	Paleozoic: Ashikaga Group	Permian: Anso Group	Triassic	Permian to Triassic	Mesozoic: Unit III	Jurassic	Middle–Late Jurassic: Kuzu Complex	Kuzu Complex: Unit 3
		Kuzu Gr.	Kuzu Group		Permian					Unit 2
		Carb.?: Tochigi Gr.		Carb.?: Tochigi Group	Triassic		Unit II			Unit 1
			Awano Group				Unit I		Kurohone–Kiryu Complex	
Paleozoic: Ashio Group									Omama Complex	

Fig. 3 Stratigraphy of the Ashio terrane in the Ashio Mountains in the major previous studies. Stratigraphic divisions in levels of the formations are omitted. Gr.: Group. Carb.: Carboniferous.

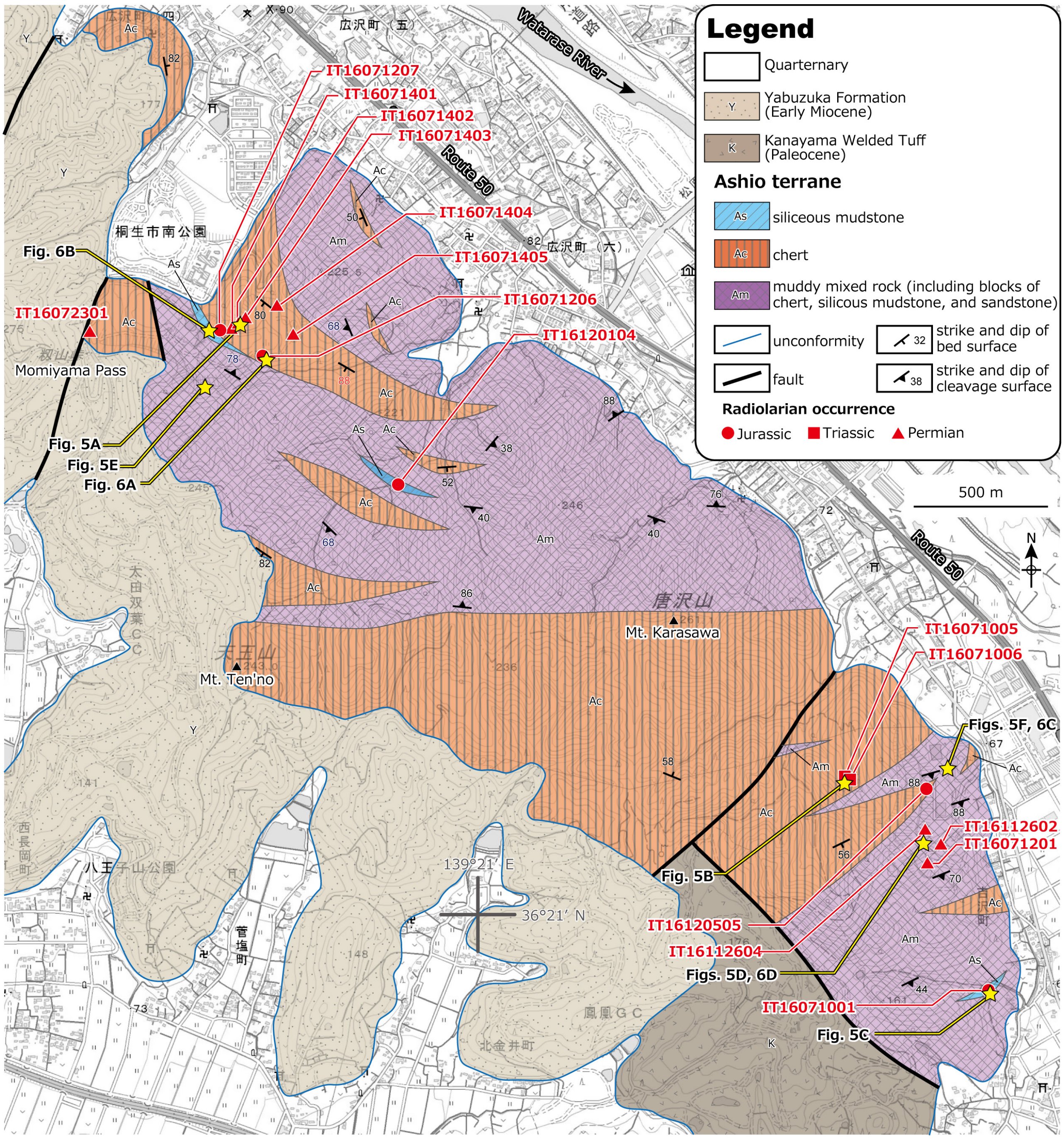

Fig. 4 Geologic map of the Ashio terrane in the Hachioji Hills. The Paleogene is based on Takahashi and Yanagisawa (2003).

matrix with blocks of chert, siliceous mudstone, and sandstone (Figs. 5D, 5E, 5F). The size of the blocks of each rock is as follows: the chert blocks range from several meters to more than 100 m (Fig. 4); the siliceous mudstone blocks, a few micrometers (Fig. 6D) to several meters (Fig. 5C); the sandstone blocks, several centimeters (Fig. 5E) to a few meters (Fig. 5F).

On the southwestern side of the hills, the Paleogene covers the Ashio terrane. According to Takahashi and Yanagisawa (2003), the Kanayama Welded Tuff unconformably overlies the Ashio terrane; the Yabuzuka Formation unconformably overlies the Kanayama Welded Tuff and the Ashio terrane. The Kanayama Welded Tuff and the Yabuzuka Formation can correlate to the Paleocene and the lower Miocene, respectively (Takahashi *et al.*, 1991; Takahashi and Yanagisawa, 2003; Nomura *et al.*, 2017). The unconformity boundaries between the Ashio terrane and the Yabuzuka Formation are observable near the Momiyama Pass.

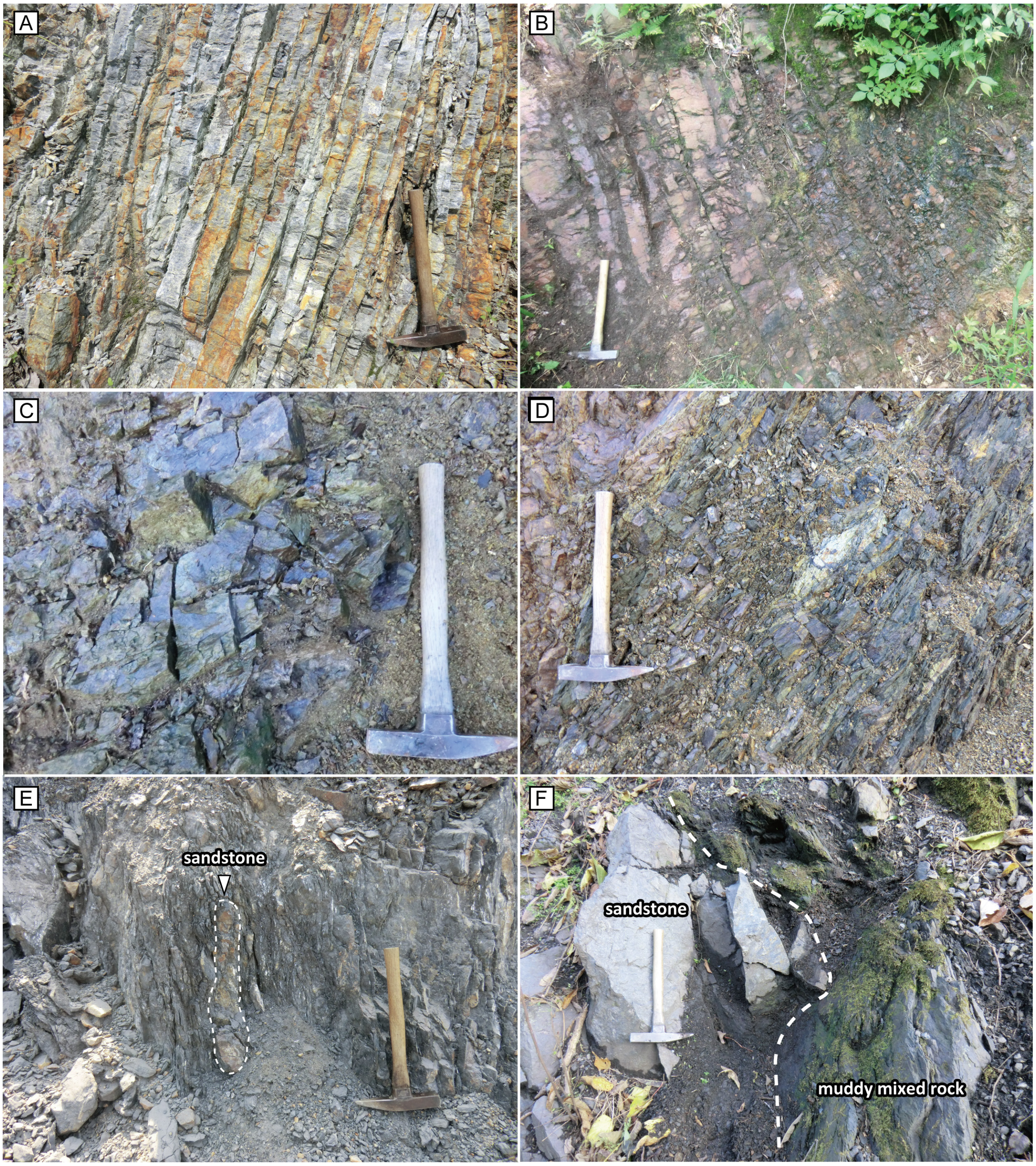

Fig. 5 Field occurrences. A: Triassic gray bedded chert in a quarry of Meisei Kousan Co. Ltd.; B: Permian red bedded chert along a forest road; C: Jurassic siliceous mudstone along a forest road; D: Muddy mixed rock including small siliceous mudstone blocks in a quarry of Meisei Kousan Co. Ltd.; E: Muddy mixed rock including sandstone block in a quarry of Meisei Kousan Co. Ltd.; F: Muddy mixed rock and sandstone block in a quarry of Meisei Kousan Co. Ltd.

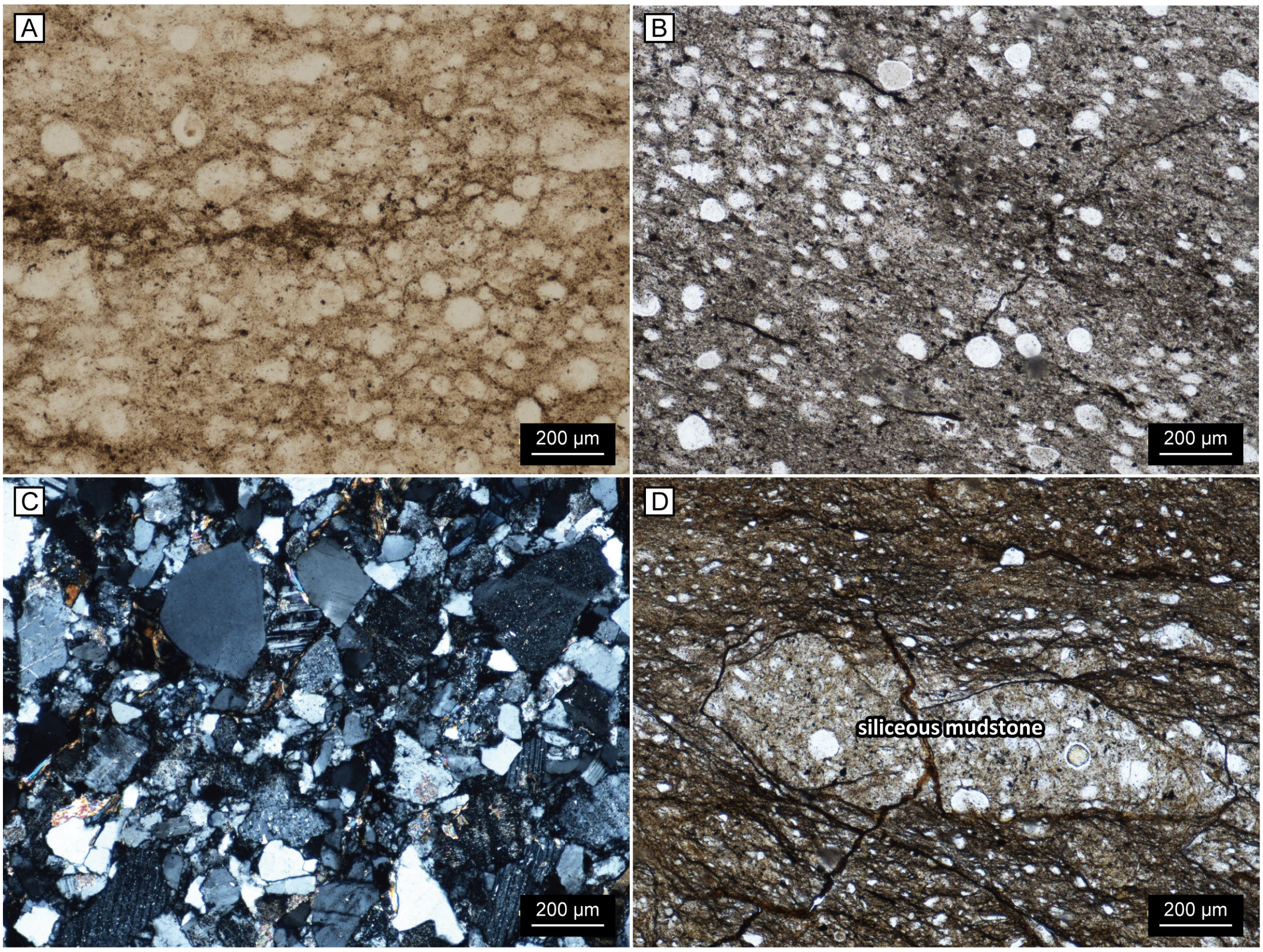

Fig. 6 Photomicrographs of thin sections. A: Lower Jurassic dark-gray bedded chert; B: Dark gray siliceous mudstone; C: Sandstone included in muddy mixed rock; D: Muddy mixed rock including siliceous mudstone fragment.

4. Radiolarian occurrences and age assignments

4. 1 Materials and methods

A total of 46 samples of chert and siliceous mudstone were collected from the Ashio terrane in the Hachioji Hills. The samples were crushed into ca. 1 cm fragments and were then soaked in a hydrofluoric acid (HF) solution (ca. 5%) at ca. 20°C–25°C room temperature for 24 hours. Residues, which were collected through a sieve with a mesh diameter of 0.054 mm, were enclosed within a slide prepared with a photocrosslinkable mounting medium (GJ-4006, Gluelabo Ltd.). These slides were observed using a transmitted light microscope and were photographed. Among the samples, 16 samples yielded radiolarians (Table 1).

4. 2 Permian radiolarians from chert

Two chert samples yielded Permian radiolarians (Plates 1, 2). Spicules were also discovered from both samples.

Samples IT16071006 and IT16071005 yielded abundant *Pseudoalbaillella sakmarensis*. This species occurs in the *Pseudoalbaillella lomentaria* Assemblage Zone and lower *Pseudoalbaillella rhombothoracata* Assemblage Zone (Ishiga, 1986). Although characteristic species of the *Pseudoalbaillella rhombothoracata* Assemblage Zone (i.e. *Pseudoalbaillella rhombothoracata*) have never been found from the both samples, *Pseudoalbaillella scalprata* Holdsworth and Jones and *Pseudoalbaillella postscalprata* Ishiga, the ancestors of *Pseudoalbaillella rhombothoracata* Ishiga (Ishiga, 1983), were obtained from the both samples and either sample, respectively. Consequently, both samples can be correlated to the upper *Pseudoalbaillella lomentaria* Assemblage Zone (middle Cisuralian, lower Permian).

4. 3 Triassic radiolarians from chert

Triassic radiolarians were obtained from eight chert samples (Plates 3, 4). Among these samples, one sample (IT16071201) yielded an age-undeterminable conodont fragment and one sample (IT16072301) yielded certain sponge spicules.

Table 1 Fossil occurrences from the Ashio terrane in the Hachioji Hills. sl. md.: siliceous mudstone.

Sample no.	IT16071005	IT16071006	IT16071201	IT16071401	IT16071402	IT16071403	IT16071404	IT16071405	IT16072301	IT16112602	IT16112604	IT16071206	IT16071207	IT16120505	IT16071001	IT16120104
Lithology	chert	chert	chert	chert	chert	chert	chert	chert	chert	chert	chert	chert	chert	chert	sl. md.	sl. md.
Spumellaria gen. et sp. indet.			+	+	+		+	+	+			+				
Nassellaria gen. et sp. indet.				+	+										+	+
Closed-end Nassellaria												+	+	+	+	+
Striatojaponocapsa synconexa O'Dogherty, Goričan and Dumitrica															+	
Praeparvicingula sp.														?		?
Dictyomitrella ? *kamoensis* Mizutani and Kido																+
Minocapsa sp.																?
Hsuum ? *matsuokai* Isozaki and Matsuda												+				
Zhamoidellum sp.															+	
Spinosicapsa sp.														?		
Pantanellium sp.													?	+		
Paronaella sp.														?		
Protunuma sp.												?				
Parahsuum sp.												+				
Eucytidiellum sp.													+		+	+
spine B5 of Sugiyama (1997)			+													
spine A2 of Sugiyama (1997)			+													
spine D1 of Sugiyama (1997)			+				+									
spine D2 of Sugiyama (1997)			+													
spine C of Sugiyama (1997)							+									
spine of *Capuchnosphaera* sp.									?							
Pseudostylosphaera japonica (Nakaseko and Nishimura)						+				+						
Pseudostylosphaera longispinosa Kozur and Mostler										+						
Pseudostylosphaera sp.			?			+				+						
Tritortis kretaensis (Kozur and Krahl)											+					
Tritortis sp.									?							
Mesosaturnalis octospinus Sugiyama								+								
Mesosaturnalis sp.				?												
Praehexasaturnalis tenuispinosus (Kozur and Mostler)					cf.											
Muelleritortis sp.																
Capnodoce sp.					?	?		?								
Hozmadia sp.									?							
Triassocampe sp.						?				?						
Sarla sp.										?						
Pseudoalbaillella sakmarensis (Kozur)	+	+														
Pseudoalbaillella lomentaria Ishiga and Imoto		cf.														
Pseudoalbaillella scalprata Holdsworth and Jones	+	+														
Pseudoalbaillella postscalprata Ishiga		+														
Pseudoalbaillella sp.	+	+														
Polyfistula sp.		+														
arm of *Quadriremis gracilis* (De Wever and Caridroit)		+														
Entactinia sp.	?	?														
Latentifistula texana Nazarov and Ormiston	+	+														
Latentifistula sp.	?	?														
Quadriremis sp.		?														
Pseudotormentus kamigoriensis De Wever and Caridroit	+	+														
Pseudotormentus sp.	+	+														
Quadricaulis inflata (Sashida and Tonishi)	+															
Conodont fragment			+													
Sponge spicule	+	+								+						

Sample IT16071201 yielded some type of spines shown by Sugiyama (1997). According to the range of the radiolarian zonation displayed by Sugiyama (1997), spines B5, D1, and D2 co-occur in TR6A–TR6B. Spine A2 occurs in the TR3A–TR6A. Based on the co-occurrence, it is possible that the sample corresponds to TR6A, uppermost Carnian–lowermost Norian, Upper Triassic.

From sample IT16071401, some satunalids were observed. The Family Satunalidae appeared in the Carnian and occurs abundantly in the Upper Triassic (e.g. De Wever *et al.*, 2001). Therefore, the sample tentatively corresponds to the Upper Triassic.

Sample IT16071402 yielded satunalids appearing to possess six spines, identified as *Praehexasaturnalis* cf. *tenuispinosus* (Kozur and Mostler). The *Praehexasaturnalis tenuispinosus* group occurs in TR7–JR0A, middle Norian–lower Hettanginian, Upper Triassic–lowermost Jurassic (Sugiyama, 1997).

Samples IT16071403 and IT16112602 yielded *Pseudostylosphaera japonica* (Nakaseko and Nishimura). The *Pseudostylosphaera japonica* group occurs in the TR2B–TR5A, middle Anisian–lower Carnian, Middle–Upper Triassic (Sugiyama, 1997).

Sample IT16071404 yielded spines C and D1 of Sugiyama (1997). The former and latter occur in TR4B–TR5A and TR5A–TR7, respectively (Sugiyama, 1997). The co-occurrence range of these two types is restricted in TR5A, Carnian.

Sample IT16071405 yielded *Mesosaturnalis octospinus* Sugiyama. The occurrence range of this species is restricted in TR7–TR8A, middle Norian.

Sample IT16072301 yielded spines of *Capuchnosphaera*? sp. *Capuchnosphaera* occurs in the Carnian–lower Norian (O'Dogherty *et al.*, 2009b).

Sample IT16112604 yielded *Tritortis kretaensis* (Kozur and Krahl). This species occurs in TR4A–TR5A, upper Ladinian–lower Carnian, Middle–Upper Triassic (Sugiyama, 1997).

4. 4 Jurassic radiolarians from chert

Three chert samples yielded possibly Jurassic radiolarians (Plate 5). However, fossil preservation is generally poor and hence the detailed ages are uncertain. All samples yielded closed-end Nassellaria. This type of Nassellaria appeared in the Early Jurassic (O'Dogherty *et al.*, 2009a). Sample IT16071206 yielded *Parahsuum* sp. The occurrence range of this genus is the Hattanginian–Kimmeridgian, Jurassic (O'Dogherty *et al.*, 2009a). Here it is tentatively considered that all samples are Jurassic, although the occurrence range closed-end Nassellaria reaches the Cretaceous (O'Dogherty *et al.*, 2009a).

4. 5 Jurassic radiolarians from siliceous mudstone

Two siliceous mudstone samples yielded Middle Jurassic radiolarians (Plate 6).

Sample IT16071001 yielded *Striatojaponocapsa synconexa* O'Dogherty, Goričan and Dumitrica. These species abundantly occur in the upper *Striatojaponocapsa plicarum* zone and lower *Striatojaponocapsa conexa* zone (Hatakeda *et al.*, 2007), Bajocian–lower Bathonian (Matsuoka, 1995).

One specimen of closed-end Nassellaria (Plate 6.39) from sample IT16120104 resembles to *Tricolocapsa* cf. *rüsti* Tan Sin Hok sensu Yao (1979). This specimen co-occurred with *Striatojaponocapsa plicarum*. Here, it is tentatively considered that the sample is correlated with the *Striatojaponocapsa plicarum* zone.

5. Implication

In this study, Permian, Triassic, and Jurassic radiolarians were discovered from the chert and Jurassic radiolarians were obtained from the siliceous mudstone. Previously, Masuda (1989) reported *Eucyrtidiellum unumaense* (Yao) and *Unuma echinatus* Ichikawa and Yao from the chert of the Hachioji Hills. According to Matsuoka (1995), *Eucyrtidiellum unumaense* occurs mainly in the *Striatojaponocapsa plicarum* zone to *Striatojaponocapsa conexa* zone, Bajocian–lower Callovian. *Unuma echinatus* occurred *Laxtorum*? *jurassicum* zone to *Striatojaponocapsa conexa* zone, Aalenian–Bathonian (Matsuoka and Yao, 1986). Masuda (1989) stated that a similar radiolarian assemblage was obtained from the manganese nodule within the mudstone, although their images were not shown.

Combined with this previous study, the primary ocean plate stratigraphy of the Ashio terrane in the Hachioji Hills is summarized below. The chert contains Sakmarian (Cisuralian, Permian), Carnian–Norian (Upper Triassic), parts of the Anisian–Ladinian, possibly Early Jurassic, and Bajocian–lower Bathonian (Middle Jurassic) (Fig. 7). Furthermore, the siliceous mudstone and the manganese nodule within the mudstone contain Bajocian–lower Bathonian (Middle Jurassic).

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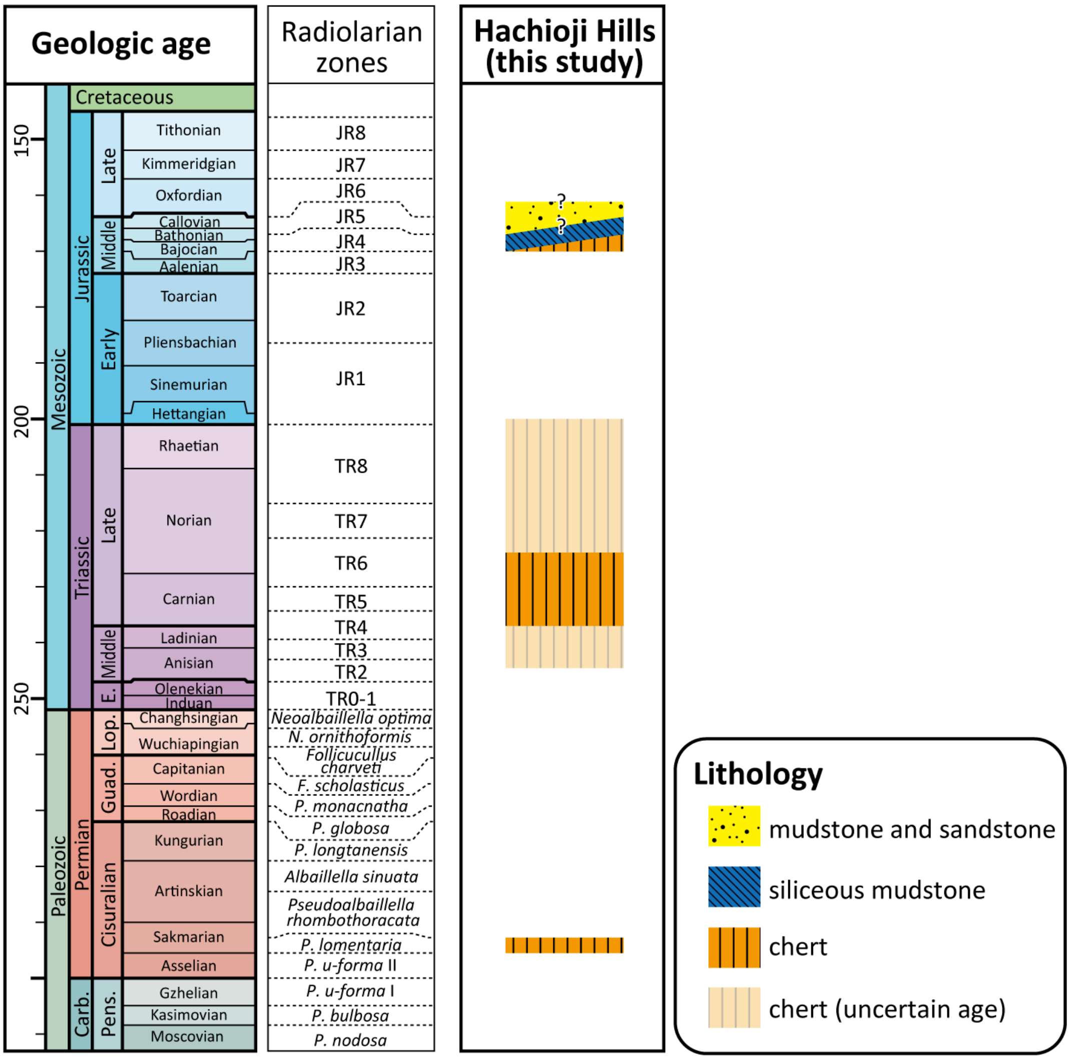

Fug. 7 Reconstructed ocean plate stratigraphy of the Ashio terranes in the Hachioji Hills and South-Southwest Ashio Mountains, and their correlation. Geologic age is after Ogg *et al.* (2016); radiolarian zones are based on Ishiga (1986), Matsuoka (1995), Sugiyama (1997), Kuwahara *et al.* (1998) and Zhang *et al.* (2014).
E.: Early; Lop.: Lopingian; Guad.: Guadalupian; Carb.: Carboniferous. Pens.: Pennsylvanian.

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群馬県東部八王子丘陵の足尾テレーンから産出したペルム紀，三畳紀及びジュラ紀放散虫の報告

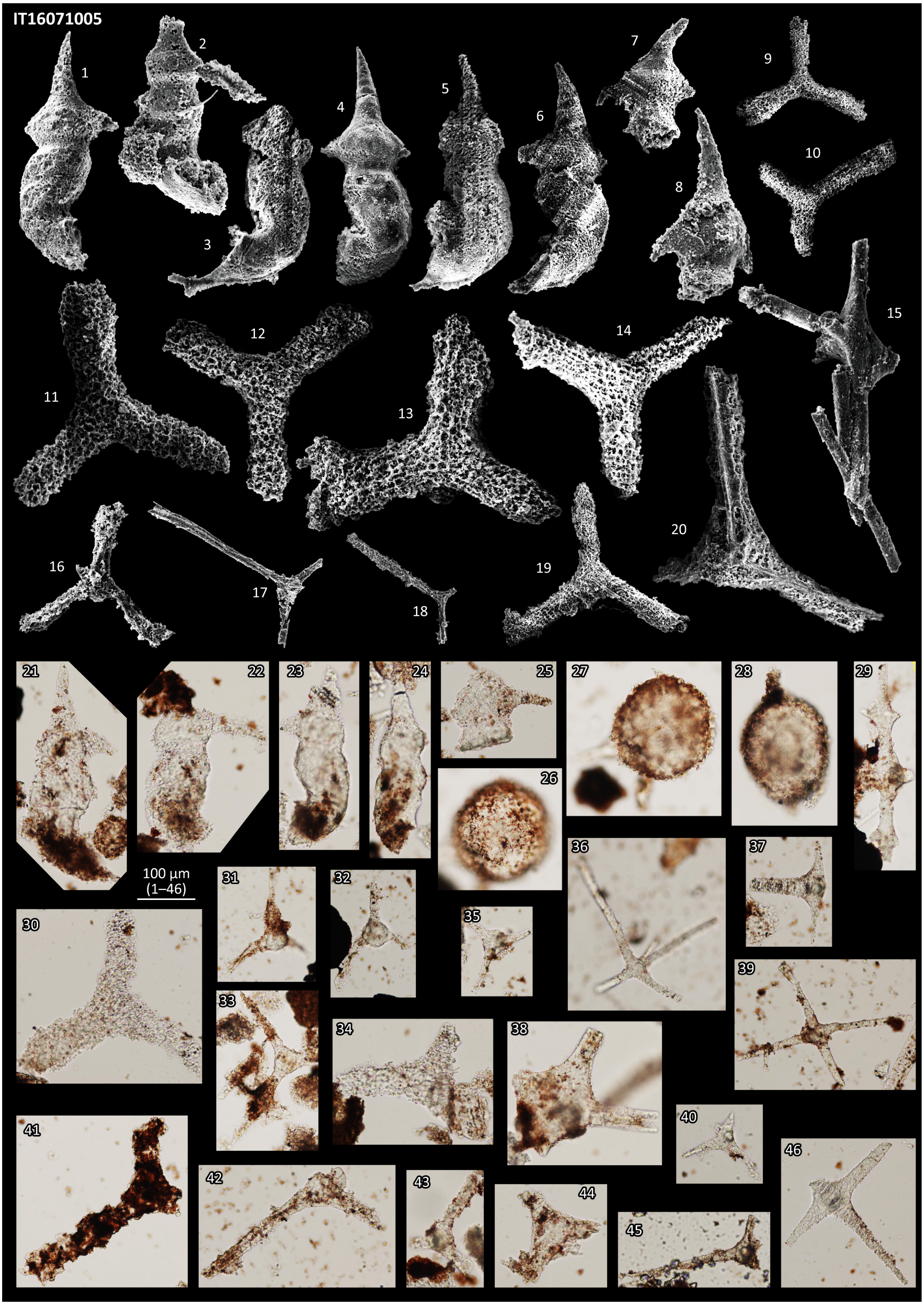
伊藤　剛

要　旨

群馬県東部の八王子丘陵にはジュラ紀付加体足尾テレーンが露出する．この足尾テレーンは，チャートと泥質混在岩を主体とし，珪質泥岩，泥岩，砂岩を伴う．ペルム紀前期（シスウラリアン世サクマーリアン期），後期三畳紀（カーニアン期〜ノーリアン期）及びジュラ紀の放散虫化石がチャートから産出し，中期ジュラ紀（バッジョシアン期〜バトニアン期）放散虫が珪質泥岩から産出した．

Plate 1 Permian radiolarians and spicules from chert.

1–6, 21–24: *Pseudoalbaillella sakmarensis* (Kozur)
7, 8: *Pseudoalbaillella scalprata* Holdsworth and Jones
9, 10, 19, 30, 34, 41: *Latentifistula* spp.
11–14: *Latentifistula texana* Nazarov and Ormiston
15, 29, 35, 36, 40, 46: Sponge spicule
16–18, 31–33, 37, 39, 43, 45: *Pseudotormentus* spp.
20, 44: *Quadricaulis* sp.
25: *Pseudoalbaillella* sp.
26–28: *Entactinia*? sp.
38: *Polyfistula* sp.
42: *Quadricaulis inflata* (Sashida and Tonishi)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100 µm
(1–46)

Plate 2 Permian radiolarians and spicules from chert.

1–7, 26–36: *Pseudoalbaillella sakmarensis* (Kozur)
8: *Pseudoalbaillella scalprata* Holdsworth and Jones
9: *Pseudoalbaillella postscalprata* Ishiga
10: *Entactinia*? sp.
11, 13: *Latentifistula texana* Nazarov and Ormiston
12, 22, 41: *Pseudotormentus kamigoriensis* De Wever and Caridroit
14: *Quadricaulis* sp.
15, 16, 47, 48: arm of *Quadriremis gracilis* (De Wever and Caridroit)
17: arm of *Quadricaulis inflata* (Sashida and Tonishi)
18–21, 23–25, 45: *Latentifistula*? spp.
37: *Pseudoalbaillella* cf. *lomentaria* Ishiga and Imoto
38, 39: *Pseudoalbaillella* sp.
40: *Entactinia*? sp.
42–44: *Quadriremis*? spp.
46: *Polyfistula* sp.

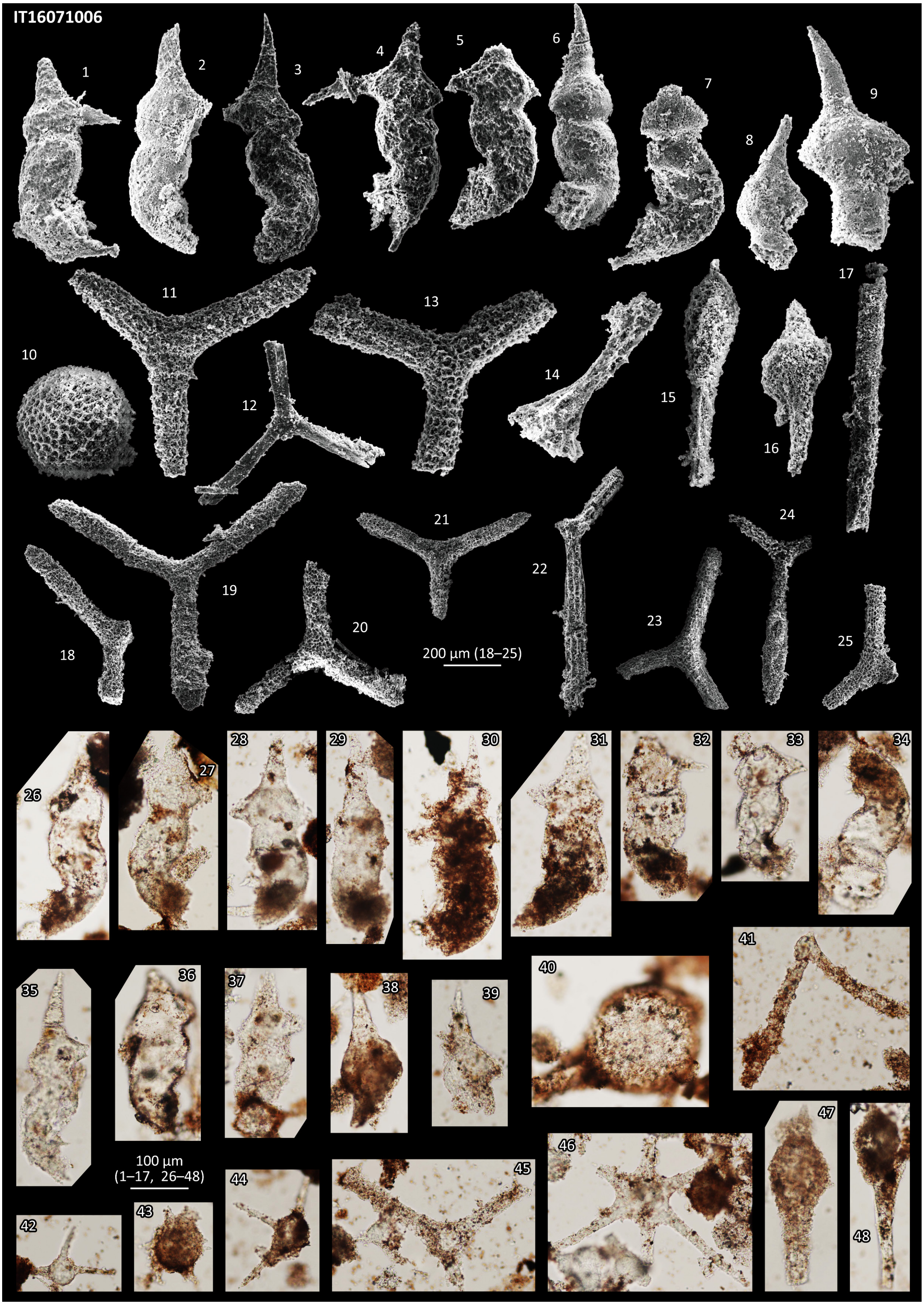
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Plate 3 Triassic radiolarians and conodont fragments from chert.

1: Spine B5 of Sugiyama (1997)
2: Spine A2 of Sugiyama (1997)
3, 4, 28, 30, 31, 33: Spine D1 of Sugiyama (1997)
5: Spine D2 of Sugiyama (1997)
6: *Pseudostylosphaera*? sp.
7, 9, 17, 20, 21, 23, 29, 51, 54–57: Spumellaria gen. et sp. indet.
8: Conodont fragment
10–16: *Mesosaturnalis*? sp.
18, 19, 22, 38: Nassellaria gen. et sp. indet.
24: *Capnodoce*? sp.
25–27: *Praehexasaturnalis* cf. *tenuispinosus* (Kozur and Mostler)
32: spine C of Sugiyama (1997)
34–37: *Triassocampe*? spp.
39–43: *Pseudostylosphaera japonica* (Nakaseko and Nishimura)
44–46: *Pseudostylosphaera* sp.
47, 48: *Pseudostylosphaera*? spp.
49: *Muelleritortis* sp.
50, 52, 53: *Capnodoce*? spp.


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100 µm (28–33)
IT16071402
100 µm (19–24)
100 µm (25–27)
IT16071403
100 µm (34–48)
200 µm (49–57)

Plate 4 Triassic radiolarians and sponge spicules from chert.

1–3, 5–10: *Mesosaturnalis octospinus* Sugiyama
4, 14–16: Spumellaria gen. et sp. indet.
11: *Capnodoce*? sp.
12: *Hozmadia*? sp.
13: *Tritortis*? sp.
17: *Spine of Capuchnosphaera*? sp.
18–21: *Triassocampe*? sp.
22: *Sarla*? sp.
23–26: *Pseudostylosphaera japonica* (Nakaseko and Nishimura)
27: *Pseudostylosphaera* sp.
28–30: *Pseudostylosphaera longispinosa* Kozur and Mostler
31, 32: sponge spicules
33: spicule
34: *Tritortis kretaensis* (Kozur and Krahl)

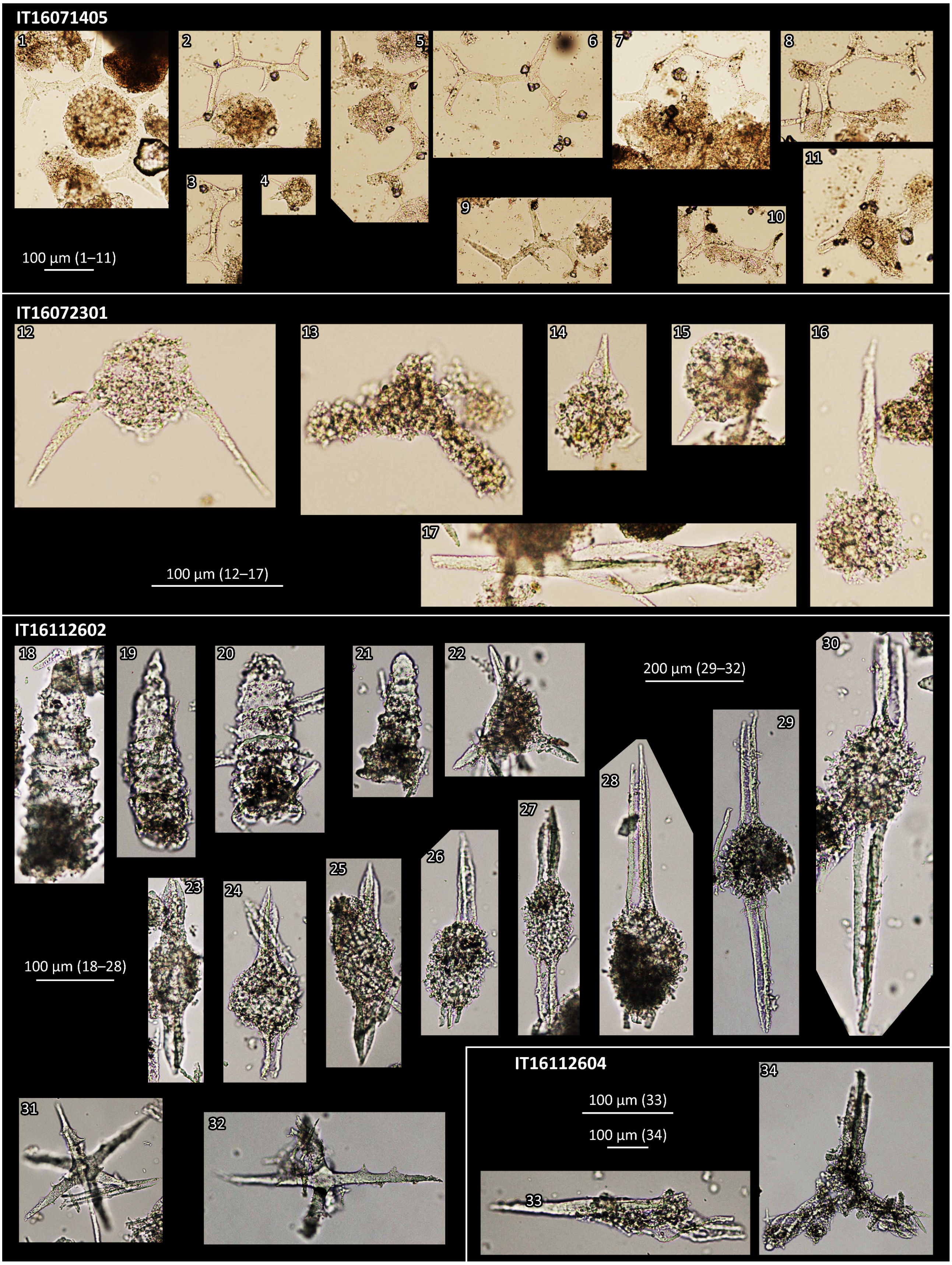
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Plate 5 Jurassic radiolarians from chert.

1–9, 12–19, 32–37, 39, 41–44, 50: Closed-end Nassellaria
20: *Protunuma*? sp.
10, 11, 21, 22, 26, 28–30, 38, 45, 48, 51, 58, 59: Nassellaria gen. et sp. indet.
23, 24: *Hsuum*? *matsuokai* Isozaki and Matsuda
25: *Parahsuum* sp.
27: *Parahsuum*? sp.
31, 46, 57: Spumellaria gen. et sp. indet.
40: *Eucytidiellum* sp.
47: *Pantanellium*? sp.
49: *Spinosicapsa*? sp.
52–56: *Praeparvicingula*? sp.
60: *Pantanellium* sp.
61: *Paronaella*? sp.

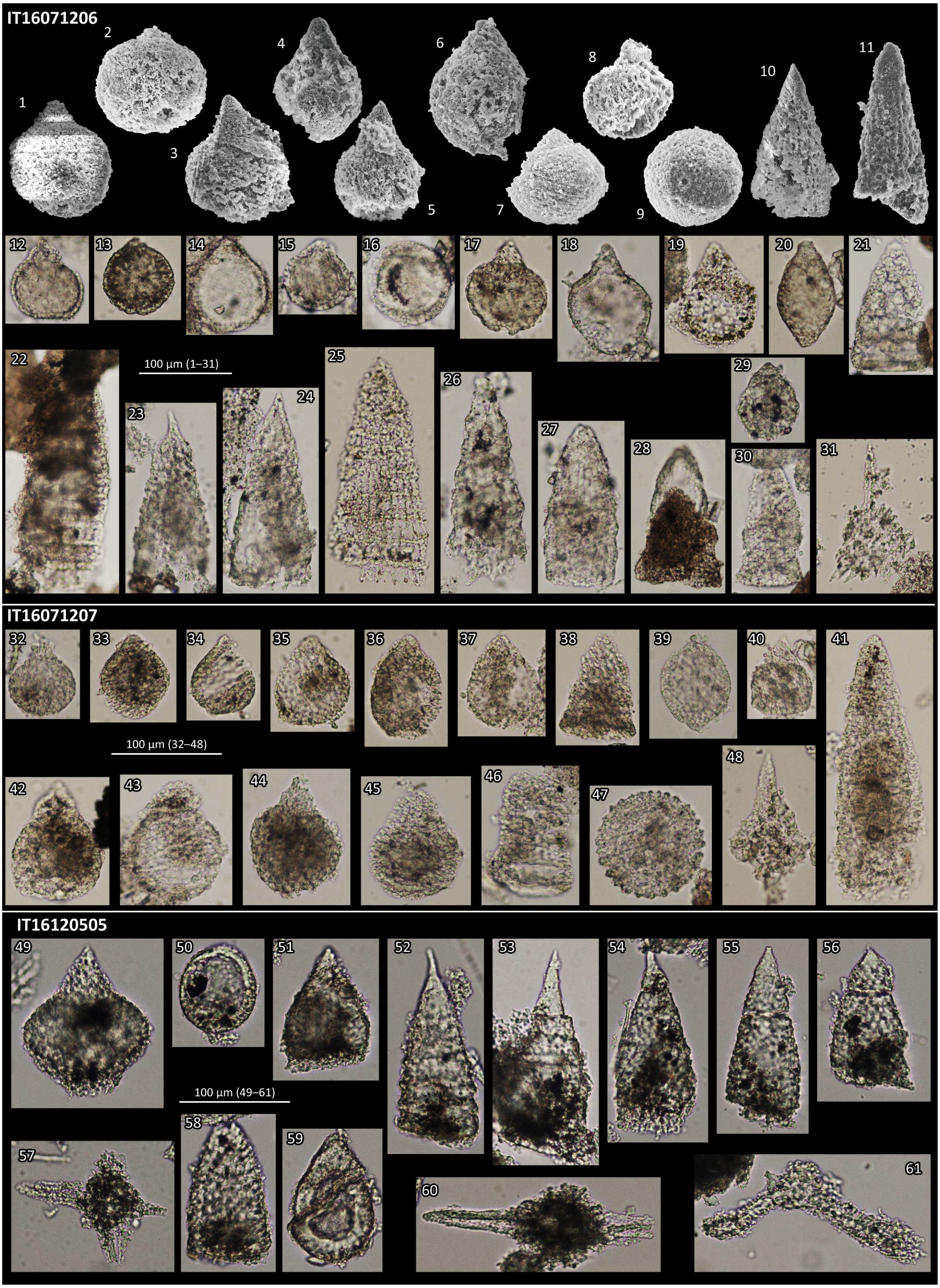
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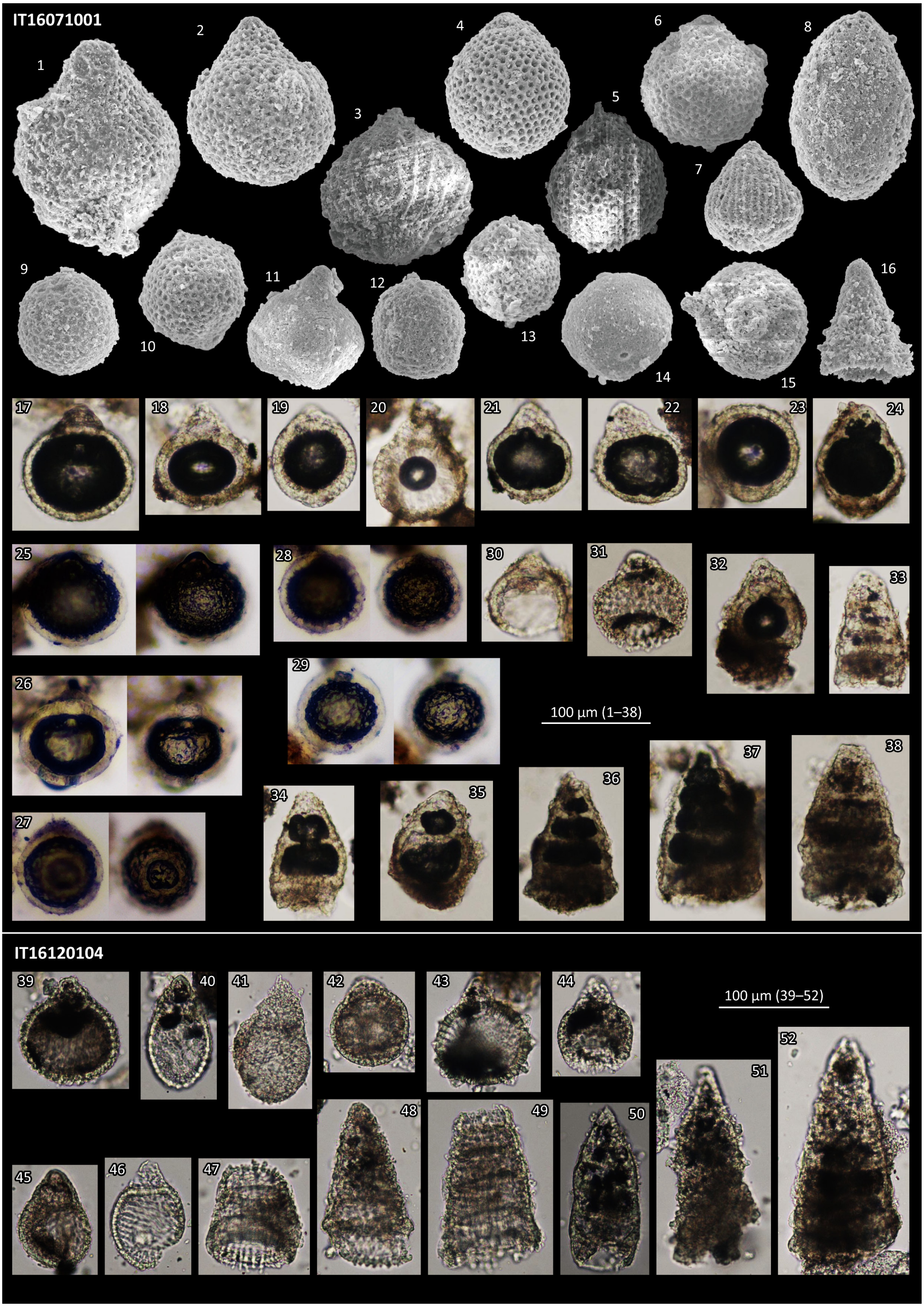
Plate 6 Jurassic radiolarians from siliceous mudstone.

1, 2, 4–6: *Stichocapsa*? sp.
3, 51: Nassellaria gen. et sp. indet.
7: *Striatojaponocapsa synconexa* O'Dogherty, Goričan and Dumitrica
8, 14: *Gongylothorax siphonofer* Dumitrica
32: *Eucytidiellum* sp.
9–13, 15, 17–31, 33, 39, 41–44, 47: Closed-end Nassellaria
16, 34–38: Nassellaria gen. et sp. indet.
40, 45, 46: *Minocapsa*? spp.
48: *Dictyomitrella*? *kamoensis* Mizutani and Kido
49, 50, 52: *Praeparvicingula*? spp.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