Occurrence report of Triassic and Jurassic radiolarians from the Jurassic accretionary complexes of the Ashio belt in eastern Mt. Narukami, Ashio Mountains, central Japan

ITO Tsuyoshi¹*, NAKAMURA Kazuya², HINOHARA Tatsuya³ and KURIHARA Toshiyuki⁴

ITO Tsuyoshi, NAKAMURA Kazuya, HINOHARA Tatsuya and KURIHARA Toshiyuki (2021) Occurrence report of Triassic and Jurassic radiolarians from the Jurassic accretionary complexes of the Ashio belt in eastern Mt. Narukami, Ashio Mountains, central Japan. Bulletin of the Geological Survey of Japan, vol. 72(4), p. 345–358, 10 figs.

Abstract: This article reports radiolarian occurrences from the Omama and Kurohone–Kiryu complexes of Jurassic accretionary complex of the Ashio belt, in eastern Mt. Narukami, Ashio Mountains, central Japan. Triassic radiolarians and conodont fragments were obtained from chert recovered from the Omama Complex. Bajocian and early Bathonian (Middle Jurassic) radiolarians were also extracted from mudstone in both the Omama and Kurohone–Kiryu complexes. In previous studies, Bajocian radiolarians had represented the youngest samples recovered from the mudstone at these complexes. Consequently, the lower Bathonian mudstone reported in the present study constitutes the youngest rock recovered from the Omama and Kurohone–Kiryu complexes to date.

Keywords: radiolaria, conodont, Ashio Mountains, accretionary complexes, Jurassic, Triassic, Ashio belt

1. Introduction

Jurassic accretionary complex of the Ashio belt is exposed around the Ashio Mountains in central Japan (Fig. 1). Kamata (1996) classified the complex into three tectonostratigraphic units: the Omama, Kurohone–Kiryu and Kuzu complexes. There are numerous radiolarian occurrence reports from the Kuzu Complex (e.g. Arakawa, 1986, 1997, 1998; Masuda, 1989; Kamata, 1995, 1996, 1997, 1999, 2000; Isogawa et al., 1998; Ootaka et al., 1998; Takayanagi et al., 2001; Motoki and Sashida, 2004), but fewer studies have reported those from the Omama and Kurohone–Kiryu complexes (Aono, 1985; Hayashi et al., 1990; Kamata, 1996; Takayanagi et al., 2001).

The authors (K. Nakamura and T. Hinohara) investigated the accretionary complex in eastern Mt. Narukami, part of the Ashio Mountains. As a result, some radiolarians were obtained from chert and mudstone. In particular, Middle Jurassic radiolarians were obtained from mudstone, which is significant because previous studies have shown just a few radiolarian images from the mudstone of the Kurohone–Kiryu Complex (Takayanagi et al., 2001) and no images from the mudstone of the Omama Complex. This article reports these radiolarian occurrences, which show Middle Jurassic radiolarians with images produced by scanning electronic microscopy (SEM) from the mudstone of the complexes. Furthermore, mudstone samples from both complexes in this study also yielded early Bathonian (Middle Jurassic) radiolarians. The youngest radiolarians from these complexes in previous studies were Bajocian species (e.g. Kamata, 1996), indicating that the present results represent the new youngest samples recovered from these complexes.

2. Geologic outline

The Jurassic accretionary complex is exposed widely in the Ashio Mountains (Fig. 1). Kamata (1996) classified the complex into three tectonostratigraphic units: the Kurohone–Kiryu, Omama and Kuzu complexes. The Kurohone–Kiryu Complex comprises mainly mudstone and chert, as well as common siliceous claystone and small amounts of limestone, siliceous mudstone and sandstone. The Omama Complex is composed mainly of basalt, chert and pelitic rock, while also featuring small amounts of limestone, siliceous mudstone and sandstone. The study area is located in eastern Mt. Narukami. The Omama and Kurohone–Kiryu complexes are

¹ AIST, Geological Survey of Japan, Research Institute of Geology and Geoinformation
² Nishiki, Nagaoka 940-0835, Japan
³ KITAC Co. Ltd., Niigata 950-0965, Japan
⁴ Graduate School of Science and Technology, Niigata University, Niigata 950-2181, Japan
* Corresponding author: ITO, T., Central 7, 1-1-1 Higashi, Tsukuba, Ibaraki 305-8567, Japan. Email: ito-t@aist.go.jp
distributed over this area (Kamata, 1996). Based on both an investigation by the author (Ito, T.) and previously-published geologic map (e.g. Sudo et al., 1991; Kamata, 1996; Geological Survey of Japan, AIST, 2018), four sample localities (110823-2, 111011-1, 111013-5 and 111013-4) are located in the distributional area of the Omama Complex, whereas two sample localities (OYK53-02, HTH12-01) are located in that of the Kurohone–Kiryu Complex (Fig. 2).

3. Materials and methods

In total, 232 samples were collected. The samples were soaked in a 5% hydrofluoric acid (HF) solution for 10–24 hours. Following this process, residues were collected through a sieve (opening: 64 μm), with the residues then washed using ethanol. Radiolarian tests within the dried residues were picked up using a stereomicroscope. The chosen radiolarian tests were conducted using SEM (JEOL JSM-5600) at Niigata University.

4. Radiolarian fauna and age assignments

As mentioned previously, four radiolarian occurrence sites are located in the distributional area of the Omama Complex, whereas two in the Kurohone–Kiryu Complex. The age assignments of each sample, summarized in Fig. 3, are described in this section.

4.1 Omama Complex

4.1.1 Chert [110823-2]

This sample yielded Pseudostylosphaera? sp. (Figs. 4.1–4.6), Triassocampe? sp. (Fig. 4.7), Hozmadia? sp. (Fig. 4.8) and conodont fragments (Figs. 4.9–4.11). The occurrence ranges of Pseudostylosphaera, Triassocampe and Hozmadia are the late Olenekian–early Carnian (Early–Late Triassic), Anisian–early Norian (Middle–Late Triassic) and late Olenekian–Carnian (Early–Late Triassic) ages, respectively (O’Dogherty et al., 2009b). Thus, this study tentatively regards the sample as corresponding in age to the Anisian–early Carnian (Middle–Late Triassic).

4.1.2 Mudstone [111011-1]

This sample yielded Striatojaponocapsa sp. cf. S. synconexa O’Dogherty, Goričan and Dumitrica (Figs. 5.13, 5.25), Japonocapsa sp. cf. J. japonica (Yao) (Fig. 5.3) and Yaocapsa sp. cf. Y. mastoidea (Yao) (Fig. 5.32). Striatojaponocapsa synconexa occurred in the upper Striatojaponocapsa plicarum Zone (JR4) to the lower Striatojaponocapsa conexa Zone (JR5) of the Bathonian.
Middle Jurassic (Matsuoka and Ito, 2019); *Yaocapsa mastoidea* occurred only in upper JR4, lower Bathonian, Middle Jurassic (Matsuoka, 1995). The co-occurrence of *Striatojaponocapsa synconexa* and *Yaocapsa mastoidea* is limited in upper JR4 of the lower Bathonian. Consequently, the age of this sample is dated to the early Bathonian.

### 4.1.3 Mudstone [111013-4]

This sample yielded *Striatojaponocapsa plicarum* (Yao) (Fig. 6.1). According to the occurrence range shown by Matsuoka and Ito (2019), this species occurred mainly in lower–middle JR4, Bajocian, Middle Jurassic. Thus, this sample is the Bajocian in age.

### 4.1.4 Mudstone [111013-5]

This sample yielded no radiolarian valuable in terms of detailed age assignment. However, closed nassellarians that occurred abundantly in the Jurassic (e.g. O’Dogherty *et al.*, 2009a) were obtained from this sample (Fig. 7). This article tentatively regards the age of this sample as being...
Fig. 3  Age of the sample reported in this study. The radiolarian zones are based on Sugiyama (1997) and Matsuoka and Ito (2019).

Fig. 4  Triassic radiolarian and conodont fragment from the chert of the Omama Complex. (1–6) Pseudostylosphaera? sp. (7) Triassocampe? sp. (8) Hozmadia? sp. (9–11) Conodont fragment.
Fig. 5  Middle Jurassic radiolarians from the Omama Complex. (1, 2, 4–12, 14–17, 19–22, 24, 36) Closed nassellarian. (3) Japonocapsa sp. cf. J. japonica (Yao). (13, 25) Striatojaponocapsa sp. cf. S. conexa (Matsuoka). (23, 26–31, 33–35) Nasseilaria gen. et sp. indet. (18, 32) Yaocapsa sp. cf. Y. mastoidea (Yao).
Fig. 6  Middle Jurassic radiolarians from the Omama Complex. (1) *Striatojaponocapsa* sp. cf. *S. plicarum* (Yao). (2–20, 22, 23, 25–28) Closed nassellarian. (21, 29) *Eucyritidiellum* sp. (24, 30–35) Nassellaria gen. et sp. indet.
Fig. 7  Middle Jurassic radiolarians from the Omama Complex. (1–17) Closed nassellarian. (18–26) Nassellaria gen. et sp. indet.
from the Jurassic.

4.2 Kurohone–Kiryu Complex

4.2.1 Mudstone [HTH12-01]

This sample yielded *Japonocapsa* cf. *J. mastoidea* (Figs. 8.1–8.5) and others (Fig. 9). *Japonocapsa mastoidea* occurred only in upper JR4 of the lower Bathonian, Middle Jurassic, according to Matsuoka (1995). The age of this sample is therefore the early Bathonian.

4.2.2 Mudstone [OYK53-02]

This sample yielded *S. plicarum* (Figs. 10.1, 10.4) and others. *Striatojaponocapsa plicarum* occurred mainly in lower–middle JR4, Bajocian, Middle Jurassic (Matsuoka and Ito, 2019). Consequently, the age of this sample is the Bajocian.

5. Paleontological note

The preservation of radiolarian fossils is generally poor; however, some radiolarians were identifiable. This section notes representative radiolarian species among the identifiable specimens. Descriptions of the species examined in this study mainly employ the taxonomic classification used by De Wever et al. (2001) and O’Dogherty et al. (2009a, b).

Subclass *RADIOLARIA* Müller, 1858

Order *ENTACTINARIA* Kozur and Mostler, 1982

Family *HINDEOSPHERAIDAE* Kozur and Mostler, 1981

Genus *Pseudostylosphaera* Kozur and Mostler, 1981

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

**Pseudostylosphaera**? sp.

Figs. 4.1–4.6

**Remarks:** This genus is characterized by having a spherical shell with two robust polar spines (Kozur and Mostler, 1981). Because of their poor preservation, the specimens are placed under *Pseudostylosphaera* with a question mark.

Order *NASSELLARIA* Ehrenberg, 1875

Family *RUDESTCYRTIIDAE* Kozur & Mostler, 1979

Genus *Triassocampe* Dumitrica, Kozur and Mostler, 1980

Type species *Triassocampe scalaris* Dumitrica, Kozur and Mostler, 1980

**Triassocampe**? sp.

Fig. 4.7

**Remarks:** The genus *Triassocampe* is characterized by having a long, slightly conical to subcylindrical multi-segmented shell without an apical horn (Dumitrica et al., 1980). The specimen also possesses a conical multi-segmented shell. Meanwhile, some genera, such as *Annullotriassocampe* Kozur, have similar outlines (e.g., Kozur and Mostler, 1994). Because of poor preservation, the specimen lacks pores in segments, which are one of the distinguishable characteristics. This study therefore regards the specimen as *Triassocampe* with a question mark.

Family *POULPIDAE* De Wever, 1981

Genus *Hozmadia* Dumitrica, Kozur and Mostler, 1980

Type species *Hozmadia reticulata* Dumitrica, Kozur and Mostler, 1980

**Hozmadia**? sp.

Fig. 4.8

**Remarks:** The specimen has a globular cephalis with an apical horn and downward spine. The genus *Hozmadia* Dumitrica, Kozur and Mostler, is characterized by having a globular cephalis with an apical horn and three downward spines (Dumitrica et al., 1980). Meanwhile, some genera, such as *Yeharaia* Nakaseko and Nishimura, possess similar shells (e.g. Nakaseko and Nishimura, 1979). This study therefore regards the specimen as *Hozmadia* with a question mark.

Family *SYRINGOCAPSIDAE* Foreman, 1973, emend.

Kozur, 1984

Subfamily *JAPONOCAPSINAE* Kozur, 1984

Genus *Japonocapsa* Kozur, 1984

Type species *Tricolocapsa (?) fusiformis* Yao, 1979

**Japonocapsa** sp. cf. *J. japonica* (Yao, 1979)

Fig. 5.3

**Remarks:** *Japonocapsa japonica* is characterized by having a spherical cephalis, a truncate-conical thorax and abdomen and a flattened-spherical fourth segment (Yao, 1979). The outline of the specimen is similar to this species, although the surface structure is not preserved.

Genus *Yaocapsa* Kozur, 1984

Type species *Cyrtocapsa mastoidea* Yao, 1979

**Yaocapsa** sp. cf. *Y. mastoidea* (Yao, 1979)

Figs. 5.18, 5.32, 8.1–8.5

**Remarks:** *Yaocapsa mastoidea* is characterized by having a large last segment (Yao, 1979). The specimens also have large last segment, although its preservation is poor.

Genus *Striatojaponocapsa* Kozur, 1984

Type species *Tricolocapsa plicarum* Yao, 1979

**Striatojaponocapsa** sp. cf. *S. synconexa* O’Dogherty, Goričan and Dumitrica, 2005

Figs. 5.13, 5.25

**Remarks:** Hataked et al. (2007) studied the morphology and lineage of *Striatojaponocapsa plicarum* (Yao) and its affinities, such as *Striatojaponocapsa synconexa* and *Striatojaponocapsa conexa* (Matsuoka), in detail. According to the study, *Striatojaponocapsa synconexa* has...
Fig. 8. Middle Jurassic radiolarians from the Kurohone–Kiryu Complex. (1–5) Yaocapsa sp. cf. Y. mastoidea (Yao). (6–23) Closed nassellarian. (24) Eucyritidiellum sp.
Fig. 9  Middle Jurassic radiolarians from the Kurohone–Kiryu Complex. (1–20) Nassellaria gen. et sp. indet.
Fig. 10  Middle Jurassic radiolarians from the Kurohone–Kiryu Complex. (1, 4) *Striatojaponocapsa* sp. cf. *S. plicarum* (Yao). (2, 3, 5) Closed nassellarian. (6) *Eucyritidiellum* sp. (7) *Archaeodictyomitra* sp. (8–18) *Hsuum* sp. (19) *Parahsuum* sp. (20) *Paronaella?* sp.
a small basal appendage with a circular depression. The specimens examined in this study have these characteristics as well. Although their surfaces are poorly preserved, the basal appendages seem to be small (possibly less than 30 μm in width). This is consistent with the measurement of the basal appendages of *Striatojaponocapsa synconexa* by Hatakeda et al. (2007).

*Striatojaponocapsa* sp. cf. *S. plicarum* (Yao, 1979)
Figs. 6.1, 10.1, 10.4
Remarks: *Striatojaponocapsa plicarum* is characterized by having a dish-like basal appendage with longitudinal rows of pores (Yao, 1979; Hatakeda et al., 2007). The basal appendage with pores is recognized in one specimen (Fig. 6.1). Other specimens (Figs. 10.1, 10.4) also have a small basal appendage, although the surface structure and pores are unclear.

Family **EUCYRTIDIELLIDAE** Takemura, 1986
Genus *Eucyrtidiellum* Baumgartner, 1984
Type species *Eucyrtidium (?) unumaensis* Yao, 1979

**Eucyrtidiellum** sp.
Figs. 6.21, 6.29, 8.24, 10.6
Remarks: The examined specimens have a subspherical cephalis, a truncated conical to hemispherical thorax and an inflated cylindrical abdomen. These characteristics fit within the parameters of *Eucyrtidiellum* (Monosera Takemura and Nakaseko, by Takemura and Nakaseko, 1986).

Family **ARCHAEODICTYOMITRIDAE** Pessagno, 1976
Genus *Archaeodictyomitra* Pessagno, 1977
Type species *Archaeodictyomitra squinaboli* Pessagno, 1976

**Archaeodictyomitra** sp.
Fig. 10.7
Remarks: The examined specimen has linearly-arranged, continuous costae with pores in a single row between the costae. The specimen possesses no primary pores. These are the characteristics of *Archaeodictyomitra* (Pessagno, 1977).

Family **HSUIDAE** Pessagno and Whalen, 1982
Genus *Hsuum* Pessagno, 1977
Type species *Hsuum cuestaensis* Pessagno, 1977

**Hsuum** sp.
Fig. 10.8–10.18
Remarks: The examined specimen has linearly-arranged, continuous costae with pores in two or three rows between the costae. These are the characteristics of *Hsuum* (Pessagno, 1977).

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

**Parahsuum** sp.
Fig. 10.19
Remarks: The examined specimen has linearly-arranged, continuous costae with pores in a single row between the costae, with primary pores. These are the characteristics of *Parahsuum* (Yao, 1982).

Order **SPUMELLARIA** Ehrenberg, 1875
Family **ANGULOBRAChCIDAE** Baumgartner, 1980
Genus *Paronaella* Pessagno 1971
Type species *Paronaella solanoensis* Pessagno, 1971

**Paronaella** sp.
Fig. 10.20
Remarks: The examined specimen has three rays with meshwork surfaces. The shell of the specimen is similar to this genus; however, some genera, such as *Patulibrachchium* Pessagno, have similar outlines (e.g. Pessagno, 1971). This article therefore regards the specimen as *Paronaella* with a question mark.

Acknowledgments: The authors wish to thank Emer. Prof. HASEGAWA Yoshiyuki, Emer. Prof. TAZAWA Jun-ichi, Prof. MATSUOKA Atsushi, Dr. NIKAWA Isao and other members of the Historical Earth Science Seminar at Niigata University for their helpful comments and suggestions. We would also like to thank Dr. HARA Kouyouke for his help and support during the fieldwork. Many thanks are due to Dr. KAMATA Yoshihito (University of Tsukuba) for his critical review of the manuscript.

References
Aono, H. (1985) Geologic structure of the Ashio and Yamizo Mountains with special reference to its tectonic evolution. *Science reports of the Institute of Geoscience, University of Tsukuba. Section B, Geological Sciences*, 6, 21–57.
Arakawa, R. (1986) Upper Paleozoic and Mesozoic strata in the southeastern part of the Ashio Mountains. *Bulletin of the Tochigi Prefectural Museum*, no. 3, 1–37. (in Japanese with English abstract)
Arakawa, R. (1997) Jurassic radiolarian succession from the siliceous mudstone in the Kuzuu area of the Ashio terrane, central Japan. *Bulletin of the Tochigi Prefectural Museum*, no. 14, 1–19. (in Japanese with English abstract)
Arakawa, R. (1998) Middle Jurassic radiolarian assemblages from Manganese dioxide nodules, Kuzuu area of Ashio terrane, central Japan. *Bulletin of the Tochigi Prefectural Museum*, no. 15, 51–76. (in Japanese with English abstract)
Baumgartner, P. O. (1980) Late Jurassic Hagiastridae and Patulibrachiidae (Radiolaria) from the Argolis Peninsula (Peleponnese, Greece). *Micropaleontology*, 26, 274–322.
Baumgartner, P. O. (1984) A Middle Jurassic–Early
Cretaceous low latitude radiolarian zonation based on unitary associations and age of Tethyan radiolarites. *Ecolegae Geologicae Helveticae*, 77, 729–841.

De Wever, P. (1981) Une nouvelle sous-famille, les Poulipinae, et quatre nouvelles espèces de Saitoum radiolaires mésozoïques tethysiens. *Geobiots*, 14, 5–15. (in French with English abstract)

De Wever, P., Dumitrica, P., Caulet, J. P., Nigrini, C. and Cardiroit, M. (2001) Radiolarians in the *Sedimentary Record*. Gordon and Breach Science Publishers, Singapore, 533p.

Dumitrica P., Kozur H. and Mostler H. (1980) Contribution to the radiolarian fauna of the Middle Triassic of the Southern Alps. *Geologisch Paläontologische Mitteilungen Innsbruck*, 10, 1–46.

Ehrenberg C. G. (1875) *Fortsetzung der mikrogeologischen Studien als Gesamm-t-Uebersicht der mikroskopischen Paläontologie gleichartig analysirter Gebirgsarten der Erde, mit spezieller Rucksicht auf den Polycystinen-Mergel von Barbados*. Abhandlungen der königlichen preussichen Akademie der Wissenschaften zu Berlin, 23–31. (in Japanese with English abstract)

Foreman, H.P. (1973) Radiolaria from DSDP Leg 20. In *Heezen, B.C., MacGregor, I.D., Foreman, H.P., Forristall, G., Hekel, H., Hesse, R., Hoskins, R.H., Jones, E.J.W., Kaneps, A.G., Krasheninnikov, V.A., Okada, H. and Ruff, M.H.*, *Eds., Initial Reports of the Deep Sea Drilling Project*, 63, 1–25. (in German)

Geological Survey of Japan, AIST (2018) Seamless digital geological map of Japan 1:200,000. January 26, 2018 version. Geological Survey of Japan, AIST. https://gbank.gsj.jp/seamless/v2full/ (Accessed: 2018-1-26)

Hataked, K., Suzuki, N. and Matsuoka, A. (2007) Quantitative morphological analyses and evolutionary history of the Middle Jurassic polycystin radiolarian genus *Striatojaponocapsa* Kozur. *Marine Micropaleontology*, 63, 39–56.

Hayashi, S., Iijima, S., Ishii, I., Nakajima, T., Sawaguchi, H., Tanaka, H. and Yoshida, T. (1990) Late Paleozoic to Mesozoic formations in the southwestern Ashio Mountains. *Bulletin of the Gunma Prefectural Museum of History*, no. 11, 1–34. (in Japanese with English abstract)

Isogawa, J., Aita, Y. and Sakai, T. (1998) Early Triassic radiolarians from the bedded chert in the Minowa quarry, Kuzuzu Town, Tochigi Prefecture. *News of Osaka Micropalaeontologists (NOM), Special Volume*, no. 11, 81–93. (in Japanese with English abstract)

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

Kamata, Y. (1996) Tectonostratigraphy of sedimentary complex in the southern part of the Ashio terrane, central Japan. *Science reports of the Institute of Geoscience, University of Tsukuba. Section B, Geological Sciences*, 17, 71–107.

Kamata, Y. (1997) Reconstruction of chert–clastic sequence of the Ashio terrane in the Kuzu area, central Japan. *The Journal of the Geological Society of Japan*, 103, 343–356. (in Japanese with English abstract)

Kamata, Y. (1999) Lower Triassic (Spathian) radiolarians from the Kuzu area (Tochigi Prefecture, central Japan). *Geodiversitas*, 21, 657–673.

Kamata, Y. (2000) Imbricate structure of chert–clastic sequence of the Kuzu Complex in the Shiraiwa area of the Ashio belt, central Japan. *The Memoirs of the Geological Society of Japan*, no. 55, 203–221. (in Japanese with English abstract)

Kozur, H. (1984) New radiolarian taxa from the Triassic and Jurassic. *Geologisch Paläontologische Mitteilungen Innsbruck*, 13, 49–88.

Kozur, H. and Mostler, H. (1979) Beiträge zur Erforschung der mesozoischen Radiolarien. Teil III: Die Oberfamilien Actinommaecae Haeckel, 1862 emend., Artiscacea Haeckel, 1882, Multiarcusellacea nov. der Spumellaria und triassische Nassellaria. *Geologisch Paläontologische Mitteilungen Innsbruck*, 9, 1–132. (in German with English abstract)

Kozur, H. and Mostler, H. (1981) Beiträge zur Erforschung der mesozoischen Radiolarien. Teil IV: Thalassosphaeracea Haeckel, 1862, Hexasteracea Haeckel, 1862 emend. Petrushevskaya, 1979, Sponguracea Haeckel, 1862 emend. und weitere triassische Lithocyclacea, Trematodiscacea, Actinommaecae und Nassellaria. *Geologisch-Paläontologische Mitteilungen Innsbruck*, 1, 1–208. (in German with English abstract)

Kozur, H. and Mostler, H. (1982) Entactinaria Subordo nov., a new radiolarian suborder. *Geologisch Paläontologische Mitteilungen Innsbruck*, 11, 399–414.

Kozur, H. and Mostler, H. (1994) Anisian to Middle Carnian radiolarian zonation and description of some stratigraphically important radiolarians. *Geologisch-Paläontologische Mitteilungen Innsbruck*, 3, 39–255.

Masuda, S. (1989) Jurassic radiolarian fossils in the Hachioji Hill. *Research reports, Ashikaga Institute of Technology*, no. 15, 207–214. (in Japanese with English abstract)

Matsuoka, A. (1995) Jurassic and Lower Cretaceous radiolarian zonation in Japan and in the Western Pacific. *The Island Arc*, 4, 140–153.

Matsuoka, A. and Ito, T. (2019) Updated radiolarian zonation for the Jurassic in Japan and the western Pacific. *Science Reports of Niigata University (Geology)*, no. 34, 49–57.

Motoki, H. and Sashida, K. (2004) Preliminary report on the chronological and lithostratigraphical studies of the Toishi-type shale (siliceous claystone) distributed in the Ashio Mountains, central Japan. *News of Osaka
足尾山地鳴神山東方地域から産出した三畳紀・ジュラ紀放散虫化石の報告

伊藤 剛・中村和也・日野原達哉・栗原敏之

要 旨

本論では、足尾山地鳴神山東方に分布する足尾帯ジュラ紀付加体の大間々コンプレックス及び黒保根桐生コンプレックスから産出した放散虫を報告する。三畳紀放散虫及びコノドント片が大間々コンプレックスのチャートから産出した。中期ジュラ紀のバッジョシアン期及びバトニアン前期の放散虫が大間々コンプレックスと黒保根桐生コンプレックスの泥岩から得られた。先行研究で両コンプレックスから報告された中では、泥岩に含まれるバッジョシアン期の放散虫が最若期の記録であった。従って、本研究で報告したバトニアン階下部の泥岩は、より若い記録となる。