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Data

Late Anisian (Middle Triassic) Radiolarians from a Chert Pebble Within the Conglomerate Bed of the Upper Lower Miocene Kurosedani Formation in Toyama Prefecture of Central Japan

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下部中新統上部黒瀬谷層の礫岩層中のチャート礫から産したAnisian後期（三畳紀中世）放散虫化石

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1. Introduction

Neogene marine sedimentary rocks in Toyama Prefecture of central Japan contain different kinds of mega-and micro-fossils abundantly, which contributed towards both the age assignments and paleo-environmental analysis for each stratum. Additionally, the conglomerate beds are intercalated within some horizons of the Neogene system. The clast composition of these conglomerates is an important source of information about the provenance of each stratum. The siliceous clasts such as chert and siliceous mudstone frequently contain abundant radiolarians, and are therefore considered as important tools for provenance analysis. However, for the Neogene strata in Toyama Prefecture, radiolarian occurrences in the siliceous clasts in conglomerate beds are mostly restricted to Kashiwagi (2012). This study reports the occurrence of a late Anisian (Middle Triassic) radiolarian assemblage from a chert pebble collected from the lower Miocene Kurosedani Formation.

2. Geological outline

Neogene strata along the Jinzu River in Toyama Prefecture consists of the Nirehara, Iwaine, Kurosedani, Higashibessho, and Otogawa formations in ascending order (Tsuda, 1953). The studied outcrop is located near the base of the river cliff along the Do-gawa River, a tributary of the Jinzu River. Since this fossil locality is famous for bearing abundant invertebrate mega-fossils, it is well known as Ikuridani or Tsuzara among fossil collectors (e.g., Tsuda, 1959, 1960; Kaneko and Goto, 1992; Hirayama et al., 1997). The study section consists of thick-stratified massive mudstone with intercalating Yamadanaka Tuff bed and conglomerate bed. The Yamadanaka Tuff bed bounds the Kurosedani Formation and its overlying Higashibessho Formation with its upper limit horizon. The Yamadanaka Tuff bed shows zircon U-Pb age of 16.6±0.2 mega-annum (Ma) (Nakajima *et al.*, 2019), which corresponds to the latest Early Miocene.

The conglomerate bed located within the uppermost Kurosedani Formation, contains numerous invertebrate fossils like bivalves, gastropods, scaphopods, decapods, balanoids, and few vertebrate fossils like turtle and whale bones, shark teeth, and bony fish otoliths (Kaneko and Goto, 1992). Due to seafloor erosion, the composition of the clast transported from the exposed strata near the source includes abundant volcanic rocks and reworking siltstones. Chert clasts are probably very rare, because the red chert pebble studied in this paper is the sole sample found at this location.

3. Radiolarians

Upon studying the red chert pebble collected from the conglomerate bed in the studied section, the author found that it had abundant radiolarians as observed by thin-section microscopy. Therefore, I carried out a radiolarian analysis for further paleontological studies. The method being used to extract radiolarians involved the following steps. The sample was first crushed into a few fragments and then processed with diluted hydrofluoric acid (5% HF) for 18-24 h. Next step involved passing the processed residue through sieves at 63-425 μm intervals, and then boiling it in a mixture containing hydrochloric acid, nitric acid, and water in an evaporating dish to remove clay minerals. Then the processed residue was washed under running water and dried on an oven hot plate at ～100° C. The radiolarian residue was picked and mounted on a Scanning Electron Microscope (SEM) stub using a thin paintbrush under a binocular stereomicroscope. The final step involved photographing them under a SEM (Hitachi TM 3030) at the laboratory of the Division of Instrumental Analysis, University of Toyama.

The radiolarians identified are listed: *Triassocampe deweveri* (Nakaseko and Nishimura, 1979), *Triassocampe* (?) sp. G sensu Yao (1982), *Triassocampe* sp., *Spinotriassocampe annulata* (Nakaseko and Nishimura, 1979), *Poulpus* sp., *Eucyrtis* sp., *Pseudostylosphaera japonica* (Nakaseko and

Nishimura, 1979), *Pseudostylosphaera spinosa* (Nakaseko and Nishimura, 1979), *Eptingium manfredi* Dumitrica, 1978, *Eptingium ramovsi* Kozur *et al.*, 1996, *Pentactinocarpus awaensis* (Nakaseko and Nishimura, 1979), *Cenosphaera parvispinosa* Kozur *et al.*, 1996, *Cenosphaera* sp. A, *Tiborella* sp. *Plafkerium* sp. A, *Plafkerium* sp. B, *Plafkerium* sp. C, *Muelleritortis* sp. and Nassellaria gen. et sp. indet. Radiolarian zones and their age assignments are followed mainly by Sugiyama (1997). Five species, *T. deweveri*, *S. annulata*, *P. japonica*, *P. awaensis*, and *E. manfredi*, occurred in the upper and lower parts of TR 2C and TR 3B, respectively (late Anisian-earliest Ladinian) (Sugiyama, 1997). *Triassocampe* (?) sp. G, which was described from the lower half horizon of the *Triassocampe deweveri* assemblage zone (Yao, 1982), corresponded to TR 2C-TR 3B, thereby indicating that the interval lied between the middle Anisian and middle Ladinian (Sugiyama, 1997). In summary, the radiolarian chert pebble from the uppermost Lower Miocene conglomerate of the Kurosedani Formation indicates a late Anisian age.

4. Brief discussion

In terms of the lithofacies and radiolarian assemblage, the red chert pebble collected from the uppermost Kurosedani Formation was similar to the Middle Triassic red bedded chert obtained from the Jurassic accretionary complex in East Asia. Provenance analysis of the chert gravels in the Imozu Conglomerate Member of the possible Middle Lower Miocene Nirehara Formation in Toyama Prefecture showed that the possible source areas of chert pebbles and cobbles, which indicated the Early Permian, Middle and Late Triassic, and early Middle Jurassic in age, were likely a Jurassic accretionary complex and/or Cretaceous-Paleogene sediments containing chert clasts derived from the Jurassic accretionary complexes (Kashiwagi, 2012). In conclusion, similar to the Nirehara Formation, the Jurassic accretionary complex and/or Cretaceous-Paleogene sedimentary strata probably cropped out in the area of the provenance of the Kurosedani Formation around 16.6 Ma.

5. Systematic Paleontology

Morphospecies unidentifiable in specific level are only explained in this chapter.

Triassocampe sp.

Figure 1.4

Remarks.—The illustrated specimen differs from *T. deweveri* by having a much less inflated test.

Poulpus sp.

Figure 1.9

Remarks.—The illustrated material consists of a large globular cephalis with two bladed feet. *Poulpus* is distinguishable from *Hozmadia* in having no apical horn.

Eucyrtis sp.

Figure 1.8

Remarks.—Although the illustrated specimen is an internal mold, segmental partitions are visible in the proximal portion of the test.

Nassellaria gen. et sp. indet.

Figures 1.6, 1.7

Remarks.—The examined materials have a triangular outline and displays a smooth surface. Due to the poorly preserved and somewhat broken specimens, it is quite difficult to identify them even at the family level.

Cenosphaera sp.

Figure 1.14

Remarks.—This morphotype is similar in the pattern of pore frames and diameter of shell to *Acanthosphaera carterae* Kozur *et al.*, 1996, but the latter species is characterized by the presence of tiny spines on cortical shell.

Plafkerium sp. A

Figure 1.18

Remarks.—The examined specimen is incomplete due to the lack of one spine. The three remaining spines show a clockwise spiral from its base to its tip. This specimen has clockwise-twisted spines similar to *Plafkerium abbotti* Pessagno, 1979 in Pessagno *et al.* (1979) and *Tetraspongodiscus cincinnalis* (Bragin, 2011), but differs from the former by having a smaller cortical test and shorter spines, and from the latter by having thicker spine at its base.

Plafkerium sp. B

Figure 1.12

Remarks.—The examined specimen is poorly preserved as indicated by the two broken spines. *Plafkerium* sp. B resembles *Plafkerium* sp. A in having clockwise twisted spines distally, but differs from the latter due to its longer spines.

Plafkerium sp. C

Figure 1.17

Remarks.—This morphospecies has four spines positioned crosswise in one plane at equal angles to each other.

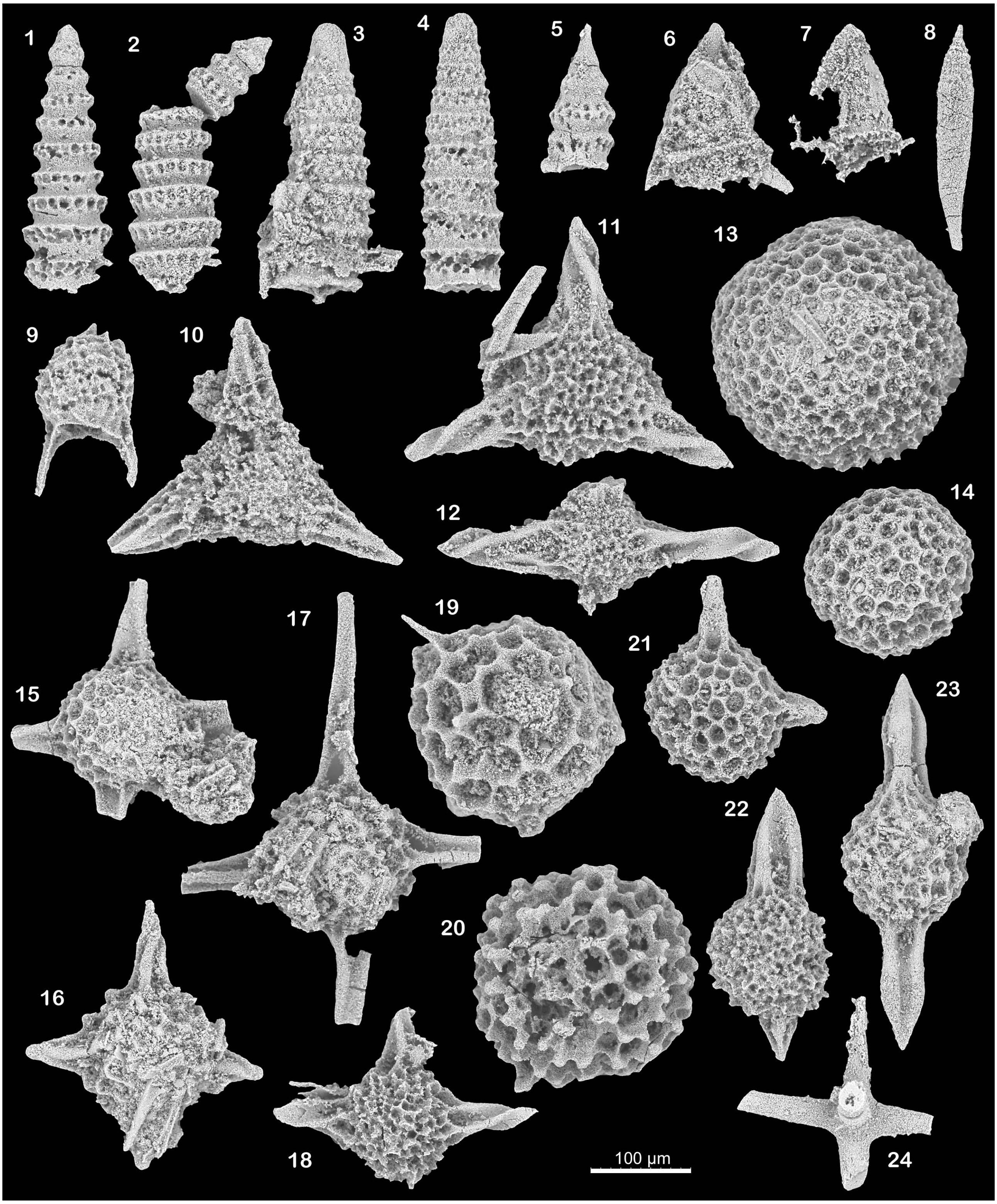

Fig. 1. Late Anisian (Middle Triassic) radiolarians from a chert pebble collected from the upper horizon of the Kurosedani Formation. 1, 2. *Triassocampe* (?) sp. G sensu Yao, 1982. 3. *Triassocampe deweveri* (Nakaseko and Nishimura, 1979). 4. *Triassocampe* sp. 5. *Spinotriassocampe annulata* (Nakaseko and Nishimura, 1979). 6, 7. Nassellaria gen. et sp. indet. 8. *Eucyrtis* sp. 9. *Poulpus* sp. 10. *Eptingium manfredi* Dumitrica, 1978. 11. *Eptingium ramovsi* Kozur *et al.*, 1996. 12. *Plafkerium* sp. B. 13. *Cenosphaera parvispinosa* Kozur *et al.*, 1996. 14. *Cenosphaera* sp. 15, 21. *Tiborella* sp. 16. *Muelleritortis* sp. 17. *Plafkerium* sp. C. 18. *Plafkerium* sp. A. 19, 20. *Pentactinocarpus awaensis* (Nakaseko and Nishimura, 1979). 22. *Pseudostylosphaera spinosa* (Nakaseko and Nishimura, 1979). 23. *Pseudostylosphaera japonica* (Nakaseko and Nishimura, 1979). 24. Pentactine sponge spicule.

Grooves and ridges on the spines are arranged straight. *Plafkerium* sp. C is distinguishable from both *Plafkerium* sp. A and *Plafkerium* sp. B due to its lack of spiral coiling of each spine.

Muelleritortis sp.
Figure 1.16

Remarks.—Although this material is poorly preserved, the two spines show anti-clockwise direction from each basal portion to tip, with one spine having upright ridges and grooves.

Tiborella sp.
Figures 1.15, 1.21

Remarks.—Spherical cortical test is covered with regular-sized polygonal (ranging mainly from pentagonal to hexagonal) pore frames. Four spines extend radially in one plane at right angles to each other. These features categorize the depicted specimens to the genus *Tiborella*.

Pentactine spicule
Figure 1.24

Remarks.—This form has been known as five-rayed pentactin spicule.

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