

## Jurassic Radiolarians from the Low-grade Metamorphic Zone of the Northern Part of the Chichibu Belt in the Kanto Mountains, Central Japan

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**Abstract** The northern part of the Chichibu belt in the Kanto Mountains, central Japan, comprises three lithologic units: Kashiwagi unit consisting mainly of low-grade metamorphosed siliceous tuff and mudstone, Kamiyoshida unit of sandstone and mudstone with subordinate amounts of exotic blocks such as chert, greenstone and limestone, and Kazahaya-toge unit of alternation of sandstone and mudstone. Middle to Late Jurassic radiolarians were newly found from the Kashiwagi unit of the northern marginal part of the Chichibu belt. They are *Archaeodictyomitra* sp., *Eucyrtidiellum* sp., *Hsuum* sp., *Pantanellium* sp., *Parvicingula* sp., *Podobursa* sp., *Pseudodictyomitra* sp., *Stichocapsa* sp., *Syringocapsa* sp. and some unidentified nassellarians. This radiolarian assemblage including the genus *Eucyrtidiellum* and *Pseudodictyomitra* indicates the involvement of middle to late Jurassic sediments in the unit. Hence it is concluded that the formation and metamorphic process of the Chichibu belt occurred during and after the accretion continued at the late Jurassic, respectively.

**Key words:** Jurassic radiolarians, Chichibu belt, Kanto Mountains, Kashiwagi unit.

### Introduction

The geologic age of the Chichibu belt and structural relationships among other tectonic belts are important in understanding the formation process of the framework of the Japanese islands. The Chichibu belt in the Kanto Mountains consists mainly of Jurassic terrigenous clastic rocks (e.g. Sashida *et al.*, 1982; Iijima *et al.*, 1990, 1993, 1994, 1995; Matsuoka, 1995, 1996) and various-sized exotic blocks of Triassic chert (Takizawa, 1979), late Paleozoic limestone (Fujimoto, 1936a, 1936b) and greenstone. Such mode of occurrence and co-existence of blocks with different geologic ages indicate that the Chichibu belt was formed as an accretion complex associated with oceanic plate subduction. The Jurassic Chichibu belt in the Kanto Mountains has been studied by many authors and has several advantages for investigation of the geologic development (e.g., Kanto Mountain Research Group, 1994; The Conveners of

the Paleo-Mesozoic Symposium of the Annual Meeting at Saitama, 1995; Matsuoka *et al.*, 1998). Late Jurassic radiolarians were reported from the corresponding mudstone to the Kashiwagi unit in southern and eastern parts of the Chichibu belt (Hisada *et al.*, 1986; Matsuoka *et al.*, 1996). However there is no evidence available for geologic age determination of the northern part of the belt, in particular of the low-grade metamorphic part named the Kashiwagi unit,

In this paper, we report some late Jurassic radiolarians from the weakly metamorphosed mudstone of the Kashiwagi unit at the northern marginal zone of the Chichibu belt. Such biostratigraphic data are useful for the discussion of accretion, underthrusting to underplating process and postaccretionary metamorphism. As a result of this investigation, a preliminary report on the early Jurassic radiolarian from the southern corresponding unit (Sekine *et al.*, 1994) has to be revised.

### Geologic Setting

The geology of the Chichibu belt in the Kanto Mountains, central Japan, had been considered to be of late Carboniferous to Triassic on the basis of fusulinids, corals and conodonts. But radiolarian biostratigraphic works clearly showed that the Jurassic strata are widely distributed and most of them are regarded as accretionary complex (e.g., Sashida *et al.*, 1982; Hisada, 1984). The northern part of the Chichibu belt between the Sanbagawa metamorphic belt and the Cretaceous zone comprises three lithologic units: the Kashiwagi, Kamiyoshida including the Manba unit (Sekine, 2001 in press), and Kazahaya-toge (Fig. 1).

The Kashiwagi unit is composed mostly of alternation of pale greenish grey slate, phyllitic black slate, dark grey siliceous slate, and grayish-green tuff, with subordinate of chert and limestone blocks of various-size. It has been considered that this unit is dominated in hemipelagic sediments because of no coarse-grained clastic

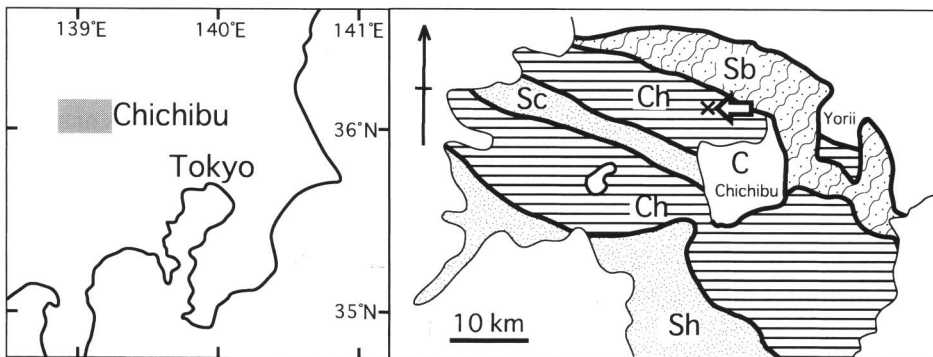


Fig. 1. Index map and geotectonic map showing studied locality. Sb: Sanbagawa Belt, Ch: Chichibu Belt, Sh: Shimanto Belt, Sc: Sanchu Cretaceous zone, C: Tertiary.

materials of terrigenous origin. A schistose texture of this unit shows apparently a gradation to the late Jurassic Mikabu green rocks (Hisada, 1984; Matsuoka, 1999) and also to the Sanbagawa metamorphics. However, tectonic relationships among them and the other units of the Chichibu belt have remained unclear (Iijima *et al.*, 1990; Kanto Mountains Research Group, 1994; Makimoto and Takeuchi, 1992; Matsuoka, 1998). This unit is correlated with the Hashidate Group to the south of the Chichibu Tertiary basin on the basis of the lithologic similarity. Early Jurassic radiolarians reported by Sekine *et al.* (1994) are in doubt as to the identification due to deformation of specimens.

The age of the other two units of the northern part of the Chichibu belt is well constrained from studies of radiolarian fossils. The geologic age of the Kamiyoshida unit, consisting of sandstone and mudstone including exotic blocks of chert, greenstone and limestone, is late Early Jurassic to middle Middle Jurassic (Iijima *et al.*, 1994; Sekine *et al.*, 1996) and the Kazahaya-toge unit, consisting of alternation of sandstone and mudstone, is of late Early Jurassic to early Middle Jurassic (Iijima *et al.*, 1993). Age determination of the Kashiwagi unit is therefore important for consideration on tectonic setting on the basis of correlation among those units.

### Jurassic Radiolarians from the Kashiwagi Unit

Well-preserved radiolarian fossils have been hardly obtained from the Chichibu belt in the Kanto Mountains due to recrystallization related with regional metamorphism. No fossils had been found from the Kashiwagi unit, but Hisada (1986) discovered late Jurassic radiolarians from the corresponding unit at Bushidaira, south of Chichibu City. They are late Jurassic ones such as *Mirifusus* sp., *Ristora* sp., *Parvicingula* sp., *Cinguloturris* cf. *carpatica*, *Pseudodictyomitra*? sp. We first found the late Jurassic radiolarians from the type locality of the Kashiwagi unit of the northern part of the Chichibu belt. Sample localities and a list of the radiolarians are shown in Fig. 2 and Table 1, respectively.

Locality KA: This is located at Kubota, upper reaches of the Otabu-gawa River, Yoshida-machi, Saitama Prefecture (Fig. 2), where alternation of dark grey mudstone and pale green siliceous tuff are developed. They show schistose appearance due to metamorphism, but the mudstone of this locality contains radiolarians (Table 1) such as *Pseudodictyomitra* sp. and *Eucyrtidiellum* sp. (Fig. 3, Fig. 4-1 and -2), *Podobursa* sp. (Fig. 3, Fig. 4-5), *Archaeodictyomitra* sp. (Fig. 3, Fig. 4-3), and *Pantanellium* sp. and *Parvicingula* sp. (Fig. 3, Fig. 4-4 and -6).

Locality KB: This is near locality KA and the strata consists of alternation of sheared black mudstone, tuffaceous mudstone and pale green siliceous tuff. *Stichocapsa* sp. and *Hsuum* sp. were obtained from two mudstone samples of KB01 and KB02 (Fig. 2, Table 1).

Locality KC: This is close to locality KB and lithologic facies are similar to

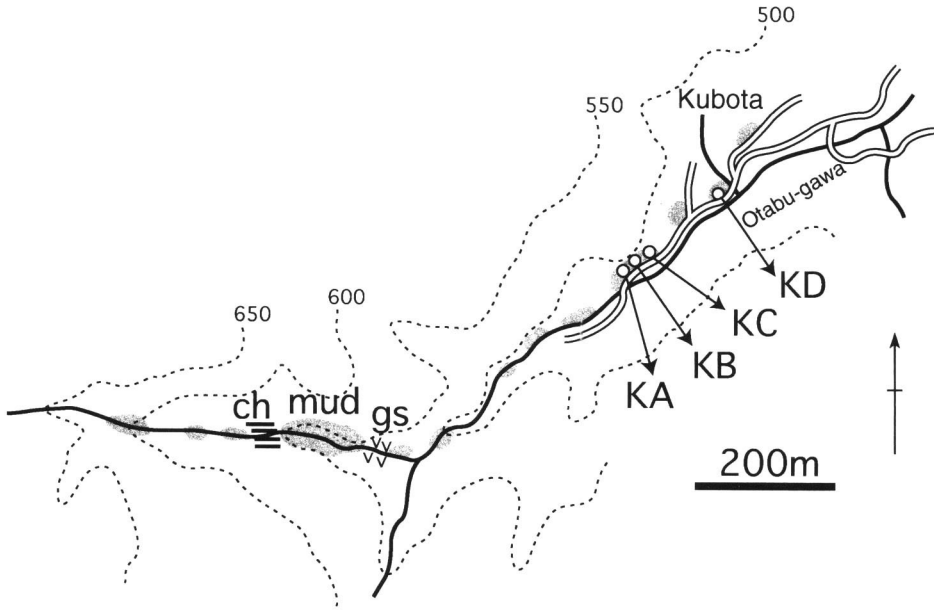


Fig. 2. Simplified route map showing the sample localities of radiolarians at Kubota, Yoshidamachi, Saitama Prefecture. gs: greenstone, ch: chert, mud: mudstone.

Table 1. List of radiolarians from the Kashiwagi unit of the northern part of the Chichibu belt, Kanto Mountains.

	KA01	KA02	KA03	KA04	KA05	KA06	KA07	KB01	KB02	KC01	KD01	KD02
	mudst.	mudst.	mudst.	mudst.	mudst.	mudst.	mudst.	mudst.	mudst.	mudst.	mudst.	mudst.
<i>Archaeodictyomitra</i> sp.	○			○							○	
<i>Eucyrtidiellum</i> sp.	○											
<i>Hsuum</i> sp.	○	○	○	○		○	○		○	○		○
<i>Pantanellium</i> sp.					○							
<i>Parvicingula</i> sp.					○					○		
<i>Podobursa</i> sp.			○									
<i>Pseudodictyomitra</i> sp.	○											
<i>Stichocapsa</i> sp.								○				
<i>Syringocapsa</i> sp.										○		

those localities of KA and KB. Mudstone of this site contains *Hsuum* sp., *Parvicingula* sp. and *Syringocapsa* sp. (Fig. 2, Table 1).

Locality KD: This sampling site is east of the former localities and relatively thick layers of black mudstone, tuffaceous mudstone and pale green siliceous tuff are developed. They are mostly sheared and deformed. From two mudstone samples of KD01 and KD02 are found *Archaeodictyomitra* sp. and *Hsuum* sp. (Fig. 2, Table 1).

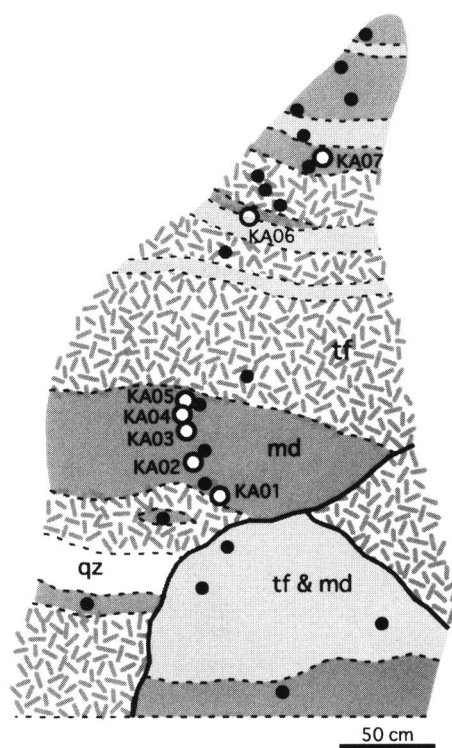


Fig. 3. Sketch of the locality KA and sampling points. tf: tuff, md: mudstone, tf & md: alternation of tuff and mudstone, qz: quartz vein.

Among these radiolarians, the genus *Eucyrtidiellum* was described from the Jurassic subduction complex in the southwest Japan by Nagai (1986), Hori (1990) and Nishizono *et al.* (1990), and the range was estimated as early Jurassic to latest Jurassic (late Tithonian). The range of the genus *Pseudodictyomitra* is of middle Jurassic (late Callovian to early Oxfordian) to late Cretaceous (late Turonian) (O'Doghery, 1994). These data show that the Kashiwagi unit of the northern part of the Chichibu belt is probably of middle to late Jurassic, in contrast with early Middle Jurassic Kazahaya-toge unit and the middle Middle Jurassic Kamiyoshida unit.

### Concluding Remarks

Radiolarians obtained from the Kashiwagi unit of the northern part of the Chichibu belt, Kanto Mountains, central Japan, yield the following results.

1. Radiolarian assemblage from the Kashiwagi unit indicates that the unit includes middle to late Jurassic sediments in part, because of the coexistence of *Pseudodictyomitra* sp. of middle Jurassic to Cretaceous and *Eucyrtidiellum* sp. of middle

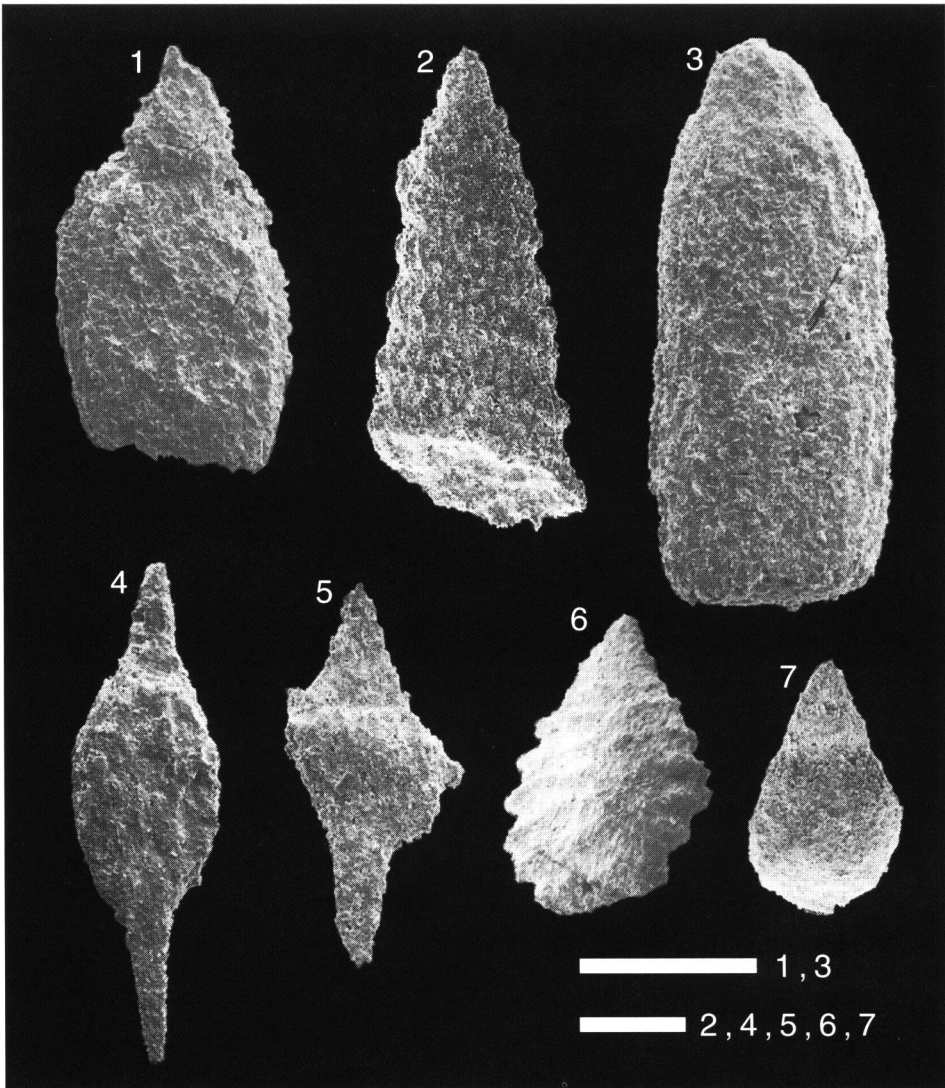


Fig. 4. Scanning electron micrographs of Jurassic radiolarians from the Kashiwaki unit of the northern part of the Chichibu belt. 1. *Eucyrtidiellum* sp., 2. *Pseudodictyomitra* sp., 3. *Archaeodictyomitra* sp., 4. *Pantanellium* sp., 5. *Podobursa* sp., 6. *Parvicingula* sp., 7. *Stichocapsa* sp.

Jurassic to latest Jurassic.

2. The biostratigraphic age evidence indicates that the Kashiwagi unit, structurally taking the lowest position, is biostratigraphically younger than other units of the Chichibu belt.

3. Geologic age on the basis of radiolarians shows that the northern part of the

Chichibu belt was formed during the middle Jurassic to late Jurassic subduction-accretion process.

### Acknowledgement

We wish to express our thanks to Professors Yoshiaki Aita and Toyosaburo Sakai of Utsunomiya University for identification of radiolarians and helpful advice through this study. Special thanks are due to Mr. H. Hasegawa of Saitama Prefectural Education Center, Fukaya City, Saitama Prefecture for help in field study. The present study has been financially supported in part by the Grant-in-Aid for Scientific Research for K. S. (No. 12916010) and Y. S. (No. 12640448) from the Ministry of Education, Culture, Sports, Science and Technology, Japan.

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