

Jurassic Radiolarians from the Clastic Rock Unit of the Northern Part of the Chichibu Belt in the Kanto Mountains, Central Japan

By

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Abstract The northern part of the Chichibu Belt in the Kanto mountains, central Japan, comprises four lithologic units: alternation of clastic rocks, volcanoclastic rocks, mudstone including exotic blocks mainly of limestone and greenstone, and mudstone with chert blocks and chert breccia. Abundant Middle to Late Jurassic radiolarians have been found from the argillaceous part of those units, although the ages of limestone and chert blocks are Permian and Triassic, respectively. They are regarded as a part of Middle to Late Jurassic subduction-accretion complex. Older Jurassic radiolarians such as *Lactorum* (?) *jurassicum*, *Hsuum fukazawaense* and *Parashuum* sp., which have been known from the central part of the Chichibu Belt, were newly found from the clastic rock unit of the northern part. It indicates that the Chichibu Belt includes late Early to early Middle Jurassic terrigenous rocks in the subduction-accretion complex formed in an active convergent margin.

Introduction

The age of the Chichibu Belt and the structural relationships among other geologic units are important in understanding the orogenic development of the Japanese islands at convergent plate boundary (e.g., HADA & KURIMOTO., 1990). The Paleozoic and Mesozoic strata of the Chichibu Belt in the Kanto mountains consist mainly of terrigenous clastic rocks containing various-sized exotic blocks of chert, limestone and greenstone. The Chichibu Belt is tectonically divided into three sub-belts: northern, central and southern. Radiolarian biostratigraphical studies on the sub-belts have shown that the clastic rocks as a matrix are mostly Middle to Late Jurassic in age (HISADA, 1983, 1984, 1989; GUIDI *et al.*, 1984; KISHIDA & HISADA, 1985; HISADA & KISHIDA, 1988; HISADA *et al.*, 1986, 1988; IWASAKI *et al.*, 1989; IJIMA *et al.*, 1990; SASHIDA & YATSUGI, 1991, SASHIDA *et al.*, 1982, SASHIDA, 1992a, b; MAKIMOTO & TAKEUCHI, 1992, etc), though chert and limestone are Triassic (TAKIZAWA, 1979) and Permian (FUJIMOTO, 1935, 1936a,b; CHICHIBU RESEARCH GROUP, 1961; MORIKAWA, 1967; OKUBO & HORIGUCHI, 1969; MATSUMARU & IJIMA, 1980), respectively. Such mode of occurrence and different geologic ages in block and matrix indicate that the constituent units of the sub-belts are subduction-accretion complex with melange formed

during oceanic plate subduction (HISADA *et al.*, 1989; IJIMA *et al.*, 1990; SASHIDA, 1992b).

In this paper, we report some Jurassic radiolarians from the clastic rock unit of the northern part of the Chichibu Belt in the Kanto mountains. The constituent rocks of the units are mostly quartz-feldspathic sandstone and mudstone. They were derived from so-called continental source with sialic crust and deposited to form turbidite sequence. The age of radiolarian fossils therefrom, as well as the geologic occurrence and lithologic characters of the constituent rocks of the unit, is one of the tectonic evidences to consider the formation of the Chichibu Belt at an active continental margin.

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Geologic Setting

The northern part of the Chichibu Belt in the Kanto mountains is composed mainly of Middle-Upper Jurassic terrigenous clastic rocks and Middle-Upper Tertiary bedded chert with minor amounts of Permian limestone and greenstone. These rocks form an almost horizontal structure of gently dipping thrust pile, where two or three tectonic units have been discriminated on the basis of lithologic assemblage (IJIMA *et al.*, 1990; MAKIMOTO & TAKEUCHI, 1992). Constituent rocks of these units commonly show "block-in-matrix" occurrence: various kinds of size and form of exotic blocks included in argillaceous matrices. These rocks occur structurally in layer-parallel slabs, probably forming parts of a huge nappe (pile of imbricated thrust sheets), and suffered low-grade metamorphism. They are regarded as a Jurassic subduction-accretion complex and are covered unconformably by early to middle Miocene sedimentary rocks.

The geology of the northern part of the Chichibu Belt in the Hinozawa area, Kanto mountains, was tentatively divided into two lithologic units: Unit I and Unit II (IJIMA *et al.*, 1990). Unit I consists of chert, chert breccia, mudstone and sandstone and mostly corresponds to the strata known as the Kamiyoshida Formation, whereas Unit II of mudstone and tuff including large blocks of greenstone, limestone and chert corresponds to the Kashiwagi and Manba formations. Detailed geological study by MAKIMOTO and TAKEUCHI (1992), however, distinguished other lithologic units occurring along ridge from Obira to Mt. Jomine through Kazahaya-toge. It consists of terrigenous clastic and volcanoclastic rocks. Hence, the constituent rocks of the northern part of the Chichibu Belt are lithologically divided into four units: Kazahaya-toge, Kamiyoshida, Manba, and Kashiwagi. An ordinary stratigraphic unit, "Formation", can not be applied here, because the mode of occurrence of constituent rocks

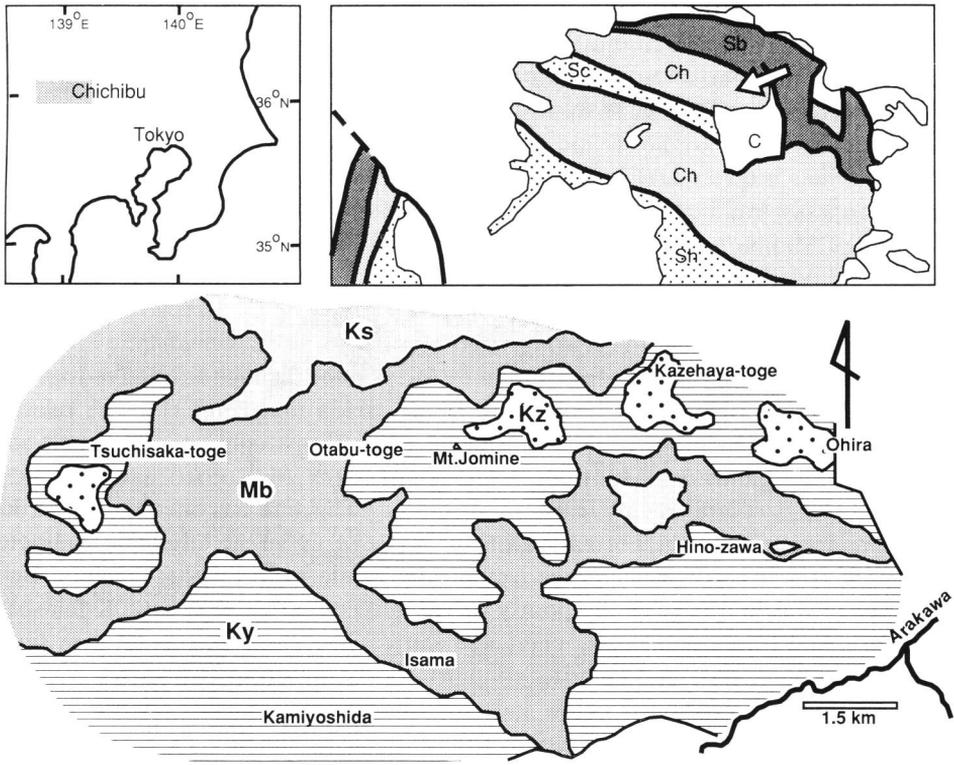


Fig. 1. Index map and map showing geotectonic units. Sb: Sanbagawa Metamorphic Belt, Ch: Chichibu Belt, C: Tertiary rocks, Sc: Sanchu Cretaceous zone, Sh: Shimanto Belt, Ks Kashiwagi unit, Mb: Manba unit, Ky: Kamiyoshida unit, Kz: Kazehaya-toge unit.

in each unit is in "block-in-matrix", characteristic in accretion complex.

The Kamiyoshida unit consists mainly of terrigenous clastic rocks which include various-sized chert blocks. Some chert blocks are strongly brecciated and mingled with argillaceous matrices, suggesting that this unit was formed as collapse deposits. This unit nearly corresponds to the Kamiyoshida Formation which have been used since FUJIMOTO (1935)'s stratigraphic division and also to most of the Unit I by IJIMA *et al.* (1990). This unit is widely distributed around Mt. Jomine, south of Hinozawa, Kamiyoshida and Tsuchisaka-toge areas (Fig. 1). We have reported from mudstone matrix of this unit such well-preserved radiolarian fossils as *Sticocapsa japonica*, *Tricolocapsa cf. plicarum*, *Protunuma* sp., *Eucrytidiellum* sp. *Hsuum* sp., *Parvicingula* sp. etc (IJIMA *et al.*, 1990). This assemblage indicates Middle to early Late Jurassic in age. On the other hand, middle to late Triassic conodonts occur from chert blocks (TAKIZAWA, 1979).

The Manba unit comprises mainly mudstone intercalated with a minor amount of tuff, including various-sized blocks of greenstone, limestone and chert. This unit

corresponds to Unit II (IJIMA *et al.*, 1990) excluding a tuff and mudstone member occupying lower part, and to the Manba Formation (e.g., FUJIMOTO, 1935). The tuff and mudstone member is the Kashiwagi Unit. It corresponds to the Kashiwagi Formation and to a part of Unit II by IJIMA *et al.* (1990). Radiolarian fossils available for age determination are not found from the Manba and Kashiwagi units. Most of the radiolarians are recrystallized due to metamorphism. However, the age of both units is probably Middle to Late Jurassic, as *Protunuma* sp. is obtained from the mudstone of the Manba unit, and SASHIDA (1992b) and MAKIMOTO and TAKEUCHI (1992) reported abundant Jurassic radiolarians from the correlative geologic unit of other areas of the northern part of the Chichibu Belt.

The Kazahaya-toge unit is characterized by sandstone and mudstone and crops out sporadically along the ridge from Obira to Mt. Jomine through Kazahaya-toge and also in Tsuchisaka-toge on the underlying Kamiyoshida unit (Fig. 1). The relation between this unit and other ones is considered to be thrust contact. This unit corresponds to the Sandstone-Mudstone Unit described by MAKIMOTO and TAKEUCHI (1992) and to a part of Unit I by IJIMA *et al.* (1990). This unit has once been regarded as the Cretaceous Atokura Formation on the basis of apparent lithologic character (INOUE, 1974) and was considered as tectonically exotic mass on the Chichibu Belt. Sandstone of this unit is generally poorly sorted and composed of quartz, K-feldspar, plagioclase, and rock fragments of chert and slate. Mudstone associated with sandstone, consisting of illite and chlorite, contains poorly preserved radiolarian remains. Those microfossils mentioned below indicate Jurassic age. Such evidence suggests that this unit is one of the tectonic units of the Jurassic subduction-accretion complex.

Jurassic Radiolarians from the Kazahaya-toge Unit

Radiolarian fossils have rarely recovered from the sandstone dominant facies of the northern part of the Chichibu Belt. We found the late Early to early Middle Jurassic radiolarians from the Kazahaya-toge unit of the northern part. Sample localities and a list of the microfossils are shown in Fig. 2 and Table 1, respectively. Among them, species of *Lactorum* (?) *jurassicum* was first described by ISOZAKI and MATSUDA (1985) from manganese micronodules of bedded chert in the Mino Belt and its range was estimated as late Early to early Middle Jurassic (late Pliensbachian to Bajocian?).

In the Kanto mountains, the species of *L.* (?) *jurassicum* has been reported from the southern and central sub-belts of the Chichibu Belt. IWASAKI *et al.* (1989) reported the species with such radiolarians as *Parahsuum simplicum* and *Hsuum fukazawaense* from shale and/or mudstone of the Kijihara and Ogurayama formations of the southern sub-belt in Minamisaku, Nagano Prefecture. SASHIDA (1992b) discriminated three Early Jurassic radiolarian Assemblage-zones in the Hanagiri and Nakato formations of the central sub-belt in Shomaru-toge area, Saitama Prefecture. They are *Parahsuum simplicum* Assemblage-zone, *Parahsuum takazawaense* Assemblage-

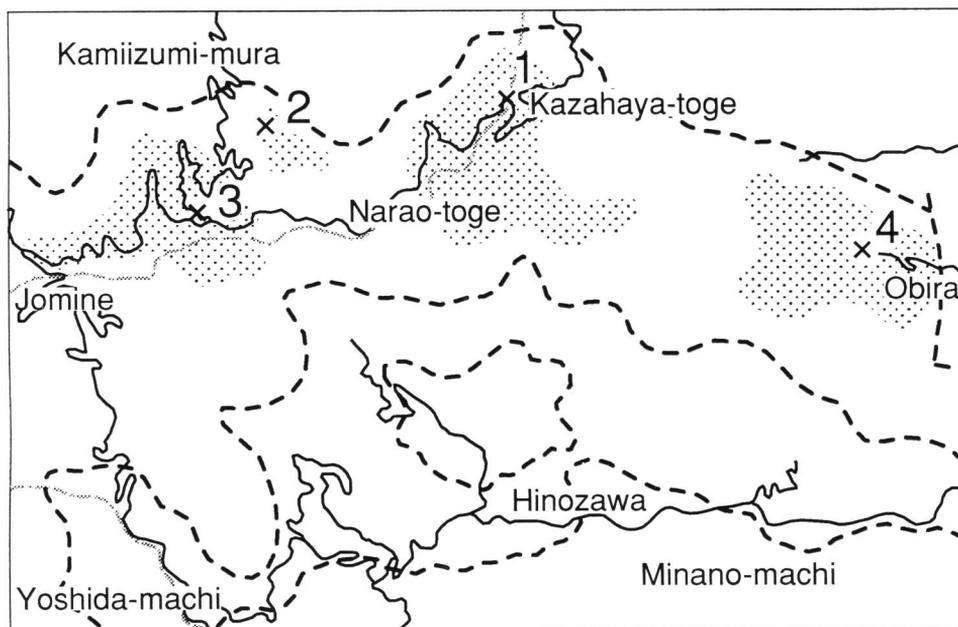


Fig. 2. Locality map of Jurassic radiolarian fossils from the Kazahaya-toge unit (see Table 1).
Dotted: Kazahaya-toge unit; broken line: geologic unit boundary.

zone and *Lactorum* (?) *jurassicum* Assemblage-zone, in ascending order. *L.* (?) *jurassicum* Assemblage-zone of SASHIDA (1992b) is characterized by co-occurrence of the following species, *L.* (?) *jurassicum*, *Hsuum* aff. *hisuikyoenese*, *H. fukazawaense*, *H. matsukoi*, *H. aff. minoratum*, *Tricolocapsa* (?) cf. *fusiformis*, and *Parvicingula* aff. *gigantocornis*. The assemblage including *L.* (?) *jurassicum* are similar to those of the Kazahaya-toge unit reported here.

In the northern sub-belt of the Chichibu Belt, Early Jurassic radiolarians have been known from mudstone of the Hebiki Formation in Nakazato-mura (HISADA & KISHIDA, 1987) and from chert in Ueno-mura (HISADA *et al.*, 1988), Gunma Prefecture. The former radiolarians including genera of *Bagotum*, *Canoptum*, *Katroma*, and *Pantanellium* indicate earliest Jurassic in age and are quite different from those of the Kazahaya-toge unit. Whereas the latter is characterized by co-occurrence of *L.* (?) *jurassicum*, *Hsuum* cf. *hisuikyoenese* and *Parahsuum* sp. and be correlative with those of the Kazahaya-toge unit.

HORI (1990) established four Lower Jurassic radiolarian assemblage-zones and four subzones on the basis of detailed radiolarian biostratigraphic data mainly from the Inuyama area in the Mino Belt (HORI, 1988; HORI & YAO, 1988; YAO, 1989, 1990). According to her study, the *Lactorum* (?) *jurassicum* Zone of the Chichibu Belt in the Kanto mountains is considered to be coeval with the *L.* (?) *jurassicum* Zone of southwest Japan (MATSUOKA & YAO, 1986). The *L.* (?) *jurassicum* Zone is correlative

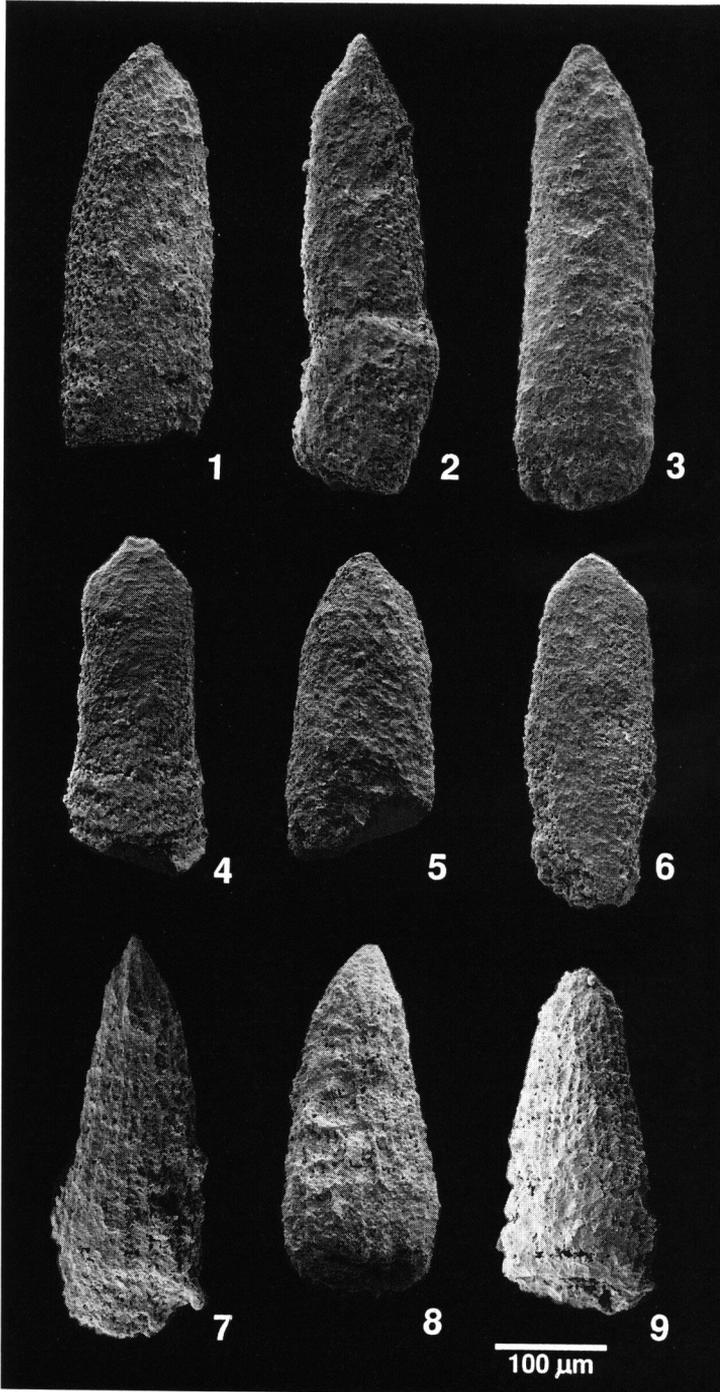


Table 1. List of radiolarian fossils from the Kazahaya-toge unit of the northern part of the Chichibu Belt, Kanto mountains.

species	locality number			
	1	2	3	4
<i>Laxtorum</i> (?) cf. <i>jurassicum</i> ISOZAKI & MATSUDA	○			
<i>L.</i> (?) sp.	○			
<i>Hsuum</i> cf. <i>fukazawaense</i> SASHIDA	○			
<i>H.</i> sp.	○	○		
<i>Parahsuum</i> sp.	○			
<i>Stichocapsa</i> sp.		○		○
<i>Tricolocapsa</i> sp.		○		○
<i>Protunuma</i> sp.			○	
<i>Parvingula</i> sp.				○

1. Kazahaya-toge, Minano-machi, Chichibu-gun, Saitama Prefecture.
2. Hamanotani, Kamiizumi-mura, Kodama-gun, Saitama Prefecture.
3. Jomine, Kamiizumi-mura, Kodama-gun, Saitama Prefecture.
4. Obira, Minano-machi, Chichibu-gun, Saitama Prefecture.

with the upper part of the *Parahsuum* (?) *grande* assemblage-zone and the whole of the *Hsuum hisuikyoense* assemblage-zone proposed by HORI (1990). Co-occurrence of *L.* (?) *jurassicum*, *Hsuum* cf. *fukazawaense* and *Parahsuum* sp. obtained from the Kazahaya-toge unit indicates that the assemblage can be correlated with *L.* (?) *jurassicum* Zone and partly with *Parahsuum* (?) *grande* assemblage-zone because *L.* (?) *jurassicum* occurs first in the upper part of the assemblage-zone. The age of radiolarian fossils from the Kazahaya-toge unit is, therefore, late Early to early Middle Jurassic. Such micropaleontologic evidences suggest that the age of the formation of the Chichibu Belt ranges at least from late Early Jurassic to Late Jurassic.

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Fig. 3. Radiolarians from the Kazahaya-toge unit (loc. no. 1). 1: *Laxtorum* (?) cf. *jurassicum* ISOZAKI & MATSUDA; 2, 3, 4, 5, and 6: *Laxtorum* (?) sp., 7: *Hsuum* cf. *fukazawaense* SASHIDA, 8: *Hsuum* sp., 9: *Parahsuum* sp.

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