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Report

Early Permian (Cisuralian) fusulinoideans from Hijima, west of Yamasaki, Hyogo—Late Paleozoic and Early Mesozoic foraminifers of Hyogo, Japan, Part 6—

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Abstract

Cuniculinella tumida was identified in the limestone block contained in the Permian accretionary complexes of the Ultra-Tamba Terrane, exposed near Hijima, west of Yamasaki, Hyogo, along with a few other schwagerinid fusulinoideans. Other foraminifers were not found probably due to recrystallization of this limestone block. This limestone block is dated as the Early Permian (Cisuralian) Artinskian to Sakmarian. *Cuniculinella tumida* is systematically described.

Key words: Early Permian (Cisuralian) fusulinoideans, limestone block, Ultra-Tamba Terrane, Hijima.

Introduction

The Ultra-Tamba Terrane is discriminated from the Jurassic Tamba Terrane on account of its Permian accretionary age and tectonic superposition on the Tamba (Caridroit et al., 1985). It is distributed in the area from the western margin of Fukui prefecture to the eastern part of Hiroshima prefecture discontinuously along the southern margin of the tectonically overlying Maizuru Terrane. The Permian accretionary complexes of the terrane are subdivided into the UT 1 (Hikami), UT 2 (Oi), and UT 3 (Kozuki) units. They are unconformably overlain by the Upper Jurassic formations (Ishiga, 1986; 1990). The isolated distribution of the terrane is known from the Akenobe-Ichinomiya area as an antiformal tectonic window under the Maizuru Terrane, and from the Sasayama and Inagawa areas as a synformal nappe on the Tamba Terrane, suggesting gentle but complicated geologic structure of these Permian and Jurassic complexes (Ishiga, 1986; 1990; Kobayashi, 1997a).

Exotic blocks in the Ultra-Tamba Terrane are composed of dominant basaltic rocks and chert, and less amount of limestone of Carboniferous and Permian ages. Limestone blocks in this terrane are exclusively known in Hyogo prefecture. Carboniferous and Permian fusulinoideans and corals have been reported from nine and seven limestone localities, respectively, mostly of the Harima district, western part of Hyogo prefecture (Kobayashi et al., 1995). Fossiliferous limestones are associated with basaltic rocks. Some of them, previously reported from the pre-Cretaceous terranes, are thought to have been emplaced in the Upper Cretaceous volcanic rock units as a tectonic block (Yamamoto et al., 2000).

Most of fossils in the terrane are less favorably preserved and rarely found in the limestone saved from strong recrystallization, dolomitization, and deformation. Illustrated and described fusulinoideans from the Ultra-Tamba Terrane are only one example

by Goto (1979) from the Early Permian limestone block near Kamiazawara, Shingu-cho, Tatsuno city. Although Late Paleozoic foraminifers are important paleobiogeographically as to discuss the origin and plate movement of the Panthalassan seamount (Kobayashi, 1997b; 2005), we have little lithologic and paleontologic information of the limestone in the terrane.

This paper announces the occurrence of Early Permian (Cisuralian) fusulinoidean, *Cuniculinella tumida* Skinner and Wilde, and others in the limestone block exposed near Hijima, west of Yamasaki, Shiso city. This paper is the sixth of the serial descriptive work under the title of Late Paleozoic and Early Mesozoic foraminifers of Hyogo, Japan. *Cuniculinella tumida* is systematically described. All limestone thin sections used in this paper are stored in the collection of the Museum of Nature and Human Activities, Hyogo, Japan (Fumio Kobayashi Collection, MNHAH).

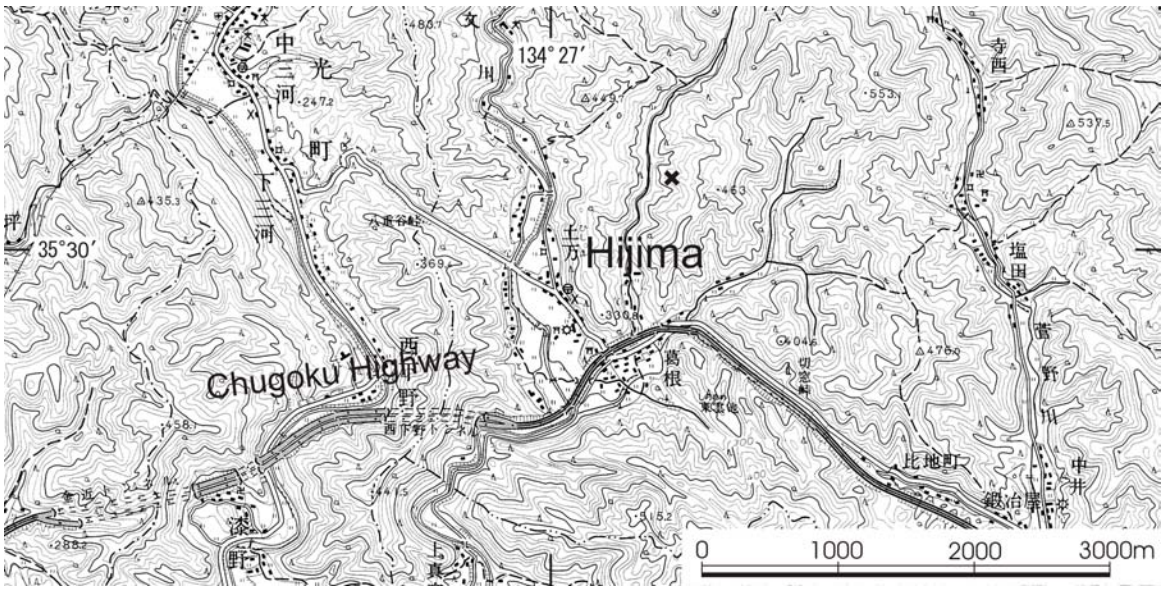

Figure 1. Sample location of Hijima in the Yamasaki area. Topographic map is from 1:50,000 map "Sayo" of Geographical Survey Institute of Japan.

Geologic setting and limestone sample

Permian accretionary complexes referable to the Ultra-Tamba Terrane are the most extensively exposed in the western part of the Harima district with NE-SW trend and width more than 20 km (Hyogo-ken, 1996). They are distributed in the area where volcanic and volcaniclastic rocks referable to the Upper Cretaceous Aioi and Ikuno groups are denuded. Jurassic accretionary complexes of the Tamba Terrane and the Yakuno ophiolitic rocks of the Maizuru Terrane are exposed as a tectonic window and a nappe in the distributional area of the Ultra-Tamba Terrane, respectively (Kobayashi, 1997a). Permian accretionary complexes both sides along the Chugoku Highway are assignable to the Yamasaki Formation (Kambe and Hirokawa, 1963; Ishiga, 1985) dominated by the greenish gray sandstone characteristic in the UT 1 (Hikami) Unit (Ishiga, 1986; 1990). Those immediately south of the Yakuno ophiolitic rocks, narrowly distributed near Hijima, west of Yamasaki, are classified into the Hijima Formation correlatable to the UT 2 (Oi) Unit from lithologic and radiolarian assemblages (Ishiga, 1986; Okamoto and Goto, 1987).

The Hijima Formation, originally proposed by Kambe and Hirokawa (1963) and redefined by Ishiga (1986), consists mainly of black mudstone and phyllitic mudstone containing blocks of sandstone, chert, basaltic rocks, and limestone. The limestone blocks of the Hijima Formation are light gray, massive, containing basaltic rocks, and yield Permian fusulinoideans, *Schwagerina* sp., *Pseudofusulina* sp., and *Parafusulina* sp. in north of Kazurane (northeast of Hijima) and east of Shimomikawa (Kambe and Hirokawa, 1963). These

two fossil localities are shown as the Locality 65 and 66, respectively by Kobayashi and Takemura in Kobayashi et al. (1995).

The limestone at Locality 65, exposed in the ridge left bank of the small valley, a tributary of the Shibumi River, about 1 km NE of Hijima (Figure 1), is gray, massive, less than 5 m in diameter, and associated with altered basalt partly showing pillow structure. Almost all limestone at this locality is barren in fossils on account of strong recrystallization. We could find Early Permian fusulinoideans from three limestone samples free from strong recrystallization and deformation. Two samples (Sample A and C) contain abundant unfavorably preserved fusulinoideans, *Cuniculinella tumida* Skinner and Wilde and *Schwagerina* sp. A (Figure 2). *Schwagerina* sp. B and *Cuniculinella?* sp. are recognized in the other one sample (Sample B) which is more strongly recrystallized.

The limestone block near Hijima is dated as the late Wolfcampian, which is equivalent to Sakmarian to Artinskian, in the standard Permian time scale based on the occurrence of *Cuniculinella tumida*. The type species of the genus was described originally from the middle part of the McCloud Limestone of northern California by Skinner and Wilde (1965). Comparison between three species reported by Kambe and Hirokawa (1963) and four species distinguished herein is impossible because of no illustration and description of the former.

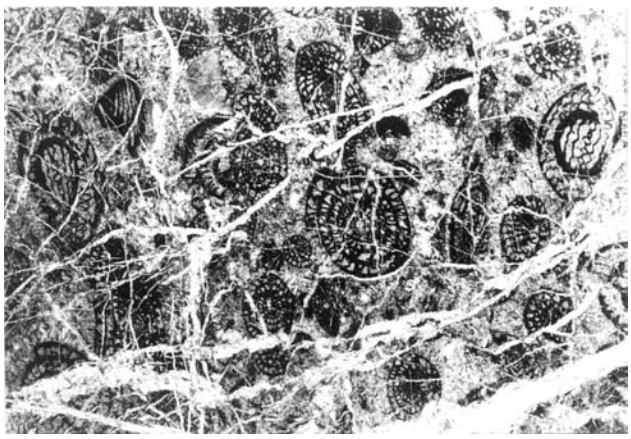

Figure 2. Photograph of the limestone (Sample C) of Hijima including many fusulinoideans. ×3.5.

Systematic paleontology

Order FORAMINIFERIDA Eichwald, 1830
Suborder FUSULININA Wedekind, 1937
Superfamily Fusulinoidea von Möller, 1879
Family Schwagerinidae Skinner, 1931
Genus ***Cuniculinella Skinner*** and Wilde, 1965
Cuniculinella tumida Skinner and Wilde.
Plate 1, Figures 1–7

Cuniculinella tumida Skinner and Wilde, 1965, p. 84, pl. 35, figs. 13–18.

Material. —Four axial, three sagittal, two tangential, and one oblique sections.

Discription.—Test inflated fusiform with broadly arched periphery, slightly convex lateral slopes and bluntly pointed poles. Axis of coiling nearly straight. Mature test with six to seven whorls, about 8.5 mm or more in length, about 5 mm in width, and 1.7 or more in approximate form ratio. Proloculus spherical to subspherical, 0.21 to 0.55 mm in longer diameter. Inner one to two whorls tightly coiled, then gradually increasing in length and width.

Septa intensely and irregularly fluted throughout the test, especially in polar regions. Septal folds narrow and high, some reaching to the top of the chamber. Septal counts 10, 17, 19. 25, 31, 41 (?) in the first to sixth whorl, and unknown in the seventh, in the specimen illustrated in Pl. 1, Fig. 7. Low and narrow cuniculi present in outer whorls. Phrenotheca present in outer whorls in specimens, but obscure in others due to recrystallization. Wall thick except for tightly coiled inner whorls, possibly as thick as 130 to 180 microns in the fifth whorl, composed of tectum and coarsely alveolar keriotheca, and partly coated by secondary dark calcareous materials. Weak chomata rudimentarily present only on proloculus. Tunnel low and narrow, and its path indistinct.

Remarks.—Coarsely alveolar wall structure, well-developed phrenotheca, and other delicate test characters, probably preserved in the original materials, are not clear in the present specimens. Exact thickness of wall and details on the septal folding are also uncertain because of recrystallization of the test. However, the present specimens have many features characteristic in *Cuniculinella* such as intensely and irregularly fluted septa, the presence of clear cuniculi, thick wall with coarsely alveolar structure, and probably well-

developed phrenotheca. They seem to be the closest to *Cuniculinella tumida* in inflated fusiform and large test, and large proloculus among 13 species of *Cuniculinella* from the McCloud Limestone in northern California.

Morikawa (1952) *proposed Parafusulina vulgariformis* for the form having similar test characters to *Chalaroschwagerina vulgaris* (Schellwien) but with distinct cuniculi. This species, probably reassigned to *Cuniculinella*, was described from the same locality of eastern part of the Kanto Mountains where Huzimoto (1936) described *Chalaroschwagerina vulgaris*. Both specimens by Morikawa (1952) and Huzimoto (1936) appear to be closely similar each other, although development of cuniculi is uncertain from the Huzimoto's description. The presence or absence of cuniculi is determined only after the careful observation of many variously orientated tangential sections of the test as indicated by Morikawa (1952).

Occurrence.—Abundant in Sample C (recrystallized bioclastic limestone).

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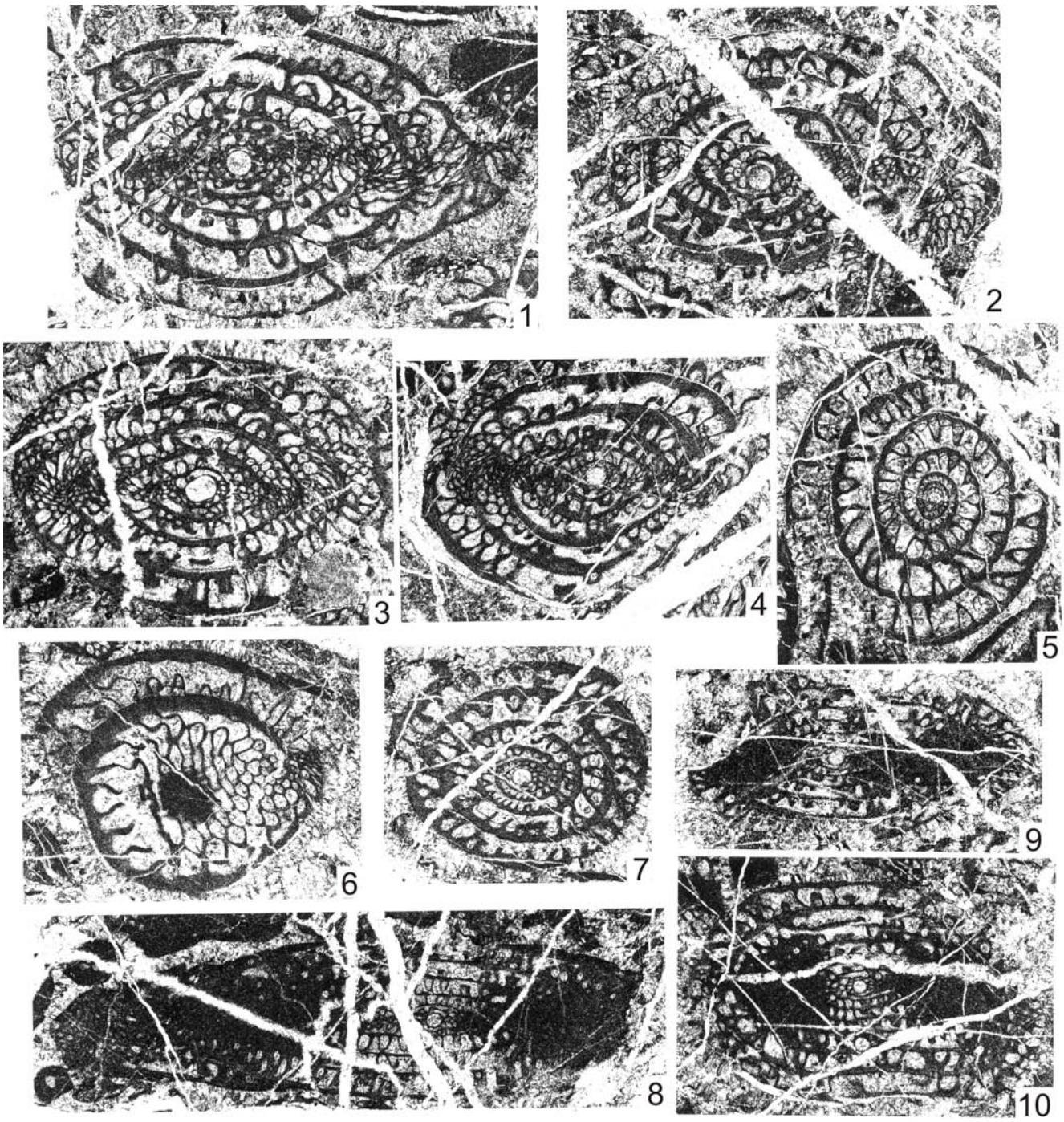
Plate 1



Figs. 1–7. *Cuniculinella tumida* Skinner and Wilde.

1: D2-029438, 2: D2-029417, 3: D2-029444, 4: D2-029413, 5: D2-029424, 6: D2-029432, 7: D2-029437, all Sample C, ×10. Note the low and narrow cuniculi well developed in the outer whorl of tangential section in Fig. 6.

Fig. 8. *Schwagerina* sp. B

D2-029331, Sample B, ×10.

Figs. 9, 10. *Schwagerina* sp. A

9: D2-029442, 10: D2-0294409; both Sample C, ×10.