

Early Permian tabulate corals from the Funafuseyama Limestone, Gifu Prefecture, Japan

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Abstract Two species of Sakmarian (early Permian) tabulate corals are described from the Funafuseyama Limestone in the Mt. Funabuse-yama area of Gifu Prefecture, Central Japan. They are a micheliniid, *Protomichelinia funafusensis* sp. nov., and an aulocystid, *Pseudoromingeria muratai* Niko, Haikawa and Fujikawa, 2012. *Protomichelinia funafusensis* is most closely related to *P. raricystosa* Wang, 1983 from Xinjiang, China, but the new species has slightly larger corallite diameters and thinner intercorallite walls than those of the Chinese species. *Pseudoromingeria muratai* is common in the Akiyoshi Limestone.

Key words: Sakmarian (middle early Permian), Funafuseyama Limestone, *Protomichelinia*, *Pseudoromingeria*, tabulate corals

Introduction

Although tabulate corals are not rare in the allochthonous limestone blocks of the Mino (-Tamba-Ashio) Belt, Japan, the only two assemblages from this belt have been described at length; they are the Ryozensan assemblage in Niko (2001) and the Akasaka one in Niko (2009). The author describes herein micheliniid and aulocystid species from the Permian Funafuseyama Limestone in the Mt. Funabuse-yama area of Gifu Prefecture, Central Japan (Fig. 1) to add new data for the fauna.

Background geology of the Funafuseyama Limestone can be found in many previous publications (e.g., Otsuki and Kiyono, 1919; Tokunaga, 1929; Iisaka, 1932; Kobayashi, 1951; Anzai, 1955; Igo and Ogawa, 1958; Kawada, 1958; Fujimoto *et al.*, 1962; Ishii *et al.*, 1963; Kawai, 1964; Nakamura, 1965; Matsumaru, 1966; Kinoshita *et al.*, 1981; Yamagata and Sano, 1987; Sano, 1988; Wakita, 1988), results from which studies have been summarized in recent papers by Wakita (1991) and Sano *et al.* (1992). The limestone consists of approximately 800 m-thick

of the seamount-type deposits juxtaposed in the Jurassic accretionary complex. It is subdivided into the lower black thin- to thick-bedded member, the middle light gray massive member, and the upper dark gray massive to thick-bedded member. Abundant and diversified fossils occur in thought the limestone. Among them, fusulinaceans suggest that the strata deposited during the period ranging from the middle early Permian to the late middle Permian.

The tabulate corals described herein were collected from float blocks of black limestones in the stream-beds of the Neohigashitani-gawa River at Neoshimoosu (localities 1, 2) and the Higashihora-dani Valley (a tributary of the Itadori-gawa River) at Kakino (locality 3). Biostratigraphically, these coral-bearing blocks derived from the lower member that belongs in the *Pseudofusulina ambigua* zone (Sakmarian). This member is interpreted as lagoonal deposits.

Described specimens are kept in National Museum of Nature and Science, Tokyo (prefixed NMNS).

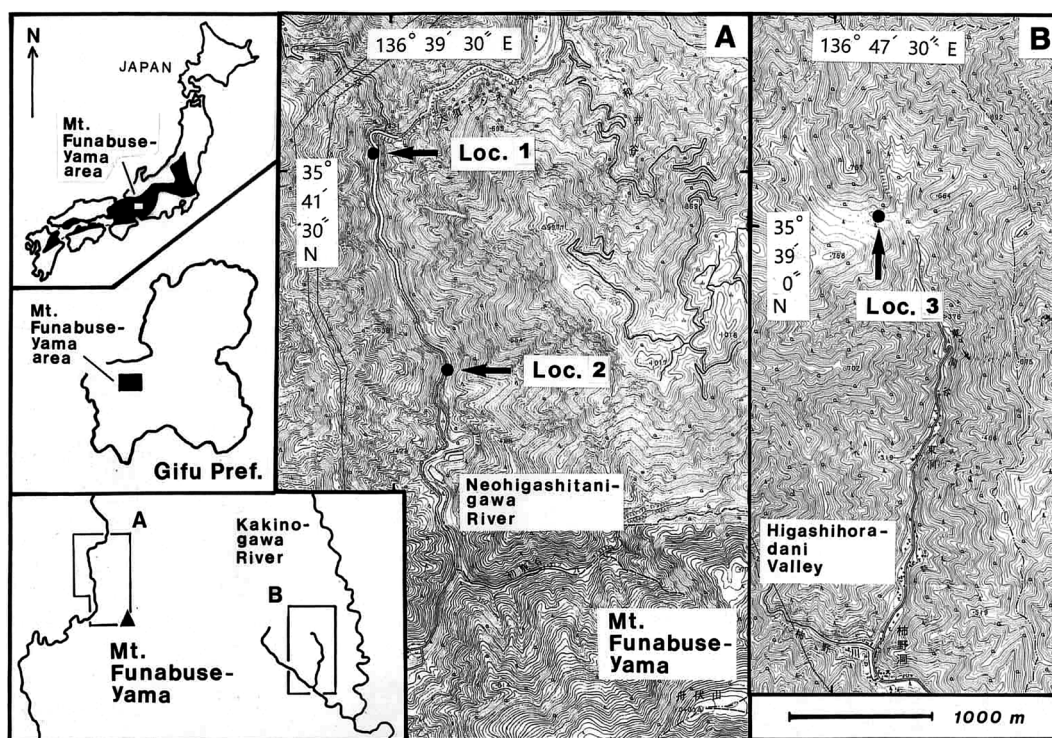


Fig. 1. Index maps showing fossil localities at Neoshimoosu (A) and Kakino (B) in the Mt. Funabuse-yama area, Gifu Prefecture, on the topographic maps of “Shimoosu”, “Taniai” and “Shimohorado”, scale 1:25,000 published by the geographical Survey Institute, and showing distributions of the Mino Belt in Japan and geographic positions of the Mt. Funabuse-yama area, Neoshimoosu and Kakino (three insets in the left side).

Systematic Paleontology

Subclass Tabulata Milne-Edwards and Haime, 1850

Order Favositida Wedekind, 1937

Suborder Favositina Wedekind, 1937

Superfamily Favositoidea Dana, 1846

Family Micheliniiidae Waagen and Wentzel, 1886

Subfamily Michelininiinae Waagen and Wentzel, 1886

Genus *Protomichelinia* Yabe and Hayasaka, 1915a

Type species: Michelinia (Protomichelinia) microstoma Yabe and Hayasaka, 1915a.

Protomichelinia funafusensis sp. nov.

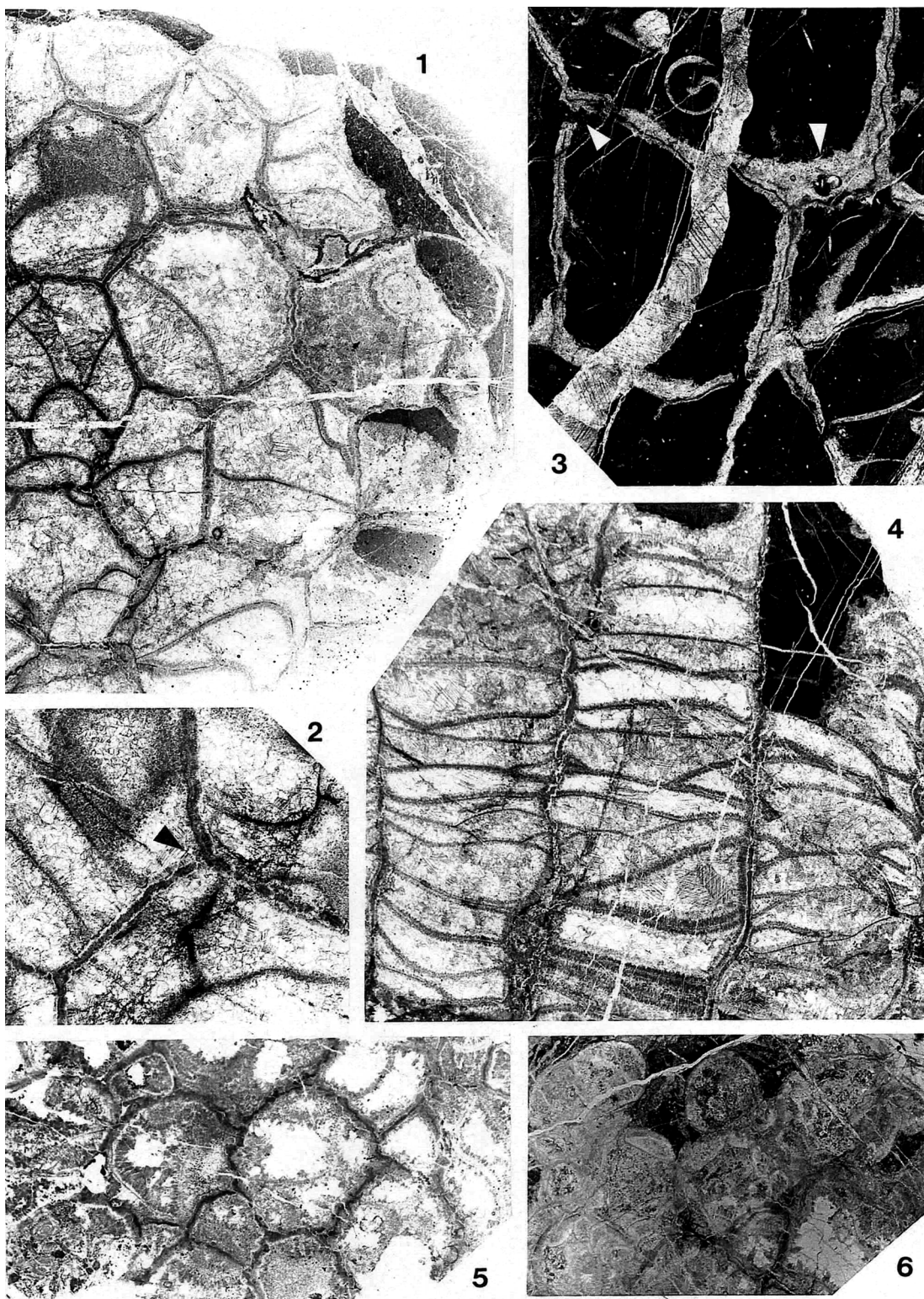
(Figs. 2-1-6)

michelinid gen. et sp. indet., Senzai, Niko and Matsuo, 2010, p. 17-19, figs. 1-1-3.

Material examined: Holotype, NMNS PA18389, from which six thin sections were made. Paratypes, NMNS PA18387, 18388, 18390.

Diagnosis: Species of *Protomichelinia* with relatively large corallite, attaining 6.9 mm; intercorallite walls thin, 0.15–0.38 mm; mural pores well developed, occur on corallite faces and at

Fig. 2. *Protomichelinia funafusensis* sp. nov., thin sections. 1, 2, 4, holotype, NSM PA18389. 1, transverse section of corallum, $\times 5$. 2, transverse sections of corallites, arrow indicates angle pore, $\times 10$. 4, longitudinal section of corallum, $\times 5$. 3, paratype, NSM PA18390, transverse (slightly oblique) sections of corallites, arrows indicate angle (left) and mid-wall (right) pores, $\times 10$. 5, 6, paratype, NSM PA18397. 5, transverse section of corallum, $\times 5$. 6, transverse section of corallum, showing subcircular transverse sections of corallites at corallum periphery, $\times 5$.



angles; pore diameters are 0.17–0.27 mm; septal spine very rare; tabulae well developed, complete or incomplete; 4–9 tabulae occur in 5 mm.

Description: Coralla probably clavate, and cerioid to sub-cerioid; the largest specimen (holotype) attains 48 mm in diameter and 81 mm in height; no corallum base preserved; holotheca absent. Most corallites prismatic, but sub-prismatic corallites with sub-trapezoidal to semicircular transverse sections also occur; in addition, corallites at corallum periphery loosely adhere to more inner corallites, and they rarely indicate subcircular to circular sections; immature portions of prismatic corallites have 3–5 sides in sections, then they indicate 6–9 sided sections in adult portions; diameters of corallites are relatively large for the genus, range from 1.5 to 6.9 mm, averaging 5.8 mm in adult corallite; no calice preserved; increase of new corallite may be intracalicular. Intercorallite walls thin, 0.15–0.38 mm, thus transverse sections of tabularia nearly identical with those of corallites; corallite walls at corallum periphery are also thin, 0.10–0.27 mm; structure of walls differentiated into median dark line and stereoplasm; microstructure of stereoplasm is not preserved; intercorallite walls partly undulated; mural pores circular, well developed, occur on corallite faces and at angles; diameters of pores are small, 0.21–0.27 mm in mid-wall pores and 0.17–0.19 mm in angle pores; septal spine very rare, low conical with approximately 0.05 mm in length; tabulae well developed, slightly thickened, and close in spacing; complete tabulae are most common, but incomplete and vesicular forms are not rare; there are 4–9 tabulae in 5 mm of corallite length.

Etymology: The specific name is derived from the Funafuseyama Limestone.

Occurrence: Locality 3.

Discussion: The generic assignment of this coral was unclear in our preliminary study (Senzai *et al.*, 2010). However, new and better preserved specimens show details of intercorallite walls and provide evidences that it is placed in the genus *Protomichelinia*.

Protomichelinia funafusensis sp. nov. is most closely related to *P. raricystosa* Wang (1983, p. 226, pl. 77, figs. 2a, b) from the Lower Permian of Xinjiang, Northwest China, from which it is separated by having slightly larger corallite diameters (attaining 6.9 mm versus 1.5–5.0 mm in *P. raricystosa*) and thinner intercorallite walls (0.15–0.38 mm versus 0.3–0.5 mm in ditto). Two Permian species of South China, *P. sinensis* Lin (1962, p. 211, 221, pl. 2, figs. 1a–d) from Sichuan and *P. subcrassitheca* Zhao (1981, p. 268, pl. 13, figs. 5a, b, 6a, b) from Sichuan and Shaanxi, also resemble *P. funafusensis*. However, the presence of well-developed septal spines distinguishes these Chinese species from the new species. *Protomichelinia foveata* Niko, Haikawa and Fujikawa (2012, p. 6, 7, pl. 2, figs. 1–8, pl. 4, fig. 9) from the Akiyoshi Limestone Group in Yamaguchi Prefecture is well differentiated from the new species by the absence of angle pore.

Order Auloporida Sokolov, 1947

Superfamily Auloporoidea Milne-Edwards
and Haime, 1851

Family Aulocystidae Sokolov, 1950

Genus *Pseudoromingeria* Yabe and Sugiyama, 1941

Type species: *Romingeria? kotoi* Yabe and Hayasaka, 1915b.

Pseudoromingeria muratai Niko,
Haikawa and Fujikawa, 2012

(Figs. 3-1-5)

annelid worm tubes, Sano, 1988, p. 968, pl. 4, fig. 5.

Pseudoromingeria sp., Hachiya and Moriwaki, 1997, fig. 25-3.13.

Pseudoromingeria muratai Niko, Haikawa and Fujikawa, 2012, p. 7, 8, pl. 3, figs. 1–6, pl. 4, figs. 5–8.

Material examined: NMNS PA18391–18398.

Description: Coralla turbinate to low domical, and consist of fasciculate corallites; sizes of the largest corallum (NMNS PA18391) attain 280 mm in diameter and 90 mm in height. Most corallites are cylindrical with phaceloid arrangement; however, partial adherences of adjoining

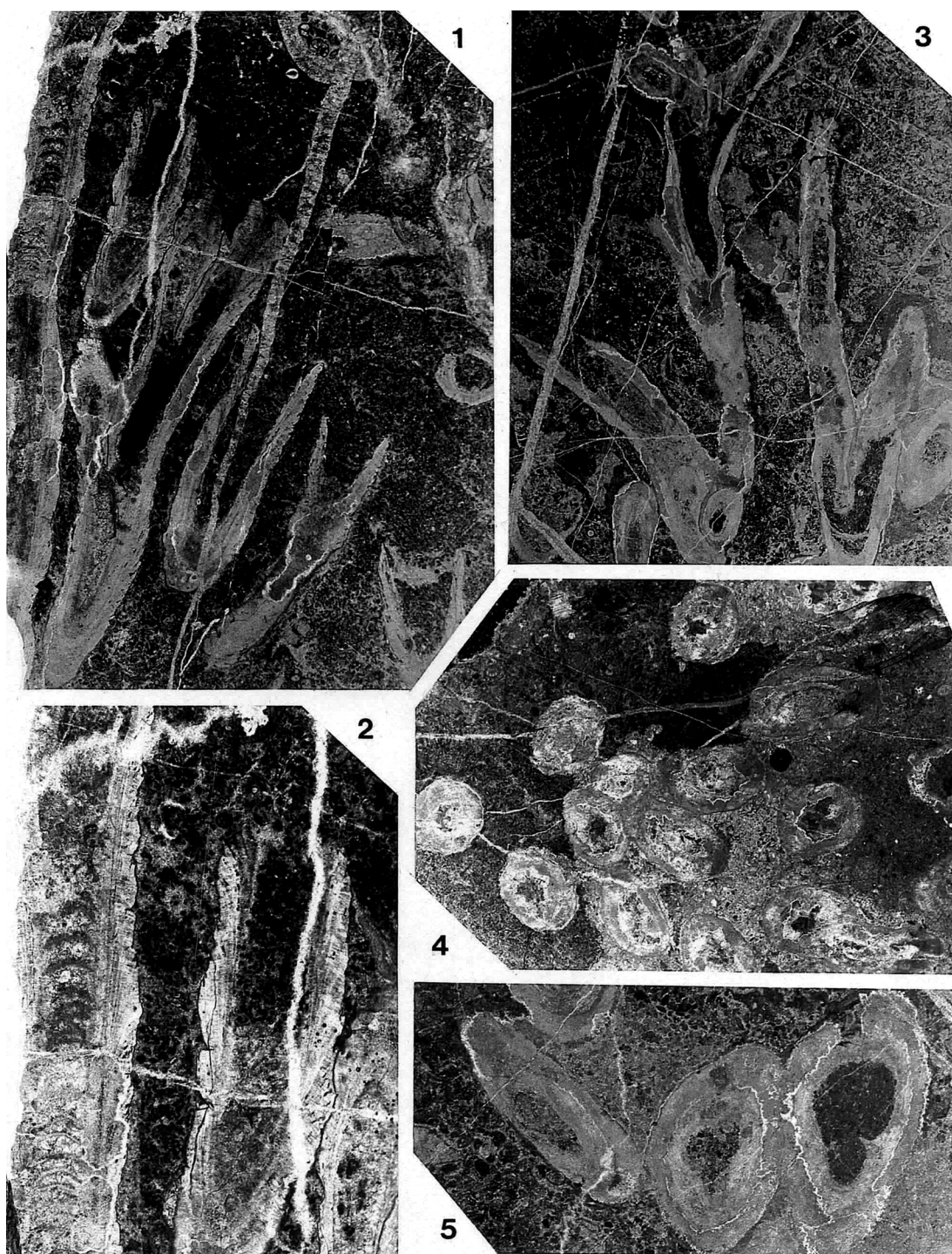


Fig. 3. *Pseudoromingeria muratai* Niko, Haikawa and Fujikawa, 2012, thin sections. 1, 2, 4, NSM PA18392. 1, longitudinal section of corallum, $\times 5$. 2, partial enlargement of Fig. 3-1 to show details of tabulae and calical rim, $\times 10$. 4, transverse section of corallum, $\times 5$. 3, 5, NSM PA18396. 3, longitudinal section of corallum, $\times 5$. 5, transverse to oblique sections of corallites, $\times 10$.

some corallites forming subcerioid portions frequently developed; diameters of corallites ranges from 1.0 to 2.4 mm; calical rims slightly inflate; budding frequent, umbelliferous. Corallite walls uniformly thickened, usually 0.25–0.82 mm; septal spines sporadic, low to high conical; tabulae complete or incomplete, convex distally; spacing of tabulae is variable, ranges from almost absent to well developed.

Occurrence: Localities 1 (NMNS PA18396), 2 (NMNS PA19392) and 3 (NMNS PA18391, 18393–18395, 18397, 18398).

Discussion: The present material from the Funafuseyama Limestone matches well with the types of *Pseudoromingeria muratai* from the *Pseudofusulina krafftii* zone (Artinskian, late Early Permian) in the Akiyoshi Limestone Group, Yamaguchi Prefecture, Southwest Japan. This species was erroneously assigned to *annelids* by Sano (1988).

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