

Sakmarian (Early Permian) Tabulate Corals from the Mizuyagadani Formation, Gifu Prefecture

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Abstract This report is the first account of tabulate corals from the Mizuyagadani Formation, Gifu Prefecture. The present Sakmarian (Early Permian) fauna consists of the schizophoritid *Schizophorites* sp. indet. of the order Favositida and the pyrgiid *Cladochonus verrucatus* sp. nov. of the order Auloporida. Previously, the occurrence of the genus *Schizophorites* was restricted in West Timor, Gondwana. *Cladochonus verrucatus* is conspecific with the Ichinotani specimens that were tentatively assigned to *C. cf. crassus* by Niko (2000).

Key words: Sakmarian (Early Permian), tabulate corals, Schizophoritidae, *Schizophorites*, Pyrgiidae, *Cladochonus*, Mizuyagadani Formation, Gifu.

Introduction

The Permian Mizuyagadani Formation of the Fukuji area in Gifu Prefecture, Central Japan consists mostly of clastic sediments with a “lenticular” limestone in its upper part. The latest geologic information of the Mizuyagadani Formation is referable in Niko and Nishida (2000). Herein the author presents a systematic treatment of tabulate corals from this formation as the first time, whose results reveal the unique faunal composition, including a Gondwana element *Schizophorites* sp. indet. and *Cladochonus verrucatus* sp. nov., of the Hida-Gaien Belt. This fauna is dissimilar to the Permian tabulate coral fauna of the adjoining Mino Terrane, which is characterized by *Pseudoromingeria* and *Sinopora*.

A single known representative of *Schizophorites* sp. indet. was recovered from sandstone rich in volcanic fragments at the Mizuyaga-dani Valley. This tabulate coral bearing bed is identical with the Sakmarian (Early Permian) foraminifer locality given in Okimura *et al.* (1984). The two type specimens of *Cladochonus verrucatus* were collected from the float blocks of greenish-gray calcareous shale at the Mizubora-dani Valley (holotype) and the Mizuyaga-dani Valley (paratype). Both rock matrices surrounding corals are distinctive and can be no doubt that these blocks were derived from the lowest part of the Mizuyagadani Formation. The lowest calcareous shale was dated by Sakmarian rugose corals (Igo, 1959).

The tabulate coral specimens studied herein are deposited in the National Sci-

ence Museum (prefix NSM), Tokyo or the Hikaru Memorial Museum (prefix HMM), Takayama.

Systematic Paleontology

Order Favositida Wedekind, 1937

Suborder Favositina Wedekind, 1937

Superfamily Favositicae Dana, 1846

Family Schizophoritidae Lin in Lin *et al.*, 1988

Genus *Schizophorites* Gerth, 1921

Type species: Schizophorites dubiosus Gerth, 1921.

Schizophorites sp. indet.

Figs. 1-1-4; 2-1, 2

Material examined: A single corallum, NSM PA14657.

Description: Corallum massive, may domed in growth form with maximum observed size 10.2 mm in diameter and 9.3 mm in height, cerioid. Corallites prismatic, divergent in arrangement; cross sections of corallites are polygonal with indistinct 5–8 sides; most distal portion of corallites more or less depressed in cross section as calical modification, where corallite diameters variable and relatively small for genus, 0.5×0.7, 1.1×1.9, 2.6, 2.2×2.7 mm in typical corallite; tabularia very narrow with irregular cross sections in central corallum, then shift to calical pits indicating elliptical, subtrapezoidal or subcircular cross sections; strong granules protrude into calical pit; calical opening perpendicular to corallum periphery; increase of new corallite not observable in sectioned parts. Intercorallite walls strongly thickened, attaining to 1.15 mm, differentiated into thin median dark line and stereoplasm with radially fibrous microstructure; mural pores frequent on corallite faces, subcircular in section, 0.10–0.17 mm in diameter, forming 2 series of longitudinal rows; tabulae vary rare, restrict to proximal portion of corallites, may incomplete; squamulae common in proximal portion of corallites, concave; some squamulae enveloped by stereoplasmic thickening; septal elements at distal portion of corallites represented by robust and conical projections, usually 0.21–0.40 mm in length.

Discussion: This species is represented by a single and poorly preserved specimen. Better material is needed for a species level determination. However, the massive corallite form with the strongly thickened intercorallite walls, the depressed cross sections of the corallites at the corallum periphery and the robust septal elements of this specimen warrant the generic assignment. Previously the type species *Schizophorites dubiosus* Gerth (1921, pl. 149, fig. 23, pl. 150, figs. 26–28), known from the Lower(?) Permian of West Timor, Gondwana, was a only representative of

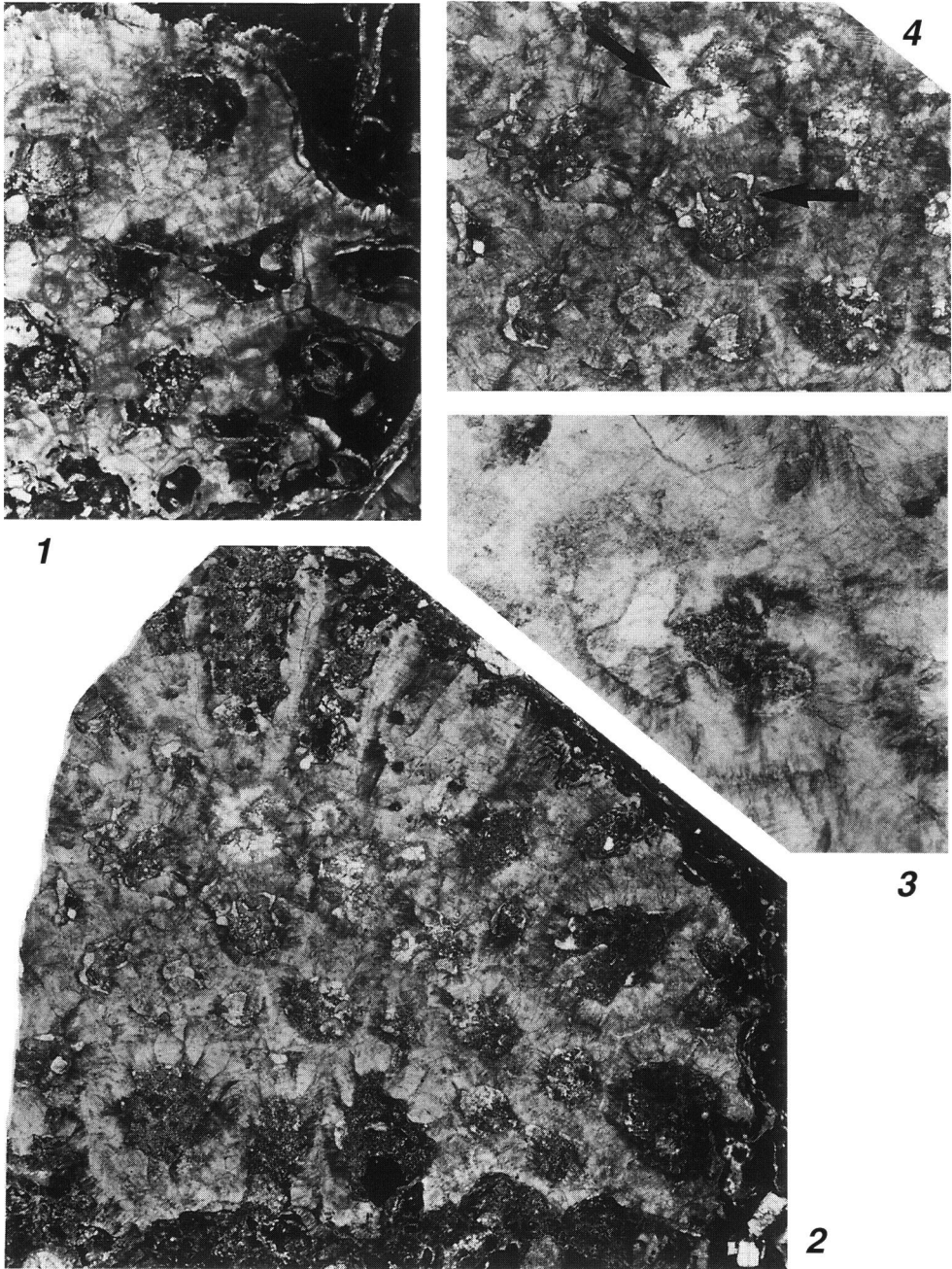


Fig. 1. *Schizophorites* sp. indet., thin sections, NSM PA14657. 1, transverse sections of peripheral corallites, note depressed cross sections, $\times 14$. 2, longitudinal section of corallum, $\times 10$. 3, oblique sections of corallites showing squamula, $\times 40$. 4, transverse sections of proximal corallites, upper arrow indicates tabula and lower arrow indicates squamula, $\times 14$.

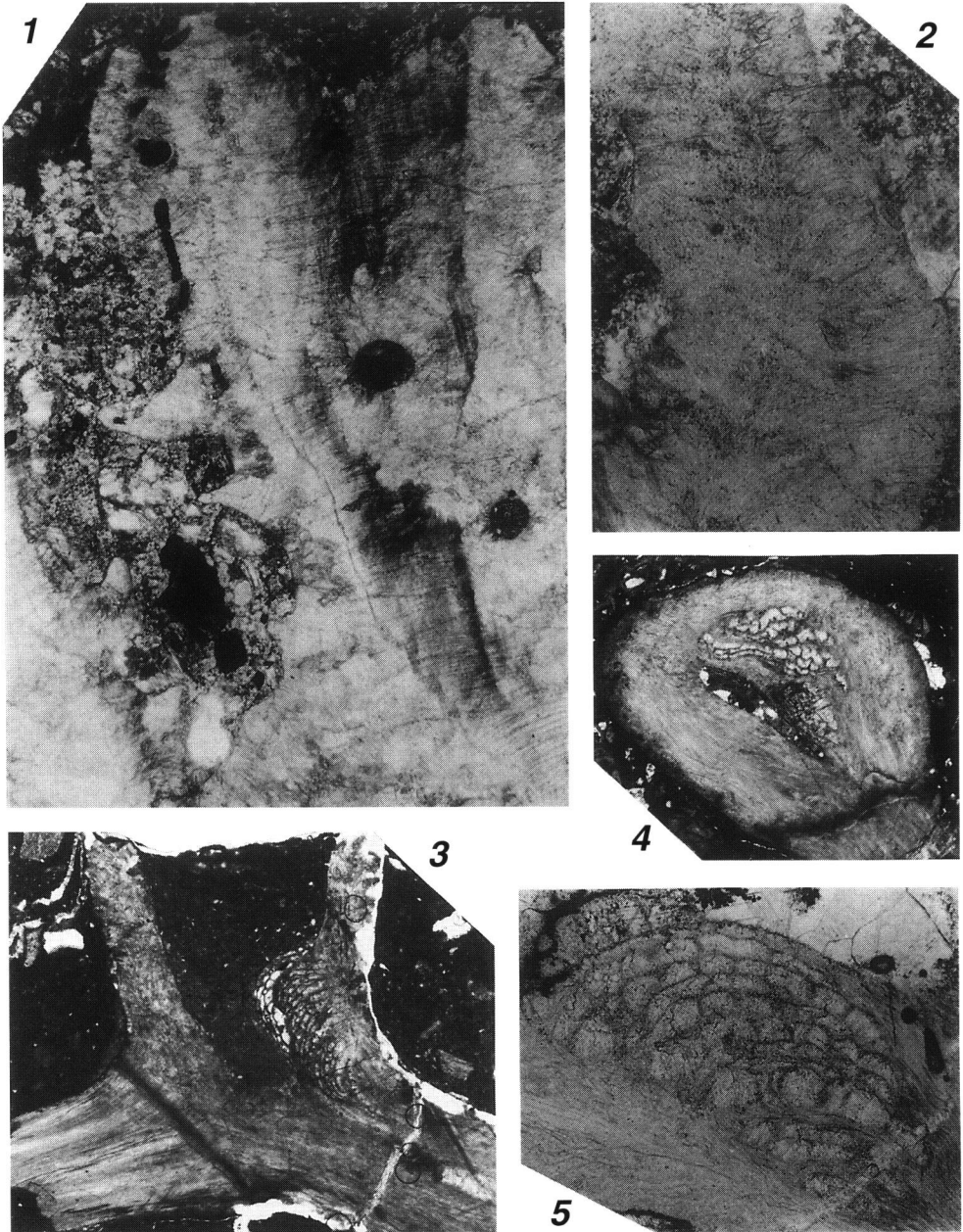


Fig. 2. 1, 2, *Schizophorites* sp. indet., thin sections, NSM PA14657. 1, longitudinal sections of distal corallites, showing septal spines and mural pores, $\times 14$. 2, partial enlargement to show corallite wall structure, $\times 80$. 3–5, *Cladochonus verrucatus* sp. nov., thin sections, holotype, HMM 04078. 3, longitudinal section, perpendicular to substrate, note calical prominence, $\times 14$. 4, near transverse section, $\times 14$. 5, partial enlargement to show intercorallite wall structure at calical prominence, $\times 50$.

the genus. Thus, this discovery is not only the first record of *Schizophorites* in Japan but also confirmation of the occurrence of the genus outside Timor.

Order Auloporida Sokolov, 1947

Superfamily Auloporicae Milne-Edwards and Haime, 1851

Family Pyrgiidae Fromental, 1861

Genus *Cladochonus* M'Coy, 1847

Type species: Cladochonus tenuicollis M'Coy, 1847.

***Cladochonus verrucatus* sp. nov.**

Figs. 2-3-4; 3-1-7

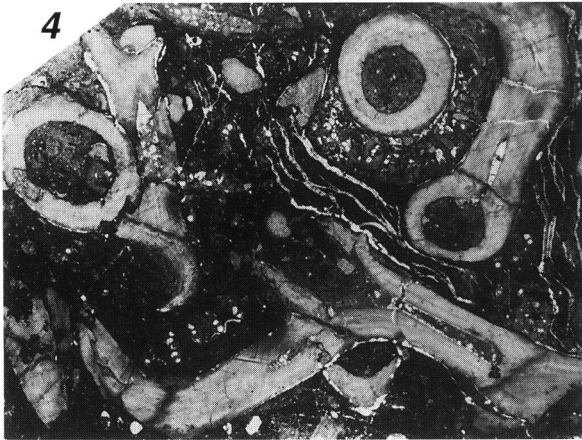
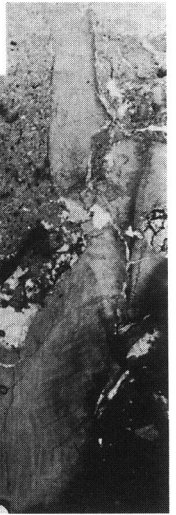
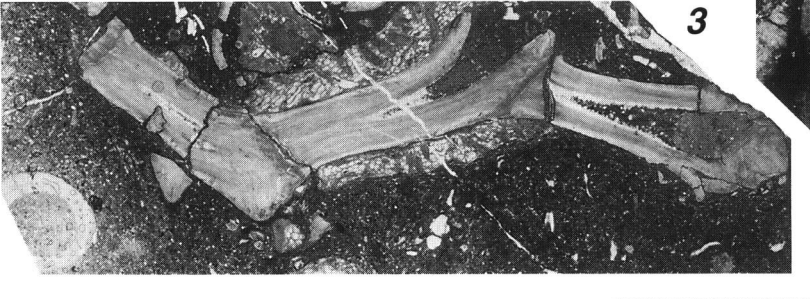
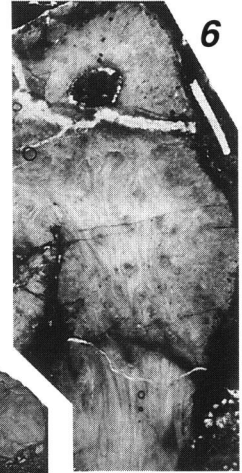
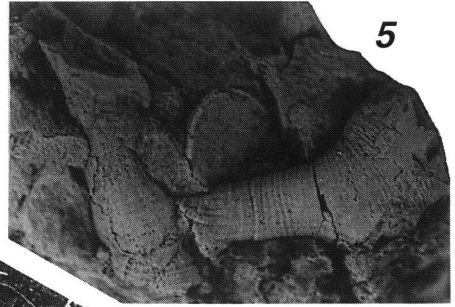
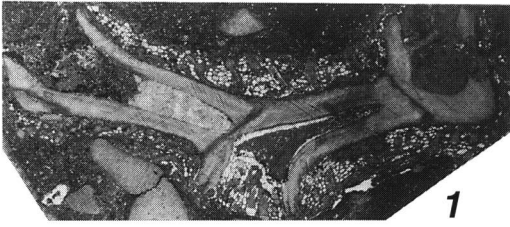
Cladochonus cf. *crassus* (M'Coy, 1844); Niko, 2000, p. 127, 128, figs. 1-1,3.

Holotype: HMM 04078, from which seventeen thin sections and a partially exposed corallum fragment from matrix were examined.

Other specimens: Eight thin sections were studied from the paratype, HMM 04109. In addition, two specimens, HMM 04105-1, 4, are assigned to this species.

Diagnosis: Species of *Cladochonus* with large corallites, approximately 3.0 mm at calical rim, longitudinal surface furrows and funnel-shaped short calices; each calical pit commonly bears high prominence at base; septal spines not reach in lumen; tabula absent.

Description: Coralla encrusting mat-like in growth form; largest corallum fragment (holotype) comprising of 4 corallites is 19.8 mm in length. Each corallite consists of cylindrical to weakly inflated proximal portion, 2.7–5.9 mm in length, and short, funnel-shaped distal portion forming calice, 1.5–2.7+mm in length; proximal portion prostrate, then turns upward with relatively sharp bend and shifts distal free portion; calices oblique, to open usually 57°–65° to substrate; cross sections of corallites are subcircular, evident attachment scar not recognized; corallite diameters large for genus ranging from 1.5 to 2.7 mm with 1.8 mm mean in prostrate portion and reach to 2.4–3.5 mm with 3.0 mm mean at calical rim; increase of new corallites unilateral and rarely bilateral, daughter corallite of offset arises at near basal part of preceding calice; lumina narrow, subcircular in cross section. Corallite walls usually 0.40–0.52 mm in thickness, composed of thin dark layer of epitheca and inner very thick stereoplasm with microlamellar structure; lamellae parallel to epitheca in prostrate portion then indicate undulation in free portion; in addition reticulate tissue composed of laminae, diaphragms and dissepiments commonly developed in most inner part of corallite walls; this tissue forms large, a high calical prominence at convex side of corallite bend where calical pit strongly constricted and corallite walls attain to 1.17 mm in thickness; outer surface of epitheca bears transverse growth lines



and shallow longitudinal furrows; septal spines rare in prostrate portion and abundant in free portion, 0.2 mm(?) in length, but enclosed in stereoplasm, not reach into lumen; tabula absent.

Discussion: In the gross morphology of the corallites and the corallite wall structure characterized by presence of the reticulate tissue, *Cladochonus verrucatus* sp. nov. closely resembles *C. crassus* (M'Coy, 1844, pl. 27, fig. 4; Hill and Smyth, 1938, pl. 22, figs. 1–12, pl. 23, figs. 2–10; Hill, 1981, figs. 288-4, 435-2f) from the Avonian (Lower Carboniferous) shale of Donegal, northern Ireland. However, the calical prominence of *Cladochonus crassus* is much lower than that of the present new species. Although the two Carboniferous species, *Cladochonus cylindratus* Niko (1998, figs. 2A–F) and *C. hamadai* Igo and Adachi (1980, pl. 36, figs. 1, 2, pl. 37, figs. 1–4, pl. 38, fig. 1; Niko, 1998, figs. 3D, 4E) have previously known from the Fukuji area, they can be easily separated from *C. verrucatus* in their smaller corallite diameters (approximately 3.0 mm at calical rim versus approximately 1.1 mm in nearly cylindrical corallites of *C. cylindratus* and maximum 2.0 mm in *C. hamadai*), the absence of the reticulate tissue, and the possession of the tabulae.

Niko (2000) tentatively assigned the two poorly preserved specimens (HMM 04105-1, 4) from a reddish shale slab originated from the Ichinotani Formation of the Fukuji area to *Cladochonus* cf. *crassus*. Judging from new material, now shows that this form should be reassigned.

Etymology: The specific name is derived from the Latin *verruca* (=wart) in reference of its calical prominence.

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←Fig. 3. *Cladochonus verrucatus* sp. nov. 1, 2, 4–7, holotype, HMM 04078. 1, longitudinal thin section, parallel to substrate, $\times 5$. 2, longitudinal thin section, parallel to substrate, $\times 5$. 4, transverse and longitudinal thin sections, $\times 5$. 5, external view, note longitudinal surface furrows, $\times 5$. 6, partial enlargement to show corallite wall structure, $\times 14$. 7, near longitudinal thin section, $\times 14$. 3, paratype, HMM 04109, transverse (left) and longitudinal (right) thin sections, parallel to substrate, $\times 5$.

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