

Carboniferous Tabulate Corals from the Fukuji Area, Gifu Prefecture

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Abstract Three species of Carboniferous tabulate corals are described from a reddish shale slab which was collected in the Fukuji area, Gifu Prefecture and most probably originated from the Bashkirian to Gzhelian intervals of the Ichinotani Formation. This assemblage comprises a favositid *Sutherlandia minatoi* sp. nov. and a pseudofavositid *Pseudofavosites okuhidaensis* sp. nov. of the order Favositida, and a pyrgiid *Cladochonus* cf. *crassus* (M'Coy, 1844) of the order Auloporida. *Sutherlandia* was not previously known in Japan. Comparable forms with those species are reported from Laurentia, Tibet, Timor, and northern Ireland.

Key words: Carboniferous, tabulate corals, Favositidae, Pseudofavositidae, Pyrgiidae, Gifu

Introduction

A reddish shale slab carrying some tabulate coral specimens is kept in the paleontological collection of the Hikaru Memorial Museum (prefix HMM) in Takayama, Gifu Prefecture, Central Japan. The present taxonomic investigation of this new material has resulted in recognition of the three taxa; namely *Sutherlandia minatoi* sp. nov., *Pseudofavosites okuhidaensis* sp. nov., and *Cladochonus* cf. *crassus* (M'Coy). This paper focuses on documentation of morphological respects of those tabulate corals. According to the accompanying information, this slab was collected as a float block in the Mizuyaga-dani Valley that is situated at about 2 km southwest of Fukuji village, Gifu Prefecture. Lithologically, it most probably originated from the Bashkirian to Gzhelian (Middle to Upper Carboniferous) intervals of the Ichinotani Formation. Lithostratigraphic description of the formation and previous researches concerning the Ichinotani tabulate coral fauna are respectively referable in Adachi (1985) and Niko (1998), thus they will not be repeated herein.

Systematic Paleontology

Order Favositida Wedekind, 1937

Suborder Favositina Wedekind, 1937

Superfamily Favositicae Dana, 1846

Family Favositidae Dana, 1846

Subfamily Emmonsinae Lecompte, 1952

Genus *Sutherlandia* Cocke and Bowsher, 1968

Type species: *Sutherlandia irregularis* Cocke and Bowsher, 1968.

Sutherlandia minatoi sp. nov.

Figs. 1–2

Holotype: HMM 04105-2, from which five thin sections were made.

Diagnosis: Species of *Sutherlandia* with subspherical and relatively large corallum, usually 0.9–1.3 mm in corallite diameter, “gear wheel like” cross sections of calical pits; mural pores abundant, large, approximately 0.17 mm in diameter, forming 2 rows; squamulae very long, attaining 0.9 in squamula length/corallite diameter ratio; proximal squamulae somewhat irregular and anastomose.

Description: Corallum small, but relatively large for genus, subspherical in growth form with maximum observed size 12.1 mm in diameter and 7.4 mm in height, encrusting on corallite of *Cladochonus* cf. *crassus*, cerioid. Corallites prismatic, almost divergent in arrangement, but proximal corallites adhere to substrate and their arrangement is somewhat irregular; cross sections of corallites are polygonal 3–4 sides in early growth stages of new corallites, then shift 6–8 sides distally; diameters of corallites somewhat variable even in corallum periphery, range from 0.3 to 1.7 mm, usually 0.9–1.3 mm; lumina polygonal in cross section and shifting deep calices that are perpendicularly oriented to corallum surface; transition point between lumen and calical pit is indistinct; low and broad longitudinal ridges recognized at calical pits; there are 10–13 ridges in each calical pit, thus cross sections of calical pits indicate “gear wheel like” appearance; increases of new corallites lateral, common. Intercorallite walls thick, but moderate for genus with 0.06–0.13 mm in thickness in proximal portion and attain 0.23 mm in thickness in distal portion, differentiated into median dark line and stereoplasm of rect-radiate fibers in microstructure; mural pores abundant, large, circular to laterally compressed oval cross section with approximately 0.17 mm in diameter, forming 2 rows in each corallite face; squamulae very long and wide, usually 0.60–0.91 mm in length; squamula length/corallite diameter ratios attain 0.9 in distal portion of corallite; number of squamulae is numerous with close spacing; there are 3–5 squamulae in 1 mm of distal corallite length; squamulae in proximal portion of corallite (=proximal squamulae) somewhat irregular in form and frequently anastomose, then shift nearly horizontal to weakly upwards with

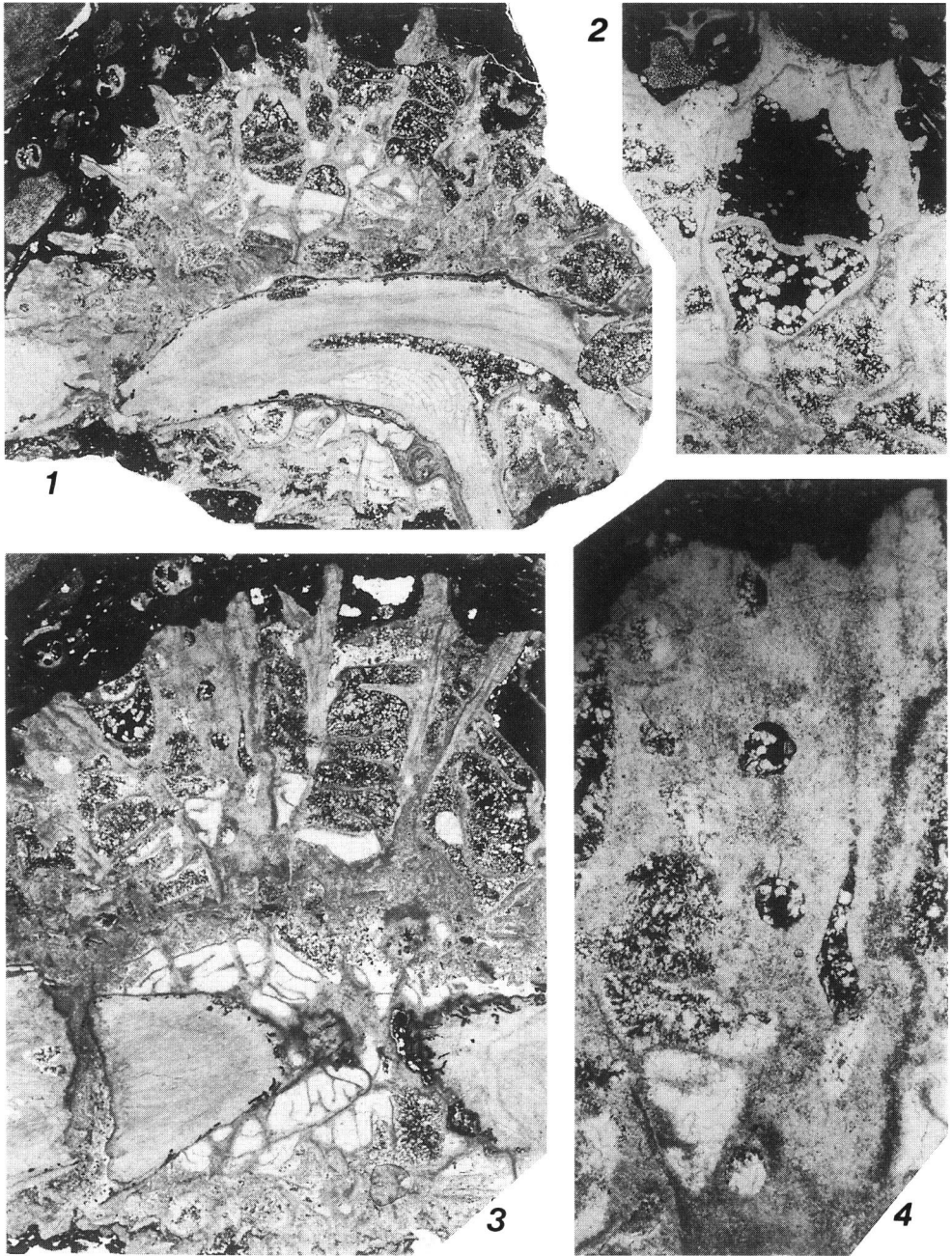


Fig. 1. 1–4, *Sutherlandia minatoi* sp. nov., holotype, HMM 04105-2, thin sections. 1, longitudinal section, encrusting on *Cladochonus* cf. *crassus*, $\times 10$. 2, oblique section at calical pit, note longitudinal ridges and “gear wheel like” appearance, $\times 20$. 3, longitudinal section, $\times 14$. 4, longitudinal section, showing mural pores, $\times 40$. 1, 3, *Cladochonus* cf. *crassus* (M'Coy), HMM 04105-1, thin sections, enclosed in *Sutherlandia minatoi*, overturned.

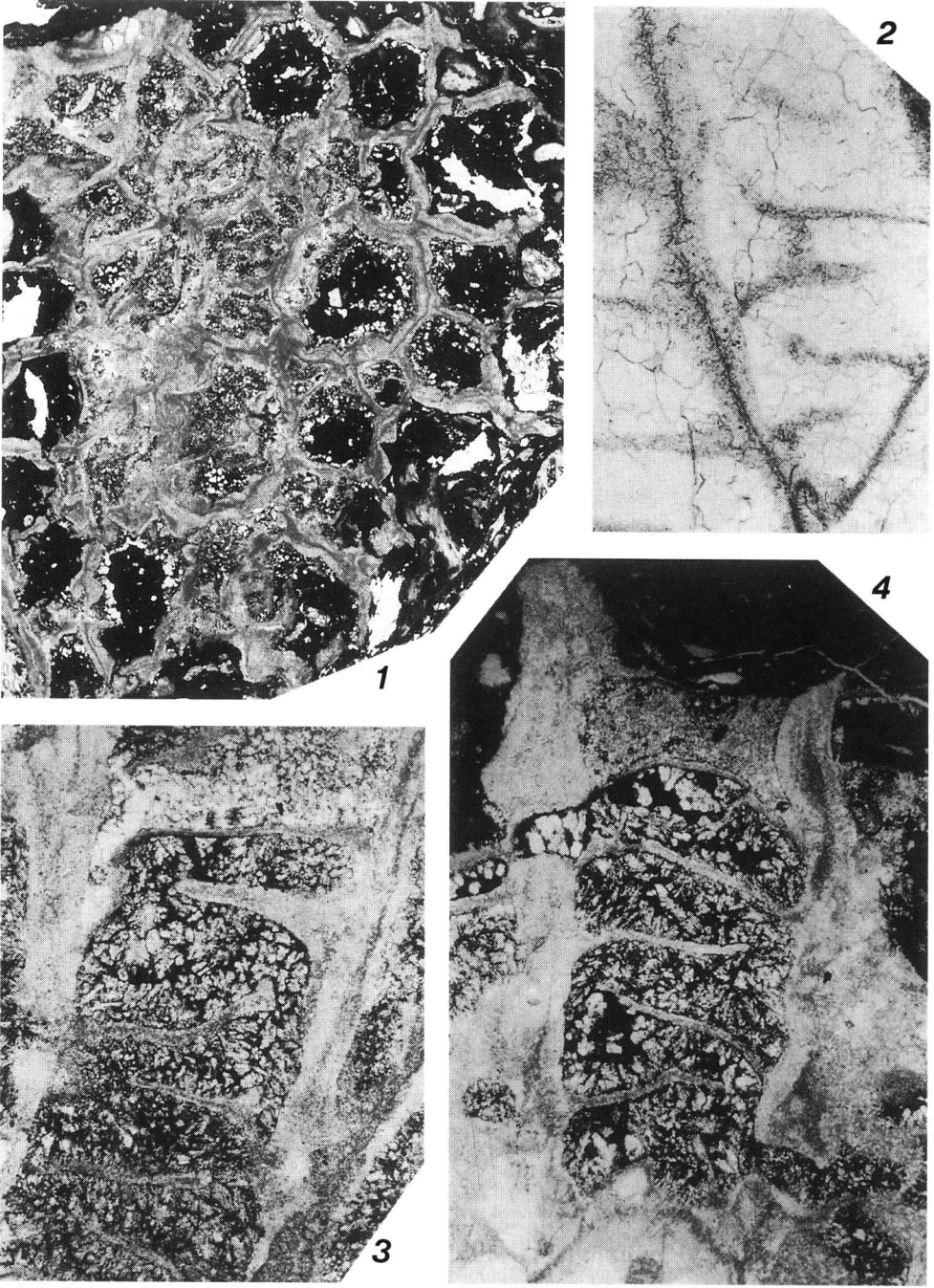


Fig. 2. *Sutherlandia minatoi* sp. nov., holotype, HMM 04105-2, thin sections. 1, transverse section, $\times 14$. 2, partial enlargement to show corallite wall structure, $\times 80$. 3, 4, longitudinal sections, showing distal squamulae, both are $\times 40$.

convex or rarely sinuate profiles, in distal portion of corallite, where each squamula (=distal squamula) is alternate with that of opposing corallite wall; tabula absent.

Discussion: This new species is most similar to *Sutherlandia irregularis* Cocke and Bowsher (1968, figs. 2-1-4) from the Missourian (Upper Carboniferous) of Oklahoma and Kansas in having the somewhat irregular proximal squamulae and the large mural pores forming 2 rows. *Sutherlandia minatoi* sp. nov. is distinguished from this Laurentian species by its larger number of the mural pores and longer squamulae (squamula length/corallite diameter ratios attaining 0.9 versus 2/3 to 3/4 in *S. irregularis*). In addition, *Sutherlandia irregularis* has the smaller corallum size (maximum 8.5×4.0 mm) than that of *S. minatoi*. *Sutherlandia alani* Cocke and Bowsher (1968, figs. 2-5-9) from the Desmoinesian (Middle Carboniferous) of Oklahoma and *S. xianzaensis* Lin (1984, pl. 3, figs. 1a-c) from the Lower Carboniferous of Tibet differ from *S. minatoi* in their more regular arrangement of the squamulae with scarcely anastomosing even in the proximal portion of the corallite. A Permian species, described as *Favosites permica* Gerth (1921, pl. 149, figs. 1-3, pl. 150, fig. 1) from West Timor, is suggestive of generic affinity to *Sutherlandia*. However, its thinly encrusting corallum form clearly separates this species from *Sutherlandia minatoi* at least in specific level. *Sutherlandia minatoi* represents the first occurrence of the genus in Japan.

Etymology: The specific name honors the late Dr. Masao Minato, in recognition of his outstanding contributions to the study of the Paleozoic corals.

Family Pseudofavositidae Sokolov, 1950

Genus *Pseudofavosites* Gerth, 1921

Type species: *Pseudofavosites stylifer* Gerth, 1921.

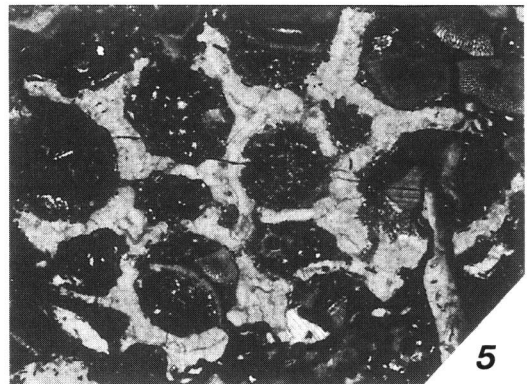
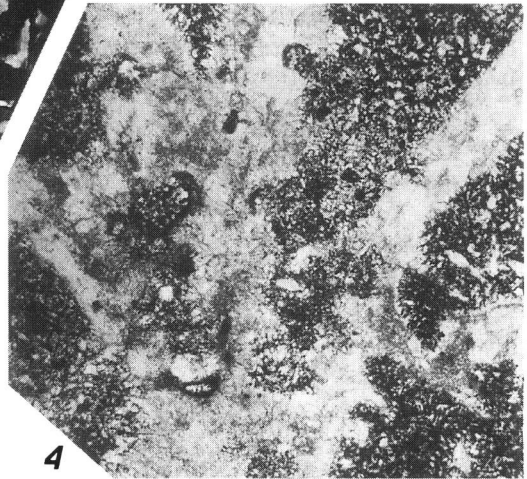
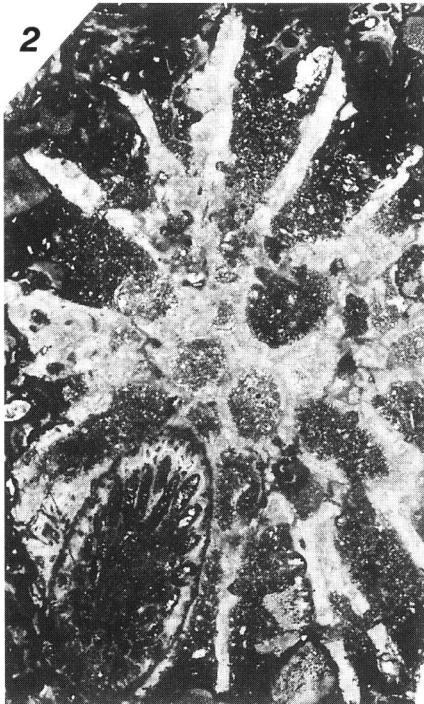
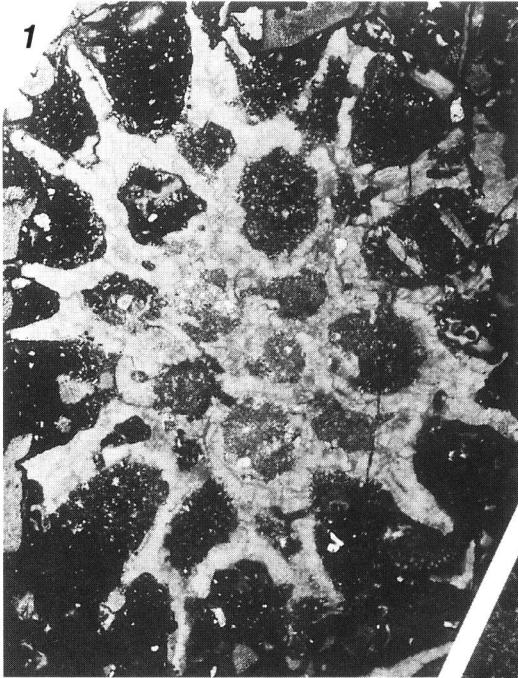
***Pseudofavosites okuhidaensis* sp. nov.**

Fig. 3

Holotype: HMM 04105-3, from which three thin sections were made.

Diagnosis: Species of minute *Pseudofavosites* with nearly spherical corallum, rapidly inflated corallites, usually 1.0–1.3 mm in corallite diameter, thick intercorallite walls attaining 0.33 mm; mural pores recognized at both corallite faces and near angles; squamulae closely spaced, restricted in proximal portion of corallite.

Description: Corallum minute, nearly spherical in growth form with maximum observed size 6.5 mm in diameter and 5.4 mm in height, encrusting on bryozoan stem, cerioid. Corallites prismatic, divergent in arrangement; cross sections of corallites are indistinct 4–8 sides; diameters of corallites not minute for family and variable even in corallum periphery, range from 0.4 to 1.3 mm, usually 1.0–1.3 mm; inflation of corallite diameter is rapid for genus; cross sections of lumen-calical pit are



polygonal to subcircular with weak depressions caused by low longitudinal ridges; calices deep but transition point between lumen and calical pit is indistinct, perpendicularly oriented to corallum surface; increase of new corallites lateral, common. Intercorallite walls thick attaining 0.33 mm in thickness, indicate radially fibrous microstructure (in addition, median dark line may present); mural pores circular in cross section with somewhat variable in diameter ranging from 0.08–0.17 mm, occur at both corallite faces and near angles; vermiform narrow mural tunnels may present; squamulae relatively long in comparing with corallite diameter, attaining 0.23 mm in length, closely spaced but restricted in proximal portion of corallite, rectangular to corallite; profiles of squamulae are concave, or convex to nearly flat in rare cases; tabula absent.

Discussion: The squamulae are disappeared in the distal portion of the specimen, of which ontogenetic change probably indicates its maturity. In addition, its usual corallite diameters for the family and thick intercorallite walls also support this interpretation.

The minute corallum size clearly separates *Pseudofavosites okuhidaensis* sp. nov. from the almost known species of the genus. This new species appears to be only comparative with a minute specimen illustrated by Lin (1984, pl. 2, fig. 2) as *Pseudofavosites minisculus* from the Lower Carboniferous of Tibet, but differs from the latter species in having the closely spaced squamulae.

Etymology: The specific name is derived from Okuhida, which is a regional name of Fukuji area and its vicinities.

Order Auloporida Sokolov, 1947

Superfamily Aulopricae Milne-Edwards and Haime, 1851

Family Pyrgiidae Fromentel, 1861

Genus *Cladochonus* M'Coy, 1847

Type species: *Cladochonus tenuicollis* M'Coy, 1847.

***Cladochonus* cf. *crassus* (M'Coy, 1844)**

Fig. 1-1, 3

Compare:

Jania crassa M'Coy, 1844, p. 197, pl. 27, fig. 4.

Jania bacillaria M'Coy, 1844, p. 197, pl. 26, fig. 11.

Cladochonus crassus (M'Coy); M'Coy, 1847, p. 227; Hill and Smyth, 1938, p. 129–133, pl. 22, figs. 1–12, pl. 23, figs. 2–10; Hill, 1981, figs. 288-4, 435-2f.

←Fig. 3. *Pseudofavosites okuhidaensis* sp. nov., holotype, HMM 04105-3, thin sections. 1, transverse section, ×14. 2, longitudinal section, ×14. 3, partial enlargement to show corallite wall structure, ×80. 4, partial enlargement to show squamulae and mural pores, ×40. 5, transverse section near corallum periphery, ×14.

Cladochonus bacillarius (M'Coy); M'Coy, 1847, p. 227.

Monilopora crassa (M'Coy); Nicholson and Etheridge, 1879, p. 293; Gerth, 1921, p. 119, pl. 150, figs. 13[?], 14[?].

Material examined: Two coralla, HMM 04105-1, 4.

Description: Corallite consists of weakly inflated proximal portion, approximately 4.8 mm in length, and funnel-shaped distal portion forming calice, 2.7 mm+ in length; cross sections of corallites are subcircular with maximum diameter at calical rim of 2.8 mm; daughter corallite of offset arises at near basal part of preceding calice. Corallite walls very thick, usually indicating microlamellar structure, attain 0.94 mm in thickness; reticulate wall tissue recognized at convex side of corallite bend; no septal spine detected in lumen; tabula absent.

Discussion: The gross corallite morphology and possession of the reticulate tissue are strongly suggestive of *Cladochonus crassus* (M'Coy), known from the Avonian (Lower Carboniferous) of northern Ireland. However, preservation of the Fukuji specimens is poor. They are left in open nomenclature until better material obtained.

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