Auloporid Tabulate Corals from the Lower Permian
Ryozensan Limestone, Shiga Prefecture

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Abstract The tabulate coral fauna from the Lower Permian Ryozensan Limestone Formation, Mino Terrane in Shiga Prefecture consists of two auloporid species, i.e. the aulocystid Pseudoromingeria onishii sp. nov. and the sinoporida Sinopora ryozensanensis sp. nov. and is of Sakmarian age. This discovery of Pseudoromingeria onishii leads to the following emendations: a revised generic diagnosis is presented, and the stratigraphic range of the genus is extended from the Capitanian (Late Permian). The comparable forms with the present Ryozensan tabulate corals are known from the Akasaka Limestone, Gifu Prefecture, and Yunnan and Guizhou of South China. This paper represents the first reliable documentation of tabulate corals in the formation.

Key words: Sakmarian (Early Permian), tabulate corals, Aulocystidae, Pseudoromingeria, Sinoporidae, Sinopora, Ryozensan Limestone Formation, Shiga.

Introduction

The first reliable tabulate corals to be described from the Lower Permian Ryozensan Limestone Formation (Takimoto, 1936; redefined by Miyamura, 1973), Mino Terrane based on material found and donated to the National Science Museum, Tokyo, by Mr. Tetsuro Onishi. Two auloporid species, Pseudoromingeria onishii sp. nov. and Sinopora ryozensanensis sp. nov., are identified in the present specimens whose localities are in the Gongen-dani Valley of Inukami-gun, Shiga Prefecture, Central Japan (Fig. 1). Previous studies considered Ryozensan corals as exclusively Rugosa, including Amandophyllum sp. nov. (Yamagiwa and Oyagi, 1989) and unnamed rugose corals (Oyagi, 1991, 1994, 2000). The presence of corals in this formation has been also noted by Miyamura (1973), Miyamura et al. (1976), and Tamura et al. (1979).

The Mino Terrane is an accreted tectonostratigraphic unit consisting mainly of Permian greenstone-limestone complex, Permian to Triassic chert, and Jurassic terrigenous sediments (e.g., Mizutani, 1990). The juxtaposed Akasaka, Ibukiya, Ryozensan and Fujiwaradake Limestones of this greenstone-limestone complex were situated in a warm-water condition of Panthalassa (Ross and Ross, 1985; Ozawa,
Fig. 1. Index map of the present coral localities (SR-1, 2) in the Gongen-dani Valley, Shiga Prefecture using 1:50,000 map of "Hikonetobu" published by the Geographical Survey Institution.

1987; Zaw Win, 2000) during Permian time. Among them, the Ryozensan Limestone Formation forms the principal axis of the northern Suzuka Mountains as the remnants of nappe on the Early to Middle Jurassic (Okimura et al., 1986) Ikuridani Group. This formation is divided into two distinct members, basic volcanic rocks (150 m thick) below and coral-bearing limestone (450 m thick) above. The types of Pseudoromingeria onishii came from light gray bioclastic packstone at locality SR-2. Sinopora ryozensanensis was collected in float blocks of black wackestone/packstone in talus at locality SR-1. The fusulinids Pseudofusulina vulgaris (Schellwien) and Paraschwagerina sp. co-occur with the both tabulate coral localities and indicate the Sakmarian (Early Permian) age.

**Systematic Paleontology**

Order Auloporida Sokolov, 1947
Superfamily Auloporicae Milne-Edwards and Haime, 1851
Family Aulocystidae Sokolov, 1950
Genus Pseudoromingeria Yabe and Sugiyama, 1941

*Type species:* Romingeria? kotoi Yabe and Hayasaka, 1915.
*Emended diagnosis:* Subramose coralla consisting of lax mass with slender
corallites in clusters, phacelo- cerioi; prostrate in early stages; increase lateral; without connecting tubule; walls thick with numerous septal spines; mural pores rare, restrict near branch periphery; tabulae infundibuliform and dissemination-like; stereoplasm consists of rect-radiate fibers.

_Pseudoromingeria onishii_ sp. nov.

Figs. 2-1–3; 3-1–3; 4-1–4

_Holotype:_ NSM PA14634, from which six thin sections were made.

_Other specimens:_ Nine thin sections were studied from the two paratypes, NSM PA14635, 14636.

_Diagnosis:_ Species of _Pseudoromingeria_ consisting mostly of ceroid branches and very narrow phaceloid portion; corallite diameters usually 1.1–1.6 mm; intercorallite walls usually very thick, attain 0.80 mm; tabulae well-developed, forming indistinct axial syrinx.

_Description:_ Coralla subramose with mostly ceroid branches, but distal corallites partly separated and phaceloid; some branches lack phaceloid portion; early growth stages are prostrate and _Cladochonus_-like; growth form of corallum may domical; maximum observed size of holotype approximately 80 mm in height. Branch shape is somewhat irregular, nearly cylindrical with usually 5–9 mm in diameter to blade-like; branching frequent, may bifurcate; length of each ceroid branch at least 19.5 mm; phaceloid portion very narrow in comparing type species, maximum 2.8 mm in length. Corallites are somewhat variable in shape, usually prismatic with indistinct 4–8 sided in cross section, but cylindrical with semicircular to fan- shaped cross sections in prostrate portion and peripheral branch, or cylindrical forms in phaceloid portion also recognized; corallite diameters range from 0.6 to 1.8 mm usually 1.1–1.6 mm with 1.3 mm mean, and attain 2.0×1.3 mm in semicircular form; there are 9–52+ corallites in cross section of ceroid branch; increase of new corallites lateral, common; tabularia narrow, usually subcircular in cross section, shifting deep calical pits, but their transition point is indistinct; calical opening obliquely upward with approximately 40° in angle to branch axis in sides. Intercorallite and corallite walls variable in thickness, but usually very thick, range from 0.10 to 0.80 mm with 0.55 mm mean in ceroid portion, composed of median dark line and stereoplasm of rect-radiate fibers; mural pores rare, restrict near corallum periphery, and occur at corallite faces; cross section of moral pores circular with approximately 0.08 mm in diameter; septal spines numerous, 0.13–0.27 mm in length; tabulae well-developed, incomplete, mostly infundibuliform, somewhat irregular in space and distribution; there are 0–4 tabulae in 2.5 mm of corallite length; crowded tabulae form indistinct axial syrinx.

_Discussion:_ Until now _Pseudoromingeria_ was the monotypic genus and repre-
Fig. 2. *Pseudoromingeria onishii* sp. nov., thin sections. 1, 3, 4, holotype, NSM PA14634. 1, transverse to oblique sections of branches, ×5. 3, cross sections of corallites, ×10. 4, longitudinal section of branch, ×5. 2, paratype, NSM PA14635; cross section of branch, ×5.

sented by the Capitanian (Late Permian) species *P. kotoi* (Yabe and Hayasaka, 1915; Yabe and Sugiyama, 1941, figs. 1–3) from the Akasaka Limestone, Gifu Prefecture. *Pseudoromingeria onishii* sp. nov. is distinctive in terms of the narrower phaceloid portion, the thicker corallite walls (maximum 0.80 mm versus 0.5 mm in *P. kotoi*),
Fig. 3. 1–4, *Pseudorongeria onishii* sp. nov., thin sections. 1, 2, holotype, NSM PA14634. 1, longitudinal sections of corallites, note infundibuliform tabulae, ×10. 2, partial enlargement to show intercorallite wall structure, ×50. 3, 4, paratype, NSM PA14635. 3, longitudinal sections of corallites, showing prostrate early growth stages, ×10. 4, longitudinal sections of corallites, arrow indicates mural pore, ×10. 5, *Sinopora ryozensanensis* sp. nov., holotype, NSM PA14641, thin transverse section, ×10.
and well-developed tabulae. The generic diagnosis, summarized by Hill (1981), is emended to include new data of Pseudoromingeria onishi, notably the confirmation of the early growth form and the presence of the mural pores. In addition, this Sak-marian new species downwards extends the stratigraphic range of the genus.

Etymology: The specific name honors Mr. Tetsuro Onishi, who discovered this coral.

Family Sinoporidae Sokolov, 1955
Genus Sinopora Sokolov, 1955
Type species: Monilopora dendroidea Yoh in Yoh and Huang, 1932.

Sinopora ryozensanensis sp. nov.

Figs. 3-3; 4-1-6

rugose coral; Oyagi, 1991, pl. 10, figs. 1–3.
compound rugose coral; Oyagi, 2000, p. 157.

Holotype: NSM PA14641, from which five thin sections were made.

Other specimens: Twenty-two thin sections and two etched corallum fragments were studied from the eight paratypes, NSM PA14637, 14639, 14643, 14644, 14653–14656. In addition, eleven specimens, NSM PA14638, 14640, 14642, 14645–14652, were also examined.

Diagnosis: Species of Sinopora with partial corallite adhesion forming cerioid-like portion; corallites usually 1.3–1.7 mm in diameter; septal spines well-developed, attaining 0.29 mm in length.

Description: Coralla domical of maximum observed size 25 mm in diameter and 16 mm in height (holotype), composed of phaceloid portion with closely spaced and dendritic branches and less frequent cerioid-like portion consisting of partial adhesion with up to 10 corallites; connecting tubule absent; early growth stages prostrate and Cladochonus-like. Corallites cylindrical in phaceloid portion with growth wrinkles on surface, range from 0.5 to 1.9 mm, usually 1.3–1.7 mm with 1.5 mm mean, in diameter; calices deep, lacking calical modification; lumina usually subcircular in cross section, shift deep calical pits without distinct transition point; increase of new corallites lateral, frequent with bifurcate branching. Corallite walls variable in thick-

→Fig. 4. Sinopora ryozensanensis sp. nov. 1, paratype, NSM PA 14656, etched corallum fragment, ×4. 2, paratype, NSM PA14644, etched corallum fragment, showing Cladochonus-like early growth stages, ×4. 3–5, holotype, NSM PA14641, thin sections. 3, cross section of cerioid-like portion, ×10. 4, longitudinal to cross sections of dendritic corallites, note well-developed septal spines, ×10. 5, longitudinal section, ×5. 6, paratype, NSM PA14639, thin cross section, ×5.
ness, but usually thick, range from 0.08 to 0.54 mm with 0.39 mm mean, consist of epitheca and stereoplasm with microstructure of rect-radiate fibers; banded structure, that parallel to epitheca, also recognized in stereoplasm; no mural pore detected even in cerioid portion; septal spines well-developed for genus, conical in profile and slightly upturned, attaining 0.29 mm in length, somewhat irregular in spacing; apparent tabula not detected.

Discussion: *Sinopora ryozensanensis* sp. nov. most resembles *S. maxima*, which was established by King (1974; not seen by the author, its specific diagnosis and geologic setting come from citation by Lin et al., 1988, p. 382) on the basis of specimens collected from the Lower to Middle Permian Chihsia Formation, Yunnan, South China. This species was also described from Middle Permian Maokou Formation in Guizhou, South China (Yang, 1978). The well-developed septal spines and the partial corallite adhesion of *Sinopora ryozensanensis* agree with diagnosis of *S. maxima*, but the corallite diameters are somewhat smaller (usually 1.3–1.7 mm) than those of *S. maxima*, whose corallites range from 1.4 to 2.2 mm, usually 1.8–2 mm in corallite diameter.

Oyagi (1991, 2000) illustrated several corals from the Ryozensan Limestone Formation and referred all specimens to Rugosa. The synonymy given above includes the three coralla in his illustrations.

Etymology: The specific name is derived from the type stratum.

Acknowledgments

The author is indebted to Mr. Tetsuro Onishi, who bring the Ryozensan corals to my attention and provided assistance in the field. He also provided access to his personal collection.

References


Permian Corals from Shiga


