

***Syringopora konishii*, a new species of Early Carboniferous tabulate corals from the allochthonous limestone blocks in the Kotaki Formation, Niigata Prefecture, central Japan**

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**Abstract**

A new tabulate coral species, *Syringopora konishii*, is established on the basis of material from float limestones in the Tsuchikura-zawa Valley of the Kotaki area, Niigata Prefecture, central Japan, origin of which limestones is the allochthonous blocks in the mélange facies of the Kotaki Formation belonging to the Hida-Gaien Terrane. The associated foraminifers suggest the age of *S. konishii* is late Visean (middle Early Carboniferous). Representatives of *Syringopora* are common components of Carboniferous tabulate coral fauna in the terrane. Paleobiogeographic significance of the new species is discussed.

*Key words:* allochthonous limestone blocks, Kotaki Formation, *Syringopora konishii* sp. nov., tabulate coral, Visean.

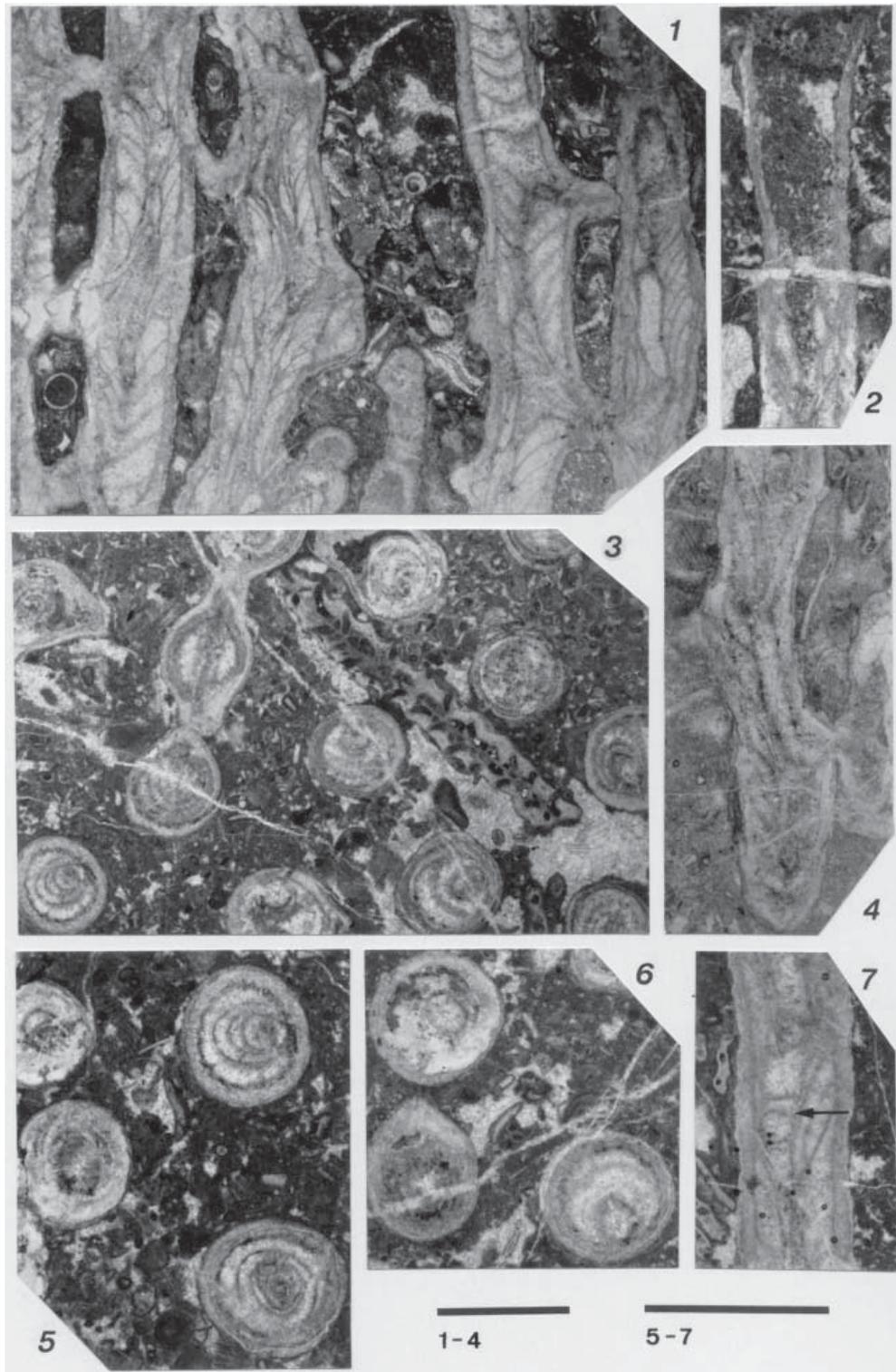
**Introduction**

The Permian Kotaki Formation of the Hida-Gaien Terrane is exposed in the Kotaki area, Itoigawa, Niigata Prefecture, central Japan, and consists mainly of pyroclastic rocks, sandstone, mudstone including mélange and chert (Takeuchi in Nagamori et al., 2010). Since the first notice by Konishi (1956), the diverse Early Carboniferous flora and fauna have been documented from the allochthonous limestone blocks to breccias (=“Tsuchikurazawa Limestone” in Nakazawa et al., 1998 and Takenouchi, 2005) in this mélange facies (i.e., Kobayashi et al., 1957; Hasegawa et al., 1982; Kamiya and Niko, 1996; Niko and Yamagiwa, 1998; Tazawa, 2004; Ibaraki et al., 2008; Niko and Ibaraki, 2011). The present study describes a new tabulate coral species, *Syringopora konishii*, as

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an additional constituent to this fossil assemblage. The material examined herein was discovered from two float blocks of limestones found in the Tsuchikura-zawa Valley. Detailed geographic point of the collecting site is referable in Niko and Yamagiwa (1998, Fig. 1).

### Systematic Paleontology

Order Auloporida Sokolov, 1947  
 Superfamily Syringoporoidea Fromentel, 1861  
 Family Syringoporidae Fromentel, 1861  
 Genus *Syringopora* Goldfuss, 1826

*Type species.*—*Syringopora ramulosa* Goldfuss, 1826.

*Syringopora konishii* sp. nov.

Fig. 1

*Etymology.*—The specific name honors Dr. K. Konishi, who first noticed the peculiar litho- and bio-facies of the limestones in the Tsuchikura-zawa Valley.

*Material.*—Holotype, FMM2013, from which 24 thin sections were prepared. Paratype, FMM2014, from which three thin sections were prepared. They are kept in the Fossa Magna Museum, Itoigawa.

*Diagnosis.*—Species of *Syringopora* with slender corallites having approximately 1.5 mm in diameter and well-developed connecting tubuli; spacing of corallites relatively close; in part, axial syringes situate marginal position of corallites; septal spines well-developed, but not numerous.

*Description.*—Coralla probably domical in growth form, large, more than 300 mm in diameter in holotype, phaceloid. Corallites slender for the genus, cylindrical having circular transverse sections, whose diameters range from 1.0 to 1.8 mm, with 1.5 mm in mean; corallite spacing relatively close for the genus, usually 1.1–3.5 mm in distance (center-to center) between corallites; in very rare cases, adhesion of adjoining two corallites is recognized; connecting tubuli well-developed, occur in nearly same level, horizontal to slightly (or strongly in rare cases) oblique; diameter and length of connecting tubuli are respectively 0.3–0.8 mm and 0.5–1.2 mm; in adhered corallites, connecting tubule is replaced by mural pore; tabularia (lumina) cylindrical in transverse sections; calices weakly inflated with deep and funnel shaped calical pits; some connecting tubuli linked together by horizontal canal in tabularium; increase of new corallite occurs as lateral

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← **Fig. 1.** *Syringopora konishii* sp. nov., thin sections. **1, 3–7:** holotype, FMM2013. **1,** longitudinal sections of corallites, **3,** transverse sections of corallites, **4,** longitudinal sections of corallites, note marginal position of axial syring and mural pore, **5, 6,** transverse sections of corallites, note marginal position of axial syring in lower right corallite in fig. 6, **7,** longitudinal section of corallite, arrow indicates diaphragm in axial syring. **2:** paratype, FMM2014, longitudinal section of corallite at calice. Scale bars equal 2 mm.

offset on parent corallites. Corallite walls moderate in thickness for the genus, usually 0.14–0.23 mm, composed of thin outer layer of epitheca and inner thicker layer of stereoplasm; microstructure of stereoplasm is lamellar; septal spines well-developed, but not numerous in comparing with typical species of the genus; shape of septal spines needle-like, with length of 0.07–0.15 mm in protrude portion into tabularium; tabulae infundibuliform, abundant, usually 10–15 tabulae in 5 mm of corallite length; axial syringes situate most commonly central to subcentral position of corallite, but syringes with marginal position are also recognized; transverse sections of axial syringes are subcircular to elliptical, having 0.31–0.48 mm in diameter; uparched to nearly horizontal diaphragms and dissepiments are frequently developed in axial syrinx; vertical diaphragms rarely developed in canal.

*Age.*—The type specimens of *Syringopora konishii* sp. nov. co-occur with *Tuberitina* sp., *Neoarchaediscus* sp., *Howchinia* sp., *Saccamminopsis* sp., *Palaeotextularia?* sp., *Endothyra* spp., *Endothyranopsis?* sp., *Tetrataxis* sp., *Eostaffella* sp., *Mediocris breviscula* (Ganelina) and *Pseudoendothyra* sp., in bioclastic wackestone to packstone containing the holotype, and *Tetrataxis* sp., *Eostaffella* sp. and *M. breviscula* in peloidal (to bioclastic in part) packstone containing the paratype. These associated foraminifers indicate a late Viséan (middle Early Carboniferous) age.

*Discussion.*—Representatives of *Syringopora* are common faunal components of Carboniferous tabulate corals in the Hida-Gaien Terrane. Previously four (or three?) species have been known, namely *S. ichinotaniensis* Niko, 1998, *S. kotakiensis* Niko in Niko and Yamagiwa, 1998, *S. sp. indet.* (Niko, 1998), and *S. sp. indet.* (Tazawa et al., 2000). *Syringopora* sp. indet., described by Niko (1998, p. 122, 124, figs. 7-A–F) from the Viséan or Serpukhovian (middle or upper Lower Carboniferous) part of the Ichinotani Formation of the Fukuji area, Gifu Prefecture, is most similar to *S. konishii* sp. nov. However, it differs from the present new species in having somewhat larger diameters of the corallites (1.2–2.5 mm versus approximately 1.5 mm in *S. konishii*) and the much fewer connecting tubuli. At the Tsuchikura-zawa locality *S. kotakiensis* Niko in Niko and Yamagiwa (1998, p. 145, 147, figs. 10-1–6) also occurs in the allochthonous limestone blocks of the Kotaki Formation that yields *S. konishii*. The major difference between the two species is larger corallite diameters of the former species attaining 3.5 mm.

*Syringopora setamaiensis* (Minato, 1955, p. 188, 189, text-figs. 25-1–11, pl. 31, figs. 3, 5, 6) from the Lower Carboniferous Onimaru Formation in the Southern Kitakami Terrane, northeast Japan appears to be distinct from *S. konishii* in its larger corallite diameters (1.8–1.9 mm), fewer connecting tubules, and essentially central position of the axial syringes. Although traditionally placed with in the genus *Kueichowpora* Chi, 1933, the Kitakami species lacks diagnostic characters found with the type species, *K. tushanensis* Chi (1933, p. 22, 23, pl. 5, figs. 2a–d), of that genus including symmetrical bifurcate branching and thin corallite walls.

*Syringopora reticulata* Goldfuss (1826, p. 75, pl. 25, figs. 6a, b), that has a cosmopolitan distribution, such as Europe, European Russia, Siberia, Central Asia, East Asia (the Nan Lin area in central China and the Onimaru Formation in northeast Japan), North America, Australia (i.e., Yabe and Hayasaka, 1915; Sokolov, 1947; Lin, 1963; Nowinski, 1976), indicates the similar corallite diameters to *S. konishii*, but differs in having the more numerous septal spines and the spine-like projections on the tabulae.

### Paleobiogeographic Significance

Based on lithologic and paleontologic evidence affinities of the allochthonous limestones with other strata have been enumerated by some authors including Konishi (1956; the Kakisako and Katauchi Formations of the Kurosegawa Terrane), Kamiya and Niko (1996; the Onimaru Formation of the Southern Kitakami Terrane and the Ichinotani Formation of the Hida-Gaien Terrane), Nakazawa et al. (1998; the Early Carboniferous continental shelf deposits in the Southern Kitakami, Hida-Gaien and Kurosegawa Terranes), Niko and Yamagiwa (1998; the Ichinotani Formation), and Tazawa (2004; the Ichinotani Formation). Among them, occurrences of *Syringopora* are also known from the Onimaru and Ichinotani Formations. Although there is presently insufficient information for detailed reconstruction of their paleobiogeographic settings, it is noteworthy that no common species of the genus is recognized as being in those areas. The specific differences may be due to intra-basin provinciality.

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