

## Some Hexacorals from the Shinkai Formation, Ōita Prefecture, Kyushu

By

Nobuo YAMAGIWA<sup>1</sup>, Minoru TAMURA<sup>2</sup> and Hitoshi TANAKA<sup>3</sup>

<sup>1</sup>Department of Earth Science, Faculty of Education, Osaka Kyoiku University, Osaka 543

<sup>2</sup>Institute of Geoscience, Faculty of Education, Kumamoto University, Kumamoto 860

<sup>3</sup>Institute of Geology and Mineralogy, Faculty of Science, Hiroshima University, Hiroshima 730

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**Abstract** Five hexacoral species including one new species were found from a limestone lens of the Torinosu type in the Shinkai Formation, Ōita Prefecture, in the Chichibu Terrain, Southwest Japan. Judging from the datum of this hexacoral fauna, the age of the Shinkai Formation indicates Late Jurassic.

### Introduction

Recently, many fossils containing hexacorals, stromatoporoids and Spongiomorphids were collected by M. TAMURA and H. TANAKA from a limestone lens of the Torinosu type in the Shinkai Formation at Ōyabu Valley 1.5 Km SW of Shinkai, Honjo-mura, Minamiamabe-gun, Ōita Prefecture, Kyusyu (see Figures 1 and 2). In this article, the above mentioned hexacorals are described, and the age of the Shinkai Formation is discussed on the basis of the hexacorals.

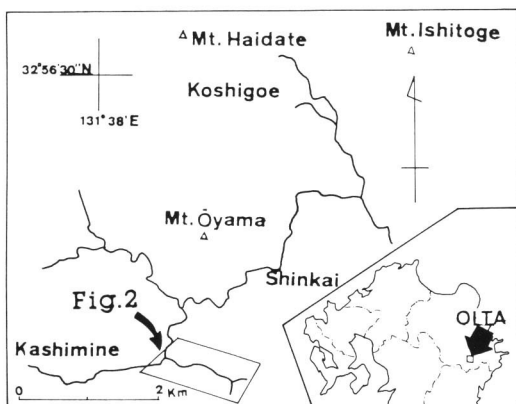


Figure 1. Index map (after TANAKA *et al.*, 1985).

### The geology of the Shinkai Formation

The Shinkai Formation is distributed in the Chichibu Terrain, Southwest Japan. The geology of the area including the Shinkai Formation was formerly surveyed by FUJII (1954), TAMURA (1960), TERAOKA (1970) and OTA and TANAKA (1980). According to them, the Shinkai Formation is correlated with the Upper Jurassic Torinosu Group in having the limestone of the Torinosu type containing hexacorals, stromatoporoids, gastropods (*Nerinea*) and echinoids. Recently, many radiolarians belonging to the *Pseudodictyomitra primitiva*-P. sp. A Assemblage<sup>1)</sup> have been discovered by TANAKA, FUJITA, MIYAMOTO and HASE (1985) from shale in the Shinkai Formation (see Figure 2). From this evidence, they considered that the age of the radiolarian fauna indicates probably Tithonian. According to them, the Shinkai Formation clinounconformably lies on the "Paleozoic" formation and the Kurosegawa Tectonic Zone's member (granitic rocks, gneiss and serpentinite) forming a syncline. It, about 150 m thick, is

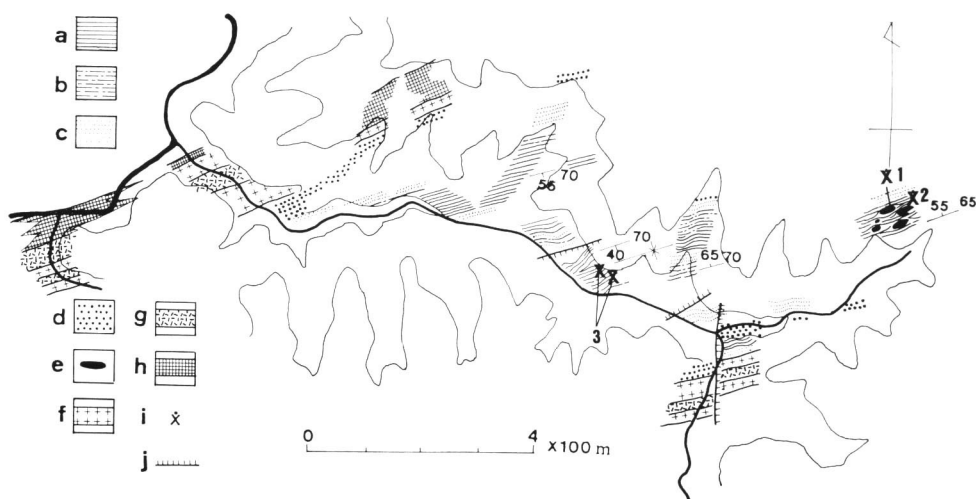


Figure 2. Route map along the Oyabu Valley, SW of Shinkai (after TANAKA *et al.*, 1985).

a: Shale b: Alternation of shale and sandy shale c: Sandstone d: Conglomerate e: Limestone of the Torinosu type f: Granitic rocks g: Gneiss h: Serpentinite i: Fossil locality j: Fault

X1: Fossil locality 1 . . . . . A limestone lens of the Torinosu type yielding Late Jurassic hexacorals, stromatoporoids and spongiomorphids.

X2: Fossil locality 2 . . . . . Shale yielding Late Jurassic radiolarians.

X3: Fossil locality 3 . . . . . Shale and alternation of shale and sandy shale yielding Late Triassic (Carnian) pelecypods.

<sup>1)</sup> *Pseudodictyomitra primitiva*-P. sp. A Assemblage is recognized in the Torinosu Group and the Yura Formation, and its age is most probably assigned to Tithonian (MATSUOKA & YAO, 1985). Very recently, YAO (1986) considered that its age includes a part of Tithonian at least and may range from Kimmeridgian? to Late Tithonian?.

composed of shale, sandstone and conglomerate, being accompanied with limestone of the Torinosu type.<sup>2)</sup>

### Fauna and correlation

In the present work, the following hexacorals are found from a limestone lens of the Torinosu type in the Shinkai Formation.

*Actinastrea* sp. aff. *A. kellumi* (WELLS)

*Stylosmilia* sp. cfr. *S. corallina* KOPY

*Stylina* (*Stylina*) *shinkaiensis* n. sp.

*Montlivaltia* sp. indet.

*Isastrea?* sp. indet.

*Actinastrea* sp. aff. *A. kellumi* is closely allied to *A. kellumi* (WELLS, 1946) from the Upper Jurassic (Kimmeridgian-Portlandian) La Casita Formation in Northern Mexico. The former also resembles *Actinastrea* sp. indet. figured by YAMAGIWA (1985) from the Upper Jurassic (Kimmeridgian?-Upper Tithonian?) Yura Formation in Kii Peninsula, Japan (see Comment 1).

*Stylosmilia* sp. cfr. *S. corallina* much resembles *S. corallina*. The latter has been found from the Upper Oxfordian in France, Poland and Switzerland and the Upper Oxfordian to the Lower Kimmeridgian in Slovenia and Roumania (TURNŠEK, 1972; RONEVICZ, 1976). The former is also related to *Stylosmilia michelini* reported by WEIHUA (1985) from the Paking Formation in Northern Xizang (Tibet). According to him, the coral fauna containing *Stylosmilia michelini* is similar to that of the Upper Jurassic in Europe. Therefore, he considered that the age of the hexacoral-bearing bed may be Late Oxfordian-Early Kimmeridgian.

*Stylina* (*Stylina*) *shinkaiensis* n. sp. much resembles *S. aff. ramosa* reported by WEIHUA (1985) from the Paking Formation, Northern Xizang (Tibet).

*Montlivaltia* sp. indet. is allied to *M. renevieri*. The latter occurs in the Oxfordian of Switzerland, the Upper Oxfordian-Lower Kimmeridgian of Slovenia, the Lower Kimmeridgian of Portugal, the Kimmeridgian of Spain and Germany and the Portlandian of Czechoslovakia (TURNŠEK, 1972).

Judging from the Paleontological evidences mentioned above, the age of the Shinkai Formation indicates Late Jurassic. This datum does not conflict with the evidence from the radiolarian fauna. The detailed age is uncertain at the present evidences.

<sup>2)</sup> The Upper Triassic (Carnian) formation yielding *Halobia* sp., *Tosapecten* sp. and *Otapiria* sp. is distributed narrowly at Oyabu Valley (see Figure 2) and is in fault contact with the Shinkai Formation on the northern and southern sides (TANAKA *et al.*, 1985). The outcrops of the Shinkai Formation containing Fossil localities 1 and 2 are about 500 m east of those of the Upper Triassic (see figure 2). TANAKA *et al.* considered that they may be bounded by a N-S fault (transverse fault).

### Acknowledgements

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### Systematic description

Genus *Actinastrea* d'ORBIGNY, 1849  
*A. Actinastrea* sp. aff. *A. kellumi* (WELLS)

Plate 1, fig. 1

#### Compare:

1946 *Astrocoenia kellumi* WELLS, p. 2, pl. 1, fig. 1

Corallum massive and cerioid. Corallites subprismatic in shape in transverse section, usually five or six sided. Inside diameter of corallites 2.0–3.0 mm in mature stage. Corallite wall relatively thick; 0.5–0.9 mm in thickness. Septa thick and hexamerous. Their lateral surface spinose. 12 septa of the first and second cycles long and thick; usually contact with a columella. The third's ones short and rudimentary. Columella somewhat lamellar; usually thickened by secondary deposits.

No longitudinal section is seen.

*Comparison:* The present form much resembles *Actinastrea kellumi* (WELLS, 1946, p. 2, pl. 1, fig. 1) from the La Casita Formation, Northern Mexico in having cerioid corallum, subprismatic corallites of almost same size, 12 thick and long septa of the first and second cycles, short and rudimentary septa of the third, septa with spines on their lateral surface and thick corallite wall. However, the present one is not well preserved. It is also similar to *Actinastrea* sp. indet. figured by YAMAGIWA (1985, pl. 8, fig. 2) from the Yura Formation, Kii Peninsula, Japan in many respects. However, the latter's septa of the third cycle are well developed.

*Occurrence:* It occurs from a limestone lens of the Torinosu type in the Shinkai Formation, Ōita Prefecture, Kyushu, Japan.

*Collector:* Minoru TAMURA.

*Repository:* Reg. no. NSM-PA 12549 (National Science Museum, Tokyo).

Genus *Stylosmilia* MILNE-EDWARDS & HAIME, 1848  
*Stylosmilia* sp. cfr. *S. corallina* KOPY

Plate 1, fig. 2

#### Compare:

1864 *Stylosmilia* var. b THURMANN & ÉTALLON, p. 360.

1881 *Stylosmilia corallina* KOPY, p. 62, pl. 14, figs. 3–7.

1954 *Stylosmilia corallina* GEYER, p. 138.

1964 *Stylosmilia corallina* BEAUVAIS, p. 116.

1966 *Stylosmilia corallina* RONIEVICZ, p. 191, pl. 7, fig. 1.

1972 *Stylosmilia corallina* TURNŠEK, p. 25, 86, pl. 10, figs. 1–2.

1976 *Stylosmilia corallina* RONIEWICZ, p. 56, pl. 8, figs. 3–4.

Corallum fasciculate. Corallites subcircular in transverse section; usually 2.3 to 3.0 mm in diameter (up to the wall) in mature stage. Corallite wall thick, mostly 0.4 to 0.6 mm in thickness. Septa 24 in number, arranged in three cycles, straight or slightly sinuous. 6 septa of the first cycle long and sometimes contact with a columella. 6 ones of the second variable in length, ranging usually from  $2/3$  to  $4/5$  the length of the first. 12 ones of the third short. Costae present; about 48 in number. Columella styliform showing somewhat prolonged type.

There is no longitudinal section.

*Comparison:* The present material has no longitudinal section. However, it much resembles *Stylosmilia corallina* Koby (THURMANN & ÉTALLON, 1964, p. 360; Koby, 1881, p. 62, pl. 14, figs. 3–7; GEYER, 1954, p. 138; BEAUVAIS, 1964, p. 116; RONIEWICZ, 1966, p. 191, pl. 7, fig. 1; TURNŠEK, 1972, p. 25, 86, pl. 10, figs. 1–2; RONIEWICZ, 1976, p. 56, pl. 8, figs. 3–4) from the Upper Jurassic in Europe in its size of the corallites, number and form of the septa and costae and size and form of the columella in transverse section. Therefore, the former may referable to the latter. It is also related to *Stylosmilia michelini* M. EDWARDS & HAIME by WEIHUA (1985, p. 132, pl. 1, figs. 5, 10, pl. 2, figs. 2, 7) from the Paking Formation in Northern Xizang (Tibet) in many respects, but differs from the latter in having smaller corallites.

*Occurrence and Collector:* Same of the preceeding species.

*Repository:* Reg. no. NSM-PA 12550 (National Science Museum, Tokyo).

#### Genus *Stylina* LAMARK, 1816

#### *Stylina (Stylina) shinkaiensis* n. sp.

Plate 1, figs. 3–5

Corallum massive and plocoid. Corallites round to subround in transverse section in mature stage. Inside diameter of corallites generally 1.4–2.0 mm. Central distance 1.5–2.6 mm. Corallite wall distinct. Septa radially arranged in three cycles. Their lateral surface spinose in transverse and longitudinal sections. 6 septa of the first cycle long and sometimes reach to a columella; always thicker and longer than those of the second. 6 ones of the second ranging usually from  $2/3$  to  $4/5$  the length of the first. 8 or 10 ones of the third thinner and shorter than those of the second; they ranging usually from  $1/3$  to  $1/2$  the length of the first. Endotheca composed of vesicular or small subtabulated dissepiments. Corallites united by costae. Costae about 24 in number. Columella distinct and styliform.

*Comparison:* The present specimens are closely related to specimens described by WEIHUA (1985, p. 133, pl. 2, figs. 5–6) as *Stylina* cfr. *subramosa* FROMENTAL from the Paking Formation in Northern Xizang (Tibet) in its size of the corallites, central distance, number of the septa and form of the columella. Therefore, the latter may belong to the former.

*Occurrence:* Same of the preceeding species.

*Collector:* Minoru TAMURA and Hitoshi TANAKA.

*Repository:* Reg nos. NSM-PA 12551 (Holotype) (Collector: Minoru TAMURA), NSM-PA 12552 (Paratype) (Collector: Hitoshi TANAKA) (National Science Museum, Tokyo).

Genus *Montlivaltia* LAMOUROUX, 1821

*Montlivaltia* sp. indet.

Plate 1, fig. 6

Corallum simple. Corallite oval in transverse section in mature stage; 28.0 mm in longest diameter and 18.0 mm in shortest diameter. Septa thick, being nearly straight or somewhat sinuous; their lateral surface spinose. They about 80 in number. Dissepiments numerous. No columella. Costae distinct. There is an oblong shaped axial opening (fossula) in axial part.

Longitudinal section absent.

*Comparison:* The present form resembles *Montlivaltia renevieri* Koby described by TURNŠEK (1972, p. 30, 90, pl. 12, fig. 2) from the Upper Jurassic of Southern Slovenia in its size and morphological character of the corallite. However, the former is not well preserved. Besides, its longitudinal section missing. Therefore, the identification will be avoided until better specimens are obtained.

*Locality:* Same of the Preceding species.

*Collector:* Minoru TAMURA.

*Repository:* Reg. no. NSM-PA 12553 (National Science Museum, Tokyo).

Genus *Isastrea* MILNE-EDWARDS & HAIME, 1951

*Isastrea?* sp. indet.

Plate 1, fig. 7

The present material is in so ill a state of preservation. However, it may belong to *Isastrea* in having cerioid corallum and rudimentary columella.

*Locality:* Same of the preceding species.

*Collector:* Minoru TAMURA.

*Repository:* Reg. no. NSM-PA 12554 (National Science Museum, Tokyo).

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### Explanation of Plate 1

1. *Actinastrea* sp. aff. *A. kellumi* (WELLS)  
Transverse section. . . . . × 4.0 (NSM-PA 12549)
2. *Stylosmilia* sp. cfr. *S. corallina* Koby  
Transverse section. . . . . × 4.0 (NSM-PA 12550)
- 3–5. *Stylina* (*Stylina*) *shinkaiensis* n. sp.
3. Transverse section. . . . . × 4.0 (NSM-PA 12551a)
4. Longitudinal section. . . . . × 4.0 (NSM-PA 12551b)
5. Transverse section. . . . . × 6.0 (NSM-PA 12552)
6. *Montlivaltia* sp. indet.  
Transverse section. . . . . × 4.0 (NSM-PA 12553)
7. *Isastrea?* sp. indet.  
Transverse section. . . . . × 4.0 (NSM-PA 12554)

