

## LOWER CRETACEOUS BIVALVES FROM GUMIZAKI AREA, KAGOSHIMA PREFECTURE, JAPAN

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### ABSTRACT

Early Cretaceous Barremian to Aptian shallow marine bivalves, such as *Nanonavis yokoyamai*, *Portlandia sanchuensis*, *Nucula (Pectinucula) tosaensis*, and *Pterotrigonia* sp. are newly found in the “Sendai Formation”, and brackish-water bivalve *Eomiodon* sp. is obtained from the lower part of the Gumizaki Formation, Gumizaki area, Satsumasendai, Kagoshima Prefecture, Kyushu, Japan. The Gumizaki Formation conformably or disconformably overlies “Sendai Formation”, and the middle and upper parts of the Gumizaki Formation commonly yield Aptian to Albian marine fossils. The Barremian to Aptian non-marine and shallow marine deposits represent a regressive to transgressive succession, which is similar to the Lower Cretaceous sequences on the Chichibu Belt of the southwest Japan reported by Matsukawa and Obata (1992). The newly proposed section in the Gumizaki area suggests that the distribution of the Lower Cretaceous non-marine and shallow marine sequences on the Chichibu Belt extended for southwestward in Kagoshima, Kyushu.

Key words: bivalve, brackish-water, Gumizaki Formation, Lower Cretaceous, shallow marine

小松俊文・渡辺正幸・石田直人（2009）鹿児島県久見崎地域から産出した下部白亜系二枚貝．福井県立恐竜博物館紀要 8 : 11–16.

鹿児島県薩摩川内市の久見崎地域において、前期白亜紀のバレミアン期～アプチアン期を示す浅海生二枚貝、*Nanonavis yokoyamai*, *Portlandia sanchuensis*, *Nucula (Pectinucula) tosaensis* や *Pterotrigonia* sp. が“川内層”から新たに産出し、汽水生二枚貝の *Eomiodon* sp. が久見崎層の下部から見つかった。久見崎層の下部は、整合あるいは非整合で“川内層”を覆い、久見崎層の中部や上部からは、アプチアン期～アルビアン期の海生の化石を産出する。これらのバレミアン期～アプチアン期の非海成および浅海成の堆積物は、海退から海進のサクセッションを示しており、Matsukawa and Obata (1992) によって報告された西南日本の秩父累帯上の下部白亜系のシーケンスと類似している。本論で新たに報告した久見崎地域の層序は、秩父累帯上に分布する下部白亜系の非海成や海成のシーケンスの分布が、さらに南西の鹿児島県下まで延びることを示唆している。

### INTRODUCTION

Lower Cretaceous non-marine and shallow marine deposits crop out in Japan and commonly yield bivalves (Matsumoto et al., 1982; Tashiro, 1985, 1993). The Lower Cretaceous Gumizaki Formation (= Gumisaki Formation in Tanaka et al.,

1999), composed of siliciclastic sediments, is exposed in the eastern part of the Gumizaki area, Satsumasendai, Kagoshima Prefecture (Hashimoto et al., 1972) (Fig. 1). The upper part (= C Member in Hashimoto et al., 1972) of this formation contains the Aptian to Albian shallow marine bivalves, such as *Pterotrigonia hokkaidoana* (Yehara), *Cucullaea* sp. aff. *C. acuticarinata* Nagao, and *Protocardia* sp. aff. *P. hiraigensis* (Hashimoto et al., 1972; Tanaka et al., 1999). The “Sendai Formation”, previously interpreted as the Palaeozoic Formation (Hashimoto et al., 1972) (= “Palaeozoic and Mesozoic of Chichibu belts” in Morishita

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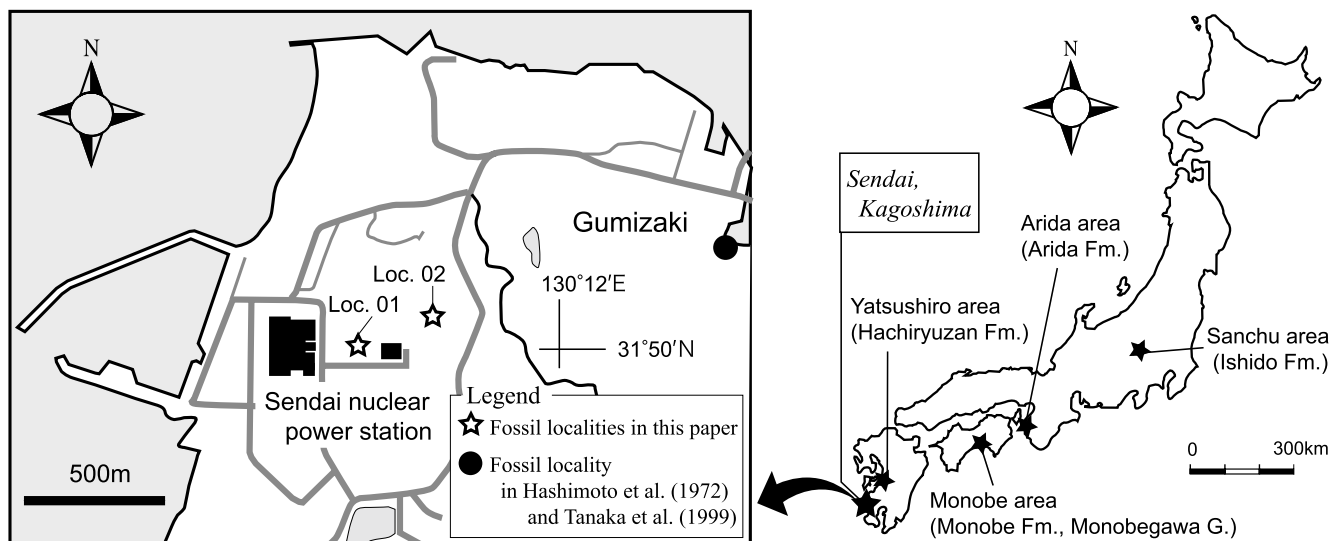


FIGURE 1. Index map of the localities of Cretaceous bivalves in the Gumizaki area, Satsumasendai, Kagoshima Prefecture.

and Teraoka, 1996), is exposed in the western part of the Gumizaki area. The stratigraphic relation has not been identified between the Gumizaki Formation and “Sendai Formation” (Hashimoto et al., 1972).

In this paper, we report some brackish-water and shallow marine bivalves collected from the “Sendai Formation” and the lower part (A Member in Hashimoto et al., 1972) of the Gumizaki Formation in the premise of the Sendai nuclear power station in the Gumizaki area. At Loc. 01 (Fig. 1), shallow marine bivalves were obtained from thick, dark-gray mudstone and sandy mudstone also containing abundant gastropods, ammonoids, and echinoids in the “Sendai Formation”. At Loc. 02, brackish-water bivalves co-occurred with well-preserved plants including *Cladophlebis geyleriana* and *Pterophyllum* sp. from mudstone layers within alternating beds of gravelly sandstone and mudstone in the Gumizaki Formation. The shallow marine and brackish-water bivalves are characteristics of the Lower Cretaceous bivalve fauna reported by Matsukawa (1983), Tashiro (1985, 1993), and Tashiro and Kozai (1994). In addition, some of the species are important for the reconstruction of depositional environments in the Gumizaki area and regional correlation in the southwestern part of Japan.

#### SYSTEMATIC DESCRIPTION

Family NUCULANIDAE Adams and Adams, 1858  
Genus *PORTLANDIA* Mörch, 1857

**Type species.**—*Nucula arctica* Gray, 1824

*Portlandia sanchuensis* (Yabe and Nagao, 1926)  
(Fig. 2.1)

*Nuculana sanchuensis* Yabe and Nagao, in Yabe, Nagao and Shimizu, 1926, p. 42, pl. 12, figs. 21–23.

*Nuculana* (s.l.) *sanchuensis* (Yabe and Nagao). Hayami, 1965, p. 235.

*Portlandia sanchuensis* (Yabe and Nagao). Hayami, in Hayami and Oji, 1980, p. 423, pl. 51, figs. 1–6; Tashiro and Matsuda, 1986, p. 368–369, pl. 74, figs. 4–7; Tashiro, 1990, p. 31–32, table 1, pl. 2, figs. 16–17; Ishida, Hashimoto and Kozai, 1992, p. 11–12, pl. 6, figs. 14–15.

**Material.**— One specimen, rubber casts from the right internal and external moulds (KSKE-002 a, b).

**Remarks.**— The specimen is preserved as internal and external moulds that are slightly flattened by secondary deformation. It is characterized by an elongate-oval outline and a rostrate posterior area. The umbo is orthogyrous. The shell surface is ornamented by numerous fine concentric striae. The hinge is composed of about 15 anterior and about 20 posterior denticles. A small resilifer is located under the beak.

**Occurrence.**— Dark-gray sandy mudstone of the “Sendai Formation” at Loc. 01.

Family PARALLELODONTIDAE Dall, 1898  
Subfamily GRAMMATODONTINAE Branson, 1942  
Genus *NANONAVIS* Stewart, 1930

**Type species.**—*Arca carinata* Sowerby, 1813

*Nanonavis yokoyamai* (Yabe and Nagao, 1926)  
(Fig. 2.3–2.6)

? *Cucullaea* cf. *striatella* Michelin. Yokoyama, 1890, p. 199, pl. 25, fig. 13.

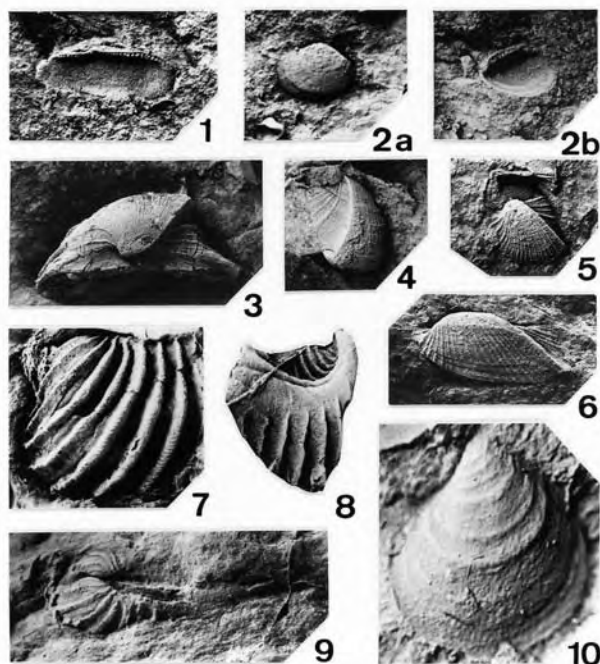


FIGURE 2. Lower Cretaceous bivalves. KSKE=Registry number of Sendai nuclear power station. 1, *Portlandia sanchuensis* (Yabe and Nagao), KSKE-002a, b, x 1.5, Loc. 01, rubber cast of inner surface of right valve; 2, *Nucula (Pectinucula) tosaensis* Tashiro and Kozai, KSKE-001a, b, x2.0, Loc. 01. 2a. Rubber cast of outer surface of left valve. 2b. Rubber cast of inner surface of left valve; 3–6, *Nanonavis yokoyamai* (Yabe and Nagao), x1.0, Loc. 01. 3. KSKE-003, rubber cast of outer surface of right valve. 4. KSKE-004, rubber cast of outer surface of left valve. 5. KSKE-005, rubber cast of outer surface of left valve. 6. KSKE-006, rubber cast of outer surface of left valve; 7–9, *Pterotrigonia* sp., x1.0, Loc. 01. 7. KSKE-011, rubber cast of outer surface of left valve. 8. KSKE-012, rubber cast of outer surface of right valve. 9. KSKE-013, rubber cast of outer surface of articulated valves; 10, *Eomiodon* sp. KSKE-015, x4.0, Loc. 02, rubber cast of outer surface of left valve.

*Grammatodon yokoyamai* Yabe and Nagao, in Yabe, Nagao and Shimizu, 1926, p. 44, pl. 12, figs. 12, 13, 25.

*Nanonavis yokoyamai* (Yabe and Nagao). Matsumoto, Hayami and Asano, 1963, p. 32, pl. 51, fig. 13.

*Nanonavis (Nanonavis) yokoyamai* (Yabe and Nagao). Shikama and Suzuki, 1972, p. 147, table 5, pl. 4, fig. 7.

*Grammatodon (Nanonavis) yokoyamai* Yabe and Nagao. Hayami, 1975, p.29; Tashiro and Yamamoto, 1980. p. 3, pl. 1, fig. 3.; Hayami, in Hayami and Oji, 1980, p. 427, pl. 52, figs. 1–6.

*Nanonavis yokoyamai* (Yabe and Nagao). Tashiro, Kozai, Okamura and Katto, 1980. p. 75–76, tables 1–2, pl. 10, fig. 10, pl. 11, fig. 4; Tashiro and Kozai, 1984, p. 14–16, pl. 2, figs. 1–16; Tamura and Nishida, 1989, p. 21, pl. 1, figs. 3, 5–10; Tashiro and Kozai, 1989, p. 13, table 1, pl. 1, figs. 1–2; Tashiro, 1990, p. 31, 32, table 1, pl. 2, figs. 1–4; Ishida, Hashimoto and Kozai, 1992, p. 11–12, pl. 6, fig. 16; Kozai and Tashiro, 1993, p. 25–27, pl. 5, figs. 29–30.

**Material.**— Eight specimens, rubber casts from the right and left internal and external moulds (KSKE-003–010).

**Remarks.**— Almost all specimens in hand are slightly deformed but display characteristic shell ornamentation, shape, ligament, and hinge area. Shells are about 10–30 mm in length and are subrhomboidal to subtrapezoidal in outline. The umbo is slightly prosogyrous, and is located at about one-third the length of the hinge line from the anterior margin. A prominent carina extends from the umbo to the posterior ventral corner. The shell ornamentation on the outer surface is different between the left and right valves. The outer surface of the left valve is marked with strong radial ribs, whereas the right valve has numerous radial striae. This ornamentation is the most important diagnostic feature at the species level.

**Occurrence.**— Dark-gray sandy mudstone of the “Sendai Formation” at Loc. 01.

Family NEOMIODONTIDAE Casey, 1955  
Subfamily EOMIODONTINAE Hayami, 1965  
Genus *EOMIODON* Cox, 1935

**Type species.**—*Astarte libanotica* Fraas, 1878

*Eomiodon* sp.  
(Fig. 2.10)







**Material.**— Two specimens, rubber casts from right and left internal and external moulds (KSKE-015–016).

**Remarks.**— Shells are well preserved, though almost all are very small, 3–7 mm in length. The shape is trigonally suboval. Shell height is longer than shell length. The outer surface is ornamented with 5–7 weakly rounded concentric ribs. The dorsal margin is characterized by a clearly impressed lunule and escutcheon. Cardinal teeth 2 and 4b and lateral teeth are preserved on the small hinge plate, although the hinge structure of the right valve is unknown. These specimens certainly belong to *Eomiodon* and resemble juveniles of *E. matsumotoi* Ohta and *E. sakawanus* (Kobayashi and Suzuki).

**Occurrence.**— Abundant shells of this species were found in dark-gray sandy mudstone of the lower part of the Gumizaki Formation at Loc. 02. These shells were preserved as disarticulated valves and fragments in very thin shell concentrations (5–10 mm in thickness) containing plant fossils.

REGRESSION (INNER SHELF TO BRACKISH-WATER ENVIRONMENTS) AND TRANSGRESSION (BRACKISH-WATER TO SHALLOW MARINE ENVIRONMENTS) FROM BARREMIAN TO APTIAN

*Nanonavis yokoyamai*, *Portlandia sanchuensis*, *Nucula (Pectinucula) tosaensis*, and *Pterotrigonia* sp. are collected at Loc. 01. The shell ornamentation of *Pterotrigonia* sp. is similar to that of *Pterotrigonia pocilliformis* (Yokoyama), though the specimens are poorly preserved (Fig. 2.7–2.9). *Nanonavis*

| Formation    |        | Lithology   | Fossil  |
|--------------|--------|---|---|
| Gumizaki Fm. | Upper  |    | Aptian-Albian shallow marine bivalves (Hashimoto et al., 1972)  |
|              | Middle |    | Early Aptian radiolarian assemblage (Ishida et al., 2008)   |
|              | Lower  |    | Brackish-water bivalve<br><i>Eomiodon</i> sp.   |
| "Sendai Fm"  |        | <br><br> | Barremian-Aptian shallow marine bivalves<br><i>Nucula (Pectinucula) tosaensis</i> , <i>Pterotrignia</i> sp.<br><i>Portlandia sanchuensis</i> , <i>Nanonavis yokoyamai</i> |

Legend




-  Conglomerate
-  Sandstone
-  Mudstone (Shale)

FIGURE 3. Stratigraphic division and key fossils in the Gumizaki area.

*yokoyamai*, *Portlandia sanchuensis*, and *Pterotrignia pocilliformis* have been reported from Lower Cretaceous (Barremian) shallow marine mudstone in the Funagawara Formation, Ofunato Group, Iwate Prefecture; Ishido Formation, Sanchu area, Saitama, Gunma and Nagano Prefectures; Kimigahama Formation, Choshi Group, Chiba Prefecture; Arida Formation, Wakayama Prefecture; Hanoura and Monobe Formations, Monobegawa Group, Shikoku; and Hachiryuzan Formation, Yatsushiro, Kumamoto Prefecture (Fig. 1). These species and *Nucula (Pectinucula) tosaensis* were obtained from the Aptian Hibihara Formation, Kochi Prefecture. *Nanonavis yokoyamai* and *Portlandia sanchuensis* are interpreted as inhabiting muddy inner-shelf environments (Komatsu, 1999) and are characteristic species of the Barremian to Aptian bivalve fauna (Tashiro, 1985, 1993; Tashiro and Kozai, 1994). Therefore, the "Sendai Formation" is regarded as Barremian to Aptian shallow marine deposits (Fig. 3), rather than the Palaeozoic Formation in Hashimoto et al. (1972).

The "Sendai Formation" yielding shallow marine bivalves is conformably overlain by the Gumizaki Formation (Fig. 3). *Eomiodon* sp. occurs abundantly in mudstone of the lower part of the Gumizaki Formation at Loc. 02. This mudstone is intercalated with alternating beds of conglomerate and poorly sorted sandstone. The sandstone and mudstone contain wood fragments and well-preserved plant leaves including *Cladophlebis geyleriana* and *Pterophyllum* sp. *Eomiodon* contains typical brackish-water species, and is a member of salinity-controlled assemblages during the Jurassic and Cretaceous (Hudson, 1963; Aberhan, 1994). The lithological sequence from the "Sendai Formation" to Gumizaki Formation represents upward-shallowing (regressive) succession from shallow-marine to brackish-water facies. A similar upward-shallowing succession has been reported from the strata ranging from Barremian to Aptian in central and southwestern Japan (Matsumoto et al., 1982; Matsukawa and Obata, 1992; Tashiro, 1993). In the Sanchu, Arida, Monobe, and Yatsushiro areas, shallow marine mudstones yielding Barremian bivalves are generally overlain by non-marine Aptian deposits containing brackish-water bivalves (Matsumoto and Kanmera, 1964;

Matsukawa, 1983; Tashiro and Kozai, 1984; Tanaka et al., 1984). In the Gumizaki area, the top part of this upward-shallowing succession conformably underlies the thick mudstone containing the early Aptian radiolarian assemblage in the middle part of the Gumizaki Formation (=B Member in Hashimoto et al., 1972) (Ishida et al., 2008). Thus, the upward-shallowing succession from shallow-marine to brackish-water facies is overlain by the early Aptian marine deposits (Fig. 3). It evidences transition from a regressive to transgressive succession in this study area, and probably represents a westward equivalent of a similar sequence in the outer side of southwest Japan (Matsukawa and Obata, 1992).

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＜ 地名・地層名 ＞

|                               |                              |                           |
|-------------------------------|------------------------------|---------------------------|
| Arida Formation…………… 有田層      | Hanoura Formation…………… 羽ノ浦層  | Monobegawa Group …… 物部川層群 |
| Choshi Group…………… 銚子層群        | Hibihara Formation…………… 日比原層 | Ofunato Group …… 大船渡層群    |
| Funagawara Formation …… 船河原層  | Ishido Formation …… 石堂層      | Satumasendai …… 薩摩川内      |
| Gumizaki Formation …… 久見崎層    | Kimigahama Formation …… 君ヶ浜層 | Sendai Formation …… 川内層   |
| Hachiryuzan Formation …… 八竜山層 | Monobe Formation…………… 物部層    | Yatsushiro …… 八代          |