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A janthinid gastropod from Late Neogene Miyazaki Group of Southwestern Japan, and a status of *Hartungia*

[1] Susumu Tomida , [2] Hiroshi Akazaki and [3] Takamasa Kawano

[1] 2-20-63, Hime-cho, Tajimi City, Gifu 507-0061
Japan <t_susumu@ob.aitai.ne.jp>
[2] Miyazaki Prefectural Museum of Nature and History, 2-4-4, Jingu, Miyazaki City,
Miyazaki 880-0053, Japan
[3] Miyazaki Fossil Club, Miyazaki City, Miyazaki, Japan

Abstract

A specimen of the fossil *Janthina* (*Hartungia*) *typica* (Bronn) from the lowermost Pliocene Tsuma Formation, at Shimoyamaji, Saito City, and also two specimens of the species from the uppermost Pliocene lower Takanabe Formation, Miyazaki Group, at Hioki, Shintomi-cho, Koyu-gun, Miyazaki Prefecture, are described herein. The author ranked this species under the subgenus *Hartungia,* because *Hartungia* differs from *Janthina* in having a shell with a shallow suture, round spiral ribs that cross dense axial riblets, and a rather shallow sinus situated at the basal lip and extending to a spiral ridge around a columella. These occurrences show that the warm Kuroshio currents flowed strongly along the Pacific Coast of Kyushu in the earliest Pliocene (N18: ca. 5Ma) and the latest Pliocene (lower N21: 2.6–2.5Ma).

Key words: *Janthina* (*Hartungia*) *typica*, earliest Pliocene and latest Pliocene, Miyazaki Group, the Proto-Kuroshio warm currents

Introduction

The *Janthina* fossils were discovered in two horizons of the Late Neogene Miyazaki Group in Miyazaki Prefecture (Figs. 1, 2). Fossil *Janthina* ranges from the earliest Pliocene to the Early Pleistocene and has been reported from Japan (Tomida and Itoigawa, 1982). Concerning the janthinid fossil of Miyazaki Prefecture, Tomida and Nakamura (2001) hitherto described as *Hartungia elegans* in the upper Miocene Boroishi Formation of Miyazaki Prefecture. The Recent *Janthina* is a pelagic gastropod that floats on the surface of tropical oceans, and feeds on siphonophores such as *Velella* (Laursen, 1953; Okutani, 1964). It has a world-wide distribution in warm ocean currents and has been driven ashore onto Japanese coasts (Komatsu, 1991). *Janthina* fossils imply the existence of a strong, warm current at times in the past, and the abundant occurrence of *Janthina* with tropical and subtropical benthic mollusks further suggests the presence of tropical and subtropical marine conditions. *Janthiina* is a clear indicator of strong, warm ocean currents.

Geologic outline and fossil localities

The geology and fossils of the Miyazaki Group (Shuto, 1952) in and around the fossil localities (Fig. 1) in Saito City and Shintomi-cho, Koyu-gun, have been studied in order to establish the Neogene stratigraphy, and also to elucidate the marine sedimentary environments of the Neogene, (e. g., Shuto, 1952; 1961; Natori, 1979; Kino et al., 1984: Endo, et al., 1986; Akazaki and Hamada, 2012, etc). According to Endo et al. (1986), the Late Neogene Miyazaki Group that ranges from Saito City to Shintomi-cho, Koyu-gun of Miyazaki Prefecture, can be divided into the Kawabaru Formation, the Tsuma Formation and the Takanabe Formation, in ascending order (Fig. 2). At first, *Janthina* (*Hartungia*) *typica* (Bronn, 1861), was obtained from the gray tuffaceous siltstone of the Tsuma Formation, the Miyazaki Group at Shimoyamaji, Saito City (Figs. 1, 2). It was accompanied by shallow warm water molluscan species belonging to the Zushi Fauna (Ozawa and Tomida, 1992), e. g., *Suchium koyuense*, *Oliva oliva*, *Baryspira albocallosa*, *Amussiopecten iitomiensis*, *Megacardita megacostata*, and *Paphia exilis* (Shuto, 1961). Concerning the geological age of the Tsuma Formation in this area, Natori (1979) reported that the Tsuma Formation, the Miyazaki Group, can be assigned to the calcareous planktonic foraminiferal Blow zone N18 (ca. 5Ma).

Next two specimens of *Janthina* (*Hartungia*) *typica* (Bronn, 1861) were recently obtained from the gray sandy siltstone of the lower Takanabe Formation, the uppermost part of the Miyazaki Group at Hioki, Shintomi-cho, Koyu-gun (Figs. 1, 2). These were accompanied by many shallow water molluscan species belonging to the Kakegawa Fauna, e. g., *Ethmonolia* cf. *sternsii*, *Bolma modesta*, *Guildifordia yoka*, *Tonna olearium*, *Xenophora pallidula*, *Columbarium pagoda*, *Pteropurpura stimpsoni*, *Siphonalia* cf. *spadicea*, *Granulifusus nipponicus*, *Spirotropis subdeclivis*, *Micantapex matsumotoi*, *Cucullaea*

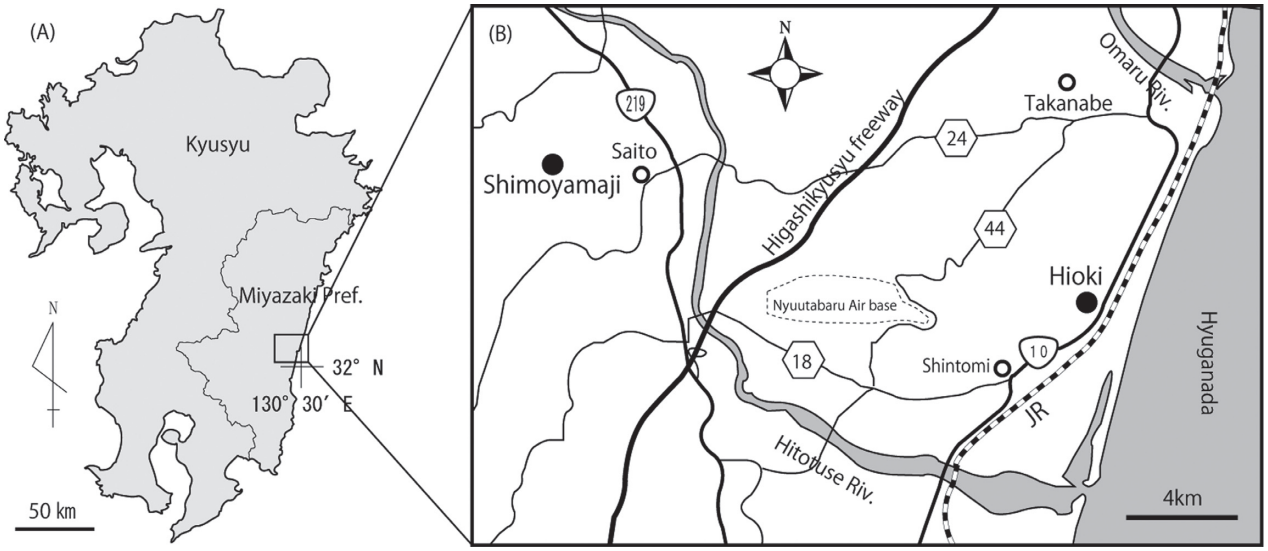

Fig. 1. Index maps showing the fossil locality in Kyushu of Japan (A) and the fossil collecting site (B) of Shimoyamaji, Saito City, and Hioki, Shintomi-cho, Koyu-gun, Miyazaki Prefecture. ● represents the fossil collecting site

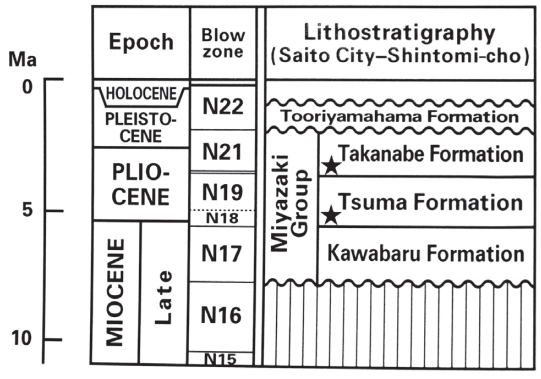

Fig. 2. Upper Neogene sequence and stratigraphical level of the occurrences of the fossil specimens of *Janthina* (*Hartungia*) *typica* (Bronn) from the Tsuma Formation, and also from the lower Takanabe Formation, Miyazaki Group in the Miyazaki Prefecture. (★ : fossil horizon)

Calibration of calcareous foraminiferal zones modified after Saito (1999), and the time scale after Gradstein et al. (2004).

labiata, *Glycymeris rotunda*, *Amussiopecten praesignis*, *Gloripallium* sp., *Cryptopecten vesiculosus*, *Eucrassatella takanabenisis, Keenaea samarangae*, and so on (Akazaki and Hamada, 2012). Concerning the geological age of the lower Takanabe Formation in this area, Natori (1979) reported that the lower Takanabe Formation, the uppermost part of the Miyazaki Group can be assigned to the calcareous planktonic foraminiferal Blow zone lower N21 (2.6–2.5 Ma).

Systematics

The materials used in this study are reposited in the Mizunami Fossil Museum (MFM) and the Miyazaki Prefectural Museum of Nature and History (MGF).

Order HETEROGASTROPODA
Family Janthinidae Deshayes, 1863

Genus *Janthina* Röding 1798
Subgenus *Hartungia* Bronn, 1861

Type species: *Helix janthina* Linnaeus, 1758 (by original designation).

Janthina (*Hartungia*) *typica* (Bronn, 1861)

(Figs. 3A–L)

Hartungia typica Bron, 1861, p. 119, figs. 3a-d; Beu and Maxwell, 1990, p. 292, pl. 37, figs. a, b; Tomida, 1996, pl. 33, figs. 3a–c, 4.

Janthina hartungi Mayer, 1864, p. 242, pl. 6, figs. 41a–c.

Heligmope dennanti Tate, 1893, p. 329, pl. 7, figs. 5–5a.

Hartungia dennanti dennanti Ludbrook, 1978, pl. 12, figs. 15, 16.

Parajanthina sp., Tomida and Itoigawa, 1982, p. 62, pl. 19, figs. 2, 3.

Hartungia sp., Tomida and Itoigawa, 1984, p. 112.

Hartungia japonica (Tomida and Itoigawa), 1989, p. 126, pl. 23, figs. 1a–d, 2a-d; Nobuhara, Takatori and Tanaka, 1995, p. 38, figs. 3–2a–2b; Noda, Watanabe and Kikuchi, 1995, p.83, figs. 11–7a–d; Tomida and Kitao, 2002, p. 158, figs. 2.1a–c, 2.2a–c.

Janthina typica (Bronn, 1861), Beu and Raine, 2009, GNS Science miscellaneous series no. 27.

Diagnosis: The subgenus *Hartungia* differs from *Janthina* in having a shell with a shallow suture, faint spiral ribs that cross dense axial riblets, a very shallow suture and a rather shallow sinus situated at the basal lip and extending to a spiral ridge around a columella.

Materials examined: A juvenile shell (MFM112194) from Shimoyamaji, Saito City, and two mature shells (MGF3472 and Kawano's collection) from Hioki, Shintomi-cho..

Description of fossils: Shell thin, medium to large for the genus, dextral, subgrobular with a rather high apex and large apical angle, and rather high-spired coniform. Whorls about 4–5 in number. Body whorl somewhat inflated growing obliquely downward in the mature specimen; periphery without an angle; base inflated. Suture shallow and not almost canaliculate. Aperture broad and subcircular; sinus shallow, situated on basal lip extending to a blunt spiral ridge around columella. Ornamentation: younger two whorls with smooth surface and last two

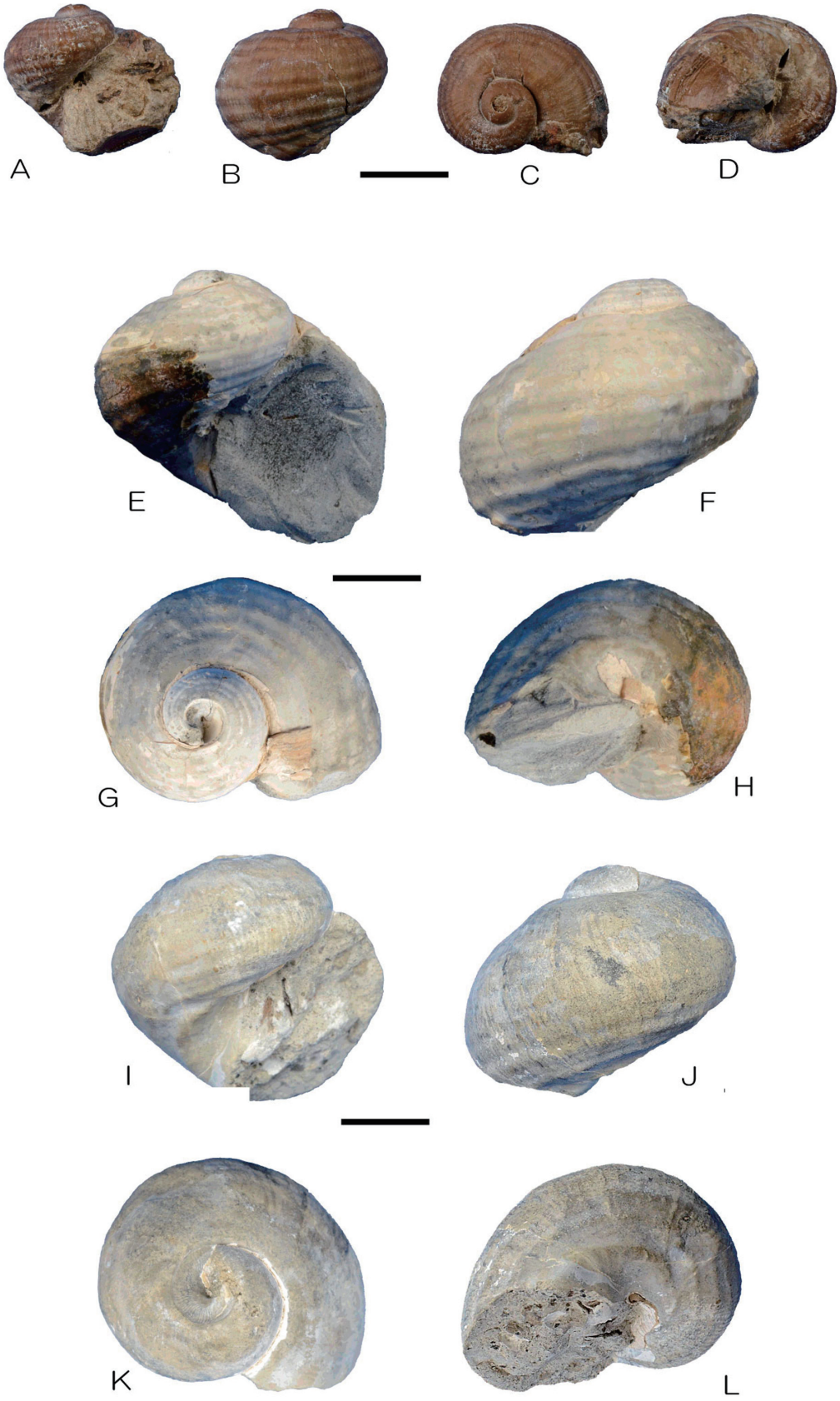

Fig. 3. *Janthina* (*Hartungia*) *typica* (Bronn) A–L: A, apertural view; B, dorsal view, C, apical view, D, basal view, (MFM112194); from the Tsuma Formation, Miyazaki Group, at Shimoyamaji, Saito City, Miyazaki Prefecture. E, apertural view; F, dorsal view, G, apical view, H, basal view, (MGF3472); I , apertural view; J, dorsal view, K, apical view, L, basal view, (Kawano's collection); from the lower Takanabe Formation, Miyazaki Group, at Hioki, Shintomi-cho, Koyu-gun, Miyazaki Prefecture. (Scale bar represents 10 mm).

whorls with growth lines prosocline, occurs as dense striae, being distinct on earlier whorl surface; around 11 rather strong but sometimes blunt, round spiral cords on whorl surface, and barely remarkable on base. Columella varies from quasi-straight to round at basal lip. Umbilicus closed and very shallow. Aperture quasi round and rather broad.

Measurements:	Maximum diameter,	Min. diameter,	Height (mm)
MFM112194 (Shimoyamaji)	19.3	16.6	17.8
MGF3472 (Hioki)	30.3	26.7	30.2
Kawano's collection	30.7	27.6	27.9

Occurrence: 1) The specimen (MFM112194) was obtained from the gray tuffaceous siltstone of the Tsuma Formation, the Miyazaki Group, at Shimoyamaji, Saito City, Miyazaki Prefecture (Figs. 1, 2).

2) Two specimens (MGF3472 and Kawano's collection) were obtained from the gray tuffaceous sandy siltstone of the Takanabe Formation, the upper part of the Miyazaki Group, at Hioki, Shintomi-cho, Koyu-gun, Miyazaki Prefecture (Figs. 1, 2).

Remarks: This species was first described as *Hartungia typica* Bronn, 1861, from the Pliocene of Azores Islands, and afterward it was reported from the Pliocene strata of New Zealand, Australia and Japan. Beu and Raine (2009) recently ranked this species under the genus *Janthina*. However *Hartungia* differs from *Janthina* in having a shell with a shallow suture, round spiral ribs that cross dense axial riblets, and a rather shallow sinus situated at the basal lip and extending to a spiral ridge around a columella. Therefore *Hartungia* seems to be ranked under the subgenus, like the living janthinid species, e.g., *Violetta*, *Amethistina* and *Iodina*.

The fossil *Janthina* of Japan was first described from the Early Pleistocene Dainichi sandstone (upper N21: 2.0–1.8Ma) of the Kakegawa Group as *Parajanthina japonica* Tomida and Itoigawa (1982). This *P. japonica* is also ranked under the genus *Janthina*. However the Early Pleistocene species, *J.* (*Hartungia*) *japonica* (Tomida and Itoigawa, 1982) resembles *J.* (*Hartungia*) *typica* (Bronn, 1861), in having around 11 rather strong to sometimes faint spiral cords on whorls, but it is distinguished from *J.* (*H.*) *typica* by having a very low spire and a more inflated body whorl growing obliquely more downward..

Distribution: **Earliest Pliocene** - JAPAN: 1) Osozawa, Minobu-cho, Minamikoma-gun, Yamanashi Prefecture (Tomida, 1996); 2) Tamari, Kakegawa City, Shizuoka Prefecture (Tomida and Itoigawa, 1982; Tomida and Itoigawa, 1984); 3) Shimoyamaji, Saito City, Miyazaki Prefecture (the present study); **Early Pliocene** - JAPAN: Hatsuzaki, Aiga-cho, Hitachi City, Ibaragi Prefecture (Tomida and Itoigawa, 1989; Noda, Watanabe and Kikuchi, 1995); **Latest Pliocene** – JAPAN: 1) Nito, Kakegawa City, Shizuoka Prefecture (Nobuhara, Takatori and Tanaka, 1995); 2) Tonohama, Yasuda-cho, Aki-gun, Kochi Prefecture (Tomida and Kitao, 2002); 3) Hioki, Shintomi-cho, Miyazaki Prefecture (the present study).

Discussion

The fossil *Janthina* (*Hartungia*) *typica* was hitherto obtained from the earliest Pliocene to the latest Pliocene formations of Japan. First this species was found in the Tsuma Formation at Shimoyamaji (N18: 5.5-5.0Ma) in Saito City, accompanied by tropical and subtropical mollusks belonging to the Zushi Fauna. Next, this species is also found in the lower Takanabe Formation (lower N21: 2.6-2.5Ma) at Hioki, Shintomi-cho, accompanied by tropical and subtropical mollusks belonging to the Kakegawa Fauna (Akazaki and Hamada, 2012).

The Late Neogene eustatic curves of Malmgren and Berggren (1987) show major rises in global sea level at c. 6.8 Ma (N17a), 5.7 Ma (N17b), 5-3.8 Ma (N18-19), 3-2.6 Ma (N20-lower21), and 2.0-1.8 Ma (upperN21). Our field studies of Late Neogene molluscan faunas in Japan have shown the clear correspondence between stratigraphic levels with warm-water faunas and the times of major eustatic sea level rises delineated by Haq et al. (1987) and Malmgren and Berggren (1987). Additional study has shown that *Janthina* occurs in all major Neogene transgressions. All these facts support the idea that vigorous, warm currents flowed along the Pacific Coast of Kyushu in the earliest Pliocene (N18), and the latest Pliocene (lower N21).

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