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Occurrence of *Hartungia* (Gastropoda: Janthinidae) from the Tonohama Group, Kochi Prefecture, Japan

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Abstract

Hartungia fossils were obtained from the Upper Pliocene Ananai Formation of the Tonohama Group, at Tonohama in Kochi Prefecture, Japan. This is the first report of the occurrence of *Hartungia* from the Upper Pliocene of the southwestern Japan. As the result of this study, it is confirmed that these are referable to *Hartungia japonica* (Tomida and Itoigawa) in shell shape and in major features of its sculpture. The occurrence of this species indicates that a warm oceanic current (the Kuroshio current) strongly flowed along the Pacific coast of the southwestern Japan during the Late Pliocene.

Key words: *Hartungia japonica*, Upper Pliocene, Ananai Formation, Tonohama Group, warm oceanic current

Introduction

In May 2001, two specimens of janthinid fossils were obtained from the fine-grained sandstone of the Upper Pliocene Ananai Formation of the Tonohama Group, outcropped at Tonohama, Yasuda-cho, Aki-gun, Kochi Prefecture (Fig. 1). Up to date, not a few paleontological, biostratigraphical, and chronological studies have been made on the Tonohama Group, and the Ananai Formation, the upper part of the group is assigned the Upper Pliocene (Katto *et al*., 1980). Nishida (1979) pointed out that the Ananai Formation is assignable to the lower to middle part of the *Reticulofenestra pacifica* Zone, and its estimated geologic age in Early Pleistocene extends from 1.7 to 1.4 Ma, on the basis of the calcareous nannoplankton fossils. There are several reports on the molluscan fossils from the Ananai Formation (e. g., Yokoyama, 1926, 1929; Nomura, 1937; Katto and Masuda, 1993; Okumura and Takei, 1993). They studied the warm water molluscan fossils from the Ananai Formation of the Tonohama Group, and concluded that this fauna was comparable with the Pliocene Kakegawa Fauna.

From the Neogene of Japan, a *Hartungia* fossil was first described by Tomida and Itoigawa (1982) who designated *Parajanthina japonica*, a new genus and a new species based on the specimens from the Pliocene Kakegawa Group. Thereafter it was revised taxonomically as *Hartungia japonica* (Tomida and Itoigawa, 1982) (Tomida and Itoigawa, 1984). This species has been hitherto reported from the Pliocene formations in Hitachi and Kakegawa areas, Japan (Tomida and Itoigawa, 1982, 1984, 1989; Nobuhara, Takatori and Tanaka, 1995; Noda, Watanabe and Kikuchi, 1995; Ozawa, Tanaka and Tomida, 1998). *Hartungia* belongs to the Family Janthinidae, and has a world-wide distribution. It drifted on warm oceanic currents, and is driven ashore to the Japanese coasts. Therefore the occurrence of this janthinid fossil shows the strong warm oceanic current at the past time.

The purpose of this paper is to report the new occurrence of *Hartungia japonica* from the Upper Pliocene Ananai Formation of the Tonohama Group, and to discuss the warm oceanic current along the Pacific coast during the Late Pliocene.

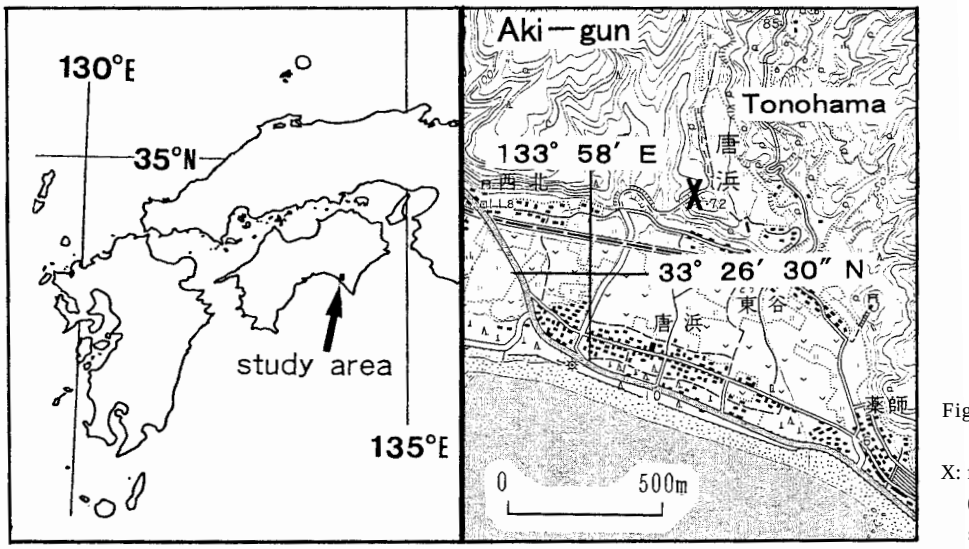


Fig. 1. Index map showing the locality of the present specimens.
X: fossil locality.
(cited from the quadrangle of "Aki"; scale of 1:25,000)

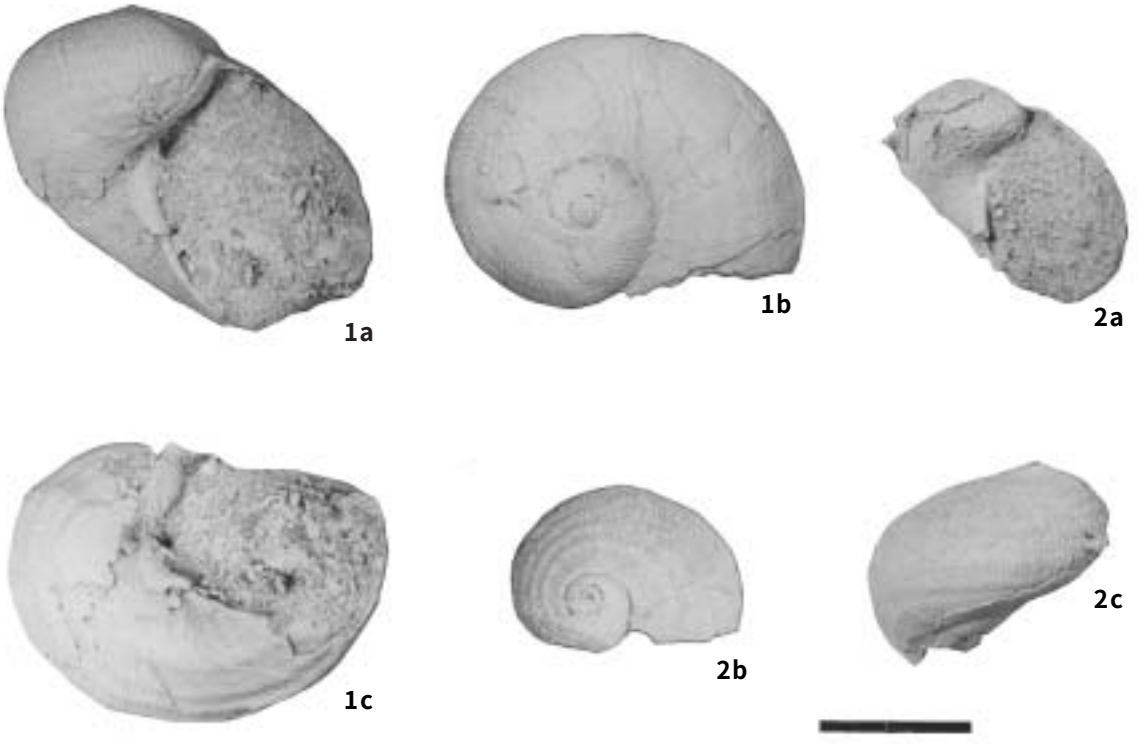


Fig. 2 *Hartungia japonica* (Tomida and Itoigawa, 1982)
1a-c. a) apertural view, b) apical view, c) basal view, ×2, MFM112203 (Upper Pliocene: Tonohama, Yasuda-cho, Aki-gun, Kochi Prefecture). 2a-c. a) apertural view, b) apical view, c) adoral view, ×2, Kitao's Collection (same with above). (Scale bar = 10mm: All figures in whitening)

Systematics

Order Heterogastropoda
Family Janthinidae
Genus *Hartungia* Bronn, 1861
Type species: *Hartungia typica* Bronn, 1861

Hartungia japonica (Tomida and Itoigawa, 1982)
(Figs. 2.1a-c, 2.2a-c)

1982 *Parajanthina japonica* Tomida and Itoigawa, p. 60, pl.

19, figs. 1a-c.
1984 *Hartungia japonica*, Tomida and Itoigawa, p. 112, pl. 31, figs. 1a, b, 2a, b.
1989 *Hartungia japonica*, Tomida and Itoigawa, p. 126, pl. 23, figs. 1a-d, 2a-d.
1995 *Hartungia* sp., Nobuhara, Takatori and Tanaka, p. 38, figs. 3-1a-2b.
1995 *Hartungia japonica*, Noda, Watanabe and Kikuchi, p. 83, figs. 11-7a-7d.
1998 *Hartungia japonica*, Ozawa, Tanaka and Tomida, p. 81, pl. 15, figs. 15a, b.

Materials: An almost complete submature shell (MFM112203: Figs. 2.1a-c) and an another inmature shell (Kitao's Collection: Figs. 2.2a-c), were obtained from the Upper Pliocene Ananai Formation of the Tonohama Group, at Tonohama, Yasuda-cho, Aki-gun, Kochi Prefecture (133° 58'14"E, 33° 26'39"N).

Description of the specimen: Shell thin, medium to small, dextral, subglobular with low apex and low spired coniform. Coiling about four in number. Body whorl well inflated suddenly enlarged, growing slightly obliquely downward. Margin of body whorl without an angle and base inflated. Suture very shallow and not almost canaliculate. Aperture broad and subcircular; sinus shallow, situated on basal lip and formed one blunt spiral ridge around columella. Ornaments; younger two spires with smooth surface and last two spires with growth lines prosocline formed in dense striae being distinct on earlier whorl surface; 11 to 12 faint spiral cords on whorl surface and barely remarkable at the base. Columellar lip slightly thick; basal part barely spread. Parietal callus very thin extending from inner lip to margin. Umbilicus closed.

Measurements: Maximum diameter 23.9mm, minimum diameter 17.4mm, height 19.9mm, apertural height 18.2mm (MFM112203); Max. diameter 15.9mm, min. diameter 11.3mm, height 14.7mm (Kitao's Coll.).

Comparison: The present specimens are referable to *Hartungia japonica* (Tomida and Itoigawa, 1982), the late Pliocene to the early Pleistocene species first described from the Dainichi Formation of the Kakegawa Group, in having common characters with the specimens in the origial description. This species is closely related with *Hartungia typica* Bronn, 1861, a Pliocene species known from Japan (Tomida, 1996), Australia (Beu and Maxwell, 1995), New Zealand (Beu and Maxwell, 1995) and Azores Islands (Bronn, 1861). However it differs from *H. typica* in having a lower spire, a more depressed and a more inflated body whorl and a more rapidly growing last whorl.

This resembles *H. chouberti* Chavan, 1951, a Pliocene species of Morocco, and *H. chavani* Ludbrook, 1978, a Late Pliocene to Early Pleistocene species of Australia and New Zealand, but it is distinguished from these species by having a more inflated body whorl, and a less downward growing last whorl. This is also distinguished from the Late Miocene species, *H. pehuensis* (Marwick, 1926) and *H. elegans* Tomida and Nakamura, 2001, by having a higher spire, a more inflated body whorl, a more downward growing last whorl, and thicker and less (11-12) spiral ribs which are not alternated with narrow and wider ribs on the upper half of whorl.

Remarks: The present specimens obtained from the Tonohama Group, were accompanied by the warm water molluscan fossils belonging to the Kakegawa Fauna, such as *Suchium suchiense suchiense* (Yokoyama), *Turritella perterebra* Yokoyama, *Terebralia palustris* Linnaeus, *Tugurium exutum* Reeve, *Glossaulax didyma* (Röding), *Tonna luteostoma* (Küster), *Siphonalia kannoi* Ozaki, *Babylonia elata* (Yokoyama), *Lyria mizuhonica mizuhonica* (Yokoyama), *Baryspira albocallosa okawai* (Yokoyama), *Cancellaria pristina* (Yokoyama), *Scapharca castellata* (Yokoyama), *Scapharca suzukii* Nomura, *Amussiopecten praesignis* (Yokoyama), *Chlamys satoi* (Yokoyama), *Clementia papyracea* (Gray), and *Paphia takanabensis* Shuto.

Distribution: Late Pliocene: Hitachi Formation, Hatsuzaki Group, at Hatsuzaki, Hitachi City, Ibaragi Pref. (Tomida and Itoigawa, 1989; Noda, Watanabe & Kikuchi, 1995); Dainichi Formation, Kakegawa Group, at Iida, Suchi-gun (Tomida and Itoigawa, 1982); Dainichi Formation, Kakegawa Group, at Nito, Kakegawa City, Shizuoka Pref. (Nobuhara, Takatori and Tanaka, 1995); Ananai Formation, Tonohama Group, at Tonohama, Aki-gun, Kochi Pref. (this report).

Early Pleistocene: Hijikata Formation, Kakegawa Group, at Hosoya, Kakegawa City, Shizuoka Pref. (Tomida and Itoigawa, 1984).

Discussion

During the late Neogene, one of major rises in global sea level occurred around 2.0 Ma (Malmgren and Berggren, 1987). *Hartungia*, a group of pelagic gastropod of the Janthinidae floated at the surface of tropical oceans of the world and drifted on warm oceanic currents. As described above, the present specimens were

accompagnied with the warm-water benthic molluscan fossils forming a fossil assemblage. Therefore the species can be considered to be an indicator of strong warm oceanic current. This fact supports that the Kakegawa Fauna was formed under a remarkable warm oceanic current flowed along the Pacific coast of Japan at time of the Late Pliocene.

This is the first report on the occurrence of *Hartungia japonica* from the Late Pliocene of the southwestern Japan.

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