

A new species of *Sulcospira* (Pachychilidae: Gastropoda) from the Miocene Katsuta Group in Okayama Prefecture, Southwest Japan

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Abstract

Sulcospira nagiensis sp. nov. is described from the early Middle Miocene Yoshino Formation of the Katsuta Group at Kaki, Nagi-cho, Katsuta-gun, Okayama Prefecture. This is the first fossil record for the genus *Sulcospira* Troschel in Japan. The members of this genus have a recent tropical Southeast Asiatic geographic distribution. Thus the occurrence of the present species seems to be an indicator of tropical environments in the early Middle Miocene of Japan.

Key words: Pachychilid gastropod, *Sulcospira nagiensis* sp. nov., early Middle Miocene, Yoshino Formation, Katsuta Group, Okayama Prefecture, Japan.

Introduction

Since a pioneer work of Yokoyama (1929), several paleontological studies of new mollusks from the Miocene Katsuta Group in the Tsuyama basin in Okayama Prefecture have been done (Hatai and Nisiyama, 1949; Taguchi, 1981; Taguchi et al., 1981; Taguchi, 1983a, b, 1990, 1992; Oyama et al., 1995; Taguchi and Kawase, 2004; Taguchi and Suzuki, 2008).

Among them, the characteristic species of the mangrove swamps have been discovered from the Chugoku district of the Honshu of Japan in the early Middle Miocene (Taguchi, 1981; Tsuda et al., 1986).

The purpose of this paper is to describe a new species of the pachychilid gastropod from the Izumotawa Sandstone Member of the Yoshino Formation of the Katsuta Group at Kaki, Nagi-cho, Okayama Prefecture, Southwest Japan.

All the type specimens described herein are kept in the Nagi Vicarya Museum with registered numbers NVMM1001–NVMM1002.

Geologic setting

The Miocene series, the Katsuta Group (Kawai, 1957; Taguchi, 2002), is extensively distributed in the Tsuyama basin, Okayama Prefecture, Southwest Japan.

According to Taguchi (2002), the Katsuta Group is stratigraphically divided into the Mimasaka, Yoshino and Takakura Formations in ascending order. Among them, the Yoshino Formation is subdivided into the Makabe Conglomerate and Izumotawa Sandstone Members. As Fig. 1 shows, the type locality of a new species is located at Kaki, Nagi-cho, Okayama Prefecture (Nagi Vicarya Museum at present; Lat. 35°6'45"

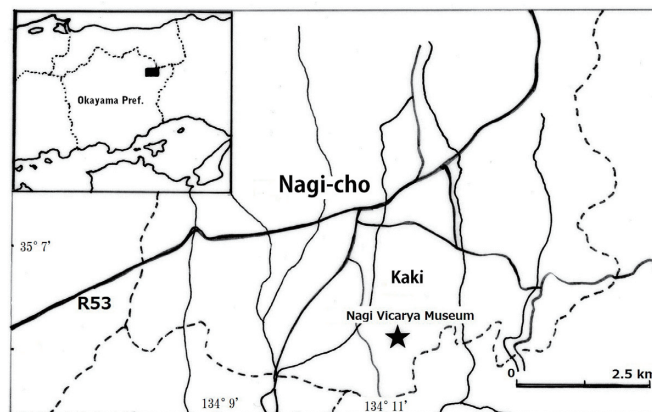


Fig. 1. Location map of collecting site.

N; long 134°11'14"E). The strata of the type locality correspond to the Izumotawa Sandstone Member of the Yoshino Formation. The species composition of the Izumotawa Sandstone Member at Kaki, Nagi-cho consists of the following species: *Anadara (Hataiarca) kakehataensis* (Hatai and Nisiyama), *Striarca elongata* Taguchi, Osafune and Obayashi, *Striarca uetsukiensis* (Hatai and Nisiyama), *Cultellus izumoensis* Yokoyama, *Geloina* cf. *stachi* Oyama, *Geloina yamanei* Oyama, *Clementia japonica* Masuda, *Turritella kiiensis* Yokoyama, *Vicarya japonica* Yabe and Hatai, *Menkrawia* sp., *Cerithideopsilla tokunariensis* (Masuda), *Telescopium* cf. *schrencki* (Hatai and Nisiyama), *Terebralia itoigawai* Taguchi, Osafune and Obayashi, *Terebralia kakiensis* Taguchi, Osafune and Obayashi, *Tateiwaia tateiwai* (Makiyama), *T. yamanarii* (Makiyama), and *Rhizophorimurex capuchinus nagiensis* (Taguchi, Osafune and Obayashi). Among them, *Cerithideopsilla*

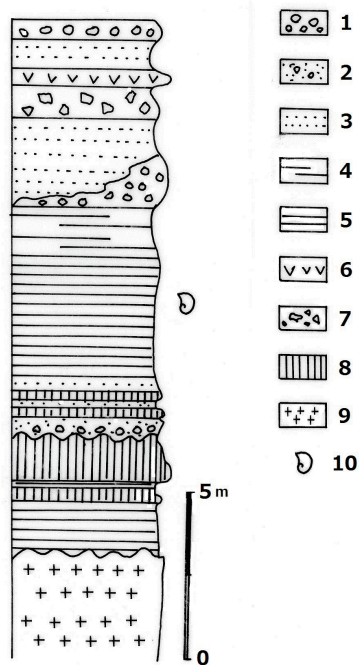


Fig. 2. Columnar section of the Yoshino Formation (revised from Taguchi, 1981).

- 1: conglomerate, 2: pebble bearing sandstone, 3: sandstone, 4: sandy mudstone, 5: mudstone, 6: tuff, 7: breccia conglomerate, 8: lignite, 9: basement rocks, 10: stratigraphic position of new species.

tokunariensis is dominant, and *Vicarya japonica* is a subdominant species. The molluscan assemblage was referred to the *Vicarya-Anadara* assemblage by Taguchi (2002). Itoigawa and Yamanoi (2003) showed based upon pollen analysis that the geologic age of the Yoshino

Formation was the early Middle Miocene.

The specimens described here were collected from a grayish mudstone of the Yoshino Formation (Fig. 2).

Systematics

Family Pachychilidae Troschel, 1857

Genus *Sulcospira* Troschel, 1857

Type species: Melania sulcospira Mousson, 1849, by monotypy.

Remarks: The distribution of the extant species is restricted in Southeast Asia; China, Vietnam, Malaysia, Indonesia, Thailand, and India. *Sulcospira* was once included in the Thiaridae (van Benthem-Jutting, 1956; Sabba Rao, 1989; Beesley *et al.*, 1998).

Morrison (1954), van Benthem-Jutting (1956), Brandt (1974) and Beesley *et al.* (1998) referred *Sulcospira* to the Thiaridae, but, most recently, it was moved to the Pachychilidae by phylogenetic analysis (Köhler *et al.*, 2004; Marwoto and Isnainingsih, 2012).

Sulcospira nagiensis Matsuoka and Taguchi, sp. nov.

(Fig. 3a–d)

Materials: NVMM1001 (holotype) and NVMM 1002 (paratype).

Diagnosis: Shell medium, elongate-conic, lirae and interspiral space on the whorls, weekly nodes on eight spirals on the penultimate whorl. The top of basal cords on the body whorl prominent keel.

Description: Shell medium for genus, elongate-conic, moderately thick. Spire turreted, approximately one-third the height of the shell, and corroded lacking the embryonic shell and post-embryonic one. Apical angle about 30°. Whorls preserved about 3.5 in number; whorl profile flat. Suture shallowly impressed. Sculpture of the spire consisting of eight spiral cords with rounded top, more or less regularly spaced. The body whorl with rounded periphery, the width about three-fifths of the

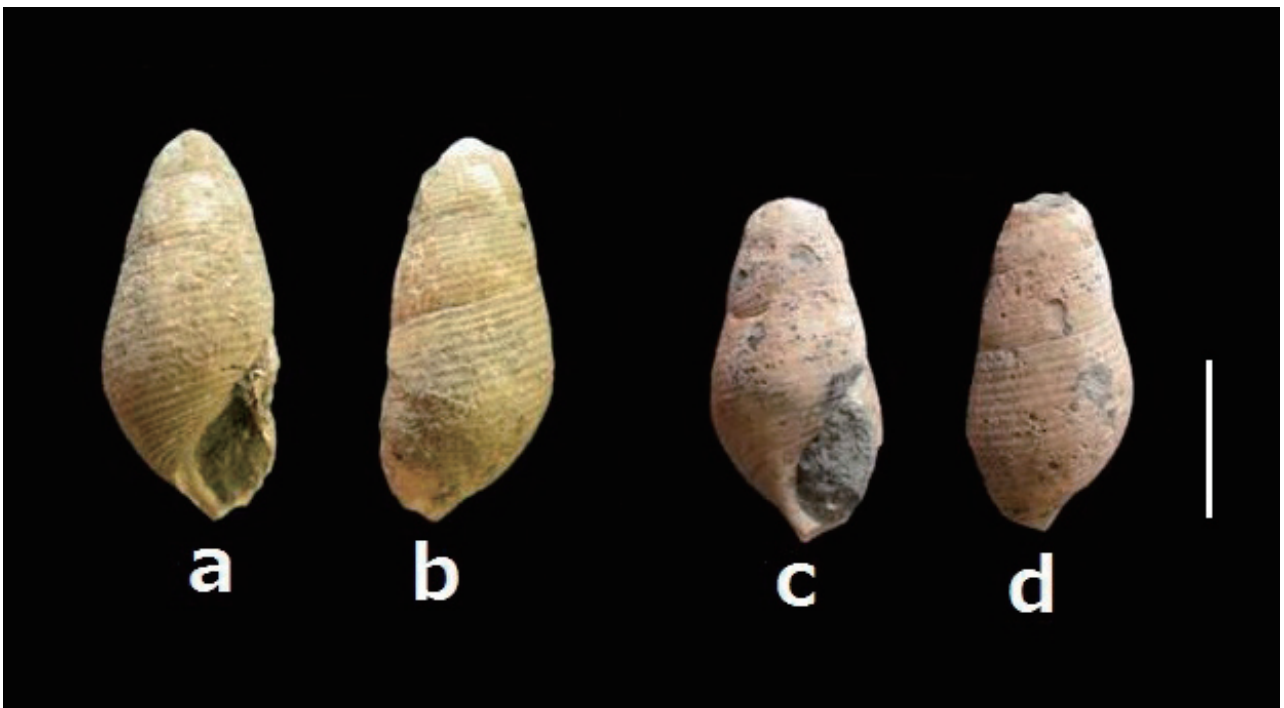


Fig. 3. *Sulcospira nagiensis*, sp. nov. from the Miocene Yoshino Formation of the Katsuta Group at Kaki, Nagi-cho, Katsuta-gun, Okayama Prefecture. a, b: holotype (NVMM1001); c, d: paratype (NVMM1002). Scale bar: 1 cm.

height, the spiral cords 8–12, more widely spaced than the interspaces, the basal cords strong, 9–12, with carinated top. The penultimate and third whorls with spiral cords 8 in number. Growth lines irregularly spaced and very fine. Aperture elongate-ovate, oblique with narrowly rounded basal lip, and angular in posterior. Outer lip broken, but seems to be thin. Columellar lip smooth, parietal callus no thicken, completely sealing the umbilicus.

Discussion: The new species differs from the Recent *Sulcospira sulcospira* (Mousson, 1849) living in Java (Marwoto and Isnaningsih, 2012) in having a larger number of spiral cords and a smaller apical angle and a broader outer lip.

Sulcospira martini (Schepmann, 1898) from Java (Köhler and Glaubrecht, 2005) differs from *Sulcospira nagiensis* in having the equivalent spiral cords.

The first author can not find the record of this genus in the Miocene age. However, Oostingh (1935) reported three species and six subspecies from the Pliocene from Java.

Sulcospira testudinaria (von dem Busch, 1842), a Pliocene and recent species in Java differs from this new species in its smaller apical angle, larger number of spiral cords and straighter columella.

Paleoenvironment: This species co-occurred with tropical elements such as *Geloina*, *Telescopium*, *Terebralia* and *Rhizophorimurex*. The brackish and freshwater condition are closely related to tropical spike proposed by Itoigawa (1989) in the early Middle Miocene of Southwest Japan.

Etymology: This new species is named after Nagi-cho where the type specimens occurred.

Type locality: Kaki, Nagi-cho, Katsuta-gun, Okayama Prefecture. The Yoshino Formation of the Katsuta Group (Taguchi, 2002, Locality 111).

Measurements (in mm):

	Height	Width	Height of Body whorl
NVMM1001 (holotype)	23.3+	10.5+	16.8+
NVMM1002 (paratype)	18.4+	9.05+	14.2+

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