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DISCOVERY OF TRAILS AND PROBLEMATICA FROM THE NICHINAN GROUP (OLIGOCENE) OF MIYAZAKI PREFECTURE, KYUSHU, JAPAN

By

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Introduction

The Cenozoic rocks distributed widely in the Japanese Islands have yielded many different kinds of marine fossils and among those published to date, there seem to be only two genera and species of marine worm-body. These two are, *Tosalorbis hanzawai* KATTO (1960) from the Eocene Muroto Formation of southeast Kochi Prefecture, Shikoku, and, *Sanbongicola nakagawai* HATAI and MASUDA (1973) from the Pliocene Omori Formation in Miyagi Prefecture. Thus, the discovery of the fossil marine worm described in the present article is considered to be an important contribution to the Cenozoic marine worm fauna of Japan.

Associated with the fossil marine worm-body are two types of trails, both of which were discovered during investigation on the geological and sedimentary structures of the Cenozoic rocks distributed in the Odotsu area, Miyazaki Prefecture (Fig. 1). In the

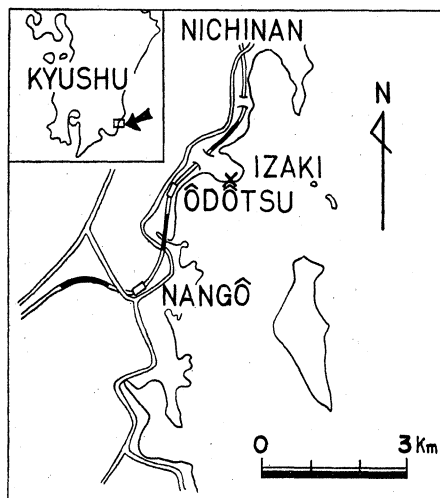


Fig. 1. Fossil locality (x) situated northeast of the Odotsu Station on the Nichinan Railway Line, Kyushu.

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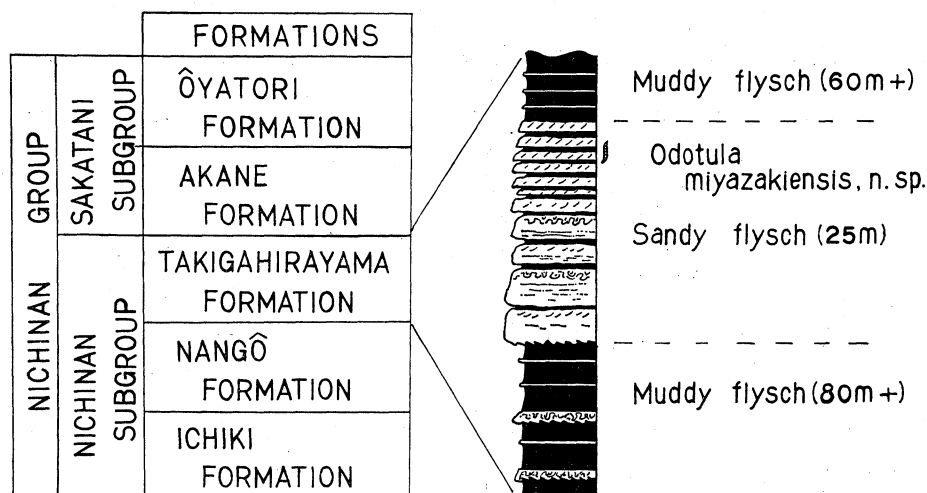


Fig. 2. Lithologic column of the Takigahirayama Formation observed in the Odotsu area and its stratigraphic position in the Nichinan Group (after Shuto, 1963).

named area flysch-type sediments are well developed and from them no fossils have been reported to date, thus the present discovery is valuable because they serve to suggest the palaeoecological conditions of the sedimentary basin during the time of survival of the marine worms. The trace and problematica occurred from the Takigahirayama Formation of the Nichinan Group (SHUTO, 1963); the stratigraphic position of the fossils and sequence of the formations in the geological column of the Odotsu area are shown in Fig. 2.

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Mode of Occurrence of the Trails

The trails and problematica were discovered on the sandstone layers of the alternation of sandstone and shale of the Takigahirayama Formation of the Nichinan Group. The alternation deposits compose the Takigahirayama Formation and are classified into muddy- and sandy-flysch-type deposits, which make cycles of sedimentation. These deposits are exposed typically in the sea-cliffs at Izaki situated at about 1 km northeast of the Odotsu Station on the Nichinan Railway Line running along the southeastern coast of Kyushu. Beautiful flute casts (AOYAMA, 1972) occur on the soles of the sandstone layers at the interface of the shale and sandstone layers in the flysch deposits.

The trails and problematica or worm-bodies were found on the sole of erratic sandstone slabs measuring about 10 cm in thickness and also on the upper surface of a

sandstone layer comprising a part of the sandy flysch deposits of the Takigahirayama Formation. The fossils observed on the upper surface just mentioned were found in the muddy part of a cross-laminated, fine-grained sandstone layer measuring 10–16 cm in thickness. The worm-bodies were found on the same surface of sandstone as some of the trails and in a position close to them. No other kinds of fossils were found on the same surface of sandstone layer in association with the trails and problematica.

All of the trails observed were developed horizontally on the surface of sandstone at the interface of the shale and sandstone. In horizontal direction their paths were sigmoidal to curved broadly or narrowly in various directions. None of the trails were noticed to penetrate the sandstone layer obliquely or vertically. This proves that the animal responsible for the trails was a surface ploughing or crawling organisms in habit.

In cross-section the trails were of two types, one being v-shaped and the other u-shaped. The trails of the former type had ridges bordering them whereas those of the latter type lacked definite ridges developed on their lateral sides. Also it is important to note that the trails of u-shaped cross-section showed good development of probable setae or appendages (Fig. 1) whereas the trails with v-shaped profile showed no such structure. This feature suggests that the two types of trails were due to different kinds of organisms.

Mode of Occurrence of the Problematica

The Problematica or worm-body fossils consist of several well preserved specimens preserved on the surface of an erratic sandstone layer. These specimens are more or less compressed as would be expected in the case of preservation of soft-bodied organisms. Each specimen lacks the posterior part of the body.

One of the specimens of marine worm body (Fig. 3, 5) preserved on the surface of an erratic sandstone layer measured about 19.5 cm in length as preserved, 0.5 to 1.2 cm in width and exhibits a long, narrow, originally cylindrical body with abundant transverse segments (Fig. 3). At about 6.5 cm from the anterior end (mouth?) is a swollen band-like structure measuring about 1.7 cm in length and 1.5 cm in width. This may represent the clitellum. The body fossils are composed of muddy sandstone like that building the layer. The segments are arranged close to one another at the anterior part of the body (Figs. 3, 4) and more widely on the preserved posterior part as if the animal was preparing to move forward.

The specimen with long, narrow cylindrical (originally) body with many segments and a band developed (Fig. 3) shows rather close resemblance with certain aquatic Oligochaete worms (YAMAGUCHI, 1953, 1954; OKUDA and IZUKA, 1949), but is not identical with them.

The other fossil worm bodies, also compressed, are judged to have been originally cylindrical, elongate, narrow, with abundant segments. One of them measures (Fig. 6) about 4 mm at the preserved anterior part and about 12 mm at the other parts of

the body. Thus specimen is smaller than the one mentioned above.

All of the worms were found in a position parallel with the bedding of the sandstone and shale layers, and at their interface. The details of the worms will be given in another section.

Remarks on the Trails and Worm-body Specimens

The body-specimens of the marine worms, characterized in general as stated above, can be distinguished from *Tosalorbis hanzawai* KATTO (1960) from the Eocene deposits of Kochi Prefecture, *Sanbongicola nakagawai* HATAI and MASUDA (1973) from the Pliocene of Miyagi Prefecture, and the fossil worms described and figured by HOWELL (1962) by possessing longer and narrower body, strong, broader and flat-topped segments with narrower interspaces that are of the Oligochaete-type rather than of the Polychaete-type. For this reason and also because the fossil worm-bodies are not identical with living worms (YAMAGUCHI, 1953, 1954; OKUDA and IIZUKA, 1949), a new name is proposed for them.

Whether both types of trails as described above were made by the same genus and species of worm is problematical. But from the features of the trails it is thought that the trails with u-shape cross-section and with setae like impressions may have been due to the fossil worm described later in this article. The other, or the trails with v-shaped cross-section is thought to have been made by some other kind of worm or marine benthic organism. Whatever be the true cause of the two types of trails, it is judged that they were not due to the worms of the *Nereites*-group (PERDIGAO, 1961; MACSOTAY, 1967; KATTO, 1960).

For the worm bodies mentioned above and as already stated, a new name is proposed, their names being based upon the geographical name of their occurrence.

Family Uncertain

Genus *Odotula*, n. gen.

Diagnosis:—Body cylindrical, elongate, narrow, long, with numerous segments which are strong, flat-topped, as broad as or broader than their interspaces; tapering anteriorly to about 4 mm, posteriorly broadening to about 12 mm. Setae or other structures not preserved on worm-body.

Syntype:—*Odotula miyazakiensis*, n. sp.

Locality, Formation and Age:—Sea-cliff at Izaki, about 1 km northeast of the Odotsu Station on the Nichinan Line, Miyazaki Prefecture. Takigahirayama Formation (Nichinan Group). Oligocene.

Remarks:—The present worm named *Odotula* is distinguished from *Tosalorbis* (KATTO, 1960) by the narrower, more elongate cylindrical body with stronger, flatter and broader segments. *Sanbongicola* HATAI and MASUDA (1973) can be distinguished from *Odotula* by the different shape of body and nature of the segments. Worms identical with the present fossil are unaware to the writer.

Although there is no positive evidence, it is thought that the u-shaped (cross-sec-

tion) trails may have been made by *Odotula*, whereas the trail with v-shaped cross-section are considered to be due to a benthic organism other than *Odotula*.

Odotula miyazakiensis, n. sp.

Pl. 1, figs. 3-6

Description:—Body cylindrical (originally), elongate, narrow, measuring more than 20 mm in length because posterior part is lost, tapering anteriorly to mouth (?) which is about 4 mm in width in compressed condition, posteriorly broader, attaining about 12 mm in general width, surface segmented throughout, segments strong, nearly as broad as flat-bottomed interspaces or broader, roundly and broadly flat on top, about 6-7 segments within a distance of 10 mm; no setae or other structures preserved on body, no mesial groove or other organic structures observed.

Type locality, Formation and Age:—Sea-cliff at Izaki, 1 km northeast of the Odotsu Railway Station on the Nichinan Line, Miyazaki Prefecture, Kyushu. Takigahirayama Formation (Nichinan Group). Oligocene.

Depository:—ESK* Reg. No. F-5011 (Syntype).

Remarks:—*Odotula miyazakiensis*, n. gen. n. sp. can be distinguished from *Tosalorbis hanzawai* KATTO (1960) and *Tosalorbis peculiaris* KATTO (1960), both from the Eocene of Kochi Prefecture, Shikoku, *Tosalorbis kattoi* HATAI and KOTAKA (1961) from the Miocene of Wakayama Prefecture, *Nereites tosaensis* KATTO (1960) and *Nereites murotoensis* KATTO (1960), both from the Eocene of Kochi Prefecture, Shikoku, by narrower cylindrical body with broader and flatter segments, and from *Sanbongicola nakagawai* HATAI and MASUDA (1973) from the Pliocene of Miyagi Prefecture by the different shape of the body and segments.

Although *Odotula miyazakiensis* shows some resemblance with the aquatic Oligochaete worms (OKUDA and IIZUKA, 1949; YAMAGUCHI, 1953, 1954) in the narrower cylindrical and elongate body and segments, species with which the present one could be identified are not known to the writer.

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Nichinan 日南
Izaki 猪崎

Odotsu 大堂津
Takigahirayama 滝ヶ平山

Explanation to Plate 1

(All specimens from the same locality of sea-cliff at Izaki, about 1 km northeast of Odotsu Station on the Nichinan Line, Miyazaki Prefecture)

- Fig. 1. u-shaped trail with setae-like impressions. Paths curved variously.
- Fig. 2. v-shaped trail, showing the ridges developed on both lateral sides and the curved path.
- Figs. 3, 4, 5 and 6. Different views of *Odotula miyazakiensis*, n. gen. n. sp. (syntype). Note the narrow cylindrical body, well developed segments and well preserved anterior part of the worm. Fig. 3, enlarged view of Fig. 5 to show details of the segments and clitellum (?).

