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Pliocaenicus omarensis (Kupts.) Stachura-S. & Khur. found from Pliocene sediments of The Koriyama Formation, Kagoshima Prefecture, Japan

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Abstract

Pliocaenicus omarensis (Kupts.) Stachura-S. & Khur. was found in diatomite from the Koriyama Formation, Kagoshima Prefecture, Japan. It is characterized by a transversely undulate valve face, puncta that are radially to randomly arranged on the valve face, valve face fultoportulae with three satellite pores arranged in a circle, mantle fultoportulae also with three satellite pores located on slightly recessed costae and a ligula-like segment covering the valvocopula opening.

Key index words : fossil diatom, Kagoshima, Koriyama Formation, Japan, *Pliocaenicus omarensis*, Pliocene

Introduction

The genus *Pliocaenicus* Round & Håk. 1992 was discussed by Khursevich & Stachura-Suchoples (2008) providing morphological characteristics, pertinent literature, ages, biogeographic and paleo-biogeographic information of all *Pliocaenicus* species and a taxonomic key for *Pliocaenicus*. In Japan, *Pliocanicus* species have been reported by Tanaka & Kobayasi (1999) including *P. omarensis* and *P. costatus* and also Tanaka & Nagumo (2004) described *P. nipponicus* H.Tanaka & Nagumo from central Japan. Recently, the authors found *P. omarensis* from sediment in the Koriyama Formation, Kagoshima Prefecture, Kyushu, Japan. The specimens from the Koriyama Formation do not share all of the same characteristics as reported by Khursevich & Stachura-Suchoples (2008), but the authors considered the two taxa similar enough to determine the taxon from Kyushu as *P. omarensis*.

In this paper, the *P. omarensis* from the Koriyama Formation is described and illustrated using light (LM) and scanning electron (SEM) microphotographs.

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Materials & Terminology

The investigated materials (samples KAG-507, 508 and 509) were collected by one of authors (H.T.) on 27 November 2007 from Kusakidan (latitude 31°44′N), Satsumasendai City, Kagoshima Prefecture, Japan (Fig. 1). All samples are diatomite of the Koriyama Formation determined to be the Late Pliocene deposit based on fission track dating (Hase & Danhara 1985) and K-Ar dating (Uchimura *et al.* 2007). *P. omarensis* was in each sample with high frequencies of 91% (KAG-507), 96% (KAG-508) and 99% (KAG-509), respectively.

General morphological terms are after Khursevich & Stachura-Suchoples (2008). However, by LM and SEM observations, the term "secondary costae" is used which lie inside of mantle alveoli between every two costae that form interstriae on valve face.

Observations

***Pliocaenicus omarensis* (Kupts.) Stachura-S. & Khur.** (Figs 2-15)

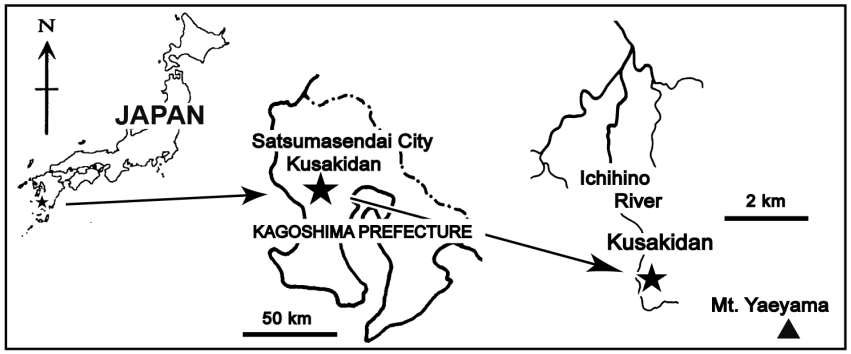


Fig. 1. Location map showing the sampling site (★), Kusakidan, Satsumasendai City, Kagoshima Prefecture, Japan.

LM observation shows valves circular, or slightly elliptical in rare cases, diameter 4.5-28 μm, a strong transversely undulate valve face and puncta rows of valve face in a radial to random pattern (Figs 2-8), puncta in rows 8-16 in 10 μm. Costae number ca. 8 in 10 μm at valve margin. The secondary costae (Fig. 14) are visible on edge of valve (Fig. 9).

SEM external observations show openings of valve face fultoportulae in a ring pattern. The openings of all fultoportulae and the rimoportula lack tubes (Fig. 10). Mantle consists of parallel rows of finer areolae and distinct interfascicles which end at middle or lower mantle where openings of mantle fultoportulae are located. There are additional areolae rows below the outer openings of fultopotulae on the mantle (Fig. 12). There are 11-20 of areolae rows between every two interfascicles with mantle fultoportulae. A rimoportula opening is located on marginal area of projected side of valve face near mantle (Figs 10, 12). Cingulum consists of four bands, broad valvocopula, two bands and ligula-like segment (Fig. 11).

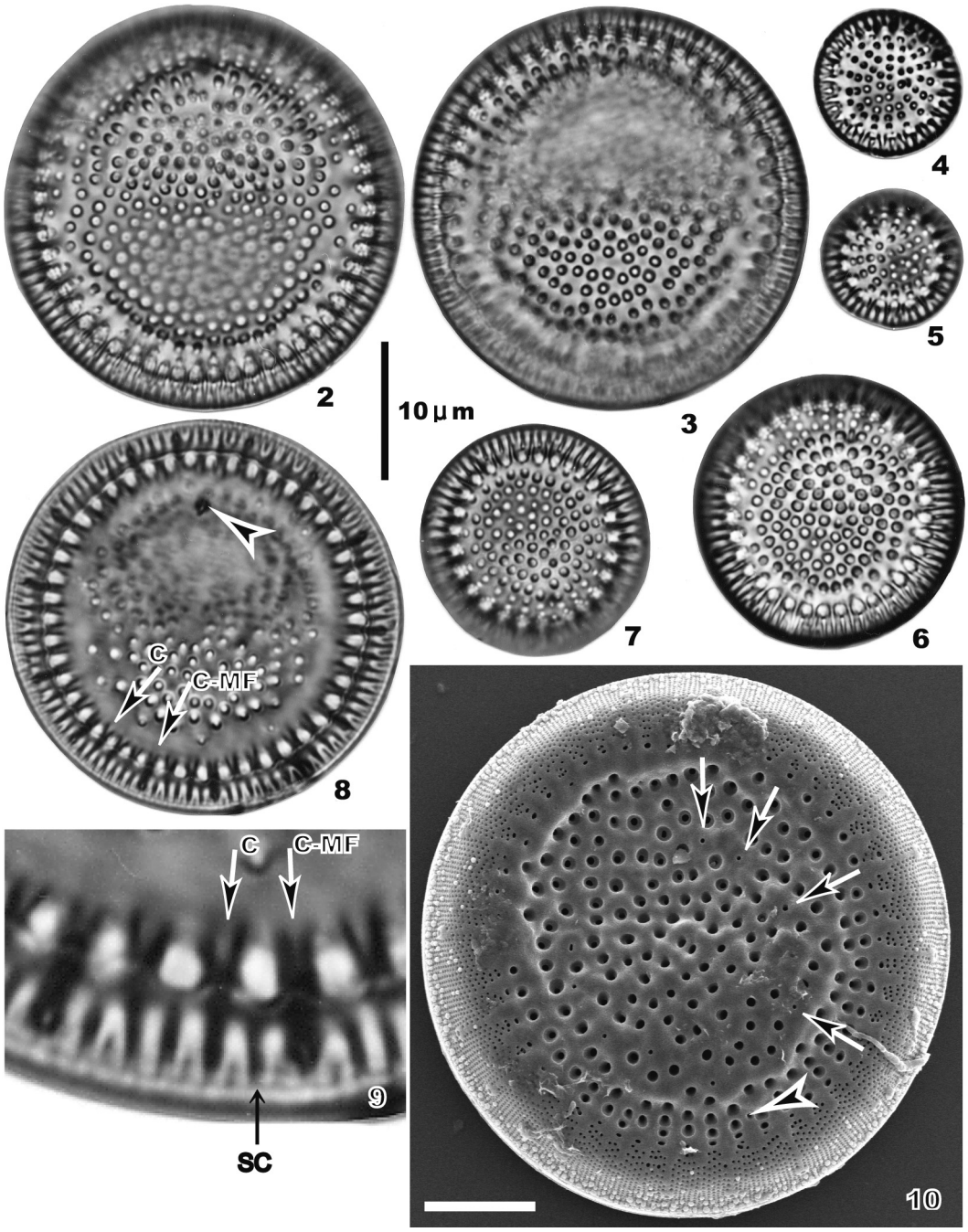
SEM internal observations show areolae covered with domed cribra and valve face fultportulae arranged in a ring pattern (Fig. 13). Valve face and mantle fultoportulae all have three satellite pores (Figs 14, 15). Mantle fultoportula located on every (1)2-4 slightly recessed costa, but all costae of same thickness. Single rimoportula located on marginal valve face (Fig. 15). The secondary costae are difficult to discern, but can be observed the alveoli inside with much enlarged photographs, or much better on a broken valve margin (Fig. 14). The alveoli lack centripetal roofing over (Fig. 14).

Comparison and Discussion

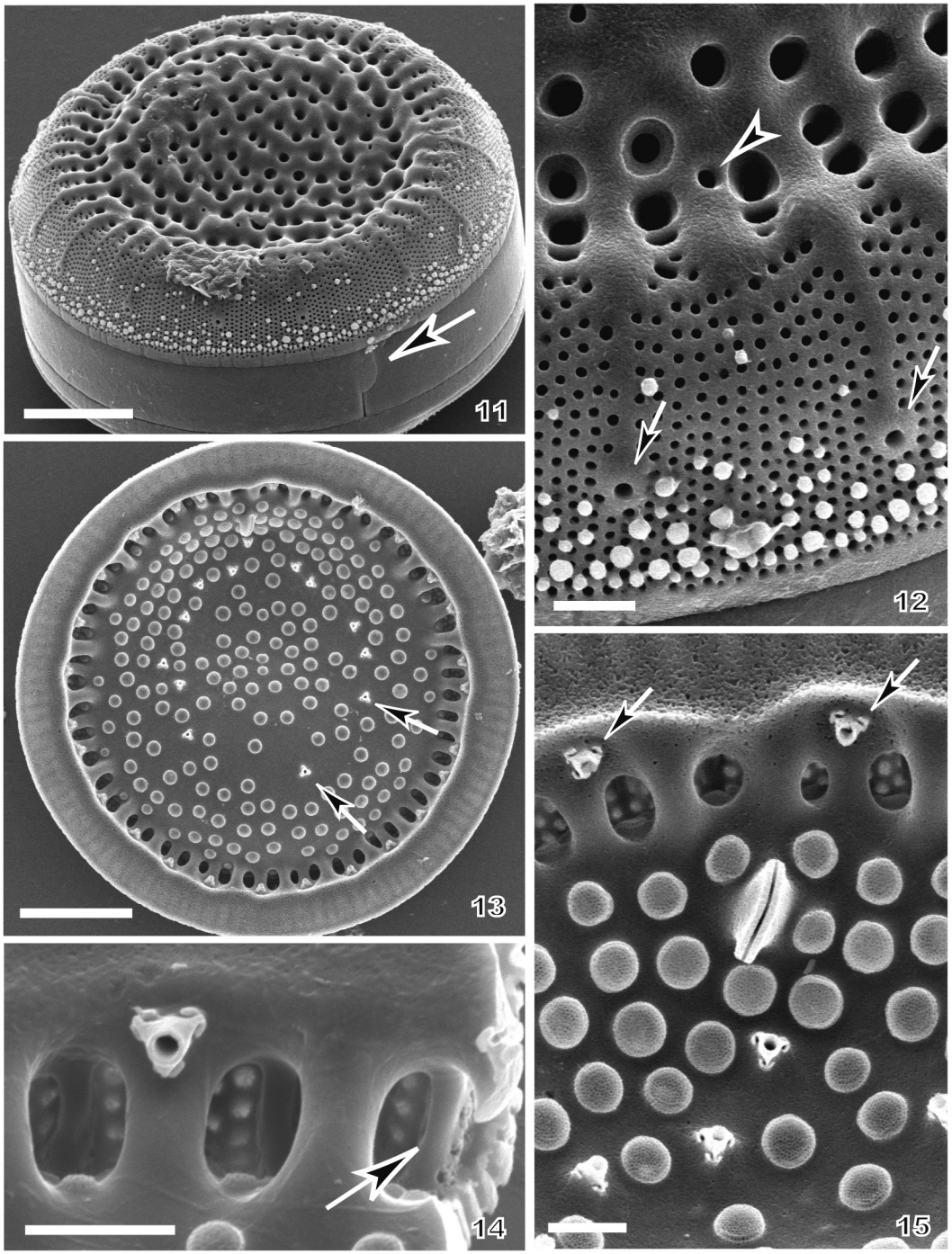
According to the taxonomic key for *Pliocaenicus* species reported in Khursevich & Stachura-Suchoples (2008), alveolae both simple and complex, diameter of valves 5-47 μm, externally narrow interstriae (costae) on the mantle do not go to the valve edge and mantle fultoportulae located on thick or thin recessed costa are characteristics of *P. omarensis*, *P. jilinensis* G.Wang and *P. cathayanus* G.Wang. In regard to the mantle fultoportulae, in *P. omarensis*, are on thick costae, whereas in the other two species, on thin recessed costae. The taxon from the Koriyama Formation has mantle fultoportulae on slightly recessed costae, but the costae are not thin as all costae are of the same thickness. The taxon also has a ligula-like segment, a feature observed in the *P. omarensis* found in Umigami Area, Hyogo Prefecture, Japan (Tanaka & Kobayasi 1999).

Pliocaenicus omarensis was originally described by Kuptsova (1962) as *Stephanodiscus omarensis* using materials from Pliocene deposits of an outcrop in Omarski Pochinok within the Kama River basin and providing 11 LM photographs of specimens. Since then LM and SEM photographs using materials from the type locality were showed by Khursevich (1989), Round & Håkansson (1992) and Khursevich & Stachura-Suchoples (2008), the last which discussed the morphology of *P. omarensis* reported up to that time.

The *Pliocaenicus* species found in the Koriyama Formation is almost the same as *P. omarensis* discussed in Khursevich & Stachura-Suchoples (2008), although there are some differences, particularly punctae pattern of valve



Figs 2-10. *Pliocaenicus omarensis*. Figs 2-9. LM. Fig. 10. SEM. **Figs 2, 3.** Same valves at different focal plans. **Figs 2-7.** External views. **Fig. 8.** Internal view showing rimoportula (arrowhead), costa (arrow : C), costa with mantle fultoportula (arrow : C-MF). **Fig. 9.** Enlargement of Fig. 8. showing secondary costa (dark arrow : SC), costa (arrow : C), costa with mantle fultoportula (arrow : C-MF). **Fig. 10.** External view of whole valve showing opening of rimoportula (arrowhead) and openings of valve face fultoportulae (arrows : four of nine). Scale bar = 5 µm (Fig. 10).



Figs 11-15. *Pliocaenicus omarensis*. SEM. Figs 11, 12. External views. Figs 13-15. Internal views. **Fig. 11.** Oblique view of Fig. 10, arrow indicates ligula-like segment. **Fig. 12.** Oblique view enlargement from projected side of valve margin of Fig. 10 showing opening of rimoportula (arrowhead), openings of mantle fultoportulae (arrows) and mantle areolation. **Fig. 13.** Whole valve showing valve face fultoportulae (arrows : two of thirteen) forming ring pattern. **Fig. 14.** Broken valve margin showing costae, secondary costae (arrow) and mantle fultoportula with three satellite pores. **Fig. 15.** Marginal valve face and mantle showing mantle fultoportulae located slightly recessed costae (arrows). Scale bars = 1 μm (Figs 12, 14, 15), 5 μm (Figs 11, 13).

face and location of valve face fultoportulae. The taxon from the Koriyama Formation has a radial to random punctae pattern on valve face and valve face fultoportulae arranged in a ring spreading over both projected and depressed part, while *P. omarensis* of Khursevich & Stachura-Suchoples (2008) has punctae in a radial pattern and valve face fultoportulae arranged in a semicircular arc. Specimens of *P. omarensis* with random punctae on the valve faces, however, also have been found from the type material or a material collected from the type locality (Kuptsova 1962, Khursevich 1989). In addition, photographs provided by Khursevich & Stachura-Suchoples (2008) showed valve face fultoportulae spreading over both the projected and depressed parts, though not in a ring pattern.

Considering the overall similarities between the *Pliocaenicus* taxon found in the Koriyama Formation and the descriptions of *P. omarensis* to date, we determine the species from the Koriyama Formation to be *Pliocaenicus omarensis* (Kupts.) Stachura-S. & Khur. This makes the specimen the second southernmost *P. omarensis* ever found following one reported from Ethiopia (Gasse 1980).

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