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Pelagodictyon Clarke, a newly recorded nanodiatom genus for China

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Abstract Marine nanoplanktonic diatoms have been frequently either underestimated or overlooked in phytoplankton investigations due to their small size (2–20 μm), which allows most of them to pass through a regular phytoplankton net of 70-μm pore size. For nanoplanktonic diatom classification, water samples (each 2000 mL) were collected from several representative sea areas of Chinese coast from May 2002 to May 2006. *Pelagodictyon* Clarke was identified as a newly recorded nanodiatom genus for China under transmission electron microscope (TEM). This genus is characterized by the delicate structure of the valve face. The striae are seen to be formed by ribs with cross-ribs (frets) and the intervening spaces are occupied by polygonal cribra situated much close to the exterior face of the valve. Just one species was found, i.e., *P. tenue* Clarke. Detailed description of the taxonomic characteristics with TEM photographs of this species and its ecological habitat and distribution are given in this paper. Morphological characteristics comparisons among several resembling genera were discussed.

Key words China, fret, nanodiatom, new record, *Pelagodictyon*, Stephanodiscaceae.

Nanoplanktonic diatoms (Nanodiatoms) are important primary producers in marine waters and make a great contribution to diatom biomass and species diversity, especially in coastal waters (Fay, 1973; Hallegraeff, 1981; Gao, 1990; Cheng et al., 1993; Jiao & Gao, 1995; Li, 2006). Some nanodiatom species are the key food source for many aquiculture organisms such as abalone, bivalves and junior fishes. Several nanodiatom species such as *Thalassiosira weissflogii* may be good environmental indicators of rivers or lakes. Many nanodiatom species belonging to the genera such as *Skeletonema*, *Thalassiosira* and *Chaetoceros*, etc., are the common and main bloom causative organisms in Chinese coast. They have been either frequently underestimated or overlooked in phytoplankton investigations due to their small size (2–20 μm), which allows most of them to pass through a regular phytoplankton net of 70-μm pore size. In the past ten years, the significance of nanodiatoms has been validated in several qualitative and quantitative studies using water samples instead of net samples in many coastal waters of China such as Xiamen Harbour (Gao, 1990), Fujian Province coastal waters (Cheng et al., 1993), Jiaozhou Bay (Jiao & Gao, 1995), Hong Kong waters (Gao et al., 2003; Li, 2006), Changjiang River Estuary waters (Li, 2006), Daya Bay (Li, 2006), etc. Many new species and new records of genera and species of nanodiatoms have been reported.

In the present study, we describe a new genus record of nanodiatoms, *Pelagodictyon*, from water samples collected from several representative sea areas of Chinese coast from May 2002 to May 2006. One species, i.e., *P. tenue* Clarke is described, along with its ecological behavior and distribution. Morphological characteristics comparisons between *Pelagodictyon* and several resembling genera were discussed.

1 Material and methods

Two liters of water samples were collected from each sampling station in several representative sea areas of Chinese coast from May 2002 to May 2006. All water samples were fixed with Lugo's solution *in situ* and brought back to the laboratory. The preserved samples were concentrated to a final volume of about 5 mL by settlement overnight repeatedly. Then they were acidized with concentrated H_2SO_4 by boiling for 20–30 minutes in a water bath and rinsed with distilled water to neutrality. Afterwards they were observed and photographed on the carbon-coated copper under HITACHI H600 TEM (Cheng et al., 1993; Gao et al., 2003).

The samples were deposited in Diatom Laboratory of Xiamen University (DLXU), numbered as JZB series and YDL series respectively.

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2 Description

Pelagodictyon Clarke was identified as a new record of genus for China. Until now, only three species of this genus have been reported and *P. tenue* was the only one species which was observed in our water samples from China.

Pelagodictyon Clarke in Diatom Research 9 (1): 18, figs. 1–13. 1994.

Cells live solely or in short chains. Valves are disc-like or drum-shaped. Frustules are circular and flat mostly. Whole valve surface has polygonal areolae which are separated by a network consisting of frets and costae. Areolae irregularly arrange in the centre of the valve, and elsewhere in radial fascicles. The fascicles are uniseriate near the valve centre and biseriate or multiseriate at the margin of the valve face. Areolae form a zigzag within the fascicles. Costae between the fascicles are deeper internally than frets between the areolae. Marginal fultoportulae exist and sometimes a central fultoportula presents. A rimoportula locates near the junction of the valve face and the mantle.

Derivation of the name: *pelagos* means a broad area of waters, and *diction* intends a net or a net-like structure of the valve. This genus was established by Clarke in 1994. So far, just three species have been found, which mainly live in the freshwaters and all of them have been reported only in the Norfolk Broads with sporadic cells.

Pelagodictyon Clarke was ranked to the Centriae, Thalassiosirales, Stephanodiscaceae.

Pelagodictyon tenue Clarke in Diatom Research 9 (1): 20, figs. 7–9. 1994.

Stephanodiscus hantzschii f. *tenuis* Qi in Flora Algarum Sinicarum Aquae Dulcls, Tomus IV, 66, pl. VI, fig. 4. 1995.

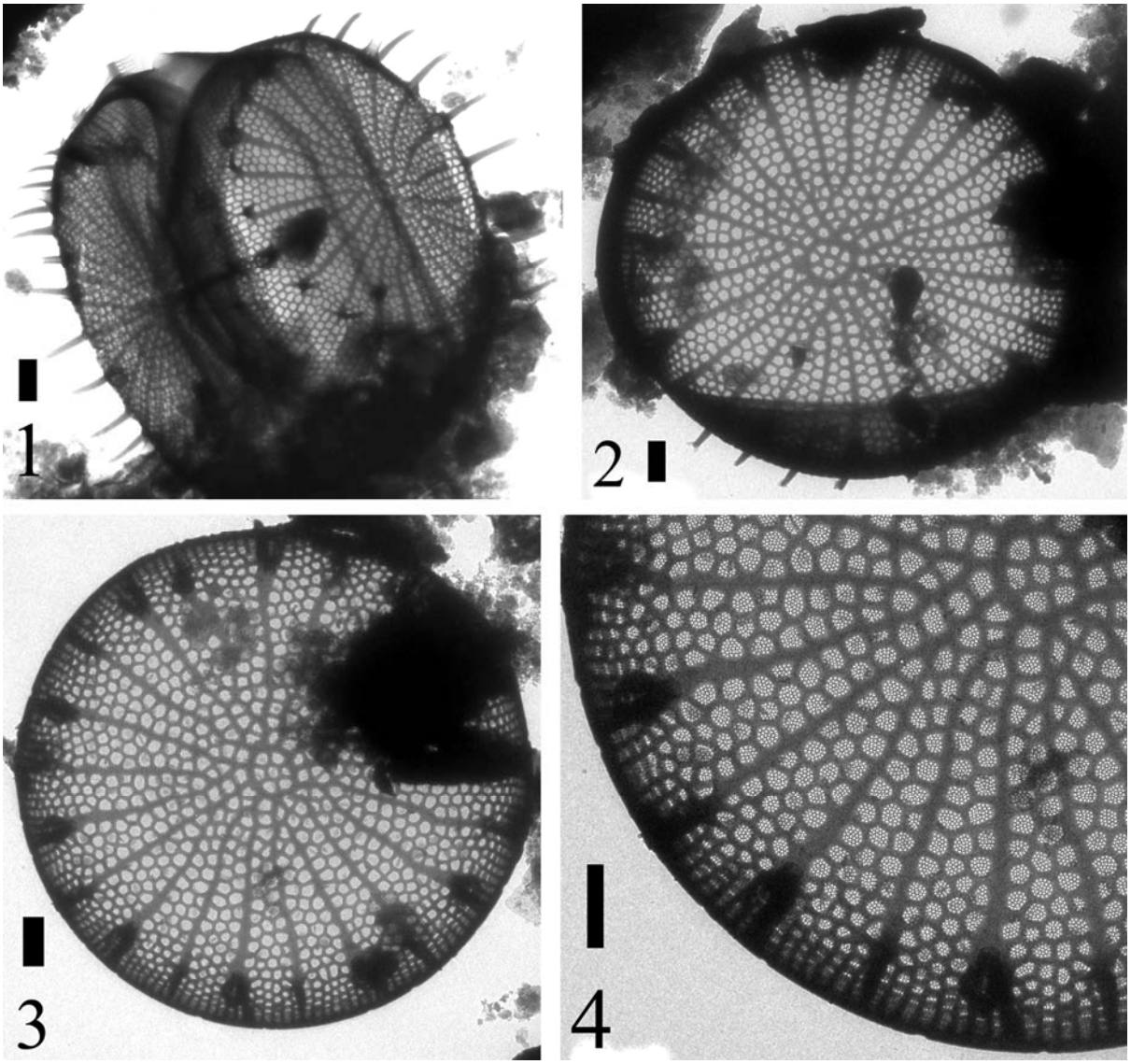
Cells are disc-like or drum-shaped. Valve diameter is about 7.5–9.5 μm. Frustules are flat with areolae irregularly arranged in the centre of the valve and elsewhere in radial fascicles. The fascicles are uniseriate near the centre of the valve and expand to be quadriseriate at the margin of the valve face. A pattern centre or annulus can be observed when cells exist in the phase of auxosporulation (Håkansson, 2002) (Shown in Figs. 2–4). Areolae are pentagonal or hexagonal and separated by shallow frets which form a net-like construction. The areolae locating near the centre of the valve face are larger than those close to the valve margin more or less. Interfascicles costate are strongly silicious, each having a spine at the outer end. All spines extend outwards and are nearly vertical to the valve surface. The density of spines is about 10–14 in 10 μm. Several marginal fultoportulae, each with three satellite pores and a short extending tube, locate immediately below every third or fourth spine. While in our specimens, one or two spines were found between two immediate marginal fultoportulae. And three spines located between two immediate marginal fultoportulae in Qi's specimen which was misidentified as *Stephanodiscus hantzschii* f. *tenuis* (Hustedt) Håkansson & Stoermer. No central fultoportula exists near the valve center. The mantle has rather smaller areolae arranged in vertical rows and has no interfascicles costate. No colonies have been found.

Ecology: Pelagic, mainly in the freshwaters such as rivers and lakes.

Distribution: It was firstly found in the Wheatfen Broad, Surlingham, Norwich, England with sporadic cells by Clarke in 1994. We observed several specimens in the surface water samples from Jiaozhou Bay (September 2005) and Yundang Lake in Xiamen Island (September 2004), with the cell densities about 4.2×10^3 cells/L and 4×10^2 cells/L respectively.

3 Discussion

Under light microscope (LM), it is difficult to distinguish *Pelagodictyon* species from the species of *Cyclotella*, *Cyclostephanos* and *Stephanodiscus*. On the main valves of these genera, areolae locate in many fascicles. And *Pelagodictyon*, *Cyclostephanos* and *Stephanodiscus* species have many obviously marginal spines, fultoportulae and rimoportulae with their external tubular extensions which are longer or shorter. For the accurate identification, electron microscope (EM) is necessary. The genus *Pelagodictyon* is characterized by the structure on the valve face. The areolae, locating on the valve of *Cyclotella*, *Cyclostephanos* and *Stephanodiscus* species, are mainly circular, occasionally slits-like or wrinkles-like during the different growth cycle phases (Håkansson et al., 1986; Håkansson, 2002). The valve surface of *Pelagodictyon* species has polygonal areolae everywhere. And the areolae locate zigzag within each fascicle. The striae are formed by ribs with delicate cross-ribs, which were called a new term "frets" by Clarke in 1994. A polygonal cribra situated close to the exterior valve face. While in the usual structure of *Cyclostephanos* and *Stephanodiscus* species, the valve consists of a sheet of silica perforated by holes and the holes are covered internally by a domed cribra (Clarke, 1994; Håkansson, 2002). The frustule at the valve mantle junction appears to be flexible in



Figs. 1–4. TEM photographs of *Pelagodictyon tenue* Clarke. **1.** Lateral valve and mantle view, indicates the spine ends extending outward with a distance away from valve margin. A marginal fultoportula, with three satellite pores and a short tube, is close subjacent the adjacent spine. **2, 3.** Valve views, show the areolae shapes and patterns, with delicate frets separating them. A marked annulus or pattern center is observed in each specimen. **4.** Detail of valve margin, indicating the polygonal cribra. Scale bars=1 μm.

Pelagodictyon while in the other genera, especially in *Cyclostephanos*, the valve is strong at this point. In *pelagodictyon*, the cribra of the areolae, distributing on the valve face and mantle, are flat and occupy the outer part of a large irregular loculus. And the loculus is always clearly on the inner surface of the frustule. In *Stephanodiscus*, the cribra are domed internally, while in *Cyclostephanos* they are domed on the external valve face but not on the mantle (Clarke, 1994). So, the forms of the cribra and areolae are the criteria for the delimitation of species or genera. No internal valves have been found in our observations.

Main differences among three reported *Pelagodictyon* species are whether they have a central fultoportula, the density of spines, satellite pores of marginal fultoportulae, and the shape of living colonies.

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