

# A new early Miocene *Sphenolithus* species from the South China Sea

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**Abstract** A routine biostratigraphic study has revealed a new early Miocene calcareous nannofossil species, *Sphenolithus pospichalii* sp. nov. from cutting materials in Well LW13-1-1 drilled by the China National Offshore Oil Corporation (CNOOC) in the northern shelf of the South China Sea. This new species is medium to large in size with a tapered, monocrystalline apical spine and a wide, trapezoidal proximal cycle. It displays a needle-nose-plier-shaped birefringence pattern with a characteristic flat-topped, arch-shaped base. *Sphenolithus pospichalii* sp. nov. occurs in Martini Zone NN4 and shows its acme in the basal part of this zone, and thus is a potential marker for the subdivision of NN4 due to its short stratigraphic range.

**Keywords** Calcareous nannofossil, *Sphenolithus*, early Miocene, South China Sea, new species

## 1. Introduction

*Sphenolithus* are an extinct group of calcareous nannofossils that are wedge-shaped with a proximal cycle of radial elements surmounted by an apical spine. This group first occurred in the early middle Paleocene (Martini, 1971), rapidly diversified and thrived in the Eocene through early Miocene (Perch-Nielsen, 1985), and finally disappeared in the late Pliocene (Boudreaux, 1974). During their diversification period, more than 23 species evolved within a <30Ma period in the mid-low latitudes and thus provided many excellent biostratigraphic markers (Martini, 1971; Bukry, 1973). The description herein of a new, short-ranging, early Miocene *Sphenolithus* species further strengthens the usefulness of this group in biostratigraphy.

## 2. Materials and methods

Drill cuttings were the only materials available for the biostratigraphic study of Well LW13-1-1, an oil exploration well drilled by the China National Offshore Oil Corporation (CNOOC). The well is located approximately 150km NWW of Ocean Drilling Program Site 1148 (18.8362°N, 116.5657°E; water depth: 3294m), in a water depth of 1920.6m on the northern slope of the South China Sea. The cuttings are mostly dark-to-medium-dark-gray, calcareous silty shale. The well has a complete sequence into the late Oligocene without major unconformities as evidenced by biostratigraphy and the through-well seismic profile.

Routine smear slides were prepared following the “double slurry” method (Watkins & Bergen, 2003), and were mounted with Norland 61 optical adhesive. This

procedure was adapted here by adding a few drops of ~5% sodium hexametaphosphate solution during smearing to better disperse the materials, in order to process coarse clastic rocks and cutting samples typically from oil industry (Jiang & Zhang, in press). Nannofossils were examined with a Zeiss Axio Imager A2 microscope under cross-polarized light at 1000x magnification. A ½λ gypsum plate was used to demonstrate birefringence patterns indicating C-axis orientation of various crystallographic units. For SEM study, a settling technique was used in stub preparation to remove large particles and fine clays (Bukry, 1969), and a Zeiss Ultra55 field emission scanning electron microscope (FSEM) was employed to examine fine-scale structures. Nannofossil zonation follows Martini (1971).

## 3. Systematic paleontology

Order DISCOASTERALES Hay, 1977

Family SPHENOLITHACEAE Deflandre in Grassé, 1952

Genus *Sphenolithus* Deflandre in Grassé, 1952

*Sphenolithus pospichalii* sp. nov.

Pl.1, figs 1–8

**Derivation of name:** After Dr. James J. Pospichal (BugWare Inc., Tallahassee, Florida, USA) in honor of his tremendous knowledge of Mesozoic and Cenozoic calcareous nannofossils.

**Diagnosis:** Medium to large pyramidal-shaped sphenolith with the upper proximal elements always aligned parallel

to the length of the species, displaying a needle-nose plier-shaped birefringence pattern with characteristic arched base.

**Description:** *Sphenolithus pospichalii* is medium to large in size with a tapered, monocrystalline apical spine and a well-developed, trapezoidal proximal cycle. The most important feature of this form is that the lateral elements (upper proximal elements) are always aligned parallel to the length of the species. Its birefringence pattern under polarized light resembles a needle-nose plier, in which the upper quadrants are triangular while the lower quadrants are bracket-shaped forming a flat-topped arch. The upper quadrants are  $\leq \frac{1}{2}$  the size of the proximal quadrants. Under polarized light, only the outer elements of the proximal cycle are highly birefringent when oriented at  $0^\circ$  to either optical axis; while oriented at the  $45^\circ$  position, the apical spine and the upper quadrant are highly birefringent with the entire lower quadrant faintly so.

**Differentiation:** *S. pospichalii* differs from all other sphenoliths by its needle-nose plier shaped overall birefringence pattern, particularly the bracket-shaped lower quadrants forming a flat-topped arch. It is most similar to *Sphenolithus milanetti*; however, the latter species has a much shorter apical spine, and also has no lateral elements aligned parallel to the length that instead gives *S. pospichalii* a flat-topped arch shaped birefringence pattern under cross polarized light.

**Remarks:** *S. pospichalii* shows very close resemblance in the overall birefringence pattern to *Sphenolithus "vietnamensis"*, which is considered invalid because it is only illustrated in a web page (<http://www.varol.demon.co.uk/vietnamensis.html>). However, the former has a characteristic flat-topped arch-shaped lower quadrant at both the  $0^\circ$  and  $45^\circ$  positions, possibly as a result of better preservation.

**Dimensions:** For the 20 specimens measured, **Base width:** 4.5  $\mu\text{m}$  (min.), 6.1  $\mu\text{m}$  (max.), 5.3  $\mu\text{m}$  (mean); **Height:** 6.0  $\mu\text{m}$  (min.), 10.2  $\mu\text{m}$  (max.), 8.1  $\mu\text{m}$  (mean).

**Holotype size:** **Base width:** 5.0  $\mu\text{m}$ ; **Height:** 8.0  $\mu\text{m}$ .

**Holotype:** Pl.1, fig. 1.

**Paratype:** Pl.1, fig. 3.

**Type locality:** South China Sea; CNOOC Well LW13-1-1 ( $\sim 19.21^\circ\text{N}$ ,  $\sim 114.97^\circ\text{E}$ ; water depth: 1920.6m).

**Type level:** early Miocene (Zone NN4) CNOOC Sample LW13-1-1, 2710–2720m (2720m below sea floor).

**Observed stratigraphic range:** Zone NN4. Its highest occurrence was found right below that of *Helicosphaera ampliapertura* (upper boundary of Zone NN4), its acme at

the basal part of NN4. Its first occurrence may be in upper NN3 (Lord *et al.*, 2009) but cannot be determined in this study due to the uncertainties inherent to the use of drill cuttings.

**Observed geographic distribution:** This species was observed from the offshore Philippines, the northern slope of the South China Sea, and the Gulf of Mexico, which suggests a global, subtropical distribution.

**Depository:** All materials are archived and deposited at the Department of Ecology, Jinan University, Guangzhou, China.

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**Plate 1**

*Sphenolithus pospichalii* sp. nov. from Sample CNOOC LW13-1-1, 2710-2720m  
for each specimen, a - aligned with polarisers, b - 45° to polarisers,  $\lambda$  - under gypsum plate

