

# A new biostratigraphically significant Late Oligocene *Sphenolithus* species from the equatorial region

Mohammed Aljahdali<sup>1,2</sup>, Sherwood W. Wise, Jr.<sup>1</sup>, James Bergen<sup>3</sup> and James J. Pospichal<sup>4</sup>

<sup>1</sup>Department of Earth, Ocean and Atmospheric Sciences, Florida State University, Tallahassee, 32306

<sup>2</sup>Department of Marine Geology, Faculty of Marine Sciences, King Abdulaziz University, Jeddah 22185 Saudi Arabia

<sup>3</sup>Paleo at the Hill Country, Brenham, Texas, 77833

<sup>4</sup>BugWare, Inc., 1615 Village Square Blvd. Suite 8, Tallahassee, FL 32309

email: ma10u@my.fsu.edu

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**ABSTRACT:** *Sphenolithus avis* n. sp. is a new calcareous nannofossil species described in materials recovered from Ocean Drilling Program (ODP) sites in the equatorial region. *Sphenolithus avis* n. sp. is small to medium size with a short tapered apical spine and a large flaring proximal cycle. Its stratigraphic range spans Martini Zones NP23 to NP25, and it is widely distributed in three different equatorial regions, ranging from marginal to deep-sea locations. Because of its relatively short range and global distribution, *S. avis* n. sp. is a potential secondary *Sphenolithus* zonal marker in the upper Oligocene.

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## INTRODUCTION

*Sphenolithus* is an extinct calcareous nannofossil genus that thrived in the Cenozoic (Deflandre 1952; Roth, Franz and Wise 1971; Romein 1979; Perch-Nielsen 1985; Aubry 1989). Deflandre (1952) was the first to describe the conical nannolith shapes that he placed in the family *Sphenolithaceae*. The genus *Sphenolithus* first appeared in the early/mid Paleocene (Zone NP4, Martini 1971), and became extinct by the early Pliocene (Romein 1979; Perch-Nielsen 1985; Aubry 1989). In the Oligocene, *Sphenolithus* underwent increased speciation in the mid-to low latitudes (Aubry 1989), which provided excellent biostratigraphic markers for this epoch (Martini 1971; Okada and Bukry 1980). A new late Oligocene *Sphenolithus* species, *Sphenolithus avis* n. sp., from equatorial belt is described herein.

## MATERIALS AND METHODS

The new species was observed in upper Oligocene sediments from three Ocean Drilling Program (ODP) sites (Holes 1237B, 709C, and 929A; Fig.1). Hole 1237B (ODP Leg 202, 16°0.421'S, 76°22.685'W) is a marginal site located adjacent to Peru in the southeast tropical Pacific Ocean at a water depth of 3212 meters (Shipboard Scientific Party 2003). Hole 709C (ODP Leg 115, 03°54.9'S, 60°33.1'E) is located in the western equatorial Indian Ocean at a water depth of 3038.2 meters (Shipboard Scientific Party 1988). From the tropical western equatorial Atlantic, Hole 929A (ODP Leg 154, 5°58.573'N, 43°44.396'W) is located on the Ceara Rise at a water depth of 4356 meters (Shipboard Scientific Party 1995). The presence of *S. avis* n. sp. is also confirmed in other deep-sea localities (i.e., Gulf of Mexico and near the island of Trinidad; James Bergen, personal communication) and in the northern Taiwan (Huang 1977).

The lithology of the studied interval ranges from nannofossil claystone (Hole 929A) to nannofossil ooze (Holes 1237B and 709C). All holes recovered near complete sequences with no

major hiatuses or unconformities (Okada 1990; Shipboard Scientific Party 1988; Shipboard Scientific Party 1995; Shipboard Scientific Party 2003).

Smear slides were prepared following the procedure of Bown and Young (1998), and were examined with a Zeiss Axioscope II under polarized light at ×1250-1600 magnifications; light micrographs with gypsum plate were taken using an Olympus BX53 microscope equipped with a PAXcam5 digital camera. Scanning Electron Microscopy (SEM) was used to illustrate the fine structure of the new species and to differentiate it from other species. Age-control is based on Oligocene calcareous nannofossil events tied to the time scale of Gradstein et al. (2012).

## SYSTEMATICS

Order DISCOASTERALES Hay 1977

Family SPHENOLITHACEAE Deflandre in Grasse 1952

Genus *Sphenolithus* Deflandre in Grasse 1952

***Sphenolithus avis* Aljahdali, Wise, Bergen and Pospichal, n. sp.**  
Plate 1, figures 1a-d, 2a-d, 3a-d, 4a-f, 5a-b.

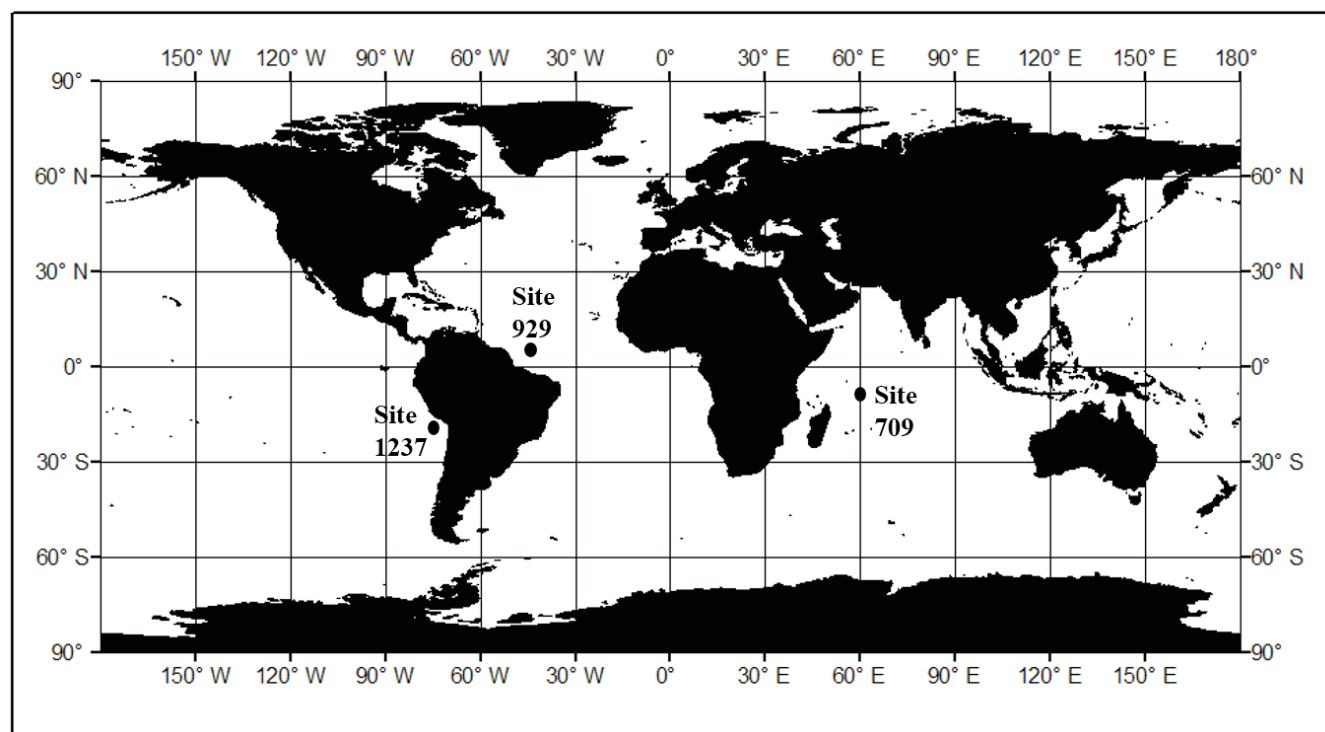
*Sphenolithus ciproensis* ROTH, FRANZ and WISE 1971, p. 1112-1113, Pl. 3, fig. 4. – HUANG 1977, p. 170-171, fig. 7B.  
*Sphenolithus* sp. aff. *S. ciproensis* OKADA 1990, p. 153, Pl. 2, figs. 3, 4.

**Holotype:** Southeast Pacific Ocean, Plate 1, Figure 1a-d.

**Etymology:** from the Latin *avis* (feminine noun) = bird, referring to the bird-like appearance of the outline when observed in side view under the light microscope.

**Diagnosis:** Small to medium (height 4.0-6.5µm) with a short tapered apical spine, and wide flaring proximal basal elements that at the end taper proximally.

**Description:** Under the light microscope (LM), *S. avis* n. sp. has wide flared proximal elements and a large base (feet) along with



TEXT-FIGURE 1  
Location map showing the occurrence of *Sphenolithus avis* n. sp.

a short apical spine. The tips of the basal elements taper proximally and form an arc. Some specimens of *S. avis* are roughly symmetrical with the same height and width, whereas others have a larger width than the height. The apical spine is short, tapered and goes extinct at 30 degrees to the polarizer.

**Remarks:** A Scanning Electron Microscope (SEM) examination of *S. avis* n. sp. reveals large proximal elements and a short apical spine. *Sphenolithus avis*, n. sp. has 10-12 large proximal elements. The apical spine is composed of two slightly offset elements. SEM investigation also shows different views (e.g., lateral, distal and proximal) of *S. avis* n. sp. in which it looks similar to a badminton shuttlecock (Plate 2, Figures 1-6).

**Differentiation:** *Sphenolithus avis* n. sp. is easily distinguished from *S. ciperoensis* and other *Sphenolithus* species by much more flared basal (proximal) elements (Plate 2, Figure 2). The flared base is similar in *S. umbrellus*, but *S. avis* differs from this species by having a short apical spine (Plate 2, Figures 3, 6).

**Holotype size:** Height: 4.33µm and width: 4.33µm.

**Paratype:** Plate 1, Figures 2a-5d, Plate 2, Figures 1-6.

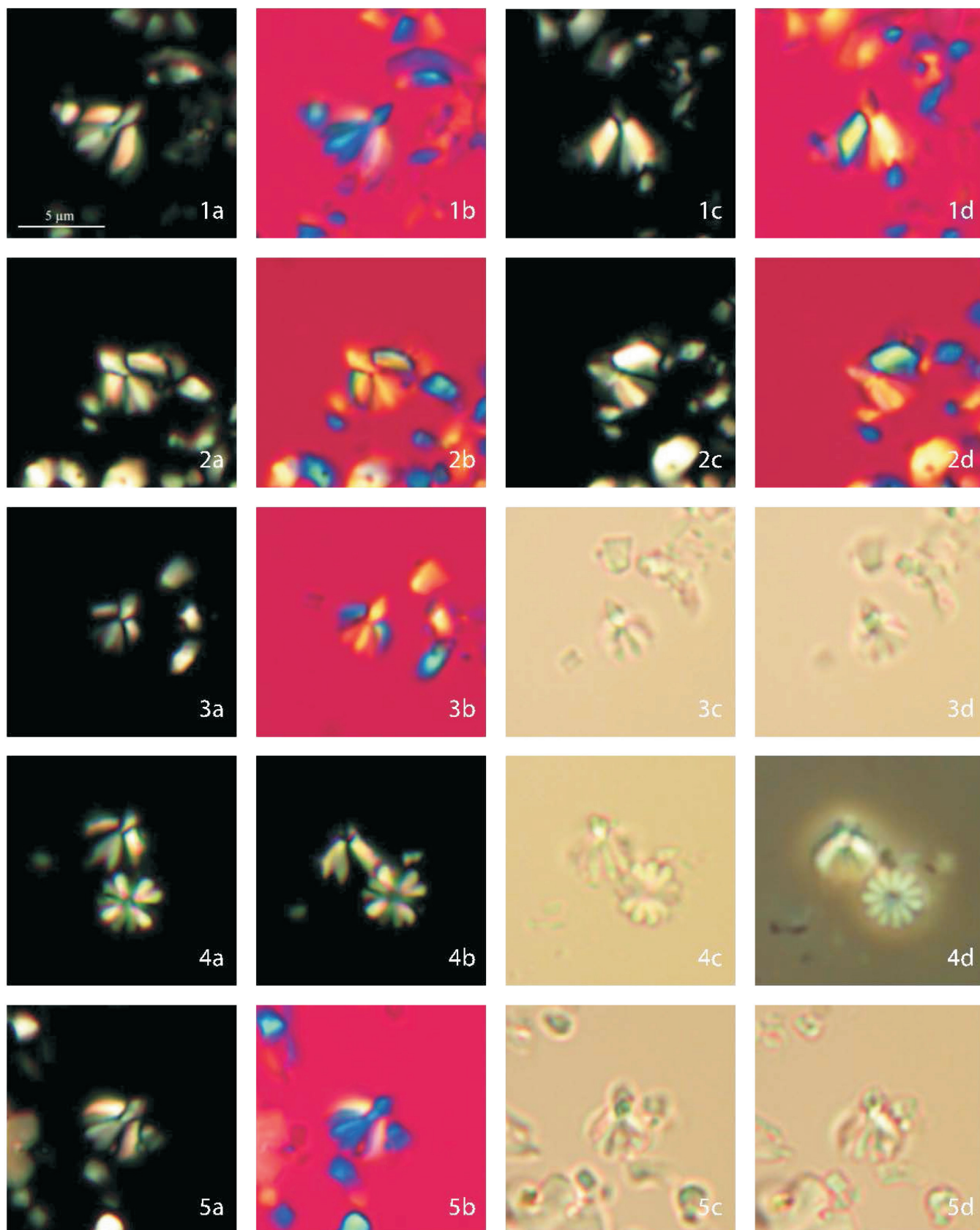
**Type locality:** Southeast Pacific Ocean; ODP Hole 1237B (16°0.421'S, 76°22.685'W).

## PLATE 1

Petrographic microscope images of *Sphenolithus avis* n. sp. Scale bar = 5µm.  
All specimens are lateral view except figure 4 where lower specimen is top view.

- 1a-d Holotype. Sample 1237B-29-7, 48-50cm (271.53 mbsf); a, c, crossed nichols; b, d, gypsum plate.
- 2a-d Paratype. Sample 1237B-29-7, 48-50cm; a, c, crossed nichols; b, d, gypsum plate.
- 3a-d Paratype. Sample 709C-23-1, 98-99cm; a, crossed nichols; b, gypsum plate; c, d, plain light.

- 4a-d Paratype. Sample 709C-23-1, 57-58cm; a, b, crossed nichols; c, plain light; d, phase contrast.
- 5a-d Paratype. Sample 1237B-29-7, 48-50cm; a, crossed nichols; b, gypsum plate; c, d, plain light.





**Type level:** Oligocene (Zone NP25) ODP Sample 1237B-29-7, 48-50cm (271.73 mbsf).

**Stratigraphic range:** Middle Zone NP23 - top Zone NP25.

**Depository:** All slides are deposited at the Department of Earth, Ocean and Atmospheric Sciences at Florida State University, Tallahassee, Florida.

## COMMENTS AND CONCLUSIONS

Okada (1990) illustrated specimens of *S. avis* n. sp. in materials from the western equatorial Indian Ocean at Site 709. In addition, Roth, Franz and Wise (1971) pictured a specimen of *S. avis* via the SEM in samples from the Blake Plateau, Western Atlantic Ocean (plate 3, fig. 4, pp. 1112-1113). However, due to the close similarity with *S. ciperoensis* and because they both co-exist in the same zone (e.g., Zone NP25 Martini 1971), Okada (1990) recorded the species as *Sphenolithus* aff. *S. ciperoensis*, whereas Roth, Franz and Wise (1971) considered it a specimen of *S. ciperoensis*. Okada (1990) reported its occurrence from the base of NP23 to the top of NP25, a range that we could not confirm in our samples despite a relatively tight 50-cm sampling interval. Because our Hole 929A has the lowest abundance of *S. avis* n. sp., the sections from ODP Holes 1237B and 709C revealed the complete range of *S. avis* n. sp. In these holes, the first appearance datum (FAD) of *S. avis* n. sp. was observed near the middle/upper part of Zone NP23 (~29.89 Ma). This precedes the FAD of *S. ciperoensis* (~29.6 Ma), whereas the last appearance datum (LAD) is found at the same level of the LAD of *S. ciperoensis* at the top of Zone NP25 (~24.4 Ma). Another Oligocene species, *Sphenolithus peartiae*, recently described by Bown and Dunkley Jones (2012) from the equatorial region, overlaps *S. avis* n. sp. in Zones NP23-NP24. The FAD of *S. peartiae* is reported at the same level of *S. distentus* (Bown and Dunkley Jones 2012). Because *S. peartiae* shows some similarities with both *S. ciperoensis* and *S. avis* n. sp., small forms of *S. peartiae* with large “feet” in Zone NP23 could be easily misidentified. Therefore, it is possible that Okada (1990) lumped *S. peartiae* (small forms), and *S. avis* n. sp., together into one species.

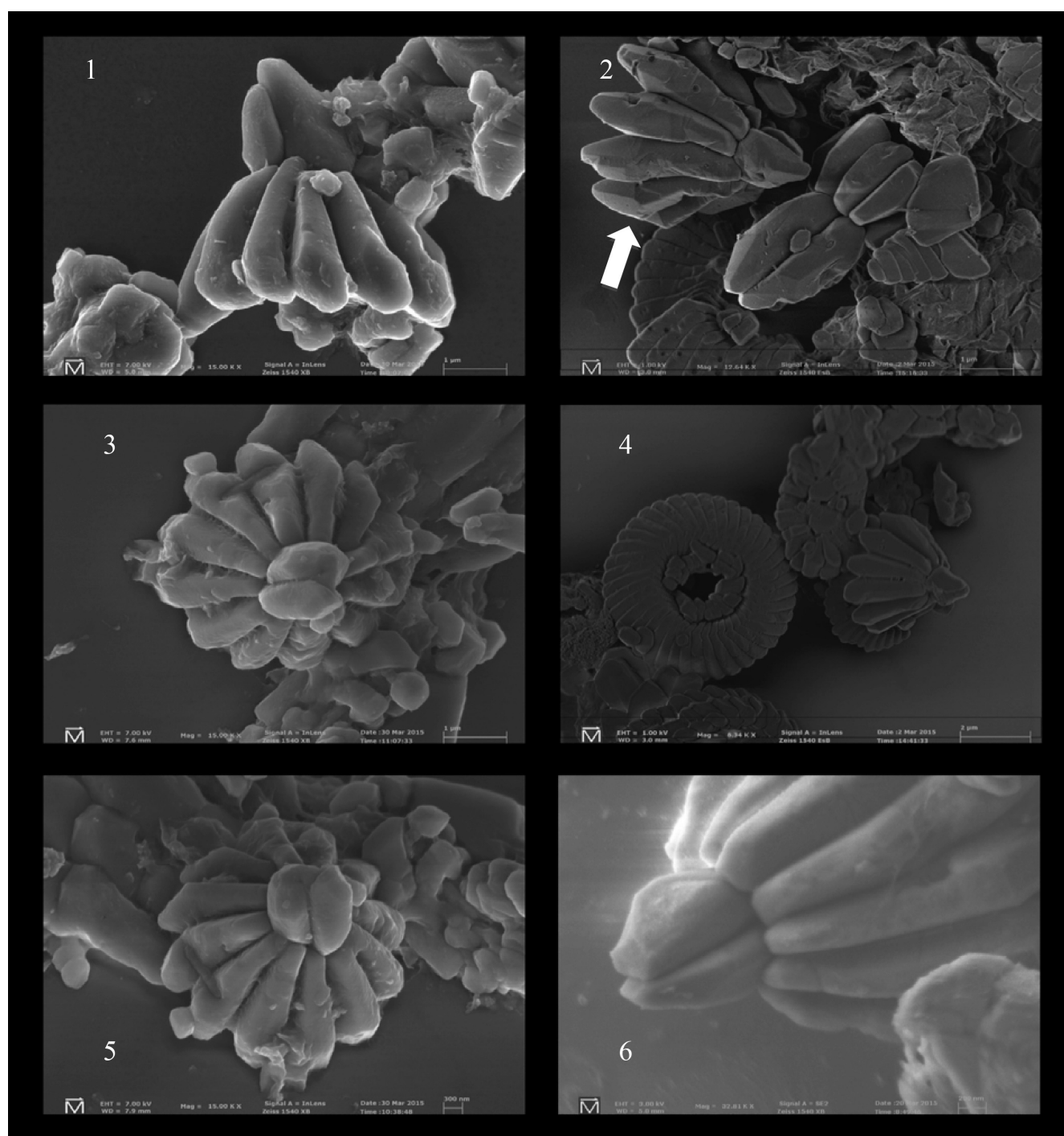
*Sphenolithus avis* is a new distinctive and widely distributed sphenolith species described from the upper Oligocene of the equatorial regions. The range of *S. avis* n. sp. is located from middle/upper part of the Zone NP23 to the top of Zone NP25. Because its FAD precedes the FAD *S. ciperoensis*, *S. avis*, n. sp. could be used as a secondary *Sphenolithus* marker in the upper Zone of NP23.

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# PLATE 2

SEM images of *Sphenolithus avis* n. sp. Scale bar = 1 µm, except in fig. 5 the bar = 300 nm.

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|---|---|
| 1 Paratype; Sample 1237B-29-7, 68-70cm  | 4 Paratype; Sample 709C-23-1, 48-49cm.  |
| 2 Paratype; Sample 709C-23-1, 48-49cm.  | 5 Paratype; Sample 1237B-29-7, 68-70cm. |
| 3 Paratype; Sample 1237B-29-7, 68-70cm. | 6 Paratype: Sample 709C-23-1, 48-49cm   |