NEW EARLY MIocene SPECIES OF SPHENOLITHUS
DEFLANDRE, 1952 FROM THE NORTH ATLANTIC OCEAN

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Introduction

Sphenoliths are key biostratigraphic markers in the Early Miocene (Rio et al., 1990; Fornaciari et al., 1990; Fornaciari & Rio, 1996; de Kaenel & Villa, 1996). We describe herein two new species, Sphenolithus procerus and Sphenolithus tintinnabulum from the Early Miocene sediments of DSDP Leg 82, Site 563 (Bouguet al. et al., 1985), located in the North Atlantic Ocean on the west flank of the mid-Atlantic Ridge.

In the studied cores, the major lithologies are foraminifer-nannofossil ooze and chalk. Preservation of coccoliths is moderate and the assemblages are reasonably diverse. The new taxa were found within cores 15 to 13 in the CN1c and CN2 Zones of Okada & Bukry (1980), equivalent to Zones NN2 and NN3 of Martini (1971). Detailed quantitative biostratigraphic results of the total assemblage at Site 563 will appear elsewhere (Maiorano & Monechi, in prep.).

In this note, the morphological features of S. multispinatus sp. nov. (= S. multispinatus Fornaciari et al. , 1990, nomen nudum), S. cometa de Kaenel & Villa, 1996 and S. disbelemnos Fornaciari & Rio, 1996 have also been described, because of their importance in the evolution of sphenoliths during the Early Miocene. In particular, the taxonomic features of S. multispinatus have been defined. This species has been differentiated from S. cometa based on its different morphology and stratigraphic range (Figure 1).

S. disbelemnos, S. procerus, S. cometa, S. tintinnabulum and S. multispinatus have also been recognised in the equatorial Indian Ocean ODP Site 758, where their stratigraphic distributions appeared comparable with those observed at Site 563 (Maiorano, 1996).

The sphenoliths described herein can be easily differentiated with the light microscope, although they appear to be related by a common feature: they all have the apical spine formed by multiple elements rather than a single unit; however the orientation and extent of the apical elements, as well as the morphology of the proximal shield and its size in relation to the apical spine, are diagnostic for the identification of the species. At present, there is no clear evidence of intergradational morphotypes among the described sphenoliths and no phylogenetic relationships have been inferred here.

Family SPHENOLITHACEAE Deflandre, 1952

Genus Sphenolithus Deflandre in Grassé, 1952

Sphenolithus procerus sp. nov.
Plate 1, Figures 1-3

Diagnosis: A species of Sphenolithus with a short proximal shield and an extended apical spine composed of elements parallel to the long axis of the sphenolith.

Description: In cross-polarised light (XPL), in the 0° position, the apical spine is divided in two by a median extinction band. At the base of the apical spine, a cycle of very short lateral elements can be recognised. At 45° to the polarisation direction, the apical spine shows a three-part arrangement similar to S. dissimilis Bukry & Percival, 1971 and loses the extinction band.

Differentiation: S. procerus differs from S. dissimilis by having a more-developed apical spine instead of an equivalent height between proximal shield and apical spine, and from S. multispinatus by having less divergent elements of the apical spine. It is differentiated from S. cometa by its shorter proximal shield and thinner apical spine.

Size: About 4-6μm long; the proximal shield is about half the height of the apical spine.

Derivation of name: From Latin procerus, slender.

Occurrence: S. procerus has a restricted range within the Early Miocene Zone NN2 of Martini (1971) and Zone CN1c of Okada & Bukry (1980); the first specimens are documented above the first occurrences (F0s) of S. disbelemnos and of S. cometa. It ranges up to the upper part of Zone NN2, above the last occurrence (LO) of S. cometa.

Holotype: Plate 1, Figure 3, DSDP Site 563, 14-6-120cm.

Type locality: DSDP Site 563, North Atlantic Ocean.

Range: Early Miocene, Zone NN2.
**Sphenolithus tinctinnabulum** sp. nov.
Plate 1, Figures 4-6

**Diagnosis:** A species with a distinctive triangular outline and a very short and multipartite apical spine.

**Description:** The proximal shield is both wider and higher than the apical spine. When oriented at 45° to the polarisation plane, a very short apical spine is visible, sometimes showing a three part arrangement. It shows intermediate characteristics between *S. disbelemnos* and *S. belemnos*; the apical spine is similar to the former and the proximal shield to the latter.

**Differentiation:** *S. tinctinnabulum* differs from *S. disbelemnos* by its distinctive triangular outline and wider proximal shield. It is differentiated from *S. belemnos* Bramlette & Wilcoxon, 1967 by the multispine structure and the length of the apical spine.

**Size:** About 2-4μm long.

**Derivation of name:** From Latin *tinctinnabulum*, small bell.

**Occurrence:** The species is recorded in the upper part of Zone CN1c and in the CN2 Zone. First occurrences of *S. tinctinnabulum* have been documented in the upper part of Zone NN2; the species partly co-occurs with *S. belemnos* and highest occurrences are recorded slightly above the LO of *S. belemnos*.

**Holotype:** Plate 1, Figure 4, DSDP Site 563, 13-3-120cm.

**Type locality:** DSDP Site 563, North Atlantic Ocean.

**Range:** Upper Zone NN2 and Zone NN3.

**Sphenolithus multispinatus** sp. nov.
Plate 1, Figures 14-16

*Sphenolithus multispinatus* Fornaciari *et al.*, 1990, p.254, pl.3, figs 1-3 (nomen nudum).

**Diagnosis:** A species of *Sphenolithus* with a short, wide proximal shield and a divergent apical spine.

**Description:** This sphenolith is characterised by a triangular proximal shield which is about half the height of the apical spine. In XPL, in the position of the proximal elements, which are parallel to the long axis of the sphenolith, and the very short and multipartite apical spine, which is about half the height of the proximal shield, *S. multispinatus* differs from *S. belemnos* by having a shorter and multipartite apical spine and parallel sides to the proximal shield. It differs from *S. disbelemnos* by having a narrower proximal shield and shorter apical spine, and from the similar *S. tinctinnabulum* by the wider proximal shield.

**Range:** At Site 563, *S. disbelemnos* first occurs in the uppermost NN1 Zone and ranges up to the lower part of NN3.

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**References**


Figs 1-3: Sphenolithus procerus sp. nov. DSDP Site 563, 14-6, 120cm. 1. XPL 0°; 2. XPL 45°. 3. Holotype SEM; Neg. DGG95-14.

Figs 4-6: Sphenolithus tintinnabulum sp. nov. DSDP Site 563, 13-3, 120cm. 4. Holotype SEM; Neg. DGG95-12. 5. XPL 0°; 6. XPL 45°.

Figs 7-8: Sphenolithus disbelemnos Fornaciari & Rio. DSDP Site 563, 14-7, 35cm. 7. XPL 0°; 8. XPL 45°.

Figs 9-10: Sphenolithus dissimilis Bukry & Percival. DSDP Site 563, 16-4, 120cm. 9. XPL 0°; 10. XPL 45°.

Figs 11-13: Sphenolithus cometa de Kaenel & Villa. DSDP Site 563, 14-6, 120cm. 11. SEM. 12. XPL 0°; 13. XPL 45°.

Figs 14-16: Sphenolithus multi spinatus sp. nov. DSDP Site 563, 12CC, 8cm. 14. Holotype SEM; Neg. DGG94-12. 15. XPL 0°; 16. XPL 45°.