Proposal for the Ericiolaceae (Prymnesiophyceae, Haptophyta) fam. nov.

Odysseas A. Archontikis*
Department of Earth Sciences, University of Oxford, South Parks Road, Oxford OX1 3AN, UK; odysseas.archontikis@univ.ox.ac.uk
Department of Earth Sciences, The Natural History Museum, Cromwell Road, London SW7 5BD, UK

Helge A. Thomsen
Technical University of Denmark, National Institute of Aquatic Resources (DTU Aqua), Kemitorvet, Building 201, DK-2800 Kgs. Lyngby, Denmark

K. J. Sebastian Meier
Institut für Geowissenschaften, Christian-Albrechts-Universität zu Kiel, Ludewig-Meyn-Str. 10, 24118 Kiel, Germany

Jeremy R. Young
Department of Earth Sciences, University College London, London WC1E 6BT, UK

*Corresponding author

Manuscript received 13 July 2023; revised manuscript accepted 24 October 2023
Available online 16 February 2024
DOI: 10.58998/jnr3470
This is an open access article licensed under the Creative Commons Attribution 4.0 International (CC BY 4.0) license (https://creativecommons.org/licenses/by/4.0/).

Abstract The extant nannolith-bearing genera Ericiolus and Pileolosphaera are distinguished by the possession of triradiate nannoliths with a very similar and highly distinctive structural pattern. The nannoliths display three symmetrically arranged rays that develop from a nannolith center but show no obvious affinities to any other currently known extant coccolithophore. On this basis, we propose the establishment of a new family, Ericiolaceae fam. nov., to accommodate Ericiolus and Pileolosphaera.

Keywords Coccolithophore, Ericiolus, Pileolosphaera, systematics

1. Introduction
The nannolith-bearing genera Ericiolus Thomsen emend. Archontikis & Young and Pileolosphaera Meier, Kinkel, & Young are taxonomically ambiguous and, at present, informally classified as ‘nannolith incertae sedis’ (Archontikis et al., 2023; Young et al., 2023). Both genera include species with monomorphic and monothecate coccospheres showing one type of triradiate nannoliths. Ericiolus, as recently revised by Archontikis et al. (2023), is used as a broad but coherent taxonomic group of at least eight morphologically different species: Ericiolus spiculiger Thomsen, E. frigidus Thomsen, E. aspiphorus (Thomsen & Østergaard) Archontikis & Young, E. multistellatus (Thomsen & Østergaard) Archontikis & Young, E. pusillus (Thomsen & Østergaard) Archontikis & Young, E. bendifii Archontikis, Millán, Winter, & Young, E. mattioliae Archontikis, Millán, Winter, & Young, and E. shelдонiae Archontikis, Millán, Winter, & Young (Figure 1), with a wide biogeographical range, having been recorded in polar surface waters and the lower photic zone of subtropical environments (Thomsen et al., 1995; Thomsen & Østergaard, 2015; Archontikis et al., 2023). Conversely, Pileolosphaera is a monospecific genus. Its type species, P. longistirpes Meier, Kinkel, & Young, was described from the surface waters of the southwestern Baltic Sea (Meier et al., 2014), whilst occurrences of the species are also reported from the northwestern Pacific Ocean, the Irish and North Seas (Tanimoto et al., 2003; Meier et al., 2014), and the Adriatic Sea (Cerino et al., 2017; Godrijan et al., 2023).

2. Discussion
As discussed in Archontikis et al. (2023), nannoliths of Ericiolus and Pileolosphaera are structurally closely related showing three-fold symmetry and a radial growth of elements (Figure 1) developing from the nannolith center rather than a rim. In Ericiolus, the nannoliths are remarkably small and can have either a) three radiating elements arranged parallel to the cell surface; b) four radiate elements with three of them parallel to the cell surface and one perpendicular to it; or c) three radiating units that
bifurcate and a distally oriented fourth element that develops into a central elongate spine with a terminal knob or a calyx (see Archontikis et al., 2023 for extended discussion). The nannoliths in *Pileolosphaera* similarly show three radiating elements that are parallel to the cell surface, and a central spine formed of three blades (Meier et al., 2014). Meier et al. (2014) showed via light microscopy observations that nannoliths of *Pileolosphaera* are composed exclusively of V-units and, therefore, have similar crystallographic properties to the nannoliths of the extinct genus *Discoaster* (Discoasteraceae, Discoasterales). Archontikis et al. (2023) further suggested potential affinities of both *Pileolosphaera* and *Eriiciolus* with the genus *Discoaster* on the grounds of all being characterised by a similar pattern of ray development and by similar morphology. *Discoaster* is an extinct genus; however, its last representatives only disappeared in the early Quaternary, ~1.8 million years ago. Although we do not have a fossil record for *Eriiciolus*, given the current diversity within the genus, it would be reasonable to predict that it evolved some time ago. Therefore, evolution from the genus *Discoaster* is not inconceivable.

While nannoliths of *Pileolosphaera* are noticeably larger than those of *Eriiciolus* (~3.0–4.0 µm versus 0.2–1.3 µm) and there are considerably fewer of them (6–8 versus 30–70) on the coccosphere (Meier et al., 2014; Archontikis et al., 2023), the similarity in nannolith structure and ray development (Plates 1 and 2) is notable and suggestive of a close taxonomic relationship between the two genera. This feature is also highly distinctive and further suggests a clear separation of *Eriiciolus* and *Pileolosphaera* from all other groups of living coccolithophores. As a result, we propose the establishment of a new family, Eriiciloaceae fam. nov., to accommodate *Eriiciolus* and *Pileolosphaera*. This principle has previously been followed by Jordan & Young (1990) and Andruleit & Young (2010).

**Figure 1**: Schematic representation (not to the same scale) and diagnostic morphological features (three-fold symmetry, radial growth of elements) for all currently known members within the Eriiciloaceae fam. nov.
who, respectively, erected and expanded the family Papposphaeraceae Jordan & Young (1990) emend. Andruleit & Young (2010) for the analogous cases of the genera Papposphaera and Pappomonas, as well as Picarola, Vexillarius, and Katuspinifera based on a set of shared morphological features. However, molecular genetic analyses are currently unavailable for the Ericiolaceae to help elucidate familial-level phylogenetic relationships; therefore, we suspend taxonomic treatment at an ordinal level.


Family ERICIOLACEAE fam. nov.

Plates 1, 2

Diagnosis: Coccosphere monothecate and monomorphic consisting of nannoliths with three-fold symmetry. The nannoliths show three radiating elements that develop from the nannolith center.

Type genus: Ericiolus Thomsen in Thomsen et al. (1995, p. 30) emend. Archontikis & Young in Archontikis et al. (2023)

Type species: Ericiolus spiculiger Thomsen in Thomsen et al. (1995)

3.1. Taxonomic Appendix

No new formal taxonomy is proposed. Here we include the recommended terminology for all currently known extant taxa within the Ericiolaceae.

Genus Ericiolus Thomsen in Thomsen et al. (1995) emend. Archontikis & Young in Archontikis et al. (2023)

Type species: Ericiolus spiculiger Thomsen in Thomsen et al. (1995)

Eriocilus spiculiger Thomsen in Thomsen et al. (1995)
Plate 2, fig. 7

Eriocilus frigidus Thomsen in Thomsen et al. (1995)
Plate 2, fig. 4

Eriocilus aspiphorus (Thomsen & Østergaard, 2015)
Archontikis & Young in Archontikis et al. (2023)
Plate 2, fig. 4

Eriocilus multistellatus (Thomsen & Østergaard, 2015)
Archontikis & Young in Archontikis et al. (2023)
Plate 2, fig. 6

Eriocilus pusillus (Thomsen & Østergaard, 2015)
Archontikis & Young in Archontikis et al. (2023)
Plate 2, fig. 8

Eriocilus bendifii Archontikis et al. (2023)
Plate 1, fig. 1; Plate 2, fig. 2

Eriocilus mattioliae Archontikis et al. (2023)
Plate 2, fig. 3

Eriocilus sheldoniae Archontikis et al. (2023)
Genus *Pileolosphaera* Meier et al. (2014)

**Type species:** *Pileolosphaera longistirpes* Meier et al. (2014)

*Pileolosphaera longistirpes* Meier et al. (2014)  
Plate 1, fig. 2; Plate 2, fig. 1

**Disclosure Statement**  
At least one of the authors is a member of the editorial board of *Journal of Nannoplankton Research*. The peer-review process was guided by an independent editor, and the authors also have no other competing interests to declare.

**Acknowledgements**  
We are thankful to Jon Schueth, Kyoko Hagino, and an anonymous reviewer for their careful reviews. We also thank Denise Kulhanek for providing a high resolution image of Plate 2, Figure 5 and her editorial assistance. The micrographs illustrated in Plate 2, Figures 7 and 8 have been included with the kind permission of *Acta Protozoologica* and Jagiellonian University, while Plate 2, Figure 5 is reproduced with the permission of the International Ocean Discovery Program. This work was supported by the UK Natural Environment Research Council [grant number NE/S007474/1] to Odysseas A. Archontikis.

**References**


