

Ultrastructure and taxonomy of the Family Fasciculithaceae

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The Family Fasciculithaceae are a group of Paleogene coccolith species with cylindrical, conical or discoidal coccoliths comprising several vertically stacked cycles of elements radiating from a central point. We will describe the ultrastructure and high-level taxonomy in detail. In plan view, the cycles are strictly circular, and vary in height and width. The lowest cycle is the column, the base of which is interpreted to be the proximal surface of the coccolith. Above the column, a cycle of variable height and width is termed the lateral cycle. Above the lateral element cycle, is the highest cycle, termed the cone cycle. The upper surface of the cone cycle is interpreted to be the distal surface of the coccolith. Genera and species are differentiated by varying proportions and shapes of the three cycles. This basic ultrastructure is shared among species and genera in the Family Fasciculithaceae. The genera included here are *Gomphiolithus*, *Lithoptychius*, *Fasiculithus*, *Bomolithus*, *Tectulithus* and *Heliotrochus*.

The genus *Heliolithus* has often been included in the Fasciculithaceae. Two vertically stacked circular cycles are present, which flare outwards. Neither of these cycles is interpreted here as being a column. *Heliolithus* is probably derived from *Bomolithus* or *Tectulithus* through loss of the column, which would make the two cycles homologous to the lateral and cone cycles of fasciculithids. It is difficult to assign either of the two cycles in *Heliolithus* to either the lateral or cone cycles of fasciculithids with any certainty. Because of this uncertainty in the exact relationship between *Heliolithus* and the fasciculithids, species of *Heliolithus* are assigned to the Family Heliolithaceae.