

# The haploid coccolithophore

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It is well known that coccolithophores have a haploid-diploid life cycle, with both phases well represented in most species, and also that each phase is characterized by structurally distinct coccoliths. For a multitude of reasons, the coccoliths produced during the diploid phase are central to the study of various aspects of Earth history, so that the diploid coccolithophore is reasonably well known. In contrast, only limited information has been available for its haploid counterpart, which, when capable of mineralization, forms holococcoliths and cryptoliths. A compilation of the characters of living species in the haploid phase resulted in (1) a qualitative and quantitative analysis that looked for morphologic/structural commonality during this phase in relation to taxonomy, and (2) a comparison between the diploid and haploid phases in the same taxa. Perhaps unexpectedly, this has revealed a morphologic organization as rigid during the haploid phase as during the diploid one, albeit in a subtler manner. For

instance, the arrangement of crystallites (fabric) in modern holococcoliths is characteristic at the rank of genus, family, or order depending on the taxa that are considered. Together with other characters, this allows consistent delineation among living coccolithophores of the same taxonomic groups as those delineated with heterococcoliths. This then can be extended to the fossil record, so that, based on fabric, size, and occurrences, it becomes possible to reconstruct the life cycles of extinct coccolithophores. A systematic comparison between extinct and modern holococcoliths reveals that the haploid coccolithophore exhibits the same evolutionary trends as the diploid organism, in particular with regard to size. It also implies a distinctive adaptive strategy of the haploid coccolithophore to life in oligotrophic waters. Most interestingly perhaps, this adaptive strategy would also seem to have been that which diploid coccolithophores of the Order Discoasterales developed.