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Late Miocene coccolithophore (r)evolution

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Cell geometry and size strongly determine the physiology of unicellular algae, whilst also affecting their ecological and evolutionary patterns. This study explores the potential long-term evolutionary forcing mechanisms on unicellular calcifying algae, the coccolithophores. A variety of passive and active selection pressures likely influence this important group of marine phytoplankton, such as resource availability and climatic change. Coccolithophorid cell size – as reconstructed from individual fossil coccolith biometry – was determined for three major coccolithophore families (the Noelaerhabdacaea, Calcidiscaceae and Coccolithaceae) from multiple Deep Sea Drilling Project and Ocean Drilling Project sites covering temperate to tropical regions in the Atlantic, Indian and Pacific oceans.

An overall macroevolutionary size decrease in coccolithophores during the Cenozoic is punctuated by distinct size decreases and biogeographic marginalization of major taxa in the late Miocene. This time period is characterized by several major biotic revolutions, notably the rise to dominance of C-4 plants on land and extensive ‘biogenic blooms’ in the sea. Despite distinct regional ecologic responses at each site, striking correspondences within the global data set call for a global forcing mechanism on the size evolution and ecological success of coccolithophores in the Neogene ‘icehouse’ world.