

MORPHOMETRICS OF THE PALEOCENE COCCOLITH GENERA
CRUCIPLACOLITHUS, *CHIASMOLITHUS* AND *SULLIVANIA*: A COMPLEX
EVOLUTIONARY HISTORY

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Investigation of the evolution of calcareous nannoplankton is hindered by the extremely small size (5-10 μm) of their fossils. We introduce new technology, a scanning electron microscope connected to an image analysis system (SEM-IAS) which allows this field to be explored as never before. This system enables a host of morphocharacters to be measured and included in studies of phylogeny and evolutionary dynamics. We have applied the SEM-IAS to study the evolution of Paleocene coccolith genera *Cruciplacolithus*, *Chiasmolithus* and *Sullivania*. A variety of detailed measurements have been made on over 4000 coccoliths from Deep Sea Drilling Project Site 384 in the temperate North Atlantic and Ocean Drilling Program Site 690 in the Weddell Sea off Antarctica. Our results indicate no simple relationships between morphocharacters, the shapes of all three genera are both complex and highly variable. Although most morphocharacters possess little phylogenetic significance, the areas of different shield cycles show gradual divergence between *Chiasmolithus* and *Sullivania* through the Paleocene. Change of most other morphocharacters occurs at variable rates and reversals in trends are common. Minimal correlation exists between the trends and oscillatory shape changes observed at the two sites. Little correlation is observed between morphocharacter evolution rate and stable isotopic records of temperature change, with the exception of one interval of more rapid evolution at Site 690 which appears to correlate with a time of rapid warming. We conclude that these trends and oscillations represent local, transitory ecophenotypic variation of the complex form. There is little stasis in the 10 million year record studied.