Size-fraction coccolith stable isotopes and Sr/Ca from the Miocene to Recent

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The preservation of coccoliths in marine sediments makes them an excellent recorder of surface ocean environmental change through geologic time. Geochemical analyses of coccolith-rich sediment fractions have recently been the basis for determining biotic responses to paleoenvironmental change, most notably through $\delta^{13}C$ stable isotopic analysis of coccolith size-separated microfractions. A marked isotopic divergence, also known as vital effects, in coccolith $\delta^{13}C$ between small (<4 µm), lightly calcifying forms (e.g., *Gephyrocapsa oceanica* and *Emiliania huxleyi*) and large (~7–10 µm), heavily calcifying forms (*Calcidiscus leptoporus* and *Coccolithus pelagicus*) is noted in extant species in culture studies. This effect originated during the Late Miocene (7–5 million years ago) and has been linked to a decline in atmospheric CO_2, causing a reallocation of carbon from calcification to photosynthesis in the coccolithophore cell during coccolithogenesis that particularly affected larger cells.

To investigate how these isotopic divergences may have been influenced by climatic events and nannofossil evolutionary changes, we generated a long-term record of coccolith geochemistry, including oxygen and carbon isotopes and strontium/calcium, from the Miocene to Recent (~10 to 0.1 million years ago). All samples that capture the emergence of these vital effects come from International Ocean Discovery Program (IODP) Site U1482 (Expedition 363) on the northwest Australian continental margin. A further high-resolution record from the same site was generated that spans the Pliocene–Pleistocene transition (3.01 to 1.38 million years ago). A novel technique allows for the rapid separation of coccolith-rich sediments into very fine and very coarse fractions, allowing for the generation of high-resolution size-specific coccolith geochemistry records over the two time periods. Further honing of this method will enable the further use of coccolithophore isotopes, particularly when paired with the alkenone CO_2 proxy, which would allow us to study coccolithophore carbon limitation through time.