Response of the coccolithophore *Calcidiscus leptoporus* to environmental change during the industrial era in the Subantarctic Southern Ocean

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The Southern Ocean plays a vital role in global thermohaline circulation and serves as a significant sink for anthropogenic CO_2. However, the physical and chemical properties of its surface waters are undergoing rapid and unrelenting transformation. The rate of warming in Southern Ocean waters surpasses that of the overall ocean, and increased CO_2 absorption leads to reduced pH levels and decreased carbonate ion concentration, a phenomenon known as ocean acidification. This significant change in marine water characteristics poses a serious threat to general marine ecosystems and particularly to calcifying marine organisms.

Coccolithophores are the most abundant group of marine calcifying phytoplankton, and they are substantial contributors to pelagic production of particulate organic and inorganic carbon. Satellite observations suggest that extensive coccolithophore blooms develop in the Subantarctic circumpolar zone during the austral summer. Therefore, alterations in coccolithophore composition and calcification may have crucial implications for Southern Ocean marine ecosystems and ocean chemistry, ultimately affecting climate change. In this study, we compared the morphometric features of the coccoliths produced by *Calcidiscus leptoporus* across different time scales. Specifically, we analyzed coccolith occurrences that spanned the Holocene Epoch during an annual cycle by making sediment trap collections of underlying sediments and obtaining a sediment core. Our findings indicate that the variability of some morphological parameters of *C. leptoporus* coccoliths has a significant correlation with changes in carbonate chemistry. Extrapolation of our observations suggests that a future reduction in cell and coccolith size will have a negative impact on the efficiency of the biological pump in the Southern Ocean through a reduction of carbonate ballasting.