Gephyrocapsa physiology over the past 400ka

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Gephyrocapsa species, some of the most common coccolithophores in the modern ocean, especially in tropical, nutrient replete coastal and upwelling waters, had distinct morphotypes throughout the Pleistocene that can be used to reconstruct paleo-sea surface temperatures and atmospheric CO_2 concentrations. The physiological effects (calcification and photosynthesis) on the carbon and oxygen fluxes through cellular membranes and their isotope fractionation between organic and inorganic carbon were also considered. For alkenone based pCO_2 reconstructions, the physiology of Noelaerhabdaceae depends upon the "b" value, and it is calibrated with cell size surface area and volume ratio, which is probably linked to coccolithophore growth conditions. In different ecological niches, *Gephyrocapsa* morphotypes have different physiological processes. We investigated *Gephyrocapsa* over the past 400ka in a west Pacific core (157˚58.91'E, 01˚25.0'S, depth: 1897m) that had well-preserved coccoliths in order to observe physiological variance with respect to glacial-interglacial cycles. The physiology should also be reflected in the changes from *Gephyrocapsa caribbeanica* to *Gephyrocapsa oceanica*, which may be important for calibrating "b" values for alkenoe-CO_2 methodology over the several hundred ka during which paleo-pCO_2 was recorded in ice bubbles.

The degree of coccolith calcification was determined from morphological parameters (shield thickness, length, and area) observed with polarized light. The photosynthesis intensity of *Gephyrocapsa* was evaluated with ^{13}C and ^{18}O isotopes, which previous studies have shown are linked to growth rates. A recent study showed that the isotopic composition of the cellular carbon pool, utilized by calcification, is greatly controlled by the strength of Rayleigh fractionation around the chloroplast, namely the photosynthesis intensity. Coccolith isotopic analyses need nearly mono-specific samples. *Gephyrocapsa* coccoliths were isolated using the different sinking velocities of varying-sized coccoliths. Sediments were first suspended in flasks, and the upper ~6cm of the water column was piped out, removing *Florisphaera profunda* and small placoliths (<2.5μm) after ~16 hours standing (7–9 repeats) at 20°C. Then ~6cm of the water column was extracted (2 hours standing, 2 repeats) and filtered on 3μm pore-sized polycarbonate membranes. The preliminary results are shown in Figure 1.

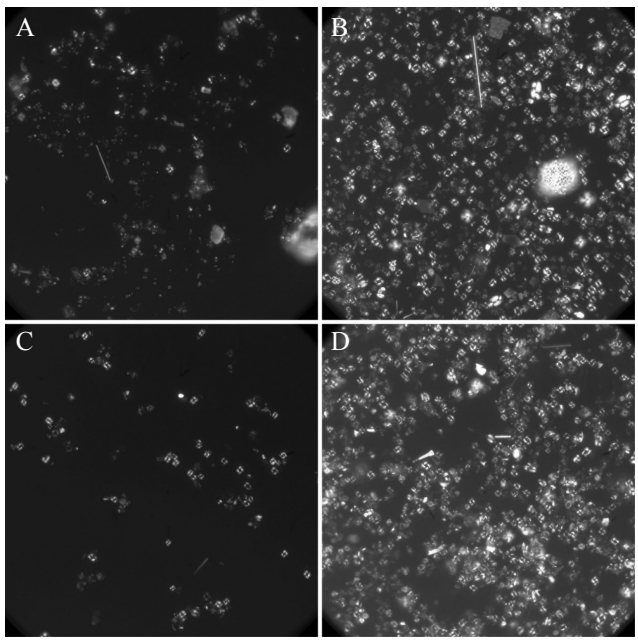

Figure 1: (A) Untreated samples with ~60% *Florisphaera profunda* relative abundance; (B) Treated samples using the first procedure and *Florisphaera profunda* <5%; (C) Second procedure to remove large particles for optical analysis; (D) Refined *Gephyrocapsa* coccoliths on membranes for isotopic analysis