Supplement to: Parallel between the isotopic composition of coccolith calcite and carbon levels across Termination II: Developing a new paleo-CO_2 probe

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1. Age model for site MD95-2037 over Termination II

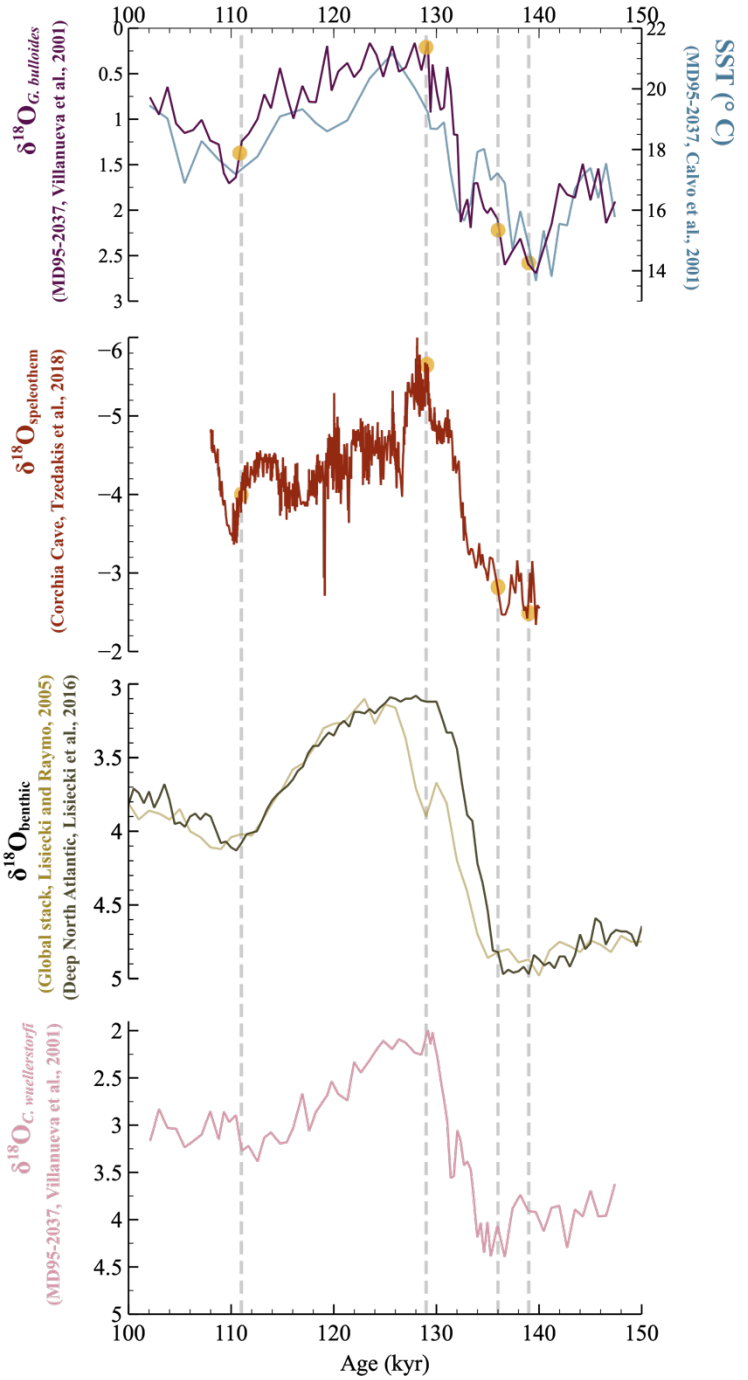

Figure S1: Synchronizing the MD95-2037 Termination II $\delta^{18}O_{planktonic}$ record with speleothem $\delta^{18}O$ records. We first aligned the *Cibidoides wullerstorfi* $\delta^{18}O$ signal of site MD95-2037 (Villanueva et al., 2001) to the Regional Deep North Atlantic $\delta^{18}O$ Benthic Stack (Lisiecki and Stern, 2016) for the first order trends. The age model around Termination II was refined by aligning the $\delta^{18}O_{bulloides}$ signal of site MD95-2037 (Villanueva et al., 2001) to the Corchia Cave composite speleothem $\delta^{18}O$ record (Tzedakis et al., 2018). Tie-points are represented as yellow dots. For comparison, we also included the Global Benthic $\delta^{18}O$ Stack (Lisiecki and Raymo, 2005) and SST records for the site (Calvo et al., 2001).

2. Fraction composition and preservation

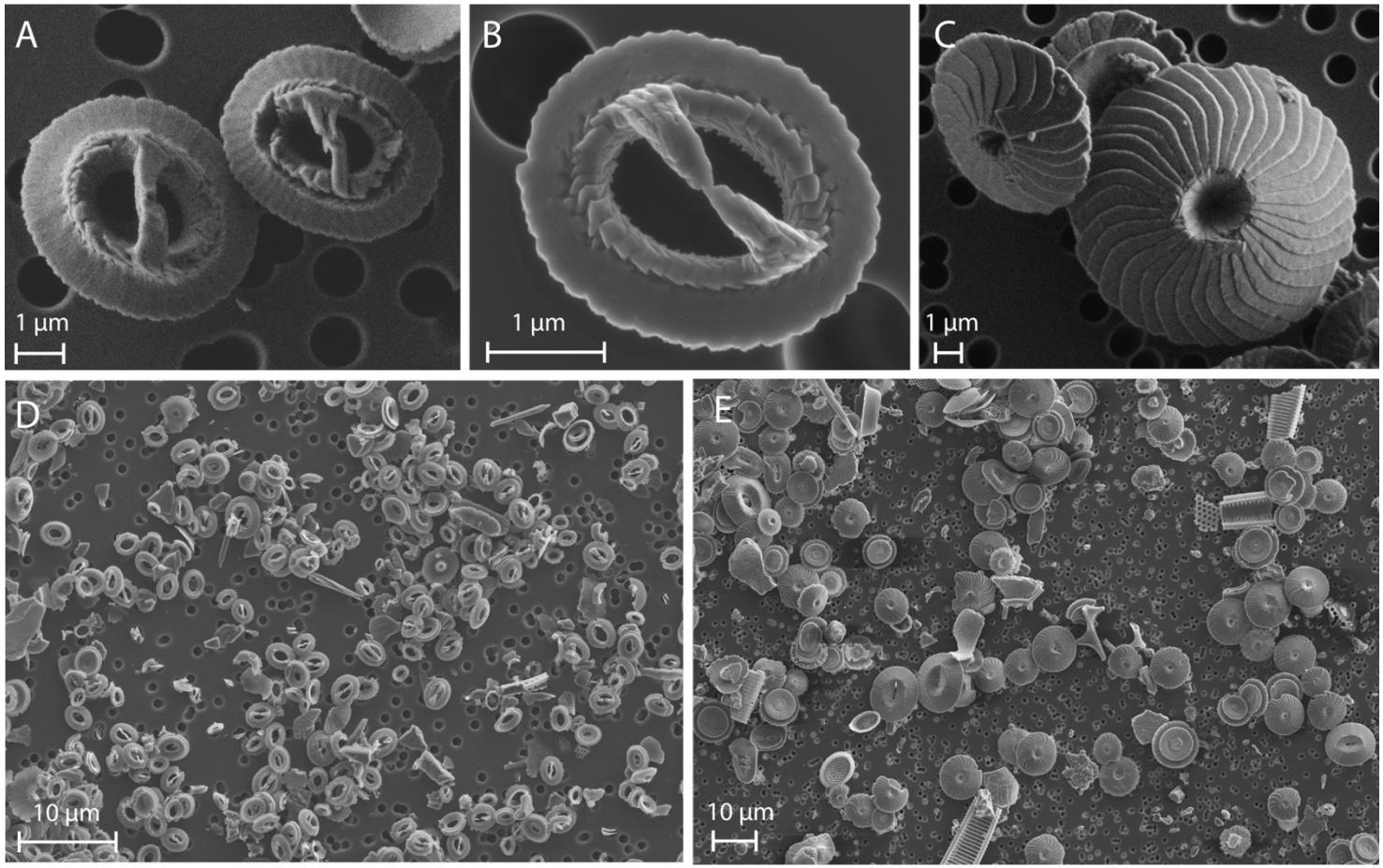

Figure S2: Coccolith close-ups and general views of the purified coccolith assemblages obtained for core MD95-2037 sediments. A: *Gephyrocapsa* sp. coccoliths at 123.5 kyrs (Interglacial). B: *Gephyrocapsa* sp. coccolith at 139.7 kyrs (Glacial). C: *Calcidiscus* sp. coccoliths at 123.5 kyrs (Interglacial). D: *Gephyrocapsa*-dominated 2-3 µm fraction at 110.5 kyrs (Last Glacial Inception). E: *Calcidiscus*-dominated 5-8 µm fraction at 135.9 lyrs (Glacial Maximum). Images were obtained using the SEM at the ISTeP Lab. The coccoliths exhibit slight etching, but no notable calcite overgrowth. The silicic material observed in the assemblages does not contribute to the isotopic signal measured on the sediment fractions.

3. Data used for the Miocene-to-present differential vital effect-CO_2 curve

Published literature provides other examples of the forcing of CO_2 on differential coccolith vital effects. We selected the datasets that provided a differential vital effect between coccolith size classes with similar diameters to those studied in this manuscript. These values are compared to the corresponding pCO_2 records available for the time period. These are translated, using the SST records available for the core location, and a salinity of 33 psu, into concentrations of aqueous CO_2, via the "seacarb" package in R (https:// CRAN.R-project.org/package=seacarb). Error estimates (1SD) for [CO_2] were obtained by running 10,000 Monte Carlo simulations with the following uncertainties: Miocene/Pliocene pCO_2 ± 50 ppm (Zhang et al., 2013), pre-industrial pCO_2 ±10 ppm to account for age uncertainties on core-top material, alkenone-derived SSTs ± 1.2°C (Conte et al., 2006), and a conservative estimate of salinity of ± 1 psu. We listed below the published datasets used to study the response of coccolith differential vital effects to aqueous CO_2 changes since the Miocene:

Table S1: Datasets used to compare the evolution of coccolith differential vital effects and aqueous CO_2 changes since the Miocene.

Differential vital effect datasets	Fraction size and composition	Period, Site location	pCO_2 data	SST data	Site location for SST data
Bolton and Stoll, 2013	2-4 μm (*Reticulofenestra* sp.-rich) and 6-9 μm (*Helicosphaera* sp.-rich)	Pliocene, ODP site 999 (Caribbean)	Zhang et al., 2013	Seki et al., 2010 Alkenone-Uk'	Same as core location
Bolton and Stoll, 2013	2-5 μm (rich in small reticulofenestrids) and 7-9 μm (rich in reticulofenestrids)	Miocene-Pliocene, site 1088 (South Atlantic)	Zhang et al., 2013	Herbert et al., 2016 Alkenone-Uk'	Same as core location
Candelier et al., 2013 (large fraction); Hermoso et al., 2015 (small fraction)	2-3 μm (*Gephyrocapsa* sp.-rich) and 5-8 μm (*Calcidiscus leptoporus*-rich)	Core-top (North Atlantic, Western Indian Ocean)	Pre-industrial 280 ppm value	Hermoso et al., 2015, from WOA13	Same as core location

4. Controls on coccolith differential vital effects

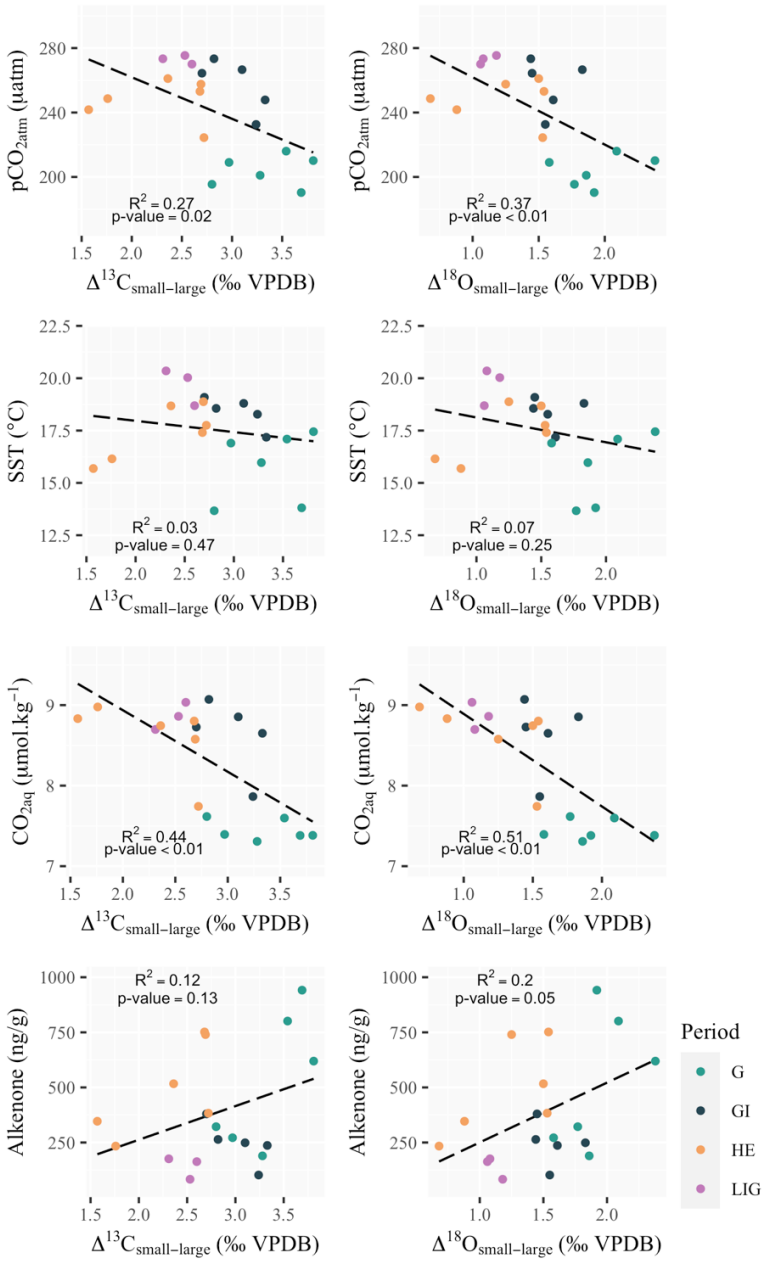

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Figure S3: Environmental controls on coccolith differential vital effects. Data points are coloured according to the time period considered: The Glacial Maximum (green), Heinrich Event 11 (orange), the Last Interglacial (pink) and the Glacial Inception (dark blue). Ice core pCO_2 data is from Bereiter et al., 2015, Sea surface temperature (SST) data are from Calvo et al., 2001 for site MD95-2037, and alkenone concentrations are from Villanueva et al., 2001 for site MD95-2037.

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