

Interactive comment on “Vanishing coccolith vital effects with alleviated CO₂ limitation” by M. Hermoso et al.

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We thank the Referee 1 for her/his prompt evaluation of our manuscript and her/his overall positive opinion of our work. In this Interactive Comment, we aim to clarify and justify the use of ambient aqueous CO₂ concentration in the calculation of the *DCUT* index originally established by Bidigare et al. (1997) and used in our study as a proxy for the degree of utilisation of the internal carbon pool.

We will address the other more minor points raised by this Referee in combination with those from the other Referees, and possibly those of other colleagues, during the Final Response Phase.

C6330

With the *DCUT* index, we are referring to an empirically well-established relationship between ambient [CO_{2aq}] and the magnitude of carbon isotope fraction in phytoplanktonic organic matter, which approximates utilisation of carbon supplied to the cell along with integration of cell geometry (Bidigare et al., 1997). Although this reviewer is correct to point out that CO₂ is the substrate for photosynthetic carbon fixation, and HCO₃⁻ (CO₃²⁻) is the substrate for calcification, the isotopic implications are complicated. In phytoplankton, CO₂ is the *main* source of dissolved inorganic carbon (DIC) acquired by the cells to build-up their internal carbon pool (Riebesell, 2004; Giordano et al., 2005; Reinfelder, 2011; amongst many others). We note that re-equilibration within compartments of contrasting chemistry allows for the interchange of dominant carbon-containing ions. Furthermore, in our experiments to first order, the supply rates of all carbon species to the sites of fixation are proportional to the external CO₂ concentration. A full mechanistic understanding requires explicit modelling, which is beyond the scope of the current paper.

Although a recent successful attempt to apply this index to coccolith calcification exists (Hermoso, 2015), we agree with the Referee that this point needs clarification in our manuscript, since as it is explained, the reader may have the impression that we state that coccolith calcification directly originates from a CO₂ substrate. We will explain more carefully and justify the use of aqueous CO₂ to represent the supply of DIC from the external milieu into the cell as a whole, or to best approximate it, and why we can conform to the authoritative empirical work by Bidigare et al. (1997).

For the purpose of our manuscript, we want to express a bulk estimate for the degree of utilisation of DIC (carbon fixation to DIC supply ratio), and so we plot the dominant original carbon source acquired by the cell, namely CO₂. We already acknowledge in the Discussion Paper the possibility for some strains of *Emiliana huxleyi* to increase the supply of DIC in the form of HCO₃⁻ to circumvent carbon limitation (Kottmeir et

C6331

al., 2014). In our study, we did not impose such limitation, but rather excess DIC with respect to acclimatised ambient DIC level.

Lastly, we would like to add that as the *DCUT* index is a relative quantity, and as the ratio of CO_2 to HCO_3^- was unchanged across all experiments, using CO_2 or HCO_3^- (or even total DIC concentration) makes no difference in our calculations and figures.

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C6332

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C6333