Light-dependent carbon isotope fractionation in the coccolithophorid Emiliania huxleyi

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ABSTRACT: The carbon isotopic composition of marine phytoplankton varies significantly with growth conditions. Aqueous CO_2 concentration [CO_2] and algal growth rate (μ) have been suggested to be important factors determining isotope fractionation (e_p). Here we examine e_p of the coccolithophorid Emiliania huxleyi in relation to CO_2 concentration and light conditions in dilute batch cultures. Cells were incubated at different irradiance cycles, photon flux densities (PFDs), and [CO_2]. Isotope fractionation varied between 6.7 and 12.3‰ under 16 : 8 h light : dark cycle (L :D) and between 14.7 and 17.8‰ at continuous light. e_p was largely independent of ambient [CO_2], varying generally by less than 2‰ over a range of [CO_2] from 5 to 34 mmol L^{-1}. Instantaneous carbon-specific growth rates (μC) and PFDs, ranging from 15 to 150 mmol m^{-2} s^{-1}, positively correlated with e_p. This result is inconsistent with theoretical considerations and experimental results obtained under constant light conditions, suggesting an inverse relationship between e_p and μ. In the present study the effect of PFDs on e_p was stronger than that of mand thus resulted in a positive relationship between μ and e_p. In addition, the L:D cycle of 16 : 8 h resulted in significantly lower e_p values compared to continuous light. Since the observed offset of about 8‰ could not be related to daylength dependent changes in μ_c, this implies a direct influence of the irradiance cycle on e_p. These findings are best explained by invoking active carbon uptake in *E. huxleyi*. If representative for the natural environment, these results complicate the interpretation of carbon isotope data in geochemical and paleoceanographic applications.

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