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Coccolithophore growth, chemistry and calcification under decoupled ocean carbonate chemistry

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Excess anthropogenic atmospheric CO_2 is absorbed largely by the oceans, causing acidification of the biologically productive surface waters with potential detrimental effects on marine biocalcification (The Royal Society, 2005). Despite the intracellular nature of coccolithophore calcification, previous experimental work confirmed that some (but not all) modern coccolithophores decrease calcification as pCO_2 increases. However, from these culture experiments, it has been impossible to determine which carbonate system parameter is fundamental to coccolithogenesis across different species of coccolithophore because the DIC is fixed and the carbonate saturation state and pH are inversely proportional to pCO_2. Additionally, these culture scenarios do not accurately capture the chemistry of the modern evolving ocean where increasing pCO_2 drives a decrease in ocean pH but also an increase in dissolved inorganic carbon (DIC). Our aim was to decouple the pH from the DIC in culture experiments of three species: *Emiliania huxleyi*, *Gephyrocapsa oceanica* and *Coccolithus braarudii (pelagicus)*, representative of two distinct phylogenetic orders and major families of coccolithophore, in order to disentangle which carbonate system parameter is crucial for calcification and develop a mechanistic view of coccolithophore response to elevated pCO_2.

Cultures were grown in North Sea water, under a constant pH of 8.13 ± 0.02, but with manipulated dissolved inorganic carbon (DIC) concentrations to represent surface wa-

ter conditions ranging from the last glacial maximum to $\sim$5 times pre-industrial pCO_2. Our results confirm that there are strong species-specific responses and potentially fundamental differences in physiology between *E. huxleyi* and $G.$ *oceanica* on the one, and *C. braarudii* on the other hand. At pH 8, algal growth rates, cell size and calcite production by *E. huxleyi* and *G. oceanica* remained unaffected by large increases in carbonate ion and DIC. By contrast, *C. braarudii* showed drastically lowered growth rates, significantly smaller cell and coccosphere diameters as well as coccolith malformation, under highly elevated carbonate ion and DIC. Due to the distinct isotopic composition of bicarbonate and carbonate ions, the isotopic composition of coccolithophore calcite could provide additional information on the physiological pathway of calcification. Both δ^{13}C and δ^{18}O of *G. oceanica* remained constant across all culture treatments. But the isotopic composition of *C. braarudii* was significantly depleted under low carbonate ion and DIC conditions, most likely as a result of kinetic controls at the higher growth rates under these conditions. *G. oceanica* therefore appears to respond primarily to pH, and *C. braarudii* to carbonate ion. This contrasting behaviour likely reveals fundamentally different physiological pathways of carbon metabolism and calcification between these two species, which could be reminiscent of adaptation to ambient conditions at the time of evolution of each lineage (Henderiks and Rickaby, 2007).

References

Henderiks, J. and Rickaby, R. E. M.: A coccolithophore concept for constraining the Cenozoic carbon cycle, Biogeosciences, 4, 323-329, 2007.

The Royal Society: Ocean acidification due to increasing atmospheric carbon dioxide, Policy Document 12/05, 60 pp., 2005.