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Biogeosciences Discussions

Interactive comment on "Algal constraints on the Cenozoic history of atmospheric CO_2?" *by* J. Henderiks and R. E. M. Rickaby

Anonymous Referee #3

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Clearly, this is a very interesting paper: it brings new thoughts on the difficult paradox of the higher coccolithophore calcification during high CO2 levels periods. The paper is well written and should be published: BUT the paper is not clear on some points. There is some questions that should be answered before publication.

-The last sentence of the introduction is a question: "Why do different species respond differently to pCO2?" In the paper the answer is not givenĚ even more it is suggested that the species calcification is enhanced at higher CO2 levels: Why that? it should be the reverse.

-The last paragraph of the discussion is vague on the relation between coccolith size and CO2 levels. By giving some examples the author give the impression that they

want to demonstrate that coccolith are larger at higher level of pCO2. Figure 1B is also inferring a decrease in size with decreasing CO2. That relation between size and CO2, should be either stated clearly, or rejected. In that later case the paper should concentrate only on tolerance to pCO2 in culture without mention of size.

-In the later case (tolerance to CO2 without mention of size) : In the example of C. pelagicus the paper of Langer et al. show more a broad tolerance to different pCO2 level than a preference to elevated pCO2. This broad tolerance is indicative that the pC02 did depart from those limits since this species originated. I do not understand how the authors can infer the level of CO2 at 920 ppmV at 63 Ma. -In the former case (relation between coccolith size and pCO2), the authors should also discuss the following: If it is true that in the past originated larger coccolithophores species than now (e.g. C. pelagicus) it is also true that at these times originated also very small coccolith species : for example, P. africanus, F. petalosus or P. teniculatus (with mean coccolith size of 2.5, 1.5, and 2 μm respectively) originated at about the same than C. pelagicus (around 63 Ma). These species were even smaller than most of E. huxleyi. These species had to be adapted to high CO2 values as well as the largest ones. Also it is said that Reticulofenestra were larger than Gephyrocapsa and Emiliania, this largely true, but there were extremely abundant minute species of Reticulofenestra (e.g R. minuta) which were often more abundant in term of individual than the larger Reticulofenestra. Do these examples contradict the suggested link between the size and the pCO2 or not?

-The last sentence of the conclusion is obscure to me: “If anything, large coccolithophores will be more successful calcifiers, and could act to release CO2 to the atmosphere with positive feedback on global warming”. Does this mean that the author are afraid that the “large calcified” coccolithophore will dominate the ocean of the 22nd century increasing the green house effect? If this is the case, this is not what the data show: The data from Langer et al show that (1) C. leptoporus should decrease in abundance when pCO2 departs from 360 ppmV, (2) C. pelagicus is tolerant to pCO2 and

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therefore it is not affected by an increased pCO2. In consequence why this species would start do bloom globally? It is now a modest contributor to global CaCO3 fluxes because of its small geographical distribution, and nothing indicates this will change.

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