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Biogeosciences Discussions

Interactive comment on "From laboratory manipulations to earth system models: predicting pelagic calcification and its consequences" *by* A. Ridgwell et al.

Anonymous Referee #4

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Ridgwell et al. discuss recently published CO2/pH effects on calcification in coccolithophores, and hypothesize that, specifically for modeling purposes, calcification responses may be better represented in an integrated response function, such as the Eppley curve. The manuscript is kind of a mixture between a mini review and a discussion note. The review addresses the current lack of knowledge regarding the mechanisms by which acidification affects calcification in coccolithophores, the reasons for potentially different outcomes of experimental studies, and the adequate representation of a pH-calcification relationship in modeling studies. The authors conclude that the main reason for different model estimates of a calcification-CO2-feedback is the large variability in species-specific responses. As a potential solution, they emphasize

the need to investigate community responses of coccolithophores in mesocosm and field studies. The authors then hypothesize that a calcification-community-response can be described in analogy to the T-growth relationship given by Eppley. Ridgwell et al start from, at least, two assumptions, 1) the existence of a calcification optimum with respect to pH, 2) an 'unambiguous direction to the CO2-calcification response across mesocosm and shipboard incubations'. Assumption 1 is referred to only one experimental study, assumption 2 to two studies. A kind of 'Eppley curve' for the pH-calcification relationship in coccolithophores would be tempting, if it really could help integrating the conflicting results of previous studies. At this stage, however, the hypothesized function is highly speculative. Langer et al (2009, same BGD issue), for example, observed an optimum curve in only one out of five strains of E. huxleyi within the relevant range of CO2 concentrations. Moreover, the physiological mechanisms underlying such function are unclear–in contrast to the T-growth relationship.

Specific comments: I strongly suggest redrawing figures 3 and 4. Even if the analogy between the Eppley curve and the pH-calcification response were justified, the direct comparison fails at several points. Why should there be a 'lethal point' of calcification at high CaCO3 saturation state? Is there any evidence that cold-water species stop calcification at relatively high pH, while continuing to calcify at low level at low pH? Species included in data of Fig. 4 do not calcify at all, etc. There is no Eppley equation given in Fig. 4 (see legend).

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