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Biogeosciences Discussions

Interactive comment on "Marine ecosystem community carbon and nutrient uptake stoichiometry under varying ocean acidification during the PeECE III experiment" *by* R. G. J. Bellerby et al.

Anonymous Referee #1

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The present manuscript deals with an important scientific topic: the ecosystem response to increasing ocean acidification. A variety of studies has indicated severe effects of ocean acidicication on cell physiology and carbon as well as nutirent uptake stichiometry of selected organisms. Hence, it is of great scientific interest to also address carbon as well as nutrient uptake stichiometry on the ecosystem level. The most important results of the present study are that a) carbon production increased relative to nutrient consumption with increasing initial pCO2 and b) the inferred cumulative C:N:P stoichiometry of organic carbon incresed with increasing pCO2. However, no effect on calcification response of Emiliania huxleyi could be observed.

Although the manuscript is well written and all data are presented in a clear and cohesive manner, the manuscript lacks precise statistical analyses. By using a more elaborate statistical analysis the result section will also become less descriptive. In my opinion a major topic of ecosystem community carbon and nutrient uptake stoichiometry should be still included into the discussion dealing with pCO2 induced effects. Although the relative influence of respiration could not be quantified heterotrophic processes may be a key of understanding pCO2 induced effects on ocean biogeochemical cycling.

Lovdal et al. (in the same issue of BGE) point out that there is a strong competition between bacteria and larger phytoplankton for nutrients in the PeECE II study. The authors conclude that bacteria prefer organic nitrogen compounds over inorganic ones whereas phytoplankton shows the opposite pattern. However, there was no such difference regarding the specific affinity for P substrates. Since heterotrophic bacteria seem to acquire N from organic compounds like leucine more efficiently than phytoplankton, different structuring of the microbial food chain in N-limited relative to P-limited environments seems to be likely. Hence, changes in the stoichiometry of dissolved and particulate organic matter in a high CO2 world should also have an effect on the secondary production. The assumption on page 4641, lines 13-16 "that there was most likely an increase in the carbon exported from the mixed layer relative to nutrient concentration in the high CO2 treatments" only holds true if secondary production did not change. Do you have indications that secondary production and may be other bacteria related parameters remained the same among the treatments? If this was the case, bacteria secondary production was limited by N and P availability rather than carbon.

In different marine systems, however, nutrient availability and competition between bacteria and phytoplankton may vary to a great extend, e.g. upwelling areas vs. open ocean systems. And often bacteria are limted by carbon rather than by N and P availability. In addition, anthropogenic nutrient input may relieve microorganisms from lim-

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itation by nutrients, such as N and P. In such a scenario the pCO2 induced carbon overconsumption by osmotrophs and increase in net community production becomes to a much higher degree available for bacteria. Hence, higher carbon export to the deeper ocean at elevated pCO2 could be balanced by increasing bacterial secondary production and respiration.

Another important -but not discussed- point is the effect of growth on the walls of the mesocosm. Many mesocosm studies have shown that benthic algae can severely impact carbon and nutrient cycling (e.g. Petersen, Cornwell, Kemp 1999, Oikos: Vol.85:3-18). Please comment on this topic.

Minor comments:

Page 4632, line 23 ...and deep ocean.

Page 4639, line 7 ...exacerbated due to the...

Page 4640, line 24 ...of sedimentary ? (word and dot missing)

P4641, line 22 Non-Redfield...

Interactive comment on Biogeosciences Discuss., 4, 4631, 2007.