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Discussions

Interactive comment on “CO$_3^{2-}$ concentration and pCO$_2$ thresholds for calcification and dissolution on the Molokai reef flat, Hawaii” *by* K. K. Yates and R. B. Halley

Anonymous Referee #2

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As atmospheric CO2 concentration is expected to reach double its preindustrial value in the next 50 years, it is of great importance to study the effects of such an increase on the biology of the oceans. Coral reefs are the most important calcium carbonate producers on earth anf therefore are expected to be strongly impacted by the atmospheric pCO2 increase. Indeed, numerous studies already showed a decrease of net calcification (gross calcification - dissolution) in laboratory artificial environments with increasing pCO2 (and decreasing saturation state). Nevertheless, very few studies focused on such an impact in in situ studies. Therefore, the paper from Yates & Halley is very interesting. These authors measured net calcification rates (based on the alkalinity anomaly method) of 4 different substrates (bare sand, coral rubble, patch reef with 10% and 20% coral cover) in benthic enclosures over a diurnal cycle (punctual

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measurements every 4 hours).and tried to linearly link the computed net calcification rates to pCo2 and [CO32-] concentrations in the water inside the chamber. Then, they used these relationships to derive pCO2 and [CO32-] thresholds (when dissolution > calcification). Based on pCO2 and [CO32-] values measured at different periods in the same area, they calculated the % of time when these thresholds were surpassed and then extrapolated to conclude that by the year 2100 these threshold will be surpassed 100% of the time, not allowing positive net calcification rates. While I strongly believe these data are of great importance and should be published in Biogeosciences, I was quite embarrassed by the way Yates & Halley used their results. The relationships these authors present in Fig. 3 are not really good and most of the time are not statistically significant. First of all, the reader can question if the experiments were well conducted (enough sampling points?), if there is a “real” link between these 2 parameters, if, as already mentioned by Gattuso in this discussion concerning light, another variable does not interfere etcĚ. A critical discussion on this benthic chamber procedure is missing although the authors suggest that dissolution could be enhanced by bacterial respiration in the sediments and release of CO2 in pore waters, process which can not be highlighted with such an experiment. Moreover, it seems really hazardous to me (and not correct) to use not statistically significant linear regressions to compute X-intercepts and build a discussion on it. In my idea, the paper would benefit from a critical discussion on the experimental setup used (more sampling points, pore water profiles would have been interesting maybe) and on its reliability to answer the problem raised in this paper rather than on a questionable extrapolation.

Specific comments

- Eq: 1: I know this equation is presented like this in numerous papers but since when G is positive, TA is decreasing, why not writing G = - 0.5 deltaTA ?? Hereafter in the paper, G is presented as positive when there is net calcification and negative when there is net dissolution....

- The authors should explain why they choose to use linear relationships between cal-

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cification rates and the saturation state (or pCO2 and CO32-) while other authors suggested non linear relationships (Zhong & Mucci, 1989; Gattuso et al, 1998)

- The authors present deltaDIC values in table 1 (due to an editorial problem I guess, units were moved to the right), would it be interesting to compute net metabolic rates and to show the effects on net calcification rates?

References:

Gattuso JP, Frankignoulle M, Bourge I, et al. Effect of calcium carbonate saturation of seawater on coral calcification GLOBAL AND PLANETARY CHANGE 18 (1-2): 37-46 JUL 1998

ZHONG SJ, MUCCI A CALCITE AND ARAGONITE PRECIPITATION FROM SEAWATER SOLUTIONS OF VARIOUS SALINITES - PRECIPITATION RATES AND OVERGROWTH COMPOSITIONS CHEMICAL GEOLOGY 78 (3-4): 283-299 DEC 15 1989

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