Biogeosciences Discuss., 6, S286–S288, 2009
www.biogeosciences-discuss.net/6/S286/2009/

Biogeosciences Discussions

Interactive comment on "Calcification of the cold-water coral *Lophelia pertusa* under ambient and reduced pH" *by* C. Maier et al.

Anonymous Referee #4

Received and published: 2 March 2009

This paper provides many new useful observations on the possible impact of reduced aragonite saturation state on the calcification rate of the cold water coral Lophelia pertusa. As such I think it should be published, however, there are some problems that need to be addressed.

1) The carbonate chemistry of the experimental treatments at the beginning of the incubations. Adding HCl will reduce the TA. The authors assume that it remains unchanged and only the pH is affected. This is incorrect. The TA will be be reduced in direct proportion to the amount of equivalents of HCl that is added. I calculate that the TA was approximately 2254 in the -0.15 pH treatment and 2151 in the -0.30 pH treatments. It is common in these manipulations to assume that the DIC is unchanged by the addition of the acid. This is also incorrect. Some amount of DIC is lost via gas exchange as the

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acid is added and mixed into the experimental water. The amount lost is variable and depends on the concentration of the acid that is added. The more concentrated the acid the higher the pCO2 in the water contacted by the acid and the more that is lost due to gas exchange. The loss can be considerable amounting to a reduction in DIC of 50-400 umol/kg. Since the loss is indeterminate it is important to measure the actual DIC concentration after the thorough mixing of the acid when doing acid manipulation type experiments in order to know the aragonite saturation state at the beginning of the experiment because it will be less than expected based in pH and the pre-acid addition DIC. The differences aren 't huge. I calculate that the saturation state of the -0.15 treatment could have been 1.2 instead of 1.4 and the -0.30 treatment 0.88 instead of 1.02.

2) Changes in carbonate chemistry during the incubation. There is no mention of gas exchange in the calculations. In the -0.15 and -0.30 pH treatments the loss of Co2 due to gas exchange over 24 h can be significant especially given the large ratio of head space (25 ml) to water volume (30 ml). The calculations on how carbonate chemistry will change during the incubation should be redone including gas exchange. The gas exchange velocity of CO2 in an unstirred system is about 3 cm/h at 27C. I am not sure what it would be at 8C. As a result of gas exchange the actual difference in carbonate chemistry between the control and treatments at the end of the incubation can be much smaller than at the start. I would like to see a plot of how saturation state changes as a function of time over the course of the incubation included in the manuscript. Until this is done it is not possible to judge the differences between the control and treatments and hence the usefulness of the experiments.

It should be noted that modelling is no substitute for actually measuring the carbonate chemistry during the course of the incubation or at the very least at the beginning and end.

3) Non-biological incorporation of 45Ca

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It is known that 45Ca can get incorporated into the exposed skeleton and is not easily or rapidly washed out at the end of an incubation. As a result calcification measured by the 45Ca method can be a significant overestimate of the true rate of calcification if care is not taken to let new coral tissue completely regrow over the portions of exposed skeleton before the experiment is begun. There is no mention that this precaution was taken in these experiments. Given that the experiments were begun shortly after collection which would have left exposed skeleton where the corals were broken from the parent colony this is certainly a problem to some degree. At the very least it should be noted that the calcification rates could be significant over estimates as well as possible underestimates of the true rates.

The manuscript should be re-reviewed after these issues have been addressed.

Interactive comment on Biogeosciences Discuss., 6, 1875, 2009.