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Biogeosciences Discussions

Interactive comment on "Threshold of carbonate saturation state determined by a CO_2 control experiment" *by* S. Yamamoto et al.

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Reply to the comments by Referee#2,

We acknowledge you for your valuable and constructive comments on this manuscript. Also, we really appreciate that you attach supplement file which helps our manuscript to be clearer. Almost all of the comments and suggestions of supplement file are taken into account in the revised paper. We have revised the manuscript as follows according to your comments.

Abstract

Comment#1: Line 10 of abstract: "However, the threshold of Omega_a for the dissolution of natural sediments has not been clearly determined, and it is unknown whether

these dissolution processes actually occur under natural conditions." As written, this is not true. There has been several studies in nearshore terrigenous deposits clearly showing temporal or spatial patterns of biogenic carbonates. In many of these, benthic foraminifera were the dissolving organisms. Some tried to constrain rate constants as well as he reaction order. In addition, there have been numerous studies in carbonate sediments of Florida Bay, USA. These studies go back to the early 1980's, before anyone ever cared. See the references below:

Reply#1: We agree the statement does not refer to the previous studies correctly. We have deleted this sentence, and referred to appropriate studies.

Introduction

Comment#2: 8621, Line 21: "The effect of the calcification performed by marine organisms on the decrease in Omega_a of seawater has been examined by laboratory experiments that control Omega_a." Sentence doesn't read well. . . 8621, Line 26: "This decrease would impact on the calcifiers themselves, as well as on the ecosystems they constructed." Sentence doesn't read well. . .

Reply#2: We have revised this paragraph and made it clear.

Comment#3: 8622, Line 1: "The value of Omega_a is different among its mineralogy." Change to something like "The value of Omega_a varies with carbonate mineralogy"

Reply#3: We have revised this sentence following the supplement file.

Comment#4: 8622, Line 25: "The difference between (1) and (2) comes from sample treatments. Although previous studies used the same biogenic samples, there are several Mgcalcite solubilities and precise values are not decided. I don't understand exactly what you mean. Consider changing the sentences to something more clear.

Reply#4: We have revised this paragraph and made it clear.

Comment#5: 8623, Line 2: "to set Omega_a in", do you mean 'to determine Omega_a

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in"? Hard to tell what you mean here. Last line, "Dissolution samples were set in this chamber, which", Worded poorly. How about "Carbonate samples for dissolution experiments were placed2 in this chamber, which"

Reply#5: We have revised this paragraph according to the supplement file.

Methodology

Comment#6: 8625, Line 25: "The A T of seawater increases by 2 moles for every 1 mole of carbonate dissolution." Should be "for every 1 mole of calcium carbonate dissolution."

Reply#6: We have revised this sentence following the supplement file.

Comment#7: 8625 and 8626: Bottle gas is very dry. If you had bubbled the gas prior to introduction into your experimental system you likely would have minimized evaporation.

Reply#7: We need to use dry gas to make exact pCO2 gas, which is explained in the revised manuscript.

Comment#8: 8626: Evaluation of the experiment system: Is this entire section even necessary? Could the paragraph on salinity variation over the course of the experiment be omitted and the following sentence inserted? "Small salinity changes that occurred due to evaporation over the course of the experiment were corrected for using predetermined relationships between gas flow and salinity change rate." Similarly, the section on Evaluation for remaining seawater seems like it could be shortened. The volume remaining is small relative to the total volume, correct (is it only 1.7% of total volume)? Can a simple sentence such as "A small amount of seawater (10mL or 1.7% of total volume) remained in the pump at the end of each experiment and was corrected for when determining mass balance of AT"?

Reply#8: We have moved section 3 to method section and revised it as you mentioned.

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Discussion

Comment#9: 8628, Line 16: “From Fig. 7, the dissolution rate was highest for coralline algae, followed by foraminifera and then coral.” Is this true based on some statistical comparisons of slopes? It certainly isn’t that clear to me. I would at least write something along the lines of “At any given value of Omega_a, relative dissolution rate is generally coralline algae>foraminifera=bulk sediment>coral.

Reply#9: We have added discussion focusing on the relation between the omega values and net dissolution rate for each of the four samples, and we have discussed the possibility of underestimating net dissolution rate because of contributions from "other minerals (neither foraminifera nor coralline algae)".

Comment#10: 8628, Line 17–: Combine these into a short sentence “Consistent with previous work (Morse et al., 2006, 2007; Bischoff et al., 1993), the results show that higher dissolution rates were observed for samples with higher Mg-calcite contents. 20 Because the grain size and other properties of the samples were as consistent as possible, the differences in dissolution rates between samples were probably caused by differences in the instability (i.e., solubility) of the minerals. How about “Consistent with earlier work (e.g. Morse et al., 2006, 2007; Bischoff et al.,1993) the differences in dissolution rates between samples presumably resulted from the solubility differences of minerals with varying Mg content”

Reply#10: We have revised this sentence as the supplement file.

Comment#11: 8630, Line 1: Sentence is wordy. Also, isn’t it ‘net’ dissolution and not ‘bulk’? How about something like “According to Eqs. (5)–(7), net dissolution of bulk sediment was zero at 3.7 < Omega_a <3.8 and 3.0 < Omega_a <3.2 for foraminifera and coralline algae.” Line 3: I don’t know what this means? ‘Difference of these values comes from “other minerals”.’ 8630, Section 5.3:lines 13-17 could be written more clearly. I suggest: We compared results of bulk sediment dissolution rate vs. Omega_a from this study with previous research. I don’t think is relative: ‘Because our labora-

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tory15 result is described by [% h-1], we have to convert the units to [mmolm-2 h-1].'

Reply#11: We have revised this section and made it clear.

Comment#12: Line 16: "If upper 1 cm sand sediment dissolves, and without considering pore water (i.e., Mgcalcite is influenced only by column seawater), dissolution rate R[mmol m-2 h-1] is described as follows:" can be simplified to:"Assuming a density of calcium carbonate of 2700 kg m-3 and a porosity of coral reef sediment = 0.45 (Morse and Mackenzie, 1990), dissolution rate (R) was converted from %h-1 to mmol m-2 h-1 according to equation (8):

Reply#12: We have revised this sentence as you mentioned.

Comment#13: 8630-8631: Line 24 until end of document. The sentence structure all needs work.

Reply#13: According to your comment and referee#1's comment, we have revised this section and made it clear.

Interactive comment on Biogeosciences Discuss., 8, 8619, 2011.