

## ***Interactive comment on “Export of calcium carbonate corrosive waters from the East Siberian Sea” by Leif G. Anderson et al.***

**Anonymous Referee #3**

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This short manuscript reports on "carbonate corrosive waters" in the Arctic Ocean and conclude that respiration of terrigenous organic matter is in part responsible for their formation.

The results arise from an extensive field campaign, the methods appear sound and the results support the conclusions. Many of the statements, however, are not substantiated by either references or clear explanations in the text. I understand that this manuscript is aiming for a focussed special issue, but BG is a multidisciplinary journal and the article should stand on its own. The opening statement on p. 1 l. 27, for instance, may be general knowledge in the field, but should nevertheless be supported by references for the readers to examine. My second general comment is with respect to some shakiness of the chemical nomenclature used. I give specific examples relative to these issues below.

C1

Specific comments:

-I feel that the 1st paragraph of the introduction should be switched with the 2nd. This way, the text would first describe and define ocean acidification. Then the controls by biogeochemical processes vs anthropogenic CO<sub>2</sub> dissolution would be contrasted.

-Equations 1–2 are unclear as to which concentration refer those at equilibrium with the solid and  $t$  to those measured. Specifically: Line 20: Eq. 2 and the definition of  $K_{So}$  refer to the same quantities in the text, while they should be different.  $K_{So}$  should be the product of the calcium and carbonate ion activity \*at equilibrium\*. Then, the ion activity product (IAP) refers to those in the sample.

- $\Omega$  is the saturation state, not the solubility state. Elsewhere in the text (e.g., p. 4) saturation state is used properly.

-p. 2 lines 22–24 as well as throughout the manuscript: Is it not calcium carbonate which is saturated, but the waters that are saturated \*with respect to it\*. So, if  $\Omega$  is  $>1$  then the waters are oversaturated \*with respect to calcium carbonate\* and the solid should precipitate. See <http://www.biogeosciences.net/10/6453/2013/bg-10-6453-2013.pdf> in the same journal for a good definition of carbonate equilibrium.

-p. 4: please give the dissociation constants used ( $K_1$  and  $K_2$ ) as well as the  $K_{So}$  used for aragonite and calcite along with references. These values are pivotal to the calculations of saturation states throughout and in the construction of the figures.

-p. 4, l. 30: The first paragraph of the result section is not actually result, but general statements probably more relevant for the discussion. References should be given to substantiate those statements.

-p. 5 \*Water undersaturated with respect to aragonite\* would be clearer than "low saturated water".

-p.5, l.29 "As is directly evident from Fig. 2 ... organic matter decay is an important process" . Please discuss which features of Fig. 2 testify of OM degradation.

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-p. 6 Figure 3 does not show a correlation (Figure 7 does). Has the correlation between  $p\text{CO}_2$  and  $\Omega$  been quantified?

-Lines 5–10 on p. 6 make a lot of shortcuts in the reasoning leading to the conclusion that "some process must compensate for the  $\text{CO}_2$  that is consumed by primary productions". What are "low nitrate", "low phosphate" in this context? In general it would be helpful to give the concentrations to better substantiate statements of highs and lows. Further, how are those concentrations evidencing recent primary production? I guess the authors mean that rates of photosynthesis, despite being high as evidenced by depletion of nitrate, were exceeded by respiration, which leads to net accumulation of  $\text{CO}_2$ ?

-p. 6 l. 12–13 . There seem to be a problem with the sentence beginning by "As  $\text{CO}_2$  is supersaturated indicates. . ."

-p. 6 l. 24: Please give a reference (even if it is a textbook one) for the C:N:P:O<sub>2</sub> ratio of 106:1:16:-138

-p. 7 l. 9 "it is evident that the aragonite under-saturated water is well confined to the high nutrient of the high Pacific N-P relation signature (Figure 8)." I can see that the samples with  $\Omega < 1$  are grouped in the upper-right corner with high N:P ratio, but what and where is the Pacific N-P relation and how does Fig. 8 support that the water masses are exported to the North Atlantic Ocean?

-p. 7 l. 15: What is "the source to the observations of this investigation" ?

-Fig. 7: The variable represented by colour coding is indicated on the upper right corner of each plot, but on plot 7c the variable indicated is  $\text{PO}_4$  while the caption indicates that the data is colour coded by AOU. Which one is it?

-Fig. 7b: Are those arrows arbitrary ? What determines length, angle, position? This is important since it is used to support the discussion on p. 6 l. 15–18.

-Fig.9: The caption read like a discussion point. Maybe move some of the text to the

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discussion on p. 7?

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