

Biogeosciences Discuss., referee comment RC2  
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## Comment on bg-2021-244

Anonymous Referee #2

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Referee comment on "Dissolution of a submarine carbonate platform by a submerged lake of acidic seawater" by Matthew P. Humphreys et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-244-RC2>, 2021

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Submarine sinkholes on carbonate platforms occur worldwide and have been recently discovered on Luymes Bank, Caribbean Sea. Humphrey et al. study four different sinkhole complexes on Luymes bank – one of those sinkholes contains dense, acidic and oxygen-poor waters ('acid lake'). The authors study the formation of the sinkholes and of the 'acid lake' and decipher the physical and biogeochemical conditions and processes that sustain its occurrence using bathymetry and water column data.

I found the manuscript overall very well written and very well described. I felt confident that the authors have carried out their study carefully and thoroughly. Therefore, I only have minor comments.

### Minor comments:

I agree that sinkholes are useful 'natural laboratories' but I think that the connection the authors draw between the acid lake and Precambrian times is not really applicable as the time and spatial scales are very different – the authors themselves write that the bubble plume is likely only short-lived. Furthermore, many processes on Luymes Bank (e.g. difference in AOU) have not been studied in detail, and thus, the "Impact and wider context" should be addressed more carefully.

Line 52: Is there more data/knowledge on the occurrence and composition of hydrothermal seeps on Luymes Bank/Saba Bank, potentially also with regards to the host rock composition?

Line 92: Please extent on the calculation of AOU and for what it is used.

Line 94: Is  $T_c = \text{DIC}$ ? I find the abbreviation  $T_c$  confusing and I would recommend to rename it to DIC.

Line 110: Please introduce  $\text{pH}_T$ .

Line 110: Maybe my knowledge is too limited but I am wondering what the difference/relation is between  $\text{pH}_T$  and  $\text{pH}_{\text{NBS}}$ ? How do you convert these?

2.3.3 Nutrients: Please provide additional information on the data quality.

Line 144: I have troubles understanding what is meant here with "preformed properties upon departure from the open ocean" – are those the off-platform seawater conditions right before the water enters the sinkhole? Please consider to rephrase.

Line 147: Please define/indicate, which  $P_{\text{pref}}$  values are used for this calculation as Fig. S1-S2 only show the ranges. Maybe the  $P_{\text{pref}}$  values can be added to Table 1 or indicated more clearly in Fig. S1-S2.

Line 158: I would encourage the authors to give more detail on why the values have been set like this. Did Anderson and Sarmiento work in the same area, also shouldn't Reefield be mentioned here? It took me quite long to understand that  $R_N$  is actually C/N and  $R_p = C/P$ . Why is "R" used here as this is otherwise introduced to represent the residual fractions? This is quite confusing.

Line 191: Why are the depth profiles for  $\theta$  and  $\sigma$  not shown?

Line 199: "In the acid lake, each physical tracer..." maybe better "the (conc.) range of each physical tracer..."?

Figure S1-S2: How did you determine such low  $\text{NO}_2^-$  concentrations? What is the LOQ of your method? Also for  $\text{NH}_3$  and Si?  
It would be useful to have the abbreviations of the variables (such as  $A_T$ ,  $T_c$ ...) defined in the figure captions.