EGUsphere, referee comment RC2 https://doi.org/10.5194/egusphere-2022-161-RC2, 2022

Comment on egusphere-2022-161

Anonymous Referee #2

Referee comment on "Benthic Alkalinity fluxes from coastal sediments of the Baltic and North Seas: Comparing approaches and identifying knowledge gaps" by Bryce Van Dam et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-161-RC2, 2022

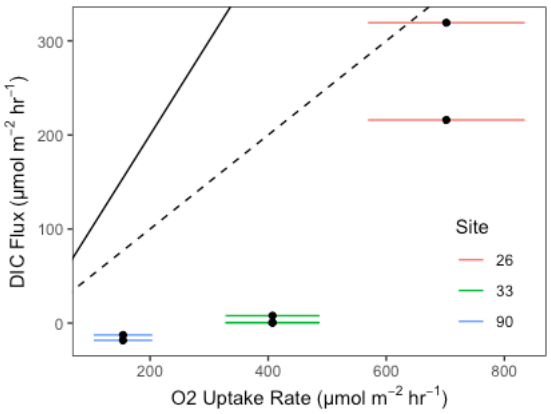
The authors measured alkalinity fluxes and other related geochemical parameters in North Sea and Baltic Sea sediments. A key strength of the study was the use of a wide variety of approaches to estimate alkalinity fluxes. The work is interesting and topical given the possible role of alkalinity production in mediating CO2 uptake in the coastal ocean. Overall, although the text was generally well written, this work felt like a rough draft rather than a polished manuscript ready for submission. The tables and figures were generally poor quality in terms of their visual appeal and ease of interpretation. The methods were incompletely described and the results and discussion unfocused.

We appreciate the detailed and critical review offered by both referees. In response to their collective suggestions, we have made major revisions to the submitted manuscript. This involved creating new versions of Figures 1-5, removing section 3.5 (“PCA and regional patterns”), adding information to the methods descriptions, and revising the discussion and conclusion (section 3) for improved clarity. We feel that these changes were very helpful, as the manuscript now more clearly conveys our methods and key findings.

Specific comments

Ship board incubations – I don’t understand why fluxes of DO, TA and DIC (and nutrients) were not measured in these incubations? This is probably one of the most common approaches (along with chambers) for measuring fluxes.

Thank you for the comment, and I agree that it would have been nice to have TA and DIC measurements in the flux incubations. But, unfortunately the assessment of alkalinity and carbon fluxes was not an objective of the original field work. We do have paired O2 and DIC fluxes for a few sites in the North Sea, from the HE541 cruise, which are presented below. The solid and dashed lines are the 1:1 and 2:1 reference lines respectively. We chose not to include this figure in the submitted manuscript because of the limited spatial coverage (just 3 sites).



Methods what was the precision of the TA analysis and all other methods?

This information has now been added to the SI in table S1.

I don't think the fluxes presented for Fe, Mn, Ca, H2S, K and HSO4 (SO42-) were meaningful as these solutes either oxidise (H2) and precipitate (Fe, Mn), or the small concentration differences between the sediment and the water column are probably random (especially without information on precision).

In an effort to simplify the figures, the elements not discussed in the text have been removed from figures 3 and 4.

Figure 2 and others. Label the x axis!

Yes, thank you for this reminder, all figures have been updated with x-axis labels

Figures 3 and 4 are a bit overwhelming and hard to interpret. Can the authors find a way to present the data more clearly (this will be easier when the analytes noted above are dropped).

We agree that figures 3 and 4 were overwhelming, and have reduced the number of elements considered so as to focus on those that are important for our discussion.

Results and Discussion

I would suggest that results and discussion be separated. This will allow a more focused discussion on the key points of interest. At the moment there is a lot of focus on details and jumping across different ideas. What are the key factors controlling alkalinity production based on your data set? It might be helpful to separate muds and sands into different sections.

We appreciate the helpful suggestion, and have put effort into revising this section for clarity, which indeed was difficult to follow in places. Following this, and the removal of the PCA section, we feel that the results/discussion is now much improved and can stay as a combined section.

I don’t think the PCA plot helped us understand the geochemistry here. This approach is useful when the a-priori mechanistic links between variables is unclear. I think the links between the geochemical variables here are well known and understood and the interpretation of the PCA plots just re-iterates this understanding.

The PCA plots and discussion surrounding this was removed, following the recommendation of both Reviewers 1 and 2.

The miller-tans plots suggest carbonate dissolution is important, particularly in the North Sea sands. It is noted this contradicts low porewater Ca concentrations, but I doubt if the method has sufficient precision to really make this assessment. Also, it is likely dissolution and precipitation are occurring simultaneously?

Indeed, the carbonate dissolution that we infer is likely matched by re-precipitation, either in-situ or in overlying sediment layers. This is supported by our very low (and variable) net Ca fluxes, which do not indicate any appreciable net dissolution of carbonate material (as described in section 3.4.1).

Conclusion

Pyrite burial is suddenly mentioned as a factor in alkalinity production with no prior mention in results or discussion.

Yes, thank you for pointing this out. We did not measure or estimate pyrite accumulation in any way, so I have removed this statement from the conclusion.