Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2020-167-AC2, 2020
© Author(s) 2020. This work is distributed under
the Creative Commons Attribution 4.0 License.

Biogeosciences
Discussions

Interactive comment on "The suspended small-particles layer in the suboxic Black Sea: a proxy for delineating the effective N_2-yielding section" *by* Rafael Rasse et al.

Rafael Rasse et al.

rjrasse@gmail.com

Received and published: 15 September 2020

Dear reviewer,

Thank you very much for spending part of your valuable time reviewing our manuscript. We also thank you for your constructive feedback because it allowed us to improve the original version of the manuscript. Below, you will find our answers and actions taken for each of your comments.

King regards,

Rafael Rasse Hervé Claustre Antoine Poteau

Comment #1

What is the typical depths ??

Are these depths vary among different ODZs?

Answer. OK

Action taken. This sentence was modified. We indicated the depths at which this layer can be found. This information is based on data from The Black Sea (this study), and the ODZs of the Arabian Sea and ETSP (Whitmire et al. 2009; Wojtasiewicz et al. 2018).

Comment #2

Are these factors listed in order of their importance?

Answer. According to the literature, we consider this is the most likely order.

Action taken. No actions were taken.

Comment #3

Will not the chemical composition, salinity and temperature of water column would also matter for resultant optical visibility / abundance of anammox and denitrifying bacteria ??

Answer. Organic matter composition should be key driving the microbial activity (e.g. anammox and denitrifying bacteria, e.g. Van Mooy et al. 2002) but this not be critical for our case (see line 165 in the old manuscript and the cited work). We mentioned an array of chemical variables (levels O2, NO3, and HS, OM) at the line 34 of the old version. We don't have information about salinity but T can affect their activity in sediments (e.g. Rysgaard et al. 2004; Canion et al., 2014).

Action taken. No actions were taken.

Comment #4

Here authors are attempting to investigate measured Bbp layer (absorption ?) with chemical parameters such as O2, NO3 H2S and N2 produced.....all chemical parameters is there any way to provide Bbp thickness and its absorption correlation with actual density of microbial mass...(just wondering samples collected on filters??)

Answer. We did not have such data .

Action taken. No actions were taken.

Comment #5

How much thick it is?

Answer. It can be highly variable with time, and between ODZs and anoxic basins. Please see section 4.1, where we indicate the thickness of the bbp-layer for the case of the Black Sea.

Action taken. No actions were taken.

Comment #6

Suppose this factor is negligible in some locations ??

Answer. Please, see how the ventilation of subsurface O2 defines the characteristics of the bbp-layer and how we used such information to explain what are the main particles contributing to its formation (e.g. section 4.2).

Action taken. No actions were taken.

Comment #7

why ? what is another factor for second sub-zone?

Answer. This is related to the biogeochemical processes that control the content of suspended small particles and N2 excess in the chemical zones of the poorly-oxygenated water masses. This is better described in the new version of the manuscript.

Action taken. We included a new “background section” to describe the key biogeochemical processes and associated inorganic-biogenic particles contributing to the formation of the bbp-layer. The interlinks among biogeochemical processes, and the vertical profiles of small-particles and N2 excess are described in the discussion as well.

These changes are highlighted in yellow in the following lines of the new version: -71-94, 171-197, and 207-230.

Comment #8: Sentences highlighted in yellow without suggestions

- of chl and bbp and due to particle

Answer. Both spikes are due to particles-aggregates. We thus consider this sentence is OK

Action taken. No actions were taken.

- o free-living bacteria (0.2-2 μm), and those associated with small-suspended particles (> 2-20 μm).

Answer. These ranges of particles size are explained in the introduction.

Action taken. No actions were taken.

- hypothesized

- Optical proxies of tiny particles can be applied as an alternative approach to assess the vertical distribution of N2-yieldingmicrobial communities in upper suboxic ODZs

- particle content inferred from bbp and N2 produced by microbial communities are at least qualitatively correlated microbial communities in upper suboxic ODZs

- bbp and O2 can be exploited as a combined proxy for defining the N2-producing section of the suboxic Black Sea

- fluorescence and total backscattering were converted into Chlorophyll concentration (chl) and particle backscattering (bbp) following standard protocols

- HS- was not used to delimit the bottom of this zone because the maximum concentration of H2S that denitrifying and anammox bacteria tolerate is not well established.

- NO3- and O2 are two of the key factors that modulate the presence of denitrifying and anammox bacteria

- bbp-layer is partially composed of N2-yielding microbial communities such as anammox and denitrifying bacteria.

- bbp-layer is at least partially composed of anaerobic microbial communities involved in the production of N2

Answer. OK

Action taken. The sentences above were modified.

—-

Comment #9: Other sentences highlighted in yellow without suggestions

- How key drivers of anammox-denitrifying bacteria dynamics impact on the vertical distribution of bbp and the thickness of the bbp-layer.

- Optical proxies of tiny particles can be applied as an alternative approach to assess the vertical distribution of N2-yielding.

- Slightly sulfidic conditions of the deepest isopycnal at which anammox bacteria can be still recorded.

- It is still debated whether the oceanic nitrogen cycle is in balance or not.

Answers. Because it is not specified what are the issues with the sentences above; we assumed that these are only semantic issues.

Action taken. No actions were taken.

References.

Canion, A., Kostka, J. E., Gihring, T. M., Huettel, M., Van Beusekom, J. E. E., Gao, H., ... & Kuypers, M. M. (2014). Temperature response of denitrification and anammox reveals the adaptation of microbial communities to in situ temperatures in permeable marine sediments that span 50? in latitude. Biogeosciences, 11(2), 309.

Rysgaard, S., Glud, R. N., Risgaard-Petersen, N., & Dalsgaard, T. (2004). Denitrification and anammox activity in Arctic marine sediments. Limnology and Oceanography, 49(5), 1493-1502.

Whitmire, A. L., Letelier, R. M., Villagrán, V., and Ulloa, O.: Autonomous observations of in vivo fluorescence and particle backscattering in an oceanic oxygen minimum zone, Opt. Express, 17(24), 21, 992–22,004. https://doi.org/10.1364/OE.17.021992, 2009.

Wojtasiewicz, B., Trull, T. W., Bhaskar, T. U., Gauns, M., Prakash, S., Ravichandran, M., and HardmanâĂŘMountford, N. J.: Autonomous profiling float observations reveal the dynamics of deep biomass distributions in the denitrifying oxygen minimum zone of the Arabian Sea, J. Mar. Syst., https://doi.org/10.1016/j.jmarsys.2018.07.002, 2020.

Van Mooy, B. A., Keil, R. G., & Devol, A. H. (2002). Impact of suboxia on sinking particulate organic carbon: Enhanced carbon flux and preferential degradation of amino acids via denitrification. Geochimica et Cosmochimica Acta, 66(3), 457-465.

Interactive comment on Biogeosciences Discuss., https://doi.org/10.5194/bg-2020-167, 2020.