Utrecht, 17 January 2023

Dear editor, dear Ji-Hyung Park,

Thank you for evaluating our revised manuscript and our comments on your and the referees' comments.

Here we resubmit the manuscript titled 'The dispersal of fluvially discharged and marine, shelf-produced particulate organic matter in the northern Gulf of Mexico' by Y.W. Yedema, F. Sangiorgi, A. Sluijs, J.S. Sinninghe Damsté and F. Peterse.

We have revised the manuscript based on the additional suggestions by the reviewer. A point-to-point list of detailed changes in response to comments of the referee can be found below. The changes in the revised manuscript are made with track changes on.

We hope that you find this revised version suitable for publication in Biogeosciences.

On behalf of all co-authors,
Yord Yedema

Reviewer #1

- Page 3: Response to Reviewer#1 comment 1, also line 235-245 in the revised manuscript
Sedimentation rate generates by 210Pb data does not really capture seasonal variation of surface sediment properties. Nevertheless, I would suggest the authors add a few sentences that discuss sedimentation and particle dynamics from previous work that use short-lived radionuclides such as Be-7 and Th-234 that can capture seasonal variation (e.g., Corbett, McKee, Allison).

Reply: We agree that Be-7 and Th-234 radionuclides can capture variations on a smaller scale than Pb-210 data could. Unfortunately, we were unable to measure these short-lived radionuclides, as the our samples were unavailable for a few months due to the COVID pandemic. We have added a few sentences on the seasonal and annual variations in sedimentation rates and particle dynamics to section 3.2, lines 235-242:

"Therefore, the upper 0-2 cm sediment analysed, which represents at least 1 year deposition time, integrates multiple years of seasonally varying oxygen conditions. Still, sediment accumulation rates can vary substantially on a seasonal scale, depending on river discharge, biological processes, and hydrological factors like waves and tides (McKee et al., 2004). For example, sediment accumulation rates near the MR delta derived from short-lived radionuclides (^{7}Be and ^{234}Th) have shown annual and seasonal variations that are larger than the average decadal sedimentation rates calculated with ^{210}Pb (Corbett et al., 2004), suggesting that active sediment reworking and possible export of particles off- and along-shore takes place. Nevertheless, albeit not completely correct, we here assumption assume is that such that the integrated, multiple years signal in our surface sediments reduces any the OM burial and preservation biases among locations in our set of GoM sediments."

- Page 4: Response to Reviewer#1 comment 2
Many publications provide evidences to support that mineral-associated OM is dominated by plant-derived OM (e.g., Angst et al., 2017) while the other showed that microbial-derived OM is more dominant (e.g., Cotrufo et al., 2019; see reviews on this in debate in Lavelle et al., 2019, Angst et al., 2021).
Angst, G., Mueller, K. E., Kögel-Knabner, I., Freeman, K. H., & Mueller, C. W. (2017). Aggregation controls the stability of lignin and lipids in clay-sized particulate and mineral associated organic matter. Biogeochemistry, 132(3), 307-324.
Cotrufo, M. F., Ranalli, M. G., Haddix, M. L., Six, J., & Lugato, E. (2019). Soil carbon storage informed by particulate and mineral-associated organic matter. Nature Geoscience, 12(12), 989-994.
Lavallee, J. M., Soong, J. L., & Cotrufo, M. F. (2020). Conceptualizing soil organic matter into particulate and mineral-associated forms to address global change in the 21st century. Global Change Biology, 26(1), 261-273.
Angst, G., Mueller, K. E., Nierop, K. G., & Simpson, M. J. (2021). Plant-or microbial-derived? A review on the molecular composition of stabilized soil organic matter. Soil Biology and Biochemistry, 156, 108189.

Reply: We thank the reviewer for their suggestions. We have included information on the association of plant and microbial OM to mineral surfaces in our discussion (end of section 5.2.3). Note that the order of this part has been slightly adjusted, so that we now both discuss the influence of natural resistance of our biomarkers to degradation and protection due to sorption to mineral surfaces on their dispersal in the marine realm.

- Page 12: Response to section 5.2.3), also line 530-532 in revised manuscript
The explanation in author's response is very clear and reasonable. However, the discussion paragraph from line 530-532 is quite short and did not explain well why the authors needed to examine marsh pollen or changes in ACL. I'd suggest the authors to copy the paragraph from their response and paste it replacing lines 530-532.

Reply: We agree that the revised manuscript was still brief on this topic and have extended this discussion using parts of our reply letter (Lines 524-529).

- Line 563-568 in revised manuscript:
What is the primary factor that control how far each organic compound could be transported offshore? Their resistance toward degradation, or how tight they were associated with sediment particles? There are many publications discussed that lignin did actually decay in similar rate compared to the simpler organic molecules (see reviews in Dynarski et al., 2020 and references therein); however, their resistance toward degradation might be controlled by degree of protection by minerals. Maybe say that in this study, lignin and n-alkanes were protected in more stable aggregates formed in soil continuum before being transported to rivers and exported to the ocean. However, diols and sterols were not protected by aggregates and were lost through transportation.

Dynarski, K. A., Bossio, D. A., & Scow, K. M. (2020). Dynamic stability of soil carbon: reassessing the "permanence" of soil carbon sequestration. Frontiers in Environmental Science, 8, 514701.

Reply: We agree with the reviewer that mineral associations may play an important role in the offshore transport of the different biomarkers. However, our current dataset does not allow us to identify whether the transport of TerrOM is controlled by mineral protection or by its resistance against degradation. Hence, both processes are explained in the discussion, which we have extended to address this additional comment. See section 5.2.3, lines 551-578.