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Biogeosciences Discussions

Interactive comment on "Source, composition, and environmental implication of neutral carbohydrates in sediment cores of subtropical reservoirs, South China" *by* Dandan Duan et al.

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Title: Source, composition, and environmental implication of neutral carbohydrates in sediment cores of subtropical reservoirs, South China Authors: Dandan Duan, Dainan Zhang, Yu Yang, Jingfu Wang, Jian'an Chen, and Yong Ran* doi:10.5194/bg-2016-505

Dear Editor and reviewer:

Thank you very much for your comments on our manuscript. We have carefully revised the manuscript according to your valuable and helpful comments. Our responses are marked in blue color below.

We are looking forward to your further comments and decision.

With best regards!

Dr. Yong Ran

—— Anonymous Referee #3:

Duan et al. obtained a very nice, enriched, dataset including neutral sugars and other parameters in three subtropical reservoirs. Based on the concentrations and composition of the neutral sugars, isotope values of TOC, and C/N ratios, they investigated source and diagenesis pathways of sedimentary organic matter (SOM). They concluded that the dominant source of SOM was phytoplankton in the ZT, LA and upper XFJ reservoirs, and there was not much degradation of carbohydrates downward in the sediment cores. Also, there seems to be a nice correlation between temperature and the levels of carbohydrates over the past 60 years. I think this paper would be of interest to the community and worthy of being published, (1) but I have issues with the way they presented, too broad and without a clear focus. The authors discussed a lot of possible sources and phytoplankton among different reservoirs, but they did not even mention why different patterns, ZT and LA vs. XFJ, were observed,. In addition, some of the conclusions are very speculative. Overall, I do not feel this paper is ready without a major revision.

Reponses: We have made some revisions on the discussion in order to refine a clear focus: The combination uses of neutral sugars, carbon isotopic composition, and pyrolytic organic parameters are recommended for reflecting the historical changes of productivity in subtropical reservoirs. They can also be used for the investigation of climate change effects on algal productivity in these reservoirs. We also added detailed discussion on the causes and reasons for the possible sources among different reservoirs. It is related to not only native species of algae, plant, and bacteria, but also to historical changes of hydrological conditions, nutrient level, anthropogenic activities,

and so on.

(2) The section of Materials and Methods needs more work. They need to include the information about measuring the sedimentation rate and pyrolysis. I know they have these in the Duan et al. 2015 paper, but these should be briefly described, since they use those data in the Results section and you can't force the audience to read your other paper. It is unclear how many cores they collected. In other words, how representative are these cores to the whole reservoirs. If these systems have been impacted by human activities, such as dredging, sediments in these reservoirs can be very heterogeneous.

Reponses: We have added the information of measurements for the sedimentation rate and pyrolysis according to your suggestion.

We have sampled 2 or 3 cores for each reservoir and all of the sediment cores were collected in the center of these reservoirs. Moreover, the reservoirs are mainly suppled by rainfall and are far away from the industrial center. The aquaculture is forbidden and there is no dredging activities in the investigated areas.

(3) A main issue with the manuscript is the lack of focus on the discussion. They talked about a lot of difference topics, but it was written like a result section with titles like, "OM characteristics", "Monosaccharide composition", "Source of neutral carbohydrates", and so on. In other words, it reads more like a data report rather than a research paper.

Reponses: The object of this study is to validate the combined uses of the carbon isotopic composition, pyrolytic organic parameters, and neutral sugars as the potential proxies for historical changes of productivity in subtropical reservoirs and their relationships with the climate changes in the investigated areas. The section of "OM characteristics" was written for the applicability of pyrolytic organic parameters as algal proxies. Both "Monosaccharide composition" and "Source of neutral carbohydrates" sections were compiled for the applicability of neutral sugars as algal proxies in the investigated

areas. We have made some revisions to emphasize a clear focus according to your suggestion.

Specific comments:

Line 43: "offer"

Reponses: We have changed "offers" to "offer" in the manuscript according to your suggestion.

Line 49: delete "and impacted"

Reponses: We have deleted the "and impacted" in the manuscript according to your suggestion.

Line 54: any evidence about the Suess effect would be particularly stronger in the industrialized areas such as Pearl River Delta? I would assume this should be about the same worldwide considering the fast CO2 mixing in the air.

Reponses: With rapid economic and industrial development in the Pearl River Delta, the local lakes and reservoirs is more easliy affected by the Suess effect due to the high-emssion of COÂň2 even the CO2 mixing is fast in the air. However, there is no data for the Suess effect in this area. Therefore, we have made some revision on the description of the Suess effect in the manuscript according to your suggestion.

Line 127: awkward wording, should be "productivity significantly contributed to dissolved oxygen content"

Reponses: We have changed "the important role of oxygen content in the growth of productivity" to "productivity significantly contributed to dissolved oxygen content" in the manuscript according to your suggestion.

Line 130: nutrients levels are always higher in the deeper depth. What do you mean by "be brought" to deeper depths"?

Reponses: During winter, the top layers of the lake have relative higher levels of productivity and the bottom layers have higher contents of nutrient. Moreover, the water column mixes from top to bottom in the lake due to the decrease in temperature (so-called autumn overturn). Therefore, the relative high contents of nutrient can be transported by the water flow to the upper depths, resulting in the increase of nutrient and productivity in the entire water column. We have made some revisions in the manuscript according to your suggestion.

Line 136: again, describe the pyrolysis

Reponses: We have added the instruction and description of pyrolysis in the manuscript according to your suggestion.

Line 193-196: have to be careful about the C/N ratios. Decomposition of terrestrial organic matter can decrease C/N ratios, not necessarily source related. This has been well documented in composting studies. Also, the C/N ratios of 3 in the XFJ upper layers should be interpreted in a more careful way. I don't think you can simply say "algal origin", because C/N ratios fresh algae are typically about 6-7, and even pure bacterial biomass typically have C/N ratios of 4. It is not very clear how you would get SOM with such low C/N ratios. The very low C/N ratios are likely to be related inorganic N in minerals. As the TOC contents are quite low in XFJ, their inorganic N contents will affect the C/N ratios. We will account for this effect in the revised manuscript.

Line 200: the removal of CH4 (13C light) should lead to the accumulation of 13C heavy SOM

Reponses: We have changed "The removal of 12CH4 by intensive methanogenesis also leads to the accumulation of 13C-depleted OM" to "the removal of CH4 (13C light) should lead to the accumulation of 13C heavy SOM" in the manuscript according to your suggestion.

Line 214-216: too speculative. The DO level you mentioned refers to the water, not

sediment. I think the major OM decomposition in these OM-enriched sediments is through anaerobic pathway, unless you have DO profile data in sediment cores.

Reponses: We have deleted the speculative part and rewrite the paragraph in the manuscript according to your suggestion.

Line 270: it's interesting to note the correlations between Zn and Cu and carbohydrates. I think more data analysis is needed, such as the contents of Zn and Cu in algae and how they trace metal got preserved, etc. It's not enough to simply have a correlation and then argue they were from phytoplankton. For example, it could have been sourced from industry contamination.

Reponses: We don't have Zn and Cu data in algae from the investigated areas. However, the Pb contents in the sediments of these reservoirs are very low, which suggesting there is no or little industry contamination in this area.

Section 4.4. When the individual carbohydrates are normalized to TOC, I don't think there is much a decreasing trend at all (Table S2). In other words, carbohydrates simply are not good indicators of digenesis. This section should be strongly condensed.

Reponses: We have condensed the section 4.4 in the manuscript according to your suggestion.

Section 4.5. This section is interesting, but still at a speculative stage. Issues why we would expect carbohydrate increase, such as increased phytoplankton production or decomposition of SOM under warmer climate?

Reponses: We have observed significant correlations among T5 temperaure and contents of algal monosacchrides in the investigated reservoirs. Moreover, these monosacchrides are significantly related to algal parameters (e.g. HI and S2). However, the diagenesis processes of neutral sugars and OM are estimated to be quite slow in the bottom sediments. Some fractions could be selectively preserved and remain unchanged during the post deposition. Therefore, the productivity proxies derived

from the neutral sugars could be significantly related to the climate warming.

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