

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

Dandan Duan et al.

yan@gig.ac.cn

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Responses to the reviewers' comments: (Our responses are marked in blue color)

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 reviewers:

Thank you very much for your helpful and thoughtful comments on our manuscript. Those comments are all valuable and helpful. In compliance with your suggestions and comments, we have been carefully revising the manuscript. The following responses

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are marked in blue color, showing how we have revised the manuscript. The annotated version of the manuscript and SI material is attached.

We sincerely appreciate your consideration. We are looking forward to your further comments and a possible publication in the BG.

With best regards,

Dr. Yong Ran

— Anonymous Referee #1:

Duan et al., have collected sediment cores from three tropical reservoirs in South China and analyzed them for the neutral carbohydrates along with algal organic matter (AOM) content, carbon isotopic composition, and elemental C/N ratios. Based on these data, they investigate the source, composition and diagenesis of the neutral carbohydrates and their relationships with the history of algal productivity induced by climate change over the last 60 years. This manuscript presents interesting results and requires minor revision before it can be accepted for publication. The following comments might help authors in their revising:

1. First, the manuscript needs some cohesive discussion to emphasize more on the combination uses of carbon isotopic composition, pyrolytic organic parameters and carbohydrates composition.

Response: We have added some cohesive discussion on the interrelationship and combination uses of the carbon isotopic composition, pyrolytic organic parameters and carbohydrates composition. As shown in the Table S4, positive correlations between corrected $\delta^{13}\text{C}$ values, hydrogen index (HI), monosaccharide contents of algal origin, and five- year moving average temperature (T5) were only observed in ZT core. The corrected $\delta^{13}\text{C}$ at LA and XFJ cores showed no relationship with other productivity parameter (HI) and T5 even though the corrected $\delta^{13}\text{C}$ were enriched in the upper layers

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of LA core. This may result from the effects of organic matter degradation and variable terrestrial inputs, etc. on the carbon isotopic composition ($\delta^{13}\text{C}$) at mesotrophic and oligotrophic reservoirs (LA and XFJ). However, the HI parameter and algal monosaccharide contents showed the same changing trends, and were positively correlated with T5 at each of the reservoirs. Thus, the pyrolytic organic parameter and monosaccharide contents were more reliable for reconstructing of historical productivity in subtropical reservoirs. In general, the corrected carbon isotopic composition could reflect the history of total productivity in one of the sediment cores. However, it is also affected by natural biogeochemical processes and anthropogenic activities. The pyrolytic organic parameter was observed to be specific to the type of NOM (e.g. algal NOM) and could help to distinguish the relative contribution of algae and higher plant to the NOM. By applying the molecular proxy of monosaccharides, the sources and detailed information of sedimentary organic matter can be provided. Therefore, the combination uses of these parameters are strongly recommended, which can help us to better understand the historical changes of past aquatic productivity and environment in the subtropical regions.

2. Second, the correlation between air-temperature changes in South China over 60 years and the trend in organic parameters of the three studied lakes is interesting. This part might be worth exploring in the future. Thus, a research outlook could be given by the authors.

Response: We have added an outlook of research on the correlation of air temperature changes and organic parameters. Elevated air-temperature could be the main driving factor in increasing productivity in Arctic lakes and some subtropical reservoirs. Sedimentary organic matter and their biomarker proxies of historical productivity are important to investigate the relationship between historical productivity and air-temperature variation. However, sedimentary organic matter comes from a variety of sources, including planktonic algae, terrestrial higher plants, zooplankton, organic detritus, black carbon, and so on. Moreover, most of organic matter is degraded during settling and

post diagenesis. Therefore, it is challenging to find the appropriate indicators for primary production in aquatic ecosystems. More work needs to be done in this field on specific organic matter proxies of productivity. Meanwhile, multiple biomarker proxies are also needed to trace the source and type of NOM and to rule out the impact of human activities. Moreover, compound-specific isotope ratios of biomarkers (e.g. neutral sugars, lipids) can provide more accurate and deep information of algal organic matter in aquatic ecosystems. Furthermore, the mechanism and modeling of relationships between air-temperature and algal organic matter parameters are worth to be exploited and established.

Specific comments/questions: Line 24: The “single neutral carbohydrate” should be replaced by “monosaccharide”, please correct it all throughout the text.

Response: We have changed “single neutral carbohydrate” to “monosaccharide” throughout the text according to your suggestion.

Line 47: The lowercase delta notation for isotopes should be italics. Please correct these all throughout the text.

Response: We have changed the lowercase delta to italics throughout the text according to your suggestion.

Line 94: The isotopic values are reported relative to the V-PDB Belemnite Standard, not just PDB.

Response: We have changed the “PDB” to “V-PDB Belemnite Standard” in the manuscript according to your suggestion.

Line 108: Is the “AC 50W-X8” right? According to the Michael’s paper in 2015, the cation resin should be “AG 50W-X8”.

Response: We have changed the “AC 50W-X8” to “AG 50W-X8” in the manuscript according to your suggestion.

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Line 243: “Fig. 3” should be “Fig. S3”.

Response: We have changed the “Fig. 3” to “Fig. S3” in the manuscript according to your suggestion.

Line 355: “Fig. S8” should be “Fig. S4”. Response: We have changed the “Fig. S8” to “Fig. S4” in the manuscript according to your suggestion.

———— Anonymous Referee #2:

This paper by Duan et al. compared organic matter characteristics ($\delta^{13}\text{C}$, C/N) and monosaccharide distributions in sediment cores from three lakes with different depths (3 m, 17 m, and 36 m) and trophic states (mesotrophic vs. oligotrophic).

The neutral sugar data is nicely presented and discussed in the context of source and changes in productivity and climate, making this a useful addition to the field. However, connections between the carbon isotopic data and the neutral sugars are not clear in the text though correlation between them is mentioned in the abstract and displayed in table S4. The manuscript would benefit from expanding on the utility of combining these types of measurements rather than discussing the data and their implications separately. After revising this and the minor (but numerous) issues below, I would recommend the paper for publication in Biogeosciences. In addition to these comments, the manuscript should be checked carefully for small grammatical errors such as missing or incorrect articles and singular/plural subject/verb issues.

Response: We have added some paragraphs and cohesive discussions on the correlation analysis and utility of combining these parameters and biomarkers. The differences and similarity of the corrected carbon isotopic composition, pyrolytic organic parameters and carbohydrate compositions have been presented and discussed. Please see the response to Reviewer 1. The corrected carbon isotopic composition is a good indicator of aquatic productivity in some of aquatic ecosystems. Pyrolytic organic

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parameters could differentiate algal organic matter and terrestrial organic fractions. Monosaccharides compositions and some of the monosaccharide ratios are appropriate proxies for identifying the specific sources and types of NOM, which can be used to reflect the historical change of productivity in aquatic ecosystems.

Minor comments: - pg 2, lines 44-48: Phytoplankton is plural so the verbs should be 'remove,' 'deplete,' and 'discriminate.'

Response: We have changed the "removes", "depletes", and "discriminates" to "remove", "deplete", and "discriminate" in the manuscript according to your suggestion.

Line 48 should be values.

Response: We have changed "value" to "values" in the manuscript according to your suggestion.

- pg 2, line 52: O'Reilly et al. (2005)

Response: We have added "et al." before "(2005)" in the manuscript according to your suggestion.

- pg 2, line 53: Verburg reference should be 2007

Response: We have changed "2006" to "2007" in the manuscript according to your suggestion.

- pg 2, line 55: It is not clear what 'it' in this sentence is referring to, please revise

Response: The "it" stands for "the $\delta^{13}\text{C}$ values in the reservoir sediment in the Pearl River Delta". We have revised it in the manuscript according to your suggestion.

- pg 3, line 58: Kirk et al. (2011)

Response: We have added "et al." before "(2011)" in the manuscript according to your suggestion.

- pg 3, lines 66-67: Typo, add 'in' after 'help'; also 'Besides' is not correctly used here,

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please revise

Response: We have added “in” after “help” in the manuscript according to your suggestion. We have changed “Besides” to “Moreover” in the manuscript according to your suggestion.

- pg 4, line 94: is this actually V-PDB?

Response: Yes, it is “V-PDB”. We have revised it in the manuscript according to your suggestion.

- pg 4, line 94: from where is ‘Product ID: GBW 04408’ sourced?

Response: The product was purchased from National Research Center for Certified Reference Materials (NRCRM), China. We have added the source of the product in the manuscript.

- pg 4, lines 107-113: Michael et al., 2015 is not listed in the references

Response: The “Michael et al., 2015” is incorrect. We have revised it to “Philben et al., 2015” in the citations throughout the manuscript.

- pg 6, line 192: Also not clear what ‘it’ refers to in this sentence, please clarify

Response: The “it” stands for “phytoplanktons”. We have clarified “it” in the manuscript according to your suggestion.

- pg 7, line 243: In this section (and in a few other places throughout the manuscript) the monosaccharide names are strangely capitalized?

Response: monosaccharide names should not be capitalized. We have revised them throughout the manuscript according to your suggestion.

- pg 8, line 281: Hernes et al. (1996)

Response: We have added “et al.” before “(1996)” in the manuscript according to your suggestion.

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- pg 8, line 292: Keil et al. (1998)

Response: We have added “et al.” before “(1998)” in the manuscript according to your suggestion.

- pg 9, line 308: Should be no ‘et al.’ for Handa, 1969 reference

Response: We have deleted the “et al.” before “(1969)” in the manuscript according to your suggestion.

- pg 9, line 316: Another unclear ‘it’ usage, please revise

Response: The “it” stands for “the k values of deoxy S/C5 in ZT, LA and XFJ sediments are low”. We have clarified “it” in the manuscript according to your suggestion.

- pg 9, line 329: Gasse et al. should be 1991 as listed in the references

Response: We have revised “2001” to “1991” in the citation according to your suggestion.

- pg 9, lines 331-332: The use of ‘algae-dominated’ and then ‘usually dominated in : : : algae’ is redundant. Additionally, the wording of ‘dominated in’ as a verb is grammatically incorrect (perhaps ‘are usually dominant in?’) and ‘algae’ is plural without the ‘s’

Response: We have deleted the “algae-dominated”. We will change “dominated” to “dominant”. We will change “algae” to “algae” in the manuscript according to your suggestion.

- pg 9, line 332: should be Haug and Myklestad, 1976

Response: We have revised “Haug et al., 1976” to “Haug and Myklestad, 1976” in the manuscript according to your suggestion.

- pg 9, line 334: typo ‘: : : the a : : :’; remove either ‘the’ or ‘a’

Response: We have deleted “the” in the manuscript according to your suggestion.

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- pg 10, line 340: the / between 'no/or' is not needed; alternatively the 'or' could be removed ('no/weak correlations')

Response: We have revised "no/or correlations" to "no/weak correlation" in the manuscript according to your suggestion.

- pg 10, line 367: this should be changed to 'neutral sugars : : : are'

Response: We have changed "is" to "are" in the manuscript according to your suggestion.

- pg 11, line 379: change 'are' to 'is'

Response: We have changed "are" to "is" in the manuscript according to your suggestion.

- pg 11, line 385: insert 'the' before 'last six decades'

Response: We have inserted "the" before "last six decades" in the manuscript according to your suggestion.

- Figure 1: Is it possible to use the same scale for all three isotope profiles? Perhaps with a range from -28 to -18 so that the reader can easily compare the three sites visually

Response: Yes, it is. We have changed them to same scale for all three isotope profiles in the manuscript according to your suggestion.

- Figure 2: The concentration range on the x-axis is quite large for the data, making it difficult to see variations with depth. Aside from the single outlier in the LA glucose profile, could these be changed to more appropriate ranges for the data?

Response: Yes, it is. We have changed these to more appropriate ranges for the data in the manuscript according to your suggestion.

- Borch et al. 1997, Gu et al. 2004, Kaiser and Benner 2000, Marchand et al. 2008,

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Philben et al. 2015, Mopper et al. 1992, Ran et al. 2007, and Wakeham et al. 1997 are listed in the references but not cited in the text. Response: The revisions have been made according to your suggestion: 1) We have deleted “Borch et al. 1997” in the reference list. 2) “Gu and Schelske, 2004” should be “Gu et al., 2004”, we have revised it in the citation throughout the manuscript. 3) Page 4, line 115: “Kaiser and Benner 2009” should be “Kaiser and Benner 2000”, we have revised it in the manuscript. 4) We have deleted the “Marchand et al. 2008” in the reference list. 5) The “Michael et al., 2015” should be “Philben et al., 2015”, we have revised it in the citation throughout the manuscript. 6) We have deleted “Mopper et al. 1992” in the reference list. 7) We have deleted “Ran et al. 2007” in the reference list. 8) We have deleted “Wakeham et al. 1997” in the reference list.

Please also note the supplement to this comment:

<http://www.biogeosciences-discuss.net/bg-2016-505/bg-2016-505-AC1-supplement.zip>

Interactive comment on Biogeosciences Discuss., doi:10.5194/bg-2016-505, 2016.

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