**Biogeosciences
Discussions**

# *Interactive comment on* "Sources and accumulation of organic carbon in the Pearl River Estuary surface sediment as indicated by elemental, stable carbon isotopic, and carbohydrate compositions" *by* B. He et al.

**Anonymous Referee #1**

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General Comments

This manuscript reports the results of a survey of the organic contents of sediments from the Pearl River Estuary. These are interpreted them in terms of organic matter source and, to some extent, organic matter accumulation. I feel that this manuscript, while containing good data, requires relatively substantial re-writing in order to ensure that a novel contribution to the literature is made. In particular it needs to be re-written to highlight any new findings, and to produce conclusions regarding the overall organic matter dynamics of the estuary in question. At present most data interpreta-

tion/discussion is focused on explaining individual features of the data, with little considerations of the wider implications of those features. I therefore do not recommend publication at present. My specific comments are outlined in the following section.

Specific Comments

At some points the text makes slightly unusual use of English, and this could lead to confusion. I suggest that it be edited once again by a native English speaker.

The way the data is presented needs to be improved. Due to the spatial distribution of sampling sites, values of ï$A$d'13C, C/N and aldose concentration and composition should be plotted on colour coded maps in order to make trends clear. At present this data is only given in tables. I would also suggest that figures 3 and 4 add little to the manuscript, and could be excluded.

It would be best if study sites could be numbered/named in a more logical way (for example with prefixes to indicate which region each is in such as estuary, inner shelf, outer shelf), so that the reader does not have to continually refer back to the site map.

Page 2891

line 6. Please add a statement to the abstract highlighting the importance and wider implications of the study (e.g. impact on our understanding of the fate of terrestrial OM in estuaries), and the novel contribution which it makes.

line 8. I think it is rather strong to say that the fate of terrestrial organic matter in the ocean is the key to understanding the global C cycle. Perhaps 'an important key' would be more accurate.

Line 17. Where you use the term 'ocean' here do you include the estuary? Please clarify.

Line 25. The phrase 'in internal heterogeneity source identification' is unclear. Please re-phrase.

Page 2892

Line 14. I suggest that the word 'recently' be deleted, as many of the studies referred to are more than 10 years old.

Line 22. Please give specific examples of how carbohydrates have been used previously to provide insight into the biogeochemical cycling of OM.

Line 26. Please give references to support your statement regarding the fate of particles discharged by the Pearl River.

Line 26. 'It is thus vital….' To 'shelf system of the SCS.'I suggest that this should be re-framed to say that an understanding of the fate of terrestrial OM in the Pearl River will be applicable to other estuarine systems. This will provide a stronger justification for the study.

Page 2893

Line 7. State which biochemical classes have been studied previously.

Page 2894

Line 5. The sampling programme was not accomplished during a single season; therefore the authors need to include a justification as to why they do not think that seasonal processes will have affected their results.

Line 9. The reference to results in Table 1 belongs in the results section.

Line 18. Please state the size in mm of a 60-mesh sieve.

Line 20. 1N HCl is fairly weak acid to use for de-carbonation of sediments prior to C/N analysis. The authors should justify the choice of acid, and provide evidence that it did achieve complete de-carbonation.

Page 2895

Line 1. 'The precision was no more than 0.2 ppt'. This phrasing is confusing. Do you

mean the standard deviation was <0.2 ppt? How many replicates was this based on? Please clarify.

Line 5. When you state your choice of sugar extraction and analysis method, please refer the reader to the later section where you justify your choice.

Page 2896

Line 25. 'identified using its relative retention time' Please state what the retention time was relative to (i.e. the internal standard?).

Page 2897

Line 5. Did this hydrolysis use the same conditions as described previously? Please state.

Line 14. Do you mean that you checked your C/N and isotopic procedure by analysing Pacific samples for which you already knew these values? It is not clear from this section exactly what you did. It is also not clear why you consider it important that the Pacific samples had a ïA̧d'13C close to marine OM and a C/N ration in line with Redfield. Please clarify.

Line 24. Is this a RSD of sugar concentrations or of spike recovery? Please clarify, and if the latter, please add the former.

Lines 16-20. This information belongs in the results section.

Page 2898

Line 25. I would suggest that the difference between the two hydrolysis techniques is likely to be largest where there is the largest amount of cellulose present, i.e. where terrestrial OM is most dominant. I therefore think that the authors should re-do this comparison using three samples, covering the full upstream-downstream range of the study. I feel that this is the only way to justify the hydrolysis methods used, and this to show that the aldose data are of good quality.

Page 2899

I suggest that this section should be called 'Results and interpretation' References to Table 1 are required at several points through this page.

Lines 10-15. It is not clear what information is gained by producing a regression of TN against TOC, apart from an averaged C/N ratio. I suggest that instead the C/N ratio for each sample should be calculated, and then plotted on a colour-coded map. This will highlight changes in C/N, and this in OM source, across the study site.

Line 24. What would the ïĄd'13C of sewage input have been, and why do you think that it did not have a measurable influence? Please also state the evidence/reasoning on which you base your conclusion that selected degradation is responsible for the dominant presence of terrestrial OM in the sediments.

Lines 26-27. Please provide references for the high Chl-a and low oxygen concentrations which you mention. Also state whether they exist in the water column or in the sediment.

Page 2900

Line 1. Please explain why the presence of Chl-a and an oxygen depletion should lead to/imply a rapid removal of labile OM. I would have thought that the opposite would apply, and that these features would suggest enhanced preservation of labile OM (such as Chl-a) in low oxygen conditions.

Line 19. Please give examples of the TNS yield values found in previous studies, rather than just stating that your values are in line with previous studies.

Line 20. Please add a figure giving a graphical representation of the average sugar composition of different types of sample. The information is very difficult to assimilate when it is only given in the text.

Line 22. From 'As compared to plant. . .' onward, this is discussion type material, and it

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could therefore be moved.

Page 2901

Section 3.3 and onwards. I suggest that the following sections be re-structured, so that there is no separation of riverine and estuarine sediments. I would describe the bulk characteristics for all samples, then move onto the carbohydrates for all samples. This will facilitate an understanding of how things change in a continuous way from the river out to the shelf. Any division of the system into sections is slightly arbitrary, and stand in the way of a whole-system understanding.

Line 15. Please state which 7 stations are being described here.

Line 25. 'A probable reason which may explain this difference. . .' The difference highlighted here is not surprising, and I don't think that comparing the bulk carbohydrates and GC methods is sensible or useful. It is sufficient simply to state that they give different values, and to state the well-established reasons for that. I am not convinced that there are any conclusions to be drawn from the difference between methods, as they are not considered comparable.

Page 2902

Line 13. Please place this description of the weight percentage monosaccharide composition much earlier in the section, ad include in a figure as suggested earlier.

Page 2903

Line 15. Please justify why sediments from the west Pacific were used to represent the marine end-member. For example, how do you know that they were purely marine? How can you show that the Pacific sediments were in any way relevant to your site, given that they were probably generated by different phytoplankton communities, sinking depths, water masses and water column chemistry? Local phytoplankton should have been used for this purpose, and I think it is highly questionable whether sedimentary organic matter from another site entirely is a valid candidate for defining the

marine end-member.

Line 19. Here you need to be able to refer to maps of C/N and ïĄď13C of your study site.

Line 28. Please state in detail what Zhang et al found, so that the reader can see for themselves whether your results are consistent with theirs.

Page 2904

Line 1. I don't see why it would be expected that the Pearl River Estuary and the Amazon delta would be in any way similar. I think you need to explain why they might show similar proportions of terrestrial OM in their sediments, and perhaps make more of the fact that they do (i.e. does this make your results applicable on a regional or global scale?).

Line 10. Sentence starting 'So carbohydrate composition. . .' Please explain the reasoning behind and justify this statement. I would have though that the opposite were true. If there are reactive and un-reactive fractions of OM then the carbohydrate composition would depend on degradation state (i.e. which of those fractions is still present).

Line 18. Please state in the text which samples/sites were put into each group.

Line 23. You should not use the term 'very significant' when describing the results of a statistical test. The test simply tells you whether a trend is significant or not. The reader can make any further judgements of their own based on the P value.

Line 26. Sentence starting 'Our results support. . .' This is not a very new or interesting conclusion and need not be included. You should concentrate on highlighting the new conclusions that your data support.

Page 2905

Lines 1-7. This section essentially says that galactose may come from almost anywhere. I would suggest that if this section is to be useful you should use it to state

where you think the galactose is from and why.

Line 7. The sentence starting 'The mixed sources. . .' appears only to say that the sediments have been analysed for other biochemical classes, which is not a particularly relevant thing to say here. Perhaps you could include more detail of the findings of the studies you reference, and state how they match with your findings.

Line 11. It would be helpful to know what the trend was from estuary out onto the shelf.

Line 11. 'Such high. . .', to 'outer shelf sediments' on line 17. Having given all this information, please clarify exactly what conclusion it leads you to in relation to your own data.

Line 29. Please state the concentrations found and the field areas studied in the previous studies which you reference.

Page 2906

Line 5. You also need to discuss whether this difference between your study and others could have been due to different hydrolysis methods.

Line 10. Why does station 8-1 have the highest percentage of ara and xyl? What does it mean, and what point are you trying to make here? Be careful to spell out all your conclusions for the reader. If you just supply them with the evidence and expect them to work out the conclusion for themselves they may get it wrong!

Line 26. Do you mean extracellular polysaccharides here? It would help avoid confusion if you use the more standard term.

Page 2907

Line 6. 'We excluded GLU. . .' Excluded glucose from what? Why mention it if it has been excluded? In any case, the variation in response to environmental conditions and diagenetic status which you use to exclude glucose is the very thing you are studying, therefore it seems sensible not to exclude it.

Line 8. This ratio should be plotted in a figure, not just included in a table.

Line 12. What were the galactose and mannose trends at the rest of the stations? If you have this data plotted it makes it easier to justify focusing in on interesting trends/stations.

Line 13. '…might be associated with the selective degradation of these two monosaccharides.' You need to elaborate on this point. What are the implications for sediment supply and decay dynamics? Where is there more or less decay, and which type of OM (terrestrial or marine) is decaying?

Line 16. Please explain more fully what you mean by 'structural features'.

Line 21. 'The sources of this highly degraded organic matter were unclear'. Surely you can suggest something based on your C/N, isotopes and sugars?

Line 24. You need to supply evidence and reasoning to support the suggestion that some OM is coming from Disneyland.

Page 2908

Line 1. 'leading to coarse suspended accumulation…'. Please clarify this statement, do you mean that there is deposition of coarse sediment in this area?

Line 5. I suggest that figure 5 adds little. You can delete it and simply describe the useful features in the text.

Line 9 and below. You imply here that there is 210Pb data presented in this paper, which there isn't (nothing about it in the methods, no table or figure of data). Please give the correct reference to this data.

Equation 4. Presumably this is applied separately to each site. Please clarify. Why do you calculate this parameter? It does not seem to be used anywhere else in the manuscript. Consider excluding, or clarify why the calculation is useful.

Lines 18 and 19. Please give units for all terms.

Equation 6. I'm not qualified to check whether this is correct. However, I can say that it is not clear why this calculation was done, and that needs explaining. I suggest that it be excluded, as results from it do not seem to be used elsewhere in the manuscript. Page 2909

Line 1. How did you calculate the average that you mention? I presume that it was spatially weighted. You need to acknowledge that this is an extremely approximate calculation, and consider whether it really has any use.

Line 4. When you refer to an average for Lindinyang Bay, please list which stations are considered to be in that sub-region of your study area.

Line 7. I don't see the use of the bulk sediment accumulation rate that you give. It is based on data that is not presented here, and it does not illuminate organic matter dynamics, therefore it should not be presented as a result of this study, which is how it looks at the moment.

Line 8. Be very careful about what you mean by organic matter accumulation. You seem to be assuming that all of the OM present in the surface sediment which you measured remains in the sediment over time. This is very unlikely to be the case, and most of it (up to 90%) will decay in the sediment over time. Therefore you cannot say that all this OM is being buried in the sediment in the long term.

Line 12. You mention the flood season. When is that? This detail needs to be included in the methods section. You also need to discuss the implications of the seasonal event on the fact that you sampled in a number of different seasons.

Line 27. What do you mean by replacement? Please clarify.

Table 1. I suggest that most of this data should also be presented in graphical form.

Table 2. I would prefer this data to be presented as a bar graph with error bars, allowing

an easier visual assessment of whether the two hydrolysis techniques were compara-
ble or not. In addition, weight percentages should be compared as well as absolute
concentrations.

Table 3. The key to the different sugar abbreviations should be in the caption to Table
2. I suggest plotting the data in this table as well.

Figure 1. This needs to be bigger and clearer, with clear labelling of which sites are
concluded in the different sub-sets such as inner shelf, outer shelf, river and estuary.

Figure 7. I don't think this plot should be included, as it presents data that was not part
of this study (not included in methods). If it stays it should be made into a colour coded
contour map.

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