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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 #2

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General comments:

The topic of this study fits the journal but the general conclusions are not new. Their two end-member model oversimplified OM cycle in a complicated environmental system. Some assumptions in the model have not been reasonably validated. For example, they assume that OM in the upper reach sediments is dominantly soil-derived. In fact, at station R01, OM from sewage source is much more important. If this is a true case, the data at station R01 should not be included to calculate mean parameters for the end-member. Second, they assume that all degradation of OM occurs before particle

settling. In a shallow and dynamic environment, a lot of labial organic matter can sink to sediments and degraded in the sediments. Measurements of reactive organic compounds such as Chl-a for sediment samples can prove this point. This study used carbohydrate compositions and specific indexes to assist identification of OM sources and microbial processes. However, both compositions and indexes seemed not to be exclusive: working for some samples but not for other samples. It may be helpful to set a new table to provide the meanings of these indexes and citation. This study also used an average sedimentation rate and entire surface area of the Lingdingyang Bay to calculate accumulation rates of sediments and sedimentary OM by assuming homogeneous settling process. Actually, export of POM from the river to the bay is very season-dependent and sedimentation rates varied largely (from 0.4 to 9.1 cm/yr at different sites) in the bay. It may be better to estimate a range of flux based on low and high parameters and discuss the potential causes for the variations.

Specific comments:

P2890-L4-5: "stable carbon isotopic (δ13C)" should be "bulk stable isotopic (δ13CTOC)" while "molecular-level analyses" should be more specific like "carbohydrate composition analyses".

P2890-L5-7: Since TOC in station R01 sediment ($\sim$4x higher than those in other sites) contains a large fraction (>70%) of OM from anthropogenic input (with a much higher C/N ratio), it should not be included to estimate average end-member parameters in the upper reach. On the other hand, data at R01 may be used to estimate parameters of anthropogenic OM end member if the natural terrestrial OM end member parameters are known from data in the upper reach stations.

P2890-L11-14: TCHO varied in a small range while TOC varied in a large rage in the estuarine and shelf sediments, so TCHO did not follow TOC.

P2890-L14-18: What does mean if a significant amount of carbohydrates were not neutral aldoses? Actually, TSN/TCHO ratios in these samples varied from 18% to

80%, which implies different microbial activities at different sites?

P2890-L21-26: The first sentence should be deleted because it repeats the following sentence.

P2891-L3: "burial efficiency of OM" generally refers the ratio between the flux at the sediment interface (x = 0) and the downward flux into non-diagenetic zone (deep sediment). In this paper, it just compares the relative fluxes of total particles and OM into the surface sediment. Thus, it may be more appropriate to use "flux ratio" or " relative accumulation rates" between particles and OM.

P2891-L23: "δ13C" should be "bulk δ13C of TOC".

P2892-L5: "in polysaccharide forms" changes to "in polymer structures".

P2892-L20-22: "insights of the organic matter biogeochemical cycle" needs more specific means such as "microbial activity" and others?

P2893-L23-24: "sedimentation types" changes to "sediment types" and "the hydrodynamics of sedimentation environment" changes to "the hydrodynamics in the area".

P2893-L25: "the eastern parts" changes to "the eastern side".

P2894-L2-3: What does mean "clayed silt"? Clay and silt have different sizes.

P2894-L5-15: "Surface sediment samples" What depth (0-1cm? 0-2cm? 0-5cm?) is for these surface samples? Because grab sampler will fold the sediments, how can the surface samples be collected as the box samples? More details are needed for sampling procedure.

P2894-L24: "The CO2 was purified" How?

P2896-L24-25: Was identification made by comparing peak retention times of samples and the standard mixture?

P2899-L8-12: If TOC and TN (from anthropogenic input) at station R01 sediment were

not correlated as equation (1), why the C/N ratio was used to estimate an average parameter of end member for TrOM in the upper reach (as in Table 1)?

P2899-L13-21: It needs to be clarified what difference between "soil derived OM" and "OM derived from land plants and undergone extensive biotransformation and/or biodegradation before deposition". What does mean "organic matter demineralization"?

P2899-L21-P2900-L6: The argument here is conflicting: high Chl-a concentration (in surface sediments?) coupled with permanent oxygen depletion does not support selected degradation of autochthonous OM. δ13C of phytoplankton varies with season and a large deposit of phytoplankton generally occurs after bloom. If sewage-derived POM (C/N > 20) and planktonic deposit (C/N $\sim$7) are all significant, the C/N ratio in the sediments can be balanced to the measured values. More evidence (e.g., biomarkers and compound-specific isotopic compositions) is needed to clarify this point.

P2900-L19-P2901-L4: Higher % of FUC in the sediment samples did not rule out the potential OM input from phytoplankton. Relatively higher ratios of (FUC+RHA)/(ARA+XYL) indicate strong bacterial activity, implying that OM has also extensively degraded in surface sediments but this paper assumes that degradation occurs only in water (before deposition of OM into sediments).

P2901-L17-19: Although TOC varies significantly from estuary to shelf, TCHO fractions in these sediment samples are almost constant. What is implication?

P2901-L22-25: The percentages of TNS in TCHO pool varied from 18 to 80 (in station 30), not 51%.

P2902-L17-22: What are Liu et al.' modeling results and how can be compared to those from this study?

P2903-L16-26: Parameters (especially C/N) for riverine OM should be corrected. Since R01 sediment receives OM from sewage source (distinctly different from other sites),

the data should not be included to estimate an average value. In fact, C/N ratios in 7 upper reach stations (not R01) varied in a smaller range (13.3+/-1.3). Therefore, all ft (fraction of terrestrial OM) values need to recalculate.

P2904-L10-12: If microbial activity is strong in surface sediments, more neutral sugars will be produced. What is the consequence for carbohydrate composition?

P2905-L1-7: Since GAL is produced by both terrestrial plant and marine phytoplankton, how can the significantly higher % in TrOC-poor sediments than in TrOC-rich sediments be explained (occurrence of phytoplankton bloom)?

P2905-L10-19: Since both ARA and XYL are abundant in terrestrial plants, why only ARA showed significantly higher % in TrOC-rich sediments (Fig. 5)? Is the correlation between ARA and GLU/RIB better than that between (ARA + XYL) and GLU/RIB?

P2905-L29-P2906-L8: If RHA is abundant in bacteria, fungi, and phytoplankton not in terrestrial plant, then the higher proportion in the upper reach sediments suggests an extensive bacterial activity while in shelf sediments, the higher proportion may indicate both bacterial activity and phytoplankton input. Is it right?

P2906-L8-13: Although at station 8-1, carbohydrate composition (the highest % of ARA and XYL and the lowest % of RIB, MAN, FUC and GAL) and bulk property (δ13C and C/N) are consistent for the dominant input of terrestrial OM, at station 5, they are inconsistent.

P2906-L22-25: If GLU and GAL are similarly abundant as cellular storage products and easily degraded, why are their distributions from estuarine to shelf sediments different (GLU – decreasing while GAL – increasing)?

P2908-L6-13: The highest sedimentation rate (9.11 cm/yr at station A3, central site of the bay) was not mentioned and what is the water depth at this site and how can this extremely high sedimentation rate occur?

P2909-L24-28: No data or calculations show that accumulation efficiency of TrOC de-

clines seaward. Low accumulation efficiency of TrOC is not only caused by degradation, but also due to a large export to shelf (preferentially compared to particles?).

P2910-L10-12: The TNS yields and the relative abundances did not suggest that degradation occurred only before settling.

Table 1: What are water depths at these sites? Mean parameters of samples from the upper reach should not include the data at station R01.

Table 2 is not necessary. One sentence may be enough to explain this point.

Table 3: The meanings of various ratios such as (GAL+MAN)/FUC+RHA), FUC+RHA/(XYL+ARA), and GLU/RIB should be provided here.

Fig. 1: It may be better to use different symbols to indicate sampling sites at different time.

Fig. 2: What are meanings of numbers followed with compound names?

Fig. 4: The ranges of end members should be changed if the data at station R01 are not included. Where is the source for marine end-member data (published)?

Fig. 5: Mark with (*) on the bars to indicate whether the differences are statistically significant.

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