Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2019-420-AC6, 2020

Biogeosciences Discussions
Open Access
EGU

Interactive comment on "Evidence of Changes in Sedimentation Rate and Sediment Fabric in a Low Oxygen Setting: Santa Monica Basin, CA" *by* Nathaniel Kemnitz et al.

Nathaniel Kemnitz et al.

kemnitz@usc.edu

Received and published: 11 March 2020

Interactive comment on "Evidence of Changes in Sedimentation Rate and Sediment Fabric in a Low Oxygen Setting: Santa Monica Basin, CA" by Nathaniel Kemnitz et al. Christopher Fuller (Referee) ccfuller@usgs.gov Received and published: 27 December 2019

This paper seeks to combine results of recent cores with those collected over the past 45 years to assess changes in sediment accumulation rate and spreading of suboxic conditions to shallower depths in Santa Monica Basin in response to urbanization. 210Pb derived sediment mass accumulation rates (MAR) are combined with pres-

Printer-friendly version

Discussion paper

ence/absence of laminations or infauna. The overall all conclusion of little change in both mass accumulation rate and extent of the low oxygen condition are generally supported by the new data in conjunction with a summary of previous studies. After addressing comments below, this paper will be a useful contribution to further the understanding of changes in sediment and geochemical dynamics in this near-shore environment.

How are constant activities in the upper 3-5 cm of cores from shallower depths defined (lines 245-250)? Are the activities within uncertainty of each other? A factor of two decrease is shown in the upper 5 cm in some of these profiles (MUC 5, 6, 7) compared to deeper depths, so not "constant" but instead upper 5 cm has a different slope than below, which can be interpreted as higher accumulation rate and/or mixing. This warrants further discussion such as whether there is a increase in MAR, or mixing is the likely cause. The reasons for excluding cores from discussion needs to be made clearer such as in lines 329-339.

Author's Response: Comment relating to "constant activities in the upper 3-5 cm of cores" was re-written and explained as constant activities in the upper 2-3 cm of cores. 3-5 cm was a little too much as most cores showed an exponential decrease below this horizon. We believe these cores on the shelf are disturbed by bioturbation and are not representing an increase in accumulation rates. We concluded this because previous studies have clearly demonstrated bioturbation via excess 234Th. While this study did not measure 234Th, it can be safely assumed that most cores were influenced by bioturbation because x-radiography showed no laminations (mixing has smeared the laminations). We will reiterate this in the text.

Turbidite layers are noted in core MUC10 (line 267), which could impact 14C profiles. Were these layers accounted for in deriving rates? Figure 10 and 11 would benefit from showing depth as well as mass on y axis. Author's Response: Yes, turbidite layers were accounted for in determining MAR. This is now more clearly stated in Figure 10 and discussed in section 4.3.

Printer-friendly version

Discussion paper

Section 4.1. It is unclear if mass accumulation rates from 210Pb profiles of the previous studies were re-determined here or if rates from previous papers are accepted as is. Did the earlier efforts account for sediment compaction?

Author's Response: This has been clarified in section 4.1. MAR were taken as is from previous studies (but we also re-calculated them and obtained similar results).

The comparison of rates within the depth regimes (Table 2 and section 4.1) uses the mean of all cores within a depth group. The means have a small standard error. However, the range in rates is a factor of 1.7 so that stating that rates are "consistent" is somewhat misleading. It would be more instructive to determine the uncertainty in each mass accumulation rate from the uncertainty in slope of unsupported 210Pb versus cumulative mass, then evaluate if rates among a depth regime are significantly different.

Author's Response: To address this point, we added MAR errors from the slope for each station/core. We also added standard deviation of the mean in each depth range (STDEV/SQRT(N)).

It would be helpful in section 4.1 to state (or remind the reader) the basis for dividing the core sites into >900 and <900-meter water depth groups.

Author's Response: We added a comment to this effect in this section.

Section 4.2, lines 318-320. It is unclear how the assignment of age was made to establish the onset of laminations, and the resulting spreading rate. Are these estimates from the literature or derived here? In either case, this warrants additional explanation.

Author's Response: These estimates were from the previous studies. We stated in clearer terms how they determined the previous rates.

The inferred step-wise change in mass accumulation rates in section 4.3 is based on 14C profiles from two cores but the inference seems erroneous. Lines 346-350 state similar MAR of 17 mg/cm2/yr for cores MUC 9 and 10, yet Table 2 lists rates of 16.8

and 12.2, respectively, for MUC 9 and 10. In addition, the comparison of two 14C rates from cores MUC 9 and 10 is made to the 210Pb MAR averages of all cores in Table 2, not to the MAR for specific two cores. Instead, the MUC10 C14 rate of 12 is in very good agreement with its 210Pb rate of 12.2 (per Table 2). Something seems a miss here in concluding a step-wise change for both sites. The ensuing discussion on lines 380-395 needs to be revised accordingly.

Author's Response: There was a typo of MUC10's MAR: it should be 14.1 mg/cm2-yr and not 12 mg/cm2-yr (we corrected accordingly). However, what was being said in this section is that MAR derived from 14C were lower (9-12 mg/cm2-yr) prior to 1900 CE than "all" the MARs derived from 210Pb values over the last 40 years, which averages 17 mg/cm2-yr. Our inference of 'step-wise change' comes from evaluating a rate of 9-12 and comparing that to a rate of 17$\pm$2. We are aware that we have only two cores to demomstrate that MARs were slower prior to 1900 CE, but we believe the confusion lies in that MUC10 has a slightly lower MAR than the average of the rest of the cores. However, given that only 1 or 2 cores from the 18 cores sampled over the last 40 years shows a MAR similar to the 2 profiles of 14C, suggests that an increase in sedimentation most likely has occurred in the last 150 years.

The statement of "nearly indistinguishable" 210Pb profiles on line 420 doesn't follow the difference in 210Pb derived MAR in Table 2 for these two cores.

Author's Response: We deleted this sentence. Statement on lines 441-443 of consistent surface 210Pb activity is not supported by the range of almost a factor of 3 shown in Table 2. Revise accordingly.

Author's Response: The reviewer is correct, 3 cores had a factor of 2 lower integrated activity than the rest of cores which averaged around 170 dpm/g. Two of those 3 cores were taken in the 1970's and the upper 1 cm was most likely disturbed due to box cores used, thus lowering its activity. A sentence to this effect has been added to the text.

Interactive comment on Biogeosciences Discuss., https://doi.org/10.5194/bg-2019-420, 2019.