

Review of Lenstra et al. 2018 - Variations in river input of iron impact sedimentary phosphorus burial in an oligotrophic Baltic Sea estuary

Decision

I would be happy for this manuscript to be published after some minor corrections.

Manuscript Quality

The paper contributes knowledge of phosphorus burial a research largely overlooked in favour of carbon and nitrogen. The research focus on the main drivers of P burial in the northern Baltic sea, though a regional study this work will be of interest to a wide audience and highly relevant to *Biogeosciences*. The authors report that in this area a significant portion of the P burial is associated with vivianite crystallisation this coupled with they're model outputs highlight an important mechanism for P Burial where increase in fresh riverine water and iron increase P burial.

The hydrological context of this research does need better clarification.

Visual Quality

Both the figures and tables are of high quality and are ready for publication.

Technical Quality

The methodologies they authors used were appropriate and applied correctly, I cannot comment on modelling. I would have liked to see the core chronologies in the main text not the Sup Mat but Table.1 does provide enough information.

Major Comments

Clarify if the flow measurement were made for the Ore river as the title and abstract suggest that the authors are directly linking river input and P burial but this is not supported by the data.

The data from the Ore river does differ from the averaged flows from the 86 other river is there a reason for this. Is the Ore and its catchment an oddity or is it comparable to other estuaries in the area.

The authors have cores form 5 sites (NB1,6,7,8 and 10) but only model site NB8. Is there a reason for this and how comparable are the different sites. From Fig.5 it is clear that all the data falls within the same ranges but NB8 is the furthest from the river mouth and a clear statement on why the model was applied to only this site would be useful.

One important question that seems to have not been mentioned is the potential for the Fe-P to be bound to FeOx. I think an additional figure illustrating downcore profile of Total Fe, FeOC, Fe-P and possibly vivianite bound P and organics.

Again line 4 Pg 13 – the refer to the years of 1977 and 1997 as high flow years but both looking at the Ore flow rates and S.Fig8 I would say that they have larger flows. I would focus more of the low flow years proceeding as the major mechanism.

Along the same lines do you have any rainfall data for this period this could be useful in further contextualising the low flows. A quick look at the UEA North Atlantic Oscillation records (<https://crudata.uea.ac.uk/cru/data/nao/nao.dat>) both 1976 and 1996 were in the

negative phase meaning dry conditions for the higher latitudes. In particular 1996 was in a very strong negative phase (NAO index:-3.27) explaining the low flows. Work completed in Scottish fjords (restricted marine environments not too dissimilar to the research area) showed that during negative NAO phases material builds up in the catchment and when the NAO switches that store of material is quickly transported to the sea – This mechanism may explain the increases in FeOx after the dry/low flow periods.

Gillibrand, PA, Cage, AG & Austin, WEN 2005, 'A preliminary investigation of basin water response to climate forcing in a Scottish fjord: evaluating the influence of the NAO' Continental Shelf Research, vol. 25, pp. 571-587. DOI: 10.1016/j.csr.2004.10.011

The authors do focus on the role of salinity as a key component of the P burial process but as the modelling only takes place at the most saline site is the importance of this overestimated. Clarification would be useful.