Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2020-231-AC2, 2020

Interactive comment on "Enrichment of trace metals from acid sulphate soils in sediments of the Kvarken Archipelago, eastern Gulf of Bothnia, Baltic Sea" *by* Joonas J. Virtasalo et al.

Joonas J. Virtasalo et al.

joonas.virtasalo@gtk.fi

Received and published: 2 October 2020

Response to Referee #1 Thomas Job

We thank referee Thomas Job for insightful and constructive comments that help improve the manuscript.

Referee has several Specific Comments, which are well justified, and which we will address as follows.

Fe-oxyhydroxides were not considered as metal carriers in the paper, because Fe typically has low relative mobility and transport in Finnish (boreal) soils (c.f., Nordmyr et

al. 2008, Marine Environmental Research). This is probably due to precipitation of Fe-oxyhydroxides in soil cracks after oxidation of sulfides, which inhibits their release from the soils. Moreover, Fe that eventually makes it to the streams, is to a large part deposited as Fe-oxyhydroxides close to river mouths (Nystrand et al. 2016, Applied Geochemistry), making it less significant offshore metal carrier. Referee is correct that Fe-oxyhydroxides deserve more attention. We will elaborate Fe behavior in the revised manuscript, and add a map of Fe contents at our coring sites in order to satisfy the international audience.

We will elaborate the inferred relationship between trace metals from acid sulphate soils, 2-6 μm grain size fraction, and C&N in the revised manuscript. The 2-6 μm lithic particles are interpreted to be constituents of the original organic-rich aggregates that were broken-up in sediments. The statistical relationship, shown by two independent methods, suggest that these organic rich aggregates were important seaward carriers of the trace metals. The weaker but existing statistical relationship between the trace metals and C&N in the PCA probably reflects marine (authigenic) source of organic material, in addition to the organic-rich aggregates that form at the river mouth.

Mn enrichment in the core tops further out at sea is a consequence of the high redox-driven mobility of Mn in the sediments. We will explain in the revised manuscript that comparable enrichment patterns were not observed for other trace metals in the studied cores. These sediments have high organic contents, and the redox transition typically is very steep, which means that newly deposited sediment is soon buried into the reducing part of the sediment column. We will explain this in the revised manuscript, but do wish to note that redox processes are not the main topic of this study, and they also are not very relevant for our interpretations and conclusions (except for Mn).

Referee is correct that bioavailability of metals is influenced by sediment redox state. We will add a statement that further data is required to determine the bioavailability of the enriched metals in the revised manuscript, as Referee suggests.

We will add a brief description of core lithologies in the primary manuscript in the revised version. Referee is correct that this is relevant information was missing.

We will add down-core logs of grain-size variability, and describe grain-size trends in the revised manuscript, as Referee suggests.

We have replicate analyses of several samples. We will add a statement about experimental precision in the revised manuscript. Referee is correct that this is relevant information was missing.

The rest of Referee's Specific Comments are justified but comparably minor, and can be fully addressed in the revised manuscript.

Referee's Technical Comments can be followed as such.

Kind regards on behalf of all co-authors,

Joonas Virtasalo, Geological Survey of Finland

Interactive comment on Biogeosciences Discuss., https://doi.org/10.5194/bg-2020-231, 2020.