Biogeosciences Discuss.,
doi:10.5194/bg-2016-222-RC3, 2016

Interactive comment on "Manganese and iron reduction dominate organic carbon oxidation in deep continental margin sediments of the Ulleung Basin, East Sea" *by* Jung-Ho Hyun et al.

Anonymous Referee #3

Received and published: 13 July 2016

The zonation of terminal electron accepting processes (TEAPs) in marine sediments and the importance of anaerobic TEAPs to the overall degradation of deposited organic carbon are concepts that all students of biogeochemistry learn very early in their careers. Nevertheless, as the authors point out, there are very few studies that attempt to quantitatively estimate the contributions of the various anaerobic dissimilatory processes to overall organic carbon decomposition. Employing a carefully calibrated set of biogeochemical rate measurements Hyun et al. tease apart the contribution of Mn, Fe and sulfate reduction to organic carbon degradation in the Ulleung Basin of the East Sea bordered by Korea, Russia and Japan. This builds on a research approach pioneered in the nineties by Thamdrup, Canfield and co-workers. Here, Hyun et al.

show that Mn reduction can be a powerful and important TEAP in during sedimentary organic matter degradation. While there are a number of assumptions built into the experiments used to estimate dissimilatoryFe and Mn reduction rates, this is still state of the art approach in sedimentary biogeochemistry. Moreover, from such experiments, they conclude that Mn reduction may be underestimated as a process in marine sediments as the techniques for studying Fe and Mn reduction require thorough and careful experimentation, as demonstrated in this study. Hyun et al.'s study is a further, solid step in the right direction and stands in stark contrast to recent efforts that only examine pore water concentration profiles (e.g. Bowles et al., Science 2014), which underestimate or miss the contribution of Fe, Mn and sulfate reduction towards organic carbon decomposition in near-surface sediments.

I especially appreciated the attempt to link the relative contribution to total carbon oxidation as a function of the Mn content of the sediment. In general, this is a solid contribution to marine sediment biogeochemistry and I look forward to using these results as an excellent example of anaerobic TEAP processes in classes for the next generation of biogeochemistry students.

Specific comments:

Line 91: The authors might want to consider estimates from D'Hondt et al. Science 2004, where areal rates of Mn and Fe reduction in the Peru Basin have been estimated. Although derived from deep sub-surface pore water profiles, it would be interesting to see how the Peru Basin site maps onto Figure 7.

Line 169: Pore water analysis....can approximate detection limits be provided?

Line 249 and following : It would be helpful to have a formula that includes the effect of SR the estimate of dissimilatory Fe (III) reduction (Equation 4) that includes the stoichiometry from Equation 5.

Line 376...."that" does not take a comma.

Printer-friendly version

Discussion paper

Line 388 and 414: Are "evidenced" and "zonated" proper verbs?

Line 440 "Consequently" not necessary

Line 489 Replace "this" with "these"

Paragraph at line 498: I find this argument to be a bit of a stretch. Basically the authors are saying because Canfield et al. had a negative result with a complexed Fe experiment that they also have no effect of ferrous iron on MnO4 reduction. This is a bit weak. The argument following at line 505 is stronger.

Paragraph starting at Line 548: I found this part very interesting. What happens when one moves out into total oxic sedimentary environments where oxygen penetration is deep and there are plenty of Mn oxide crusts (deep ocean sediment)? Should perhaps the Figure 7 refer to relative contribution of Mn reduction to "anaerobic" carbon oxidation?

Line 594: The authors might point out that they are probably underestimating total oxygen uptake. Bioirrigation might very likely play a major role in these sediments.

Interactive comment on Biogeosciences Discuss., doi:10.5194/bg-2016-222, 2016.