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Interactive comment on "Organic N and P in eutrophic fjord sediments – rates of mineralization and consequences for internal nutrient loading" *by* T. Valdemarsen et al.

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This MS discusses a topical, important and controversial aspect in aquatic ecosystem protection and restoration – the effect internal, independently of external, nutrient loading has on the water quality. While internal nutrient loading has traditionally been seen only as phosphorus release from iron hydroxides under oxygen stress, these authors define it wider, as the release of inorganic nutrients by mineralization of organic matter. To quantify such a release they performed a two-year experiment in which they incubated different types of sediments from different areas of a eutrophied fjord in both oxic and anoxic conditions and followed the fluxes of inorganic nutrients in and

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out of the sediments, production of ammonium and phosphate in anoxic conditions and the concentrations of total nutrients in the sediments. The same authors have recently published the results of organic carbon mineralization in this same experiment in Marine Ecology Progress Series (503: 41-58; 2014), stating that organic carbon accumulates in sediments and it's degradation is a slow process that delays the recovery of the water ecosystem. In this discussion paper the authors present data on nitrogen and phosphorus mineralization, concluding that internal nitrogen loading ceases much faster than that of phosphorus, which can be seen as good news for nitrogen limited systems (although the authors fail to mention e.g. that low N:P ratio favors the growth of cyanobacteria that, in turn, may release plenty of freshly fixed nitrogen to the system). The experiment has been carefully conducted and the paper is well written, with good quality tables and figures. The authors show that they are quite well aware of the shortcomings of the experimental setup used and discuss the results mainly accordingly. While the paper does not present especially novel ideas, it strengthens theories on shallow-water ecosystem recovery processes. I have very few specific comments:

Page 15114 row 5: The selected habitat types are said to have covered the whole fjord (100%) – still, for example the highest porosity found in these samples was 0.8 which is surprisingly low – are there no high-organic muddy areas in this estuary, with porosities well over 0.9?

Page 15114 row 20 on; removing macrofauna from naturally permanently oxic system makes the interpretation and generalization of the results dubious. The authors mention this shortcoming briefly in discussion as a possible source of error, and probably this is the only way to study slow processes in laboratory conditions. However, the role of macrofauna in benthic mineralisation in shallow, oxic waterbodies is very large and excluding them from the experimental setup a very drastic manipulation of the system. This might merit a bit longer discussion about the reliability of the results from this point of view. Similarly, some mention could be made about the annual oxygen and temperature conditions these sediments might be exposed to in contrast to fully oxic, 15 degree

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incubation used in the experiment.

Page 15117 Jar experiments. These experiments were run fully anoxic to prevent oxidation of end products, and homogenized probably for minimizing variation between samples. Both cutting the contact with oxygen for the surface sediments and homogenizing across redox zones heavily changes conditions compared to core incubations. These effects are not discussed at all. Was oxygen penetration to the sediments so shallow that it merited the anoxic incubation in the top layer?

Page 15117 row 25; you probably mean that the concentrations of Fe (III) were compared at the beginning (initial) and end (final) of the experiments using pairwise t-tests? the results are really surprising – according to table 3 there are no significant differences, despite increase or decrease by 2.5-3.4 times.

Page 15120 rows 18-25; there seems to be some words missing and some in excess in the text (check grammar).

Page 15123 general comment on all the discussion about the sandy site: Sandy sediments are usually permeable, which means they operate by advection, not by diffusion. Enclosing sand in a core, out of reach of advective flow, changes conditions in the porewater dramatically. Recent research has indicated sandy sediments as areas of extremely high mineralization despite the low organic content. The authors mention that the sandy sediment came from area affected by with wind driven waves, deeply burying macrofauna and intense microphytobenthic production. None of this could be reproduced in the experimental setup, which questions the interpretation of the results on this site.

Page 15124 row 25 typos- subscripts instead of superscripts in Mkg.

Page 15128 Ecological implications – the first half of the chapter is very repetitive and could be pruned heavily.

Page 15138 Table 2 should show “average TN:TP ratios” but it does not.

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Page 15146 Figure 5 DIN= NH4+ + NOx- in figure but DIN= NH4+ + NO3- in legend.

Page 15147 Figure 6 I am not sure this figure is really needed, although it is nice.

Interactive comment on Biogeosciences Discuss., 11, 15109, 2014.