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Interactive comment on "Temperature response of denitrification and anammox reveals the adaptation of microbial communities to in situ temperatures in permeable marine sediments that span 50 in latitude" *by* A. Canion et al.

Anonymous Referee #2

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The paper decribes measurements of denitrification and anammox rates in permeable sediment from different latitudes, including analyses of the temperature dependence of these processes in short-term incubations. The novelty lies in the temperature aspect with this paper probably being the first to compare sites across climate zones.

The study is well conceived, performed with care and good quality in the analyses, and it is clearly written with generally sound and straight-forward conclusions. A few issues need clarification, and the discussion needs to go deeper in places where the interpretations are somewhat simplistic.

The main general issue is that the temperature dependence results are discussed as if they only reflect enzymatic temperature dependencies in different populations with fixed temperature characteristics, which is an over-simplification. The temperature dependence of microbial respiration depends not only on enzyme kinetics, but also on factors such as the fluid state of lipid membranes, which clearly could affect the functioning of respiration chains and might well contribute to the distinct temperature characteristics of anammox bacteria and nitrifiers known to be particularly dependent on intracellular membrane systems. The ability of bacteria to adjust membrane composition (acclimate) to temperature is well-known (I believe there are even studies with anammox bacteria), which implies that respiratory rates may also show an acclimation response on the time scale required for lipid synthesis. Acclimation could also include differential enzyme expression. Altogether this means that a different temperature response might have been observed even without population change had the organisms been allowed to acclimate. The similarity between seasons for denitrification at the Sylt site argues against this as an huge issue, but nonetheless it needs to be discussed.

Another issue that there is too much focus on the optimal temperature relative to the temperature response in the environmetally relevant range (e.g., only T-opt and not Ea is mentioned in the abstract). The authors cite Feller and Gerday who correctly note the irrelevance of T-opt particularly for organisms in colder environments, but nontheless continue to focus on T-opt. T-opt is an easily recognized and understood parameter, but it really only indicates the point where organisms begin to malfunction. I suggest to focus the discussion more on the relevant range.

Specific comments: 14602, 4: I believe that it is statistically more correct to make a non-linear for of the Arrhenius equation directly to the data, but regardless, it is ot clear how a ”linear range” can be defined BEFORE the linear regression is made. For clarity the fitted function should be included in Fig. 3 and 4. I further recommend to list Q(10) values together with Ea. Although this is in principle redundant, Q(10) values are much easier to understand and use for quick estimates of temperature effects.

BGD
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Table 3 and throughout the text: Given the uncertainties in rates, it makes little sense to report single optimum temperatures for most experiments. Ranges as those given in parentheses in Table 3 should be used throughout. You might consider if a statistical definition of the T-opt range (i.e. range of values not significantly different from the highest value) would beetter than the 90% definition, though it would not make a big difference.

14610, 25: It is also relevant to compare to values for other benthic respiratory processes - could could temperature changes switch the partitioning between pathways?

14611, 4: I am not convinced that there is significant difference between summer and winter results.

Fig. 5: Mention that curves are hand fitted (?) and avoid the initial decrease in rates at the Arctic site.

Interactive comment on Biogeosciences Discuss., 10, 14595, 2013.