

## ***Interactive comment on “Nitrogen cycling in the subsurface biosphere: nitrate isotopes in porewaters underlying the oligotrophic North Atlantic” by S. D. Wankel et al.***

**Anonymous Referee #1**

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This is a very interesting paper about N processing and cycling in deep ocean sediments underlying oligotrophic waters. The authors measured nitrate dual isotope profiles next to nitrate concentrations. An inverse reaction diffusion model was used to calculate rates of nitrification and denitrification which fit the observed profiles. Their model also returned estimates for the isotopic discriminations associated with denitrification and the isotopic composition of nitrate produced by nitrification. Overall I found the text very clear and their discussion and conclusion sound. I consider my comments listed below as minor.

General considerations: When integrated over the whole sediment height the model calculated nitrification and denitrification rates closely compensate each other with  
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trification slightly exceeding denitrification (case of core 2B). Does this suggest this whole sediment layer is in some kind of steady state for  $\text{NO}_3$ ? If so it would imply that areas where oxidants ( $\text{NO}_3$ ) are produced are ‘connected’ to areas where it is consumed in the respiration process. Is this interconnectivity between layers taken into account in the modelling approach (which tackles the oxic and anoxic sediment intervals separately)? How would such a connection work? Is it possible that a microbial system would operate similar to what is known for cable bacteria in coastal environments? The sediment column (B2) integrated activities would also imply a whole sediment column integrated chemolithotrophic microbial C production rate of some 1.5  $\text{gC/m}^2/\text{d}$ , balanced by an approx. equal amount of organic C being oxidized by nitrate reduction (1.3  $\text{gC/m}^2/\text{d}$ ). To what extent can  $\text{N}_2$ -fixers contribute to such C production rate? Authors argue that core 44, which shows little variability in nitrate isotopic composition, is characterized by substantially lower levels of microbial activity due to very low organic carbon levels. For sites which are separated from each other by only a few Km and with similar sediment thickness for 2B and 4A (reflecting similar accumulation rates) this appears as strange. It would be nice to have some idea about the organic C contents of the different cores. Defforey and Paytan 2015, report organic P contents for cores 4A which do not appear as very different from those at 2B and 3D. Can authors comment on whether or not this also could hold for organic C?

Specific comments: P13551: While available in Edwards et al., it would be nice to reproduce the map locating North Pond and the core sites. P13552: Authors should provide more details about analytical methods for assessment of concentrations and stable isotope composition: In particular the limits of detection for  $\text{NO}$ ,  $\text{NO}_2$  should be indicated. Apparently sulfamic acid treatment was applied only for cases where  $\text{NO}_2$  was detected; on from what concentration level was sulfamic acid removal applied? Ammonium is reported (P13557, L10) to be less than ‘measurable’; please mention the method and the detection limit for  $\text{NH}_4^+$ . P13563; L21: micro-aerophilic respiration: please clarify P13564; L23 and P13565; L16: “extremely low levels of organic material” please specify the POC concentration P13570; line4: please clarify what is meant by

biologically catalyzed equilibration P13571; L8: "incorporation of dual nitrite isotopes"  
.. would such incubation experiments be feasible? Decompression effects may cause  
a major problem.

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