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Discussions

Interactive comment on "Heterotrophic denitrification vs. autotrophic anammox – quantifying collateral effects on the oceanic carbon cycle" *by* W. Koeve and P. Kähler

Anonymous Referee #2

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This paper provides a link that has been long missing from the denitrification/anammox debate. This is the need for rigorous stoichiometric modeling of the processes and evaluation of the mass balance requirements of the system. Performing the analyses for both standard and N-enriched organic matter is also quite useful, as this makes it clear that the composition of organic matter cannot possibly be tweaked enough to change the conclusions. The paper reaches the unintuitive conclusion that the OMZs must be net heterotrophic at all times, even when the ratio of anamox to denitrification is impossibly high, and sets limits for the relative contributions of the multiple processes.

Given that complete correct stoichiometry is one of the main goals of the paper, it

seemed strange that anammox was represented without any overt carbon stoichiometry. Why not use the complete equation presented by Kartal et al (2008)? In Table 1, the authors state that the very small amount of C fixed per N oxidized allows this to be ignored, and that the 0.07 N:C ratio is included in the model. It's probably true that this small C sink makes no difference to the calculation, but it is the essence of the autotrophic argument and to my mind, omitting it undermines the argument.

Kartal et al equations:

1NH4 + 1.32NO2 + 0.066HCO3 + 0.13H+ $\rightarrow$ 1.02N2 + 0.26NO3 + 0.066CH2O0.5N0.15 + 2.03H2O (1)

NH4 + NO2 $\rightarrow$ N2 + 2H2O (2)

0.26NO2 + 0.066HCO3 $\rightarrow$ 0.26NO3 + 0.066CH2O0.5N0.15 (3)

The Kartal et al. equations also include the oxidation of nitrite to nitrate, which supplies the reducing power for CO2 assimilation in the anammox organisms. Is this additional NO2 sink and NO3 source included in the model? It is a rather substantial effect on the NO3 balance, in that for 1.32 NO2 consumed, 0.26 NO3 is produced along with 1.02 N2.

One very useful purpose of this paper is to explore the theoretical possibilities, which includes evaluating the full range of ratios of denitrification to anammox and the full range of "denitrification efficiency". It would, however, be useful to the reader to point out the range of values that are actually encountered in nature. For the major OMZs, the value of the ratio NO2 accumulated to NO3 removed is often around 0.5. Just to present a few values, perhaps as marks on the plots, would help orient the reader and make the significance of the exercise a bit easier to comprehend.

I found the axes labels somewhat confusing. For example, in Figure 3, I thought at first that the slashes in the Y axis labels were functional, implying division by a denominator. Then I figured out, I think, that the text below the slash is actually a unit, an explanation of the axis label. So for 3a, the Y axis represents the amount of NH4 that is derived from DNRA as a percent of (DNRA + DNRN). This might be a better way to label the axis: DNRA/(DNRA+DNRN). In general, if the axes could be labeled more clearly to reflect the processes to which they relate, it would be much easier to understand.

There is a minor but important typo on line 8 of paragraph 2.1. I think that “nitrate” should be “nitrite”.

Interactive comment on Biogeosciences Discuss., 7, 1813, 2010.