

Interactive comment on “Nitrogen cycling in shallow low oxygen coastal waters off Peru from nitrite and nitrate nitrogen and oxygen isotopes” by H. Hu et al.

Anonymous Referee #3

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General impression This manuscript presents a suite of what appears to be high quality N-isotopic data from the Peru margin OMZ. From these data they draw conclusions that seem relatively sound. However, right now the discussion is rather unfocused and sometimes redundant and their data is not put into the context of the larger global data set on N-isotopes in OMZs. For example. Although they note the difference between the epsilon values calculated from their data and Bourbonnais et al. and briefly mention values from the ETNP and Arabian Sea, there is no thoughtful discussion of these as a whole. Elaboration of these points follows below. Consequently, my opinion is that the manuscript needs revision before publication. Scientific Page 7265. On this page they give the equations for open and closed system calculation of epsilon. They say

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“The fraction of remaining DIN is a better estimation of the overall isotope effect for N-loss (Bourbonnais et al., 2015), while using NO₃ as the basis to calculate ϵ specifically targets NO₃ reduction.” I agree DIN is better. OK, so on line 2 they give the equation for $\delta^{15}\text{N}_{\text{NO}_3-\text{NO}_3}$ which has no equation number and then on line 3 for $\delta^{15}\text{N}_{\text{NO}_3-\text{DIN}}$ which is equation (1) and they use the corresponding values for f for each equation. If I have this correct, the $\delta^{15}\text{N}_{\text{NO}_3-\text{NO}_3}$ equation is the one they say is specifically for NO₃ reduction. It seems to me that almost all of their samples have NO₃ and NO₂ and some N-deficit. In that case then this equation is not NO₃ reduction to NO₂ because some went to N-deficit and it's not denitrification because some remains as NO₂. Why do this calculation? What does it mean?? The same comment applies to the open system equation (line 15).

Page 7267 line 11-13. Why do they say the upwelled water appears to be a single water mass...originating from the offshore OMZ? Why can't it be a coastal undercurrent. Do they have evidence for stronger wind forcing at station 63?

Page 7271 line 15. “ $\delta^{15}\text{N}_{\text{NO}_3-\text{N}_2}$ anomaly ranged from -0.2 to +0.1.” Figure 8c shows that most anomalies are negative and only highest biogenic N₂s have positive anomalies. What would cause a negative N₂ anomaly? I don't think this is ever discussed.

Specific. Page 7259 line 27, DIN=NO₃, NO₂ and NH₄ should be DIN=NO₃+NO₂+NH₄
 Page 7260 line 11. The sentence starting with “Canonical” says epsilon associated with NO₃ reduction. NO₃ reduction is the reduction of NO₃ to NO₂. Do they mean NO₃ reduction or canonical denitrification, which is NO₃ to N₂? The studies by Brandies et al and Voss et al and Granger et al that they cite are actually equivalent to their DIN because they measured NO₃+NO₂ Page 7260 line 13 “are ranging” should be “range”
 Page 7260 line 15 “...sedimentary denitrification is highly suppressed in the water column.” This is confusing (although I think I know what they are trying to say). Delete “in the water column”.
 Page 7261 line 22 Ryabenko et al not in References
 Page 7262 Line 20 name of the manufacturer of the CTD/Rosette and O₂ sensor and type?

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This is important because we are talking about processes that take place at the limit of detection of O₂ sensors. How were the O₂ sensors calibrated? Page 7262 line 1. They say “NO₂ samples were collected and stored inHDPE bottles” but on the previous page they say the samples were collected in Niskin bottles. Delete the word “collected”. Page 7262 line 14. Same for NO₃ samples change collected to stored. Page 7263 line 21. I assume for nutrient analysis that DIN=NO₃+NO₂ was done by Cd reduction and NO₂ was done colorometrically and NO₃ was determined by difference. How do their concentrations measured by their methods compare with the hydrographic ones?

Page 7265 Line 20-22. “. . . .increasing noise with small levels of biogenic N₂ (up to 20 μ M in this study)” This makes it seem like 20 is the small level with increased noise. Why not just say something like “. . . .greater than 7.5 μ M because of increasing noise below this level”

Line 7268 line1. “. . .below this value.” What value? Does this refer to undetectable or 10 μ M? And then on line 4 “. . .such low concentrations..” Again, what are such low concentrations. Any good O₂ sensor should be able to go somewhat below 10. Then on line 14 “O₂-depleted zone”. Is there a difference between OMZ and O₂-depleted zone? What oxygen values define the OMZ and O₂-depleted zone?

Page 7269 Line 3 is the slope of 0.86 statistically different from 1.0?

Page 7269 Line 20. They are using the biogenic N₂ data before they present it. Shouldn't they present the data first. Also in this section that present results of epsilon calculation for changes in d15N-DIN and d15N-NO₃ using equations 1-4. However the equations for d15N-NO₃ have no equation numbers. Shouldn't they have numbers?

Page 7220. Lines 8-11. Again, they say for “NO₃ reduction alone” but Brandes et al., Voss et al., Granger et al and Cline and Kaplan did their studies with N+N not nitrate alone.

Page 7220. Line 21. What are d15N-N₂ anomalies. I think this means the deviation

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from atmospheric equilibrium but I'm not sure. If that is indeed what they are, how do they compare to those given by Brandes et al., and Chang et al.?

Page 7272 Paragraph starting on line 6. Much of this is a repeat of a previous paragraph. Condense this into a single paragraph.

Page 7272 line 14. “have” should be “has”

Page 7273. Paragraph starting on line 4. There is a lot of background here but it is generally not summed up as to how it might explain their data. One is left with the general feeling that we don't really understand much more than we did before. Is there a conclusion they can draw?

Page 7273 line 3. “M90” In the methods you say this paper is from M91. Is this just a typo. If not you need a reference for this.

Page 7273 line 9. Sentence starting with NO₂ oxidation. First, use the word Nitrite at the beginning of a sentence. Second, is this sentence really necessary, all this has been explained before?

Page 7273 line 26. Delete the word “presumably”.

Page 7275 Lines 16-18. “our data suggests (sic) NO₂ oxidation up to only up to 80% of total NO₃ reduction.” On the bottom of page 7272 they said “the dominance of NO₂ reduction over oxidation. 80% to 100% doesn't seem like dominance to me. Also, it should be “our data SUGGEST”.

Page 7276 lines 13-15. I'm not sure how this tests the assumptions in the balance. What is the result of this test, and what do they think is correct. They then go on on line 19 of this page to say that relationships are not sensitive to the method of calculating epsilon. This seems that it's not much of a test.

Page 7279 line 25. Concentrations of what were “relatively low? Concentrations of oxygen or concentrations of the different N species?

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Page 7280 lines 23-25. Again in the T/S plot I see a surface mixed layer (above 14 degrees C) and a deeper mixing line pointing at some unresolved water mass (points in the box). So I would like to see their choice of epsilon of 7 better supported.

Table 2. What does “error on slope” mean? Is it S.D. or confidence limits on slope or what at what level of significance?

Figure 5. The x-axis in panel C should be smaller, i.e. from -30 to zero, so we can see the scatter better. Also, for this figure and others, are all regressions significant at the 0.05 level?

Figure 7. is the regression line for the >30 m data only or for all data?

Again, I think it is important that all the data be available as supplementary information to this proposal.

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