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Interactive comment on "Latitudinal variations of δ^{30}Si and δ^{15}N signatures along the Peruvian shelf: quantifying the effects of nutrient utilization versus denitrification over the past 600 years" *by* Kristin Doering et al.

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By Patrick Rafter*

Summary The manuscript brings together new sedimentary d30S8 and (published) water column isotope measurements to examine the spatial and temporal variability of nutrient consumption in the Peruvian upwelling zone. This manuscript then applies a relationship between coretop sediment d30Si and d15N to estimate past changes in the source of upwelled nitrate d15N. This is an interesting application, but I have some

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suggestions that I think are both necessary for supporting the core argument and will greatly improve the readability and therefore effectiveness of this manuscript.

Five suggestions to improve the manuscript First, I think the d30Si and d15N relationship in Figure 4A must be examined in a more robust manner. For example, I don't think it is appropriate to simply state that the surface sediment core measurements "remain close to the respective 1:1 utilization line" for nitrate to silicate in Figure 4A. This needs to be shown, regardless of this approach being previously published by Ehlert et al. (2015). Specifically, the study would be improved with a more precise quantification of this relationship in Figure 4A. Similarly, the frequent use of "correlation" in the text (n=9) is not supported with any statistics. This must be fixed.

Second, I think it would improve this study if the "nutrient utilization" plots in Figures 2 and 3 were separated instead of overtop each other. The estimated nitrate and silicate utilization by phytoplankton should be on separate plots.

Another strong recommendation is to compile the sediment core measurements per latitude in Figure 3 in a more comprehensible way. The reader will have a much easier time understanding the relationships in Figure 3 if they: (1) Show one measurement at a time and (2) Are "stacked" from low to high southern latitudes. In this new figure, the bulk sediment d15N for all sites will be shown 'stacked' in one column that moves from 11°S at the top to 15°S at the bottom. This new arrangement of the Figure 3 data will include the same data, but in a more easily understood arrangement and will allow the reader to identify the spatial and temporal variability of each proxy.

Fourth, the use of sedimentary percentages is not appropriate; we must see the percentage data expressed as a mass accumulation rate or MAR. This needs to be changed before I would have confidence in the interpretation (any interpretation) of the percentage measurements. The addition of MARs may actually improve the interpretation of the data, since there seems to be some confusion in the interpretation of these measurements (see Lines 204 and on).

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Finally, I don't think the Discussion section is the location for describing every individual wiggle of the observations and /or the estimated source nitrate d15N. I think that an improved manuscript would have a robust statistical examination of the surface sediment d15N and d30Si (from Figure 4) in the Results section followed by text that describes the temporal variability of Figures 4 and 5. In this way, the Discussion section can be used to discuss the observed / estimated spatial and temporal changes, which will be more easily understood and (I think) enjoyable for the reader. No one wants to read a listing of which way the wiggles are wiggling and when. :)

Line-by-line notes: Figure 2: Illustrating the nutrient utilization in this way is not helpful. I would discard this plot and explore other options.

Figure 3: As I mentioned above, these plots are almost impossible for the casual reader to understand. I would re-plot using one observation at a time. Furthermore, they should move from lowest latitude at the top to highest latitude at the bottom (this is intuitive).

Figure 4: Incorrectly labeled as Figures A and C-E in caption.

Figure 5: Once again, the nutrient utilization plot is painful to look at and I cannot interpret it. Re-format. I also suggest that the percent sedimentary concentrations be converted to Mass Accumulation Rates.

Figure 6: This is probably the most useful of the figures.

Line 28: I don't think "humid conditions" is appropriate at this point; it is not common knowledge, it is not supported with evidence, and is out of place in the Abstract.

41: The isotope effects of nitrate assimilation were estimated at sites across the Pacific basin in Rafter and Sigman 2016. This is blatant self-promotion, but it is entirely relevant when citing reasonable isotope effects in the tropical Pacific (we found an average of 6 per mil). We also identify the origin of variability between Rayleigh (closed system) versus Open System isotopic fractionation.

62: This is a good sentence.

72: The statement that sedimentary d15N and d30Si variability “mainly depends on the degree of utilization of both nutrients” is not correct. This statements is disproven by this study’s own Figure 4 and text later in the manuscript. This text should be restated.

81: remove “been”

89: remove “too”.

99: When dealing with nitrate d15N, a difference in source waters of 5.5 to 7.0 per mil is quite large. Especially considering the small spatial difference between these sources.

139: The use of “BP” in age models is universally acknowledged to refer to the year 1950 of the Common Era. The date of BP cannot be adjusted to a new year. This will inevitably lead to much confusion.

201: Sedimentary concentration measurements are common, but they are not useful or appropriate proxies in 2018. MASS ACCUMULATION RATES are necessary. Apply and then we can re-examine the records.

273: correlation must be associated with an examination of the statistics.

*Why I am signing all my reviews Full transparency of peer reviews makes reviewers accountable for their work. I say this based on my own experience; my signed reviews are more thoughtful and useful, which leads to better science.

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