

Interactive comment on “Contrasting biogeochemistry of nitrogen in the Atlantic and Pacific oxygen minimum zones” by E. Ryabenko et al.

Anonymous Referee #1

Received and published: 4 October 2011

Besides the appealing perspective of the manuscript – comparing these geographically analogous but nevertheless very different OMZ's – I found the most novel findings to be (1) the observation of very low DIN d15N in the upper 100 m of the eastern tropical Atlantic and (2) the isotopic distinction between off-shore and shelf OMZ nitrate in the ETSP, consistent with a greater signal of benthic N loss near the shelf. I have a major concern about (1) above, which I describe first. Then I have a question about the data in Figure 4.

The authors interpret the very low d15N of DIN in the upper 100 m in the eastern tropical Atlantic (Figure 5) to be the result of low-d15N atmospheric N deposition. As

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discussed in the text, it is uncertain whether dry deposition of nitrate could ever dominate the sources of the low levels of nitrate in the surface layer, to the degree that their interpretation requires to explain the very low DIN d15N relative to the nitrate supply from below. In the long term, the nitrate supply from below is likely to be much greater than the total atmospheric N inputs. Thus, the authors suggest that they might have caught transient events leading to temporary conditions under which large atmospheric inputs might dominate the surface DIN reservoir. This is plausible and very interesting.

However, it seems problematic for this interpretation that some of the very low DIN d15N samples occur in water samples with substantial nitrate concentrations (1–20 micromolar). Here are the major cases of this that can be picked out from Figure 5: The red station (station 5?) has DIN d15N of about 4 permil at 40 m, where the nitrate concentration is 20 μM . The brown station has a d15N of about 1 permil at 50 m depth, and this water also has 20 μM nitrate. The green and purple stations have a d15N of 0 and -3 permil in waters with 1–2 μM nitrate. The black station samples at 60 and 80 m have 6 and 10 μM nitrate with a d15N of 1 and 2‰. Lacking additional information, I cannot see how the authors' atmospheric N input interpretation could explain these data. It would seem to take an impossibly large input of atmospheric N to lower the d15N of nitrate so much in these high-nitrate samples. Or to be more precise, this is implausible as a short term impact. Low nitrate d15N might accumulate in the subsurface over years, but then it should be evident in broadly distributed subsurface water masses. As far as I can tell (from Table A1), the authors do not observe coherent zones in the interior with substantial concentrations of nitrate and yet consistently having extremely low nitrate d15N (i.e. near 0 permil). They apparently only observe it sporadically at the top of the nitracline.

Now for a separate issue. In Figure 4, the upper panels show the data for a South Pacific OMZ profile (station 84). In the far right panel, the d15N of nitrate, nitrite, and nitrate+nitrite are each plotted. I cannot see how the d15N of nitrate+nitrite could be higher than the d15N of both the nitrate and nitrite as measured separately; mass

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balance requires that the $\delta^{15}\text{N}$ of nitrate+nitrite be between them. Are these data all for the sample profile?

Minor: –Table 1: The F_{total} equation cannot be correct, among other things. The assimilation is a nitrate removal terms, with an isotope fractionation, not a $\delta^{15}\text{N}$.

Interactive comment on Biogeosciences Discuss., 8, 8001, 2011.

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