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Biogeosciences Discussions

Interactive comment on "Nitrogen stable isotopes of ammonium and nitrate in high mountain lakes of the Pyrenees" *by* M. Bartrons et al.

Anonymous Referee #1

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General comments:

This manuscript presents a dataset on variations in 15N isotope signatures in lakes in the Spanish Pyrenees. It is a valuable dataset that will be useful in the community. However, the paper needs significant revisions before it should be considered for publication in Biogeosciences. One major issue is that some of the interpretation of the data needs to be reconsidered. For example, one of the major conclusions of the paper is that catchment nitrification has a large influence on the N cycle of these lakes, but there are no data from streams or soils to defend this claim. Also, much of the data interpretation is from the perspective of explaining algal 15N patterns, but there are no primary producer data presented to back this up. Finally, the conclusions section contains many apparent errors and is contradictory in parts. In general, I think this

is a good dataset worthy of publication, but in the present form the manuscript is not suitable for this journal.

Specific comments:

Page 480, abstract: Overall I would like to see more strong conclusions in the abstract. This will help attract readers to your paper.

Page 480, lines 8-9: Was the 15N of atmospheric N estimated or measured? Can you add a sentence explaining the concentration patterns observed in atmospheric deposition.

Page 480, line 12: What kinds of samples are you referring to in this sentence?

Introduction, first paragraph: I think this paragraph should be rewritten to minimize the focus on interpreting primary producer 15N data, since you don't actually address this question in the paper. Why not frame the paper as an exploration of the variability of 15N of lake water versus altitude and how environmental variables can affect observed isotope ratios? This seems to be the main question that the paper can address. You can also say that 15N data such as yours can be valuable for studies of, yes, primary producer N sources, but also as tracers of atmospheric pollution and N cycling pathways.

Page 481, lines 10-12: I thought oxidized nitrogen such as nitrate was the primary form of atmospheric N deposition. Can you cite more papers that show that NO3 and NH4 are deposited in equal proportions?

Page 482, lines 16-18. Here you say that there are two main sources of N to mountain lakes, soil catchment (I think you mean soils in the catchment) and sediment pools. But on the previous page, in lines 9-10, you say that atmospheric deposition is the dominant source of N to mountain catchments. Don't these two paragraphs contradict each other? Is there a way you can estimate the main source of N to your lakes with your concentration data? For example, can you estimate the N flux from streams,

sediments, and the atmosphere? This would really make your paper stronger.

Page 482, last paragraph: Can you make this paragraph more clear? It might be helpful to state how you expect d15N to vary with depth and altitude, perhaps in the form of hypotheses.

Page 482, lines 16-18: Can you be more specific about how altitude affects lake biogeochemistry? Is it just because of temperature?

Page 484, lines 7-16: This paragraph needs more specifics. Are you collecting wet or dry deposition, or both? How was it collected? Why don't you describe the 15N-NH4 analysis here? Also, isn't refrigeration at -20°C essentially freezing?

Page 485, lines 5-9. Some of the methods described here don't have data shown in the results or figures (e.g., LOI, DIC). Conversely, some of the parameters shown in the table are not explained in the methods (like DOC).

Page 486, line 18: I don't think the isotope data are "very distinctive" as stated here. But, this may be because of the way Figure 2 is shown. Most of the d15N values do not appear to be different from each other.

Page 486, line 23: Can you provide all the data for d15N of NO3 and NH4 of deposition in a table, perhaps with the concentration data? This will be valuable for other researchers.

Page 487, lines 3-4: "It is worth to highlight the low variability..." Can you be more specific here? What about the average $\pm$ the standard deviation?

Page 487, line 5: Aren't nitrate concentrations higher in the water column than in porewaters? I think the statement here is only true for NH4+.

Page 488, line 5: Here again you state that most of the N loading from the catchment is in the form of nitrate. You need to be able to provide some data to back this up or else just cite that in other studies (on other continents!), the dominant N species in

streams is NO3. As I said above, I'm not really sure this is actually true. There may be a substantial DON component to these streams.

Page 488, line 15: It seems like from Figure 2 that there is actually a very high standard deviation of NH4 concentration in porewaters. Be careful not to oversimplify your data.

Page 488, line 17: "high variability in water column values" – again, this seems wrong to me. In Figure 2, it appears that NH4 concentration is not variable at all in water column samples?

Page 488, line 17: "buffering mechanism". I don't know what this means! I'm pretty sure you don't mean a buffering of pH changes, but I don't know what else it could mean. Please explain!

Page 488, line 21: "SPW convergence among lakes" – what do you mean by this?

Page 489, line 9: Here you cite a study on lakes in Colorado to defend your statement that inflow waters to the lake are low in NH4+. You need to explain why you feel this is justified.

Page 489, lines 16-17: "In addition, the nitrification influence can be more apparent at lower the NO3- concentrations." What is the significance here? Why does Figure 4 back this statement up? Wouldn't more nitrification cause higher NO3- concentrations?

Page 489, lines 21-30: Here you say that NH4+ concentrations are low and similar among lakes. On the previous page, you say that there is high variability in NH4 water column values? Please get these issues straightened out.

Page 490, lines 2-3: Here you say that external sources of N are only relevant during thawing. But you have dedicated a significant portion of this paper to explaining why nitrification in soils is a major control on your observed N isotope patterns. This doesn't seem to add up.

Page 490, line 4: Are you sure there is a significantly higher d15N of NH4+ in deep

waters as opposed to epilimnetic water? In Figure 2, it seems clear that there is no difference.

Page 490, lines 10-21: I'm not sure how to interpret this paragraph. Why would greater NO3 uptake affect NH4 isotopes? And why is this relevant to the paper?

Page 490, line 23: Can you add some examples of other N cycling processes that may be taking place in these lakes?

Page 490, line 26: I think you haven't quite explored the denitrification angle here. If denitrification in the sediments is so prevalent, it seems unlikely that you would see no signature in 15N of NO3 emitted.

Page 491, lines 1-8: I think you really need to provide some quantitative information here about these different processes. Using your data, can you make estimates of the magnitude of these rates? Also, I'm unclear on how NO3- uptake is relevant to your data. You state repeatedly in the paper how primary producers don't like to use NO3. So why is it such a major process in your lakes?

Interactive comment on Biogeosciences Discuss., 6, 11479, 2009.