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Interactive comment on "Nitrate retention capacity of milldam-impacted legacy sediments and relict A horizon soils" *by* Julie N. Weitzman and Jason P. Kaye

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General comments

The topic of the manuscript is suitable for the journal Soil. It reports on nitrate leaching from two soil horizons originating from sediments behind a milldam and from an older horizon buried under them. From the regional prevalence and from the high leaching rates observed, this study is certainly justified. The topic is very well explained in the introduction, which describes not only the specific questions of the study but also the geographic and historic context. The presentation of the site is extensive and very well written.

The main value of the experiment lies in the fact that such soil profiles have barely been studied in this manner. This value is, however, limited in the sense that it covers

only one site. It is therefore not obvious to draw conclusions for other sites impacted by milldam sediments.

The study was conducted on soil columns, which is an efficient way to measure leaching. Nitrate added to these columns was labelled with 15N, which allows to distinguish it from soil-derived nitrate. It would have been useful to add also a biologically inert tracer like bromide, to be able to distinguish between physical and biological processes. This would have especially been useful to ensure a better interpretation about preferential water flow, which may have been favoured by the mechanical extraction of the soil columns, as the authors note. A dye may also have been useful to answer this question. For the interpretation of the flow regime, the authors analysed the texture of the soil and estimated hydraulic conductivities. However, they do not describe the structure of the soil, nor if there were roots in the soil columns. In spite of the weight of the sediments, the buried, relict A horizon was found to have a high porosity, but it had a low hydraulic conductivity: this may be due to an horizontal structure within this horizon, with some less permeable layer. It is at least not likely that a former A horizon would be homogeneous over 30 cm in depth (even if it had been ploughed, then at that time certainly not so deep). Without a proper description of the structure, interpretations about the flow regime are difficult. It would certainly be useful to compare the measured water infiltration rates with those predicted by the parameters of table 3.

The results about general soil properties are given after the results of nitrate leaching. The contrary would certainly facilitate the presentation and discussion.

Further, the question of N saturation (especially its kinetic aspect) would require a comparison of the applied amounts (approximately 0.5 g/m2 if my calculation is correct) with nitrification rates and with nitrate in atmospheric deposition. These rates are unfortunately not quantified here. The discussion about assimilation and remineralisation is essentially justified, but quantitatively it is likely to play only a minor role: it is less likely that N is assimilated and remineralised and nitrified and leached than just leached. The relative importance of direct leaching versus leaching after mineralisation

and nitrification should be discussed in the light of the tracer fraction in the leachate, i.e. the molar ratio of tracer N to total N in leached nitrate.

Finally, the discussion about a co-saturation of C and N is not convincing in this case. At the basis of this concept, there is the work of Cleveland & Liptzin (Biogeochemistry 85 (2007): 235-252), who give for such a co-saturation a C/N ratio of the soil near 14. Here, however, C/N ratios are around 9 or 10 (calculated from table 1). This means that the amount of C present in the soil would still give much "room" for N immobilisation. Further, a co-saturation is likely to be limited to soils which are well drained, have a sufficient pH and are warm enough. While the third condition is certainly fulfilled here, the other ones would need to be discussed: what is the pH in these soil horizons, and are there signs of anaerobicity that could hinder mineralisation?

Details

Introduction

Page 3, line 27: the abbreviation BSR should be defined here in the introduction (it is defined only later).

P. 3, L. 27: "created" is perhaps not the best wording for nitrate. And there is also nitrate which is not formed in the soil but brought by atmospheric deposition.

Material and methods

P. 6, L. 14: was the soil cultivated? If there were plants, how were they removed? Was there a litter layer, and if yes was it removed?

P. 7, L. 12: the amount of water corresponds to 92 mm, which is high but not impossible for a single precipitation event.

P. 7, L. 28: "g soil-1" should be written with a parenthesis: (g soil)-1, otherwise it would be like only "soil" and not "g" is at the power -1.

P. 8, L. 16: atom% enrichment is not defined. This would be necessary to understand

correctly the given equations.

P. 9, L. 8: multiplying by 100 is for a unit transformation (from a simple ratio to percent): such unit transformations are not an essential part of an equation and should be given only if it explicitly presented a such.

P. 9, L. 22: it would be useful to write in a couple of words what is the working principle of this software.

Results and discussion

P. 11, L. 23: "vice versa"

P. 11, L. 29: better name a dimension by its proper name than indirectly by it units, i.e. better "abundance" than "atom%".

P. 12, L. 26: "too slow" is relative to the speed of leaching, i.e. the interpretation could as well be that leaching is too fast, especially in the case of preferential flow.

P. 13, L. 7: adsorption of ammonium is certainly also a reason why the concentration in solution are lower.

P. 14, L. 3: this repeats what has bee written above.

P. 15, L. 2: quite a long sentence.

Tables and figures

Tab. 1: the legend of the figure mentions "concentrations" but the data are amounts per area, and it is not clear if these amounts are only for the 30 cm columns or if they are extrapolated for the whole corresponding horizon in the field.

Tab. 2: it is astonishing that the relict A horizon has as much organic matter than the other horizons while it has (according to table 1) a much higher C content (but this may be related to the question above).

Fig. 2: all the information in this figure is already contained in figure 1. It should thus

be deleted.

Fig. 4: what are "atm%" in the legend of the Y axis? Are these atom%? The graph would be easier to read if it would give a tracer fraction (as defined above).

Conclusion

The manuscript discussed here starts very well and lets the reader hope for an exciting story. However, it shows then some limitations in the material and methods and ends with a discussion that misses some important aspects.

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