

***Interactive comment on* “Strong correspondence between nitrogen isotope composition of foliage and chlorin across a rainfall gradient: Implications for paleo-reconstruction of the nitrogen cycle” by Sara K. E. Goulden et al.**

Anonymous Referee #1

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General comments

This paper describes an initial test of the hypothesis that $\delta^{15}\text{N}_{\text{pheo}}$ may be a good proxy for original $\delta^{15}\text{N}_{\text{leaf}}$ values, and therefore a way to trace the history of N limitation/availability in terrestrial soils. The paper is well-written and the authors successfully demonstrate that $\delta^{15}\text{N}_{\text{pheo}}$ is a better tracer of $\delta^{15}\text{N}_{\text{leaf}}$ than soil $\delta^{15}\text{N}_{\text{bulk}}$. This is an important first step toward developing such a proxy, although the authors correctly point out that additional work in a system where dating of soil horizons is possible will be necessary, in order to resolve some of the outstanding questions regarding how

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$\delta^{15}\text{N}_{\text{pheo}}$ integrates different timescales and across different plant species. The difference between plant species I found very interesting- future measurements will maybe help to define those trends in more detail. A few specific comments follow, but overall this was an easy and interesting read.

Specific comments

1. Upon initial reading of the paper I got a little confused trying to sort out exactly what $\epsilon_{\text{pheo-bulk}}$ meant. I think now I understand it depends on the material being discussed, for example it could be either: the difference between $\delta^{15}\text{N}_{\text{pheo}}$ of leaves and bulk $\delta^{15}\text{N}$ of leaves or the difference between $\delta^{15}\text{N}_{\text{pheo}}$ of soil and bulk $\delta^{15}\text{N}$ of soil organic matter. But this is different from comparing the $\delta^{15}\text{N}_{\text{pheo}}$ in soil/litter with $\delta^{15}\text{N}_{\text{pheo}}$ and $\delta^{15}\text{N}_{\text{bulk}}$ of leaves. I'm not sure if anything really needs to be changed, but maybe a sentence of clarification somewhere might help?

2. The methods for HPLC should be more specific. For example what does “variable ratio” mean? (p. 6 line 24). What is the advantage of using two HPLC steps? Was the sample divided in half, then each part passed through each HPLC method/column? Or was it successive, i.e. sample goes through column A and into B?

3. I strongly suggest the authors consider depositing their data into a data repository where it can be easily accessed by anyone, in keeping with global scientific trends of making more data open access.

4. Do the authors have any theories for why trees exhibit more positive $\epsilon_{\text{pheo-bulk}}$ of leaves compared to herbaceous plants? Cellulose accumulation is mentioned in the paper but I'm unclear how it's connected to nitrogen isotope values?

5. I read another paper recently (Wang et al 2019, GRL) that used bulk N isotope values of black carbon deposited in lake sediments as a proxy for regional N availability over the last 10,000 years. I wonder if the $\delta^{15}\text{N}_{\text{pheo}}$ proxy in soil could be coupled or compared with that method, both to further validate both proxies but also to study

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changes in N availability in more detail.

Technical corrections

1. Line 4 methods should be “factor”
2. Figure 3: is there a blue triangle where there shouldn't be in the 2500 mm precipitation category?
3. Figure 5: Color code here instead of label? Some of the labels overlap and can be hard to read.
4. Table 2: what is “Py Chl a”? I could not find a definition.

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