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Interactive comment on “Relative stability of soil carbon revealed by shifts in $\delta^{15}\text{N}$ and C:N ratio” by F. Conen et al.

Anonymous Referee #3

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This paper describes an interesting approach to derive the relative age of two SOM fractions (POM and mOM) from their $\delta^{15}\text{N}$ and C/N ratios. If these findings could be further validated (by other studies) with data from other ecosystems, this would become a promising tool to assess turnover times of $\delta^{15}\text{N}$ -labile (POM) vs. $\delta^{15}\text{N}$ -recalcitrant mOM soil organic matter. The paper is well written and reads smoothly.

In general, I recommend that the paper can be published in Biogeosciences. However, I would like to see some clarifications and/or adjustments made by the authors. These are outlined below.

Abstract and introduction Mention (for the less experienced reader) why scientists

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are interested in age and stability of SOM. Mention in brief the GHG issue and C-sequestration.

Concept This part is crucial for the rest of the paper and especially equations 1-3. Equation 1 is the so called Rayleigh equation. This might even not be obvious to all readers. So elaborate a bit on this. Even more equation 2 and 3 need more explanation on how they were derived. This is essential for the understanding of the paper. Now this is not entirely clear (also not to me). Eventually this can be added as an annex to the paper, but remains essential.

Material and Methods Mention, for completeness, that in general $\delta^{15}\text{N}$ data increase with depth in undisturbed soil profiles. The derivation of the epsilon value (which is an enrichment factor and not a fractionation factor as mentioned wrongly) is crucial. Although I can agree with the value of two per mil and is most likely correct, I wonder whether the authors have more evidence from literature to support that e.g. from papers of Baisden. Maybe even a probability range can be developed.

Similarly, as mentioned before equation 5 should be explained more in detail in an annex. Besides, I do not see a time factor t in that equation, which I guess is needed to calculate ages?

Results I suppose AMS measurements of ^{14}C are also associated with an error. So, similarly as was done for the epsilon value also here a small exercise related to, on the one hand precision of ^{14}C measurements with AMS and on the other the uncertainty for the calculated ages should be included. Can the authors include a reference on the podsolisation? The authors should comment why ^{14}C -ages of mOM (0-5 cm) decrease with altitude. The explanation that is given is rather speculative. I understand this was not the focus of this paper. So, maybe it is better to leave that out until more supporting data for this observation have been collected and focus this paper only on the fact the $\delta^{15}\text{N}$ and C/N ratio's in POM and mOM could eventually be a proxy for ^{14}C -ages of these SOM fractions.

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