Authors' Comment in response to Reviewer 1: Dr. Jeff Bird

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Reviewer's comments italicized.

General: The authors examine the distribution of soil organic matter C and N (and their stable isotopes) among operational soil organic matter fractions to better understand stabilization mechanisms. Soils examined included 5 paired forest/arable soils. These data are considered with associated soil chemical and physical measures - including short order range mineralogy, C content, and texture. In addition, the authors compare their findings to the conceptual model described by Kleber (2007), which provides a framework for the main chemical interactions of organic matter molecules on charged mineral surfaces. Overall the data set is a very nice addition to the literature. The topic is appropriate for this journal, and will be of interest to terrestrial biogeochemists in agricultural and forest soil areas. The authors utilize a thoughtful SOM fractionation scheme to elucidate the mechanisms involved in partitioning of the continuum of organic compounds. The findings are interesting – especially between the land use comparison. The utility of these isotope results – especially in understanding the divergent findings in arable and forest sites, could be greatly enhanced by providing more information regarding the inputs and land use history of the arable soils – as this might have significant effects of observed trends in 15N enrichment.

Authors' response: We thank the reviewer, Dr. Jeff Bird, for his helpful comments and suggestions that have ultimately improved this manuscript. We have included more information concerning the soil and its management to augment the previous data. We have also included a supplementary section for graphs omitted from the main text and for further explanation of some of the PLS results.

Overall, I recommend for acceptance with revisions. One additional review would be useful. The paper would benefit from revisions that address the following:

***1.** More information on sources of C and N and their isotopic signatures (13C/15N) among sites and especially between forest and arable soils would have been very useful to interpret possible mechanisms for differences in reported d15N and d13C(i.e., N fertilizers, manures, plant litters, etc). In addition, authors might well consider the effects of tillage in the arable soils on SOM stabilization mechanisms.*

Authors' Response: We added a table (table 2) of the different crop rotations and fertilization regimes. We further addressed the potential effects of different sources with respect to our interpretation. We added the following text in the discussion:

"Past land management effects are difficult to assess; however, tillage practices are generally thought to destabilize OM occluded in aggregates thus freeing OM for microbial decomposition. In this study, we separated the more labile, physically uncomplexed, macro- and micro-aggregate occluded organic particles as well as water extractable OM (Kaiser et al., 2010) prior to separating the OM(PY) fraction. Thus, the effect due to plowing should be negligible. Management practices extended to fertilization application at our sites. There

were different fertilizers applications over the past 100yrs (table 2) that could lead to a misinterpretation of the data. Effects due to different land use practices are often unavoidable with investigations that attempt to understand processes that occur over multiple time scales, such as OM stabilization in soil. We sought to limit these effects by centering our hypothesis around the organo-mineral interactions that occur on two very specific OM fractions. This approach reduces the uncertainty associated with the analysis of multiple isotopic sources represented in bulk OM. Furthermore; our results are consistent with previous studies that found a consistency in isotopic signals within OM fractions that identified microbial processing as a precursor to deposition (Bol et al., 2005; Lobe et al., 2005). Nitrogenous compounds are increasingly seen as important for OM stabilization and only with further study can we realize the impact of varying nitrogen fertilization practices on the subsequent ^{15}N isotopic signature of stabilized OM."

2. *The number of figures (esp. 2-4) could be substantially reduced, as few significant differences occur. Possibly place data from figure 2 in results text and indicate some additional means/st. errors from figs 3-4? Figure 1 labels could be made larger (clearer?) or use shades of grey to further differentiate soil origin.*

Authors' response: We kept figure 2 in the main text so that readers may understand our results initially with only viewing the tables and graphs. We placed figures 3 and 4 in the supplementary material (S.1) so that readers can view the results compiled by OM fraction and soil type. We also made Figure 1 more readable for the revised manuscript.

3. *The abstract would benefit from shortening; and at times, more specific in reporting what differences were found.*

Authors' response: In the revised version of the manuscript we have shortened the abstract and focused on the core conclusions.

4. *The authors don't comment on the relative yields of C and N in these SOM fractions. Might the extraction yield efficiency also inform this discussion – essentially what is not isolated (free light material/water soluble I am guessing) and does this vary consistently by site? Also the depths of these soils were quite different. How might these differences have influenced the results observed. Some differ by _ 20 cm.*

Authors' Response:
To address this point, we have included in the results section the following text:

"The relative yield of OM extracted from organic particle and water extractable fractions of the forest site was 23.9%(mean) ± 6.6 (s.d.) and when the HC soil was omitted (5.4%) the relative yield for the arable sites was 13.6% ± 0.41%. "

We have addressed the comment about different soil properties in the conclusion section with the following text:

"Some caution must be exercised when comparing the two land use types, for example, the soil depths were different between the sites, which could adversely affect decomposition conditions especially when considering different soil horizons. However, we went through extensive measures to ensure similar soils between the two land use types (i.e. paired plot design) and we did not observe differences in aeration or soil water status, therefore, we expect the conditions of the top 30cm of soil for a given land use pair to be similar."

5. *I think a clarification of the SOM extraction method would be useful for readers not experienced in these fractionations, maybe a small figure would help.*

Authors' Response: We have added a figure (figure 1) that depicts the OM fractionation process.

6. *Overall the manuscript is well written, however a thorough edit would help make the paper more concise and clear.*

Authors' Response: We have re-edited the manuscript for the revision with the goal of a clear and concise paper.

7. *Literature to consider in revised discussion:* The role of Ca in SOM stabilization: Olk, D.C., 2006. Soil Science Society of America Journal, 1013–1022. Olk, D.C., Gregorich, E.G., 2006. Soil Science Society of America Journal 70, 967–974.

Authors' Response: We have included these references within our discussion.

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