EGUsphere, author comment AC1
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Reply on RC1

Yike Wang et al.

Author comment on "Effect of rare earth oxide labeling and sieving methods on aggregate turnover and carbon dynamics" by Yike Wang et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-728-AC1, 2022

We gratefully thank the editor and reviewer for the time spent making their constructive remarks and helpful suggestion, which has significantly raised the quality of the manuscript and has enabled us to improve the manuscript. Each suggested revision and comment, brought forward by the reviewer was accurately incorporated and considered. Below the reviewer's comments are response point by point and revisions are indicated.

General Comments: This manuscript from Wang et al. aims at elucidating the effect of rare earth oxide labeling and sieving methods on aggregate turnover and carbon dynamics. To reach their objectives, they conducted labelling and incubation experimentations with dry or wet sieving methods. SOC fractions (DOC, fPOM, MBC and HF) were detected and their relationship with aggregate dynamics were analyzed herein. Indeed, little research have reported the effects of labelling and sieving processes on SOC fractions, it is interesting to investigate the discrepancy caused by various methods. But in my view, the authors do not provide a clear response to the topic, the research questions are not well stated in the introduction and the findings are not fully discussed in the discussion part. Besides, I doubt the calculation on aggregate turnover rate, which is different from the calculation proposed by De Gryze et al. and Peng et al. For these reasons, I do not recommend the publication of the article in SOIL.

Response: We greatly appreciate the reviewer's insightful comments. In fact, while processing the data for this manuscript, we found that there was perhaps a hidden innovation, the application of soil organic fractions to quantify soil organic matter, with REE oxides to track the aggregate turnover. In previous studies, Peng et al. (2017) analyzed the organic matter dynamics by adding 13C-labeled glucose to REE oxides labeled soils and determining the ^{13}C content in different aggregate fractions. Subsequently, M. Halder et al. (2022) used eleven organic materials characterized in terms of nutrient stoichiometry, biochemical features and carbon (C) functional groups, to determine which characteristics of organic materials control soil aggregate turnover. However, in the following studies, we found that it would be too expensive to use carbon isotope methods in field experiments or to determine the contribution of organic matter monomers (e.g. galactosamine) for aggregate turnover. This is why a large number of descriptions of the relationship between aggregates and organic carbon have appeared in previous manuscripts.

The main reason for your query about the calculation is that the transformation paths of

three aggregate fractions were divided into (1) turnover directly caused by the labeling and sieving processes (at 0 days incubation); (2) turnover caused by soil microorganisms during the incubation process (at 7,14,21,28 days incubation). The excessively low transformation of aggregate turnover pathways is due to the subtraction of transformation before incubation (0 days). We will provide a detailed response to your question about the aggregate turnover calculation in a point-to-point response.

Based on your suggestions, we have restructured the logical framework of the manuscript and will respond to your suggestions in a point-to-point response. In the revised version of the manuscript, we have refined the abstract and main text (especially the Introduction, the Results and the Discussion sections) to make the paper easier to read, the procedure for the calculation of aggregate turnover, which was originally placed in the appendix, has also been collated into 2.5.1 Calculation of soil aggregate turnover in the revised manuscript.

In the Introduction section, we have (1) restructured the framework of the manuscript to make the manuscript more palatable to general readers; (2) outlined the major assumptions briefly; (3) deleted unnecessary description of the relationship between aggregate turnover and soil organic carbon dynamics to make the introduction section more relevant to the topic.

In the Material and method section, we have (1) introduced a more specific description of the Andisols soil samples in 2.1 Soil characteristics; □2□Changed the description of the experiment design in 2.3 Experiment design to make it more consistent with the research topic. (3) Added a flow chart of the recombination process in 2.3.1 Recombination process, to make the recombination process more accessible to the readers; (4) Added 2.5.1Calculation of soil aggregate turnover in the revised manuscript, from the original appendix and added Figure2 The 6 possible transformation pathways of aggregate.

In the Results section, we have (1) modified the structure of the result section according to the revised experiment design, and described the effect of the labeling and sieving process on aggregate turnover and organic carbon fractions, respectively; (2)added transformation aggregates turnover pathways before incubation (0 days) in 3.1.2 Soil aggregate turnover pathways; (3) Added soil organic carbon fraction dynamics of BG treatment during incubation in 3.2.2 The effect of labeling and sieving processes on SOC fractions during incubation process; (4) placed the relationship between aggregate turnover and organic matter dynamics in 3.3 The effects on the quantitative study of the relationship between aggregate turnover and organic matter dynamics.

In the Discussion section, we have reorganized the discussion according to the research topic and your comments. the impact of the labeling and sieving processes on soil aggregate turnover and soil organic carbon fractions were discussed, respectively.

In the Conclusion section, We have (1) identified that labeling and sieving processes could affect aggregate turnover and soil organic carbon fractions; (2) made suggestions for eliminating the disturbances.

Point-to-point response

Comment 1: Introduction**,** The title focused on two factors, namely labelling processes and sieving methods, to aggregate turnover and SOC. Insufficient statements on the importance of these two factors are provided, instead, authors illustrated more the interaction between SOC and soil structure.

Reply1: We gratefully appreciate for your valuable comment. In the Introduction section, we have (1) deleted unnecessary description of the relationship between aggregate turnover and soil organic carbon dynamics; (2)Restructured the introduction section from labeling and sieving processes on aggregate turnover and organic matter dynamics, to make the introduction section more relevant to the research topic(as shown in supplement).

Comment 2: L80 More details on the investigated soil should be provided, such as the initial SOC content, sand/clay/silt content, bulk density etc.

Reply2: We gratefully appreciate for your valuable comment. We provide the soil properties in 2.1Soil characteristics in the revised manuscript (2.1 Soil characteristics, as shown in supplement).

Comment 3: L90-100 Four oxides were used for labelling, but only 3 aggregate fractions were used? So which three oxides you used herein? How to get the recombined soil columns? The soil content and bulk density of these recombined columns? How many soil columns in total? More detailed information is needed.

L120 What do you mean by "regularly"? Every two days?

Reply3: We feel sorry for the inconvenience brought to the reviewer. The comment relates to the labeling process, the recombination process, and the incubation process, therefore we will reply in three parts.

(1) We have placed the labeling process in the 3 Experiment design section, together with the sieving process, recombination process and incubation process. And the labeling process is described in *2.3.1 Labeling process* (**as shown in the supplement**).

(2)For details of the recombination process are described in *2.3.3 The recombination process* and the protocol for recombining aggregates into recombined soils was added, as shown in *Figure 1* (**as shown in the supplement**).

(3)Details of the container for recombined soil and the way of maintaining soil moisture content were described in *2.3.4 Incubation process*(**as shown in the supplement**).

Comment 4:L125 How much soil is used for dry/wet sieving and SOC fraction detection, respectively?
Reply4: Thank you for your rigorous consideration. We would like to respond to this comment in two parts:(1) sieving methods; and (2) soil organic carbon fractions.

(1)For the dry/sieving aggregate fraction. Because five treatments were designed in this experiment, we prepared 500g soil samples for each treatment, except for the BG treatment, the treatments involved the labeling process. After labeling process, all labeled soil samples were sieved and recombination, 50 g of sample was sieved at each time (as shown in *2.3.2 Sieving process*).

1) Where the descriptions of five treatments are described as: (1) soil without REE oxides labeling and sieving processes (background treatment, BG), (2) soil with dry sieving and REE oxides labeling (REO-labeled and dry sieved treatment, REO-D), (3) soil with wet

sieving and REE oxides labeling (REO-labeled and wet sieved treatment, REO-W), (4) soil with dry sieving but without REE oxides labeling (dry sieved treatment, CK-D), and (5) soil with wet sieving but without REE oxides labeling (wet sieved treatment, CK-W).

2) Where the descriptions of the sieving process are described(as shown in supplements)

(2) **For the soil organic carbon fractions.** Different weights of soil samples were selected according to soil organic carbon fraction determination methods. Where, Total organic carbon(TOC): 0.15–0.20 g; Microbial biomass carbon(MBC):20.00g; Dissolved organic carbon (DOC): 20.00g; free particulate organic carbon (fPOC), occluded particulate organic carbon (oPOC), and a heavy fraction (HF):4.00g. These details about weight have been supplemented in *2.4.2 Analysis of soil organic carbon fractions* (as shown in the supplement)

Comment 5:L175 How to calculate the aggregate turnover?

Reply5: We feel sorry for the inconvenience brought to the reviewer. The previous manuscript placed the calculation process in the appendix, which may have caused inconvenience to readers. Therefore, in revised manuscript, we have (1) introduced the calculation procedure in *2.5.1 Calculation of soil aggregate turnover*; (2) inserted the schematic diagram of aggregate turnover, to make it easier for readers to understand(as shown in supplements).

Results

Comment 6: L190 Since the results and discussion parts are separated herein, no reference should be included in results part.

Reply6: We gratefully appreciate for your valuable comment. Following your suggestion, the discussion and references in the Results section have been moved to the Discussion section.

Comment 7:L200 Please explain the meaning of "unaffected carbon pools".

Reply7: Thank you so much for your careful check. In previous manuscripts, as oPOM and HF fractions in Table 1 were less affected by REE oxides addition, labeling, sieving and recombination processes, we have attempted to unify this part of the soil organic carbon fractions into 'unaffected carbon pools' for discussion. In the revised manuscript, we did not add new concepts(like 'unaffected carbon pools') , but described all carbon fractions according to Table3(as shown in the supplement).

Comment 8:L210 It will be easier for readers to follow when 0.25- to 2-, 0.053- to 0.25-, and <0.053-mm are replaced by 0.25-2 mm, 0.053-0.25 mm and <0.053 mm.

Reply 8: We feel sorry for the inconvenience brought to the reviewer. Following your suggestion, we have replaced 0.25- to 2-, 0.053- to 0.25-, and <0.053-mm with 0.25-2 mm, 0.053-0.25 mm and <0.053 mm in revised manuscript.

Comment 9:L265 I doubt the calculation on aggregate turnover. Take turnover rate of 0.25-2 mm at 7 days as an example, 0.75=(4.58+0.68)/7, it seems that the formation processes are not taken into consideration, which is different from the calculation proposed by De Gryze et al. and Peng et al.

L270 According to Fig.5, the breakdown and formation of dry sieving aggregates occurred not only the first week.

L275 Transformation pathways in Fig. 6 are much smaller than published data. Why? No further discussion are displayed.

Reply 9: We totally understand the reviewer's concern. These three questions are about the transformation of aggregate turnover pathways, so we would like to provide better responses to your comments.

In earlier manuscripts, we were too concerned with the relationship between soil aggregate turnover and soil organic matter, and therefore removed the transformation of aggregate turnover pathways before incubation(0 days) as a disturbance. Actually, to elucidate the influence of the labeling and sieving processes on the aggregates turnover, The transformation paths of three aggregate fractions were divided into (1) turnover directly caused by the labeling and sieving processes (at 0 days incubation); and (2) turnover caused by soil microorganisms during the incubation process (at 7,14,21,28 days incubation). Soil samples obtained from 7, 14, 21 and 28 days of incubation included both the labeling-sieving and recombination processes and the incubation process, whereas samples from 0-day incubation included only the labeling, sieving and recombination processes. Therefore, the turnover pathways of the incubation process are calculated as the difference between the turnover pathways of different incubation days (7, 14, 21, 28days) and the turnover pathways of 0 days of incubation.

In the revised manuscript, we have

(1) Introduced the labeling and sieving process and the incubation process in *2.3 Experimental design* describe as:

A series of experiments were conducted in this study. First, The feasibility of REE oxides as tracers to track Andisols aggregate turnover was determined. Then, we divide the effects of REE oxides on Andisols aggregate turnover and organic carbon dynamics into two processes: labeling and sieving processes and incubation process. In the labeling and sieving processes, REE oxides addition, labeling method and sieving method are the main causes of soil organic carbon and aggregate turnover. And in the incubation process variations in soil organic carbon dynamics and aggregate turnover are caused by initial soil organic carbon fractions differences and the soil microbial.

(2) Added Equation(7) in the calculation section as a supplement to the calculation procedures.

Because the Andisols samples were subjected to the labeling process, the sieving process, and the recombination process, and finally to incubation, The labeling, sieving and recombination processes have a destructive effect on aggregates. Soil samples obtained from 7-, 14-, 21- and 28-days incubation included both the labeling-sieving and recombination processes and the incubation process(Ktx), whereas samples from 0-day incubation included only the labeling, sieving and recombination processes (Kt0), then the contribution of the incubation effect to aggregate turnover is calculated as: $K_{inc}= K_{tx}-K_{t0}$.

(3) Included images and analysis of the transfer pathways between the three aggregate size fractions before incubation(0day) in 3.1.2 Soil aggregate turnover pathways(as shown in supplement).

(4) Compared with Peng et al. (2017) and M. Halder et al. (2022) for the transformation of aggregate turnover pathways and turnover rates in Discussion section *4.1Effects of labeling and sieving processes on Andisols aggregate*(as shown in supplement).

Comment 10:L300 There are two "Wet-MBC" in Fig.7a? To present the same SOC fraction, authors used the same color in a, while used the same shape in b, please keep them uniformed.

Reply 10: Thank you so much for your careful check. We apologize for our carelessness. In earlier manuscript, the grey circle represents the "Wet-DOC" instead of "Wet-MBC" in Fig. 7a. In the revised manuscript we have (1) corrected the error in the figure legend; (2) increased the dynamic of the BG treatment organic carbon fractions during incubation(3.2.2 The effect of labeling and sieving processes on SOC fractions during incubation processes, as shown in supplement).

Discussion

Comment 11: There are lots of repetition of results. No highlights were proposed and discussed here. For section 4.2, lots of publications have proved it, there is no need to discuss again. For section 4.4, the relationship between SOC and aggregate are analyzed, which should be displayed in results rather than discussion part.

Reply11: We feel sorry for the inconvenience brought to the reviewer. We have tried too much to illustrate the feasibility of using soil organic carbon fractions and REE oxides to quantify soil organic carbon dynamics and soil aggregate turnover, respectively, and to analyze their relationship. This resulted in the Discussion section being inconsistent with the research topic.

(1)We discussed the effect of labeling and sieving processes on the aggregate turnover from 1)the feasibility of REE oxides as Andisols aggregate tracers; 2) The transformation of aggregate turnover pathways before incubation (0d); 3) The transformation of aggregate turnover pathways during incubation;4) the aggregate turnover rate during incubation(*4.1 Effects of labeling and sieving processes on Andisols aggregate,*as shown in supplement).

(2) We discussed the effects of the labeling and sieving process on soil organic carbon in terms of 1) the effect of wet sieving on soil organic carbon dynamics; 2) the effect of dry sieving on soil organic carbon dynamics; 3) the feasibility of using soil organic carbon fractions to analyze the relationship between organic matter dynamics and aggregate turnover. (*4.2 Effects of REE oxide labeling and sieving processes on soil organic carbon*, as shown in supplement)

Conclusion

Comment 12: It is abstract, not conclusion. The main findings/conclusions, rather than results, are supposed to be included here.

Reply12: Thank you for your valuable suggestion.

Conclusions based on the research topic and discussion were obtained from aggregate turnover and soil organic carbon dynamics, respectively. The addition of REE oxides would have no effect on the Andisols aggregate turnover and organic matter dynamics, but the REE oxides labeling and sieving processes would have effects on soil aggregates and soil organic carbon(**as shown in supplement**).

Acknowledgement

We gratefully thanks for the precious time the reviewer spent making constructive remarks.

Add: We also acknowledge one anonymous reviewer for helpful comments on an earlier draft of our manuscript.

Reference

Based on your suggestions, the Introduction and Discussion sections have been revised a lot, so we have restructured the Reference section. (*8 Reference*).

We hope you will find our revised manuscript acceptable for publication.

Yours sincerely,

Wang Yike

Please also note the supplement to this comment:
https://egusphere.copernicus.org/preprints/2022/egusphere-2022-728/egusphere-2022-728-AC1-supplement.pdf