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Interactive comment on "Lithology and climate controlled soil aggregate size distribution and organic carbon stability in the Peruvian Andes" *by* Songyu Yang et al.

Anonymous Referee #1

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Soil organic matter storage and sequestration is a function of multiple factors from climate over parent material to plant traits and soil biology. The experimental differentiation between these factors in order to assess what drives SOC sequestration at a given soil ecosystem is always a tricky thing as it includes often multiple assumptions and or possible artefacts. The authors were up for the endeavour and aimed to elucidate how lithology and precipitation affect SOC stability in the Peruvian Andes. On top of this, the authors tried to measure if aggregation is the key factor that determines SOC stability at the study sites. This work in general is of special interest to a wider community working on the stabilization and destabilization of SOC. As the authors used a manipulation of the aggregation of the soils to compare intact and disrupted soils, this study

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Discussion paper

adds a novel aspect to an ongoing discussion on the importance of aggregation vs. mineral-association. Furthermore, there are not so many studies that tried this so far. Thus, the study is well suited for SOIL and also might provide some new insights into SOC sequestration in soils of the Peruvian Andes. Nevertheless, I think there are some major points that should be addressed by the authors, namely vegetation and plant trait information, incubation conditions of crushed vs. intact soils in terms of physical soil properties (O2 diffusion, water content etc.) and a possible lack in temporal resolution due to the late start of the CO2 measurements. All of these aspects are mentioned in the detailed remarks below and also commented with respect to possible improvements of the manuscript: line 20 and general - To improve readability I would use no abbreviations for the soils, there is enough space to use e.g. "limestone soils" instead of LS. line 30 How much occluded OM was present in these soils? Thus is aggregation at all relevant for OM storage in these soils in contrast to mineral association? line 40 The Andes stretch over 7000 km, please be more specific on the location of your work. line 44-47 Again, the Andes stretch over vast distances, its clear that there are drastic climatic differences. But even at one location you get changes with exposition and elevation. Please be more specific! line 50-51 This is redundant in itself, OM and OC is stabilized and of course is tightly linked. line 54-56 Again, this is highly dependent where you are in the Andes. In the Southern Andes you'll have soils that are completely dominated by particulate OM rather than mineral-associated OM. line 93 describe shortly Puna and Jalca line 103 Are there records about a longer consistent land use at the sampling sites? Or do you have indices that show a longer sustained land use type? line 122 So there was a mixture of different land uses between the three site replicates? Was this detectable in the soil profiles or SOM properties? line 147 How was the gravel content calculated, thus how did the authors differentiate between large aggregates (>2mm) and stones of this size range? line 157-158 Why you analyse in the one approach the fraction <63 μm, but don't use it in the incubation? Please describe here. line 162 By this approach you are not only crushing aggregates, but also rock fragments. How did you account for the different content of pure mineral constituents in relation to aggregates? line 164 It was shown before that aggregate/soil disruption can lead to a rather fast spike in CO_2 evolution within a few days. Did you in any way account for this CO_2 loss between the different treatments during the first days of incubation before entering a sort of basal respiration? line 208-215 This is a nice exemplary paragraph to show how hard a text is to read for an outsider - let me summarize: "...LS is larger than AS, has more LM but minor Mi; AS has larger SM and Mi; LS were not different but wet-AS was slightly different from dry-AS..." I would really appreciate if you find a way to use even short words that are more descriptive and don't ruin the flow of reading. line 226-227 Please also give mineralization rates normalized to the amount of OC in the individual samples. This will give a better mechanistic insight on the fate of OM with respect to aggregation. This might also level off possible differences in stone content etc. line 233-234 How is this relation if you normalize OC mineralization rates with sample amount OC? line 239 Also if normalized on the amount of OC in LM vs. SM? line 253-256 You are using two very contrasting parent materials which foster completely different soil biological communities and soil chemistry and thus of course yield different soil structure - so far its textbook knowledge. Such statement might be more interesting if comparing Granodiorite and a Granite or Basalt etc. However, this comment is just about leaving out such "general textbook statements" and focus on the core of the story. line 256-260 This could possibly find its way into the Introduction as you could put this as a rational to take these two contrasting materials. In the discussion it appears again as a redundant textbook message. line 262 So basically the lack of fine material causes the lack of a more advanced aggregation. line 271 You are comparing a silicate rock and a carbonate rock - I would be more than surprised if precipitation would not have a less pronounced effect. line 275-280 There are in parts differences in aggregation and SOC stocks between wet and dry sites. Why are you neglecting those and talking them down as minor or biased by stoniness? If stoniness is the driving property, than how can you compare aggregate mineralization etc. at all? line 282 Given the high amount of stones and a some other constraints, the significant effects are worth taking them serious. Presumably as a result of altered soil biology and/or plant diversity / litter/root input. line 294-295 Which is a function of primary production and decomposition. Please give in the M&M more details on vegetation at the respective sites. line 299-304 What soil horizons comprise the low SOC values with high CO2 evolution? Are those the low C/N ratio subsoils? If so, you are mixing two opposite factors, aggregation and soil material origin. Please give specific OC mineralization normalized per amount OC. And the very low C/N ratios under 5, would mean you have pure amino acid material in the sample. Could here values around the detection limit for N play a role? line 310-314 How much OM is stored within the aggregates? Do you have estimates of amounts of e.g. occluded POM? line 315 The cited work showed a clear effect of aggregate disruption within the first days of incubation. You lack this information due to the late start after 10 days. So the low differences between crushed and intact might be due to fact that you missed the CO2 spike. Furthermore, how did you adjust comparable soil porosity/O2 diffusion and thus water contents between finely crushed/ground soil material and naturally aggregated soil? line 343 Do you have data on exchangeable ions? line 358 How is the vegetation at the sites, how is primary production, above and belowground OM input? The biggest control on SOC stocks besides soil properties are plant traits at comparable parent materials. So as stated above, please give information on vegetation data in M&M. line 368-370 Or these compounds are just more stable at dry conditions. On top of that, plants produce e.g. more suberin in the roots as protection against drought. And without a baseline of the initial plant material above and belowground this data just tells you there are differences in these acids due to precipitation. line 376-377 There is the same amount of work showing plant species and traits having these effects on SOC storage and stability. Thus to prove the solely precipitation effect you would have to work with comparable plant species and traits. line 381 So how high is the OM input? line 385 You compare limestone with granodiorite, as mentioned above this of course outcompetes any effect of precipitation at same altitude and latitude. line 385-387 For this you would have to show that there is no occluded light fraction/POM, and you didn't miss the fast pulses (>10 days) in CO2 after soil structure disruption found by others.

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