Point-by-point response to community comment by Dr. Dan Wan

Dear Dr. Dan Wan,

First of all, thank you very much for taking the time to read and comment on our manuscript. Please see the following point-by-point response to your important comments. Reviewer original comments are highlighted in grey.

We hope you find our response and changes to the manuscript satisfying and we are looking forward to hearing your opinion on our revised manuscript.

Yours sincerely,

The authors

COMMUNITY COMMENT 1: "1) this is a research article, so the subtitle of the introduction is unnecessary, the authors should rearrange this section"

Our response: Thanks for the comment. According to the Journal's guidelines, we decided to use subtitles in the introduction to provide better guidance to the reader, since it helps to assimilate the key points of the study framework much faster in our opinion. We also wanted to be consistent with the subtitle structure throughout the manuscript. Nevertheless, if the editors are sharing the same opinion that removing the subtitles helps to streamline the introduction, we will happily do so.

COMMUNITY COMMENT 2: "2) line 260: the concentration of OM-complexed metal usually very low, diluted this solution by 1000 folds, the concentration of Fe, Al and Mn may below the detection limit of ICP-OES."

Our response: Thanks for pointing this out. The concentration of pedogenic oxides (Al, Fe, Mn), especially of DCB-extractable oxides, was high in the majority of our samples. We were expecting such high concentrations of pedogenic oxides, since we sampled Ferralsols and Nitisols. We used 5 calibration points using a multielement standard solution. The concentration of each calibration point was at least two-times above the detection limit of the ICP-OES. To cover the concentration range of all our analyzed samples with the above mentioned calibration points, the dilution ratio of 1:1000 worked best. We also used internal standards (i.a. of other Ferralsols) to check the accuracy of the extraction, dilution and measuring procedure. The average error/deviation of 3.8±12.03 rel. % was small, therefore giving us confidence in the accuracy of the ICP-OES data.

COMMUNITY COMMENT 3: "3) the SOC stabilization mechanism was pH-dependent (Rasmussen et al., 2018 Biogeochemistry 137, 297– 306; Wan et al., 2019 Eur. J. Soil Sci. 70, 1153–1163; Wan et al., 2021 Sci. Total Environ. 10.1016/j.scitotenv.2021.145037), therefore, the soil pH should be added to the results and discussed."

Our response: Thank you very much for pointing out this very interesting literature. Indeed, our data shows a significant relationship between pyro and oxalate extr. oxides (py+ox) with soil pH. Comparable to the study of Rasmussen et al. (2018), we observed higher oxide contents with lower soil pH (Figure R1). However, soil pH was not a significant predictor for py+ox. Instead, the effect of the geochemical region on py+ox was highly significant (Table R1). We conclude that the amount of highly relevant C stabilization partners represented by py+ox is dependent on the geochemical region. Hence, we focus on the pedogenic oxides fractions in the result section. Furthermore, we accounted for the effect of soil pH on soil properties and SOC stocks by including it in the rotated principal component analysis. For

more detailed information about other geochemical soil properties (i.a. soil pH), we kindly refer to the project-specific database publication (Doetterl et al., 2021a; 2021b).

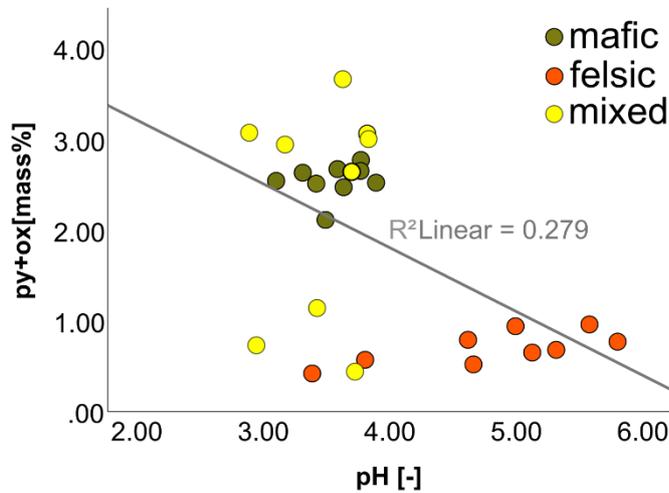## Pyro. and oxalate extr. oxides (Al, Fe, Mn) against soil pH (KCl)

Figure R1: pyro. and oxalate extr. oxides (Al, Fe, Mn) in relation to soil pH (KCl). Including non-valley positions (n = 27).

Table R1: Multiple linear regression explaining content of pyro. and oxalate extr. oxides (Al, Fe, Mn) with soil pH (KCl) and geochemical region (dummy coded). Including non-valley positions (n = 27).

	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (beta)	t	Sig.
(Constant)	1.751	1.005		1.743	0.095
soil pH (KCl)	0.222	0.274	0.167	0.809	0.427
geochemistry = felsic	-2.12	0.48	-0.95	-4.418	0
geochemistry = mixed	-0.223	0.335	-0.1	-0.665	0.513

response: py+ox
reference: geochemistry = mafic
ANOVA: p < 0.001
Adj. R^2: 0.61

Used literature:

Doetterl, S., Asifiwe, R.K., Baert, G., Bamba, F., Bauters, M., Bukombe, B., Cadisch, G, Cizungu, L., Cooper, M., Hoyt, A., Kabaske, C., Kalbitz, K., Kidinda, K.L., Maier, A., Mainka, M., Mayrock, J., Muhindo, D., Mujinya, B., Mukotanyi, S.M., Nabahungu, L., Reichenbach, M., Rewald, B., Six, J., Stegmann, A., Summerauer, L., Unseld, R., van Oost, K., Verheyen, K., Vogel, C., Wilken, F., Fiener, P. Organic matter cycling along geochemical, geomorphic and disturbance gradients in forests and cropland of the African Tropics - Project TropSOC DATABASE_v1.0, Earth System Science Data DISCUSSIONS (pre-print), https://doi.org/10.5194/essd-2021-73, 2021a.

Doetterl, S.; Bukombe, B.; Cooper, M.; Kidinda, L.; Muhindo, D.; Reichenbach, M.; Stegmann, A.; Summerauer, L.; 36 Wilken, F.; Fiener, P. TropSOC Database. Version 1.0. GFZ Data Services. https://doi.org/10.5880/fidgeo.2021.009, 37, 2021b.

Rasmussen, C., Heckman, K., Wieder, W. R., Keiluweit, M., Lawrence, C. R., Berhe, A. A., Blankinship, J. C., Crow, S. E., Druhan, J. L., Pries, C. E. H., Marin-Spiotta, E., Plante, A. F., Schädel, C., Schimel, J. P., Sierra, C. A., Thompson, A., and Wagai, R.: Beyond clay: towards an improved set of variables for predicting soil organic matter content, Biogeochemistry, 137, 297-306, https://doi.org/10.1007/s10533-018-0424-3, 2018.

COMMUNITY COMMENT 4: "4) the meaning of letters (e.g. a, b, A, B) in figures 3 and 4 was not clear, I can not understand these figures easily. Besides, the color scheme of all figures was not appropriate, the authors should select the same color system or use grayscales (white, black, and gray) or patterns for bars. Table 3 has the same problem."

Our response: Thanks for the comment. The ANOVA compare means across geochemical regions for each soil layer. Each soil layer has its own letter font to guide the reader which bars are compared with each other. We pointed this out in more detail in the Figure caption (Figure 4 example 1). The authors think that the color scheme of Figure 3 and 4 helps to quickly differentiate between soil C fractions and pedogenic oxide fractions without having to read the full figure caption. Using only grayscales will make it difficult to differentiate between the different soil layers and fractions (Figure 4 example 1). Another option would be to use the colorblind safe color scheme from colorbrewer2.org (Figure 4 example 2) or using the recommendations of Fortuna et al. (2013) (Figure 4 example 3). If the editors share the same opinion with Dr. Dan Wan, we will revise the color scheme of the figures and also that of table 3.
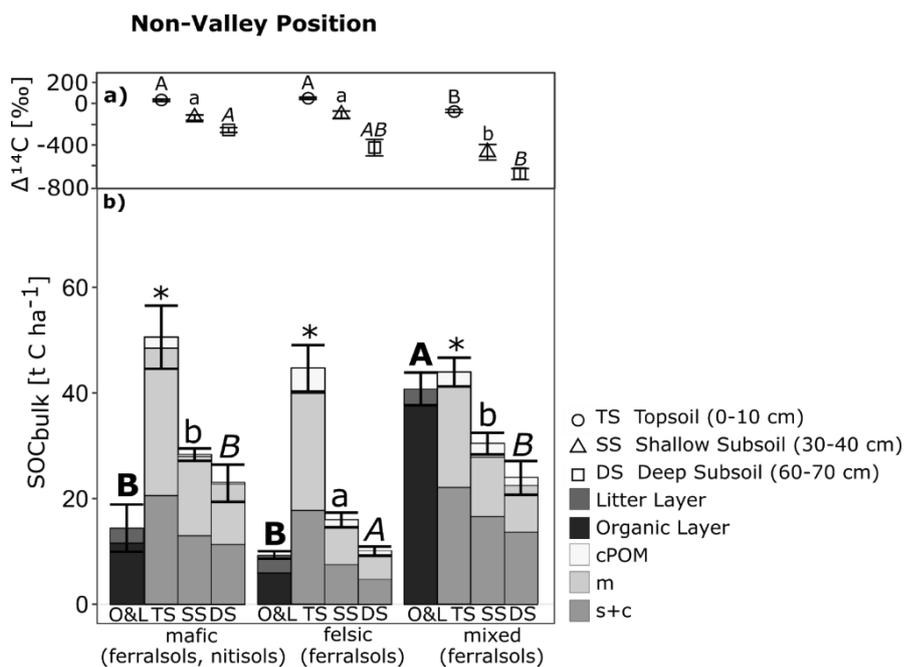

Figure 4 example 1: (a) m / s+c ratio (n = 9 per bar) and (b) pedogenic oxide fractions (n = 3 per bar) of the sequential extraction across geochemical regions in non-valley positions. Letters sharing the same text font indicate significant differences between geochemical regions per soil depth for m / s+c ratio (a) and total pedogenic oxide mass (b). Asterisks indicate no significant differences in means (p > 0.05). Error bar represents standard error.
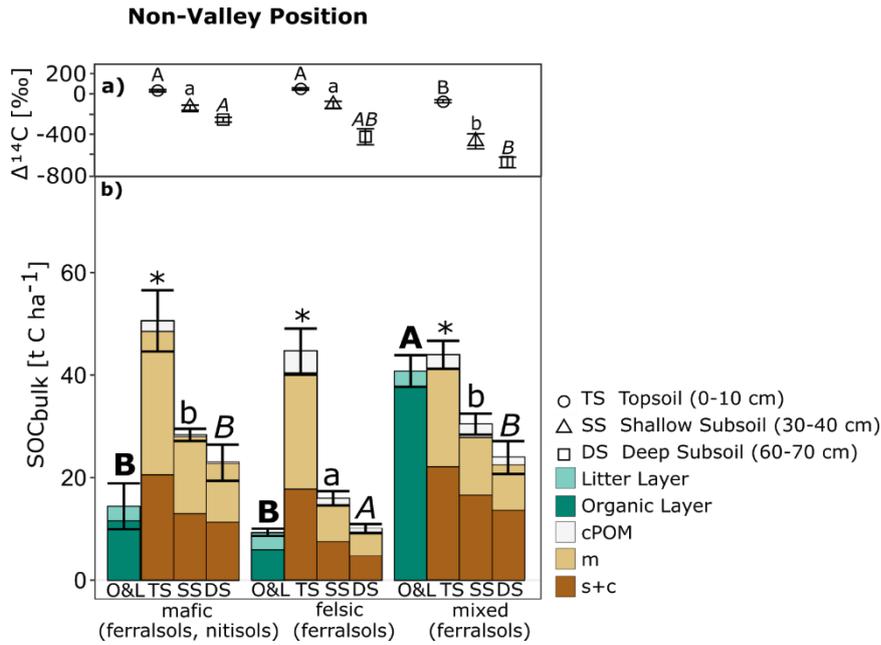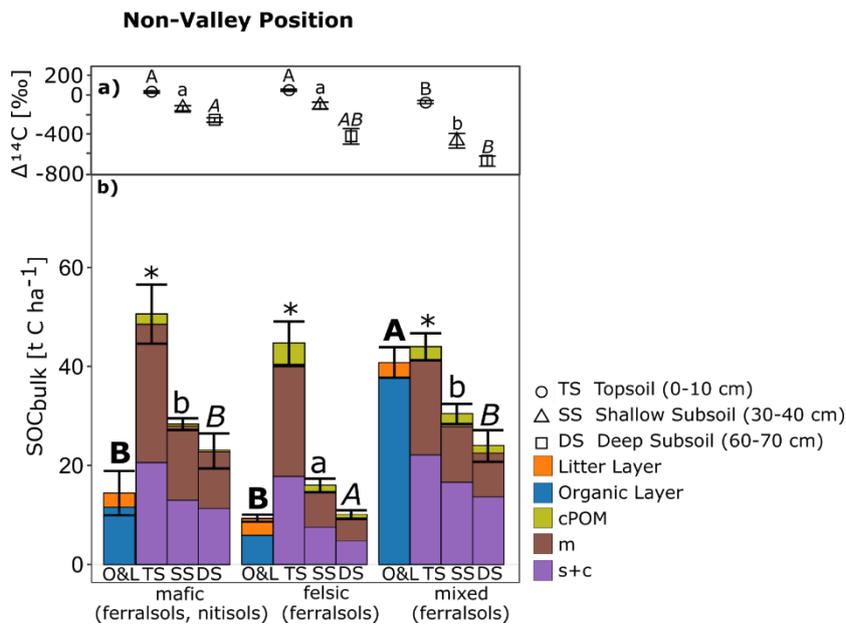
Figure 4 example 2

Figure 4 example 3

Used Literature

Fortuna, S. L. J., Kulkarni, C., Stone, M., and Heer, J.: Selecting semantically-resonant colors for data visualization, EuroVis, 32, 401-410, 10.1111/cgf.12127, 2013.

We hope we have addressed all concerns and look forward to hearing from you.

 Best regards,

The authors