

Response to Reviewer Comment RC1

<https://doi.org/10.5194/egusphere-2026-4145-RC1>

I enjoyed reading this manuscript. It addresses an important question for microbially accelerated weathering and presents a well-designed mesocosm experiment. The manuscript is clearly written, the methods are well described, and the discussion is generally balanced. I particularly appreciated the use of sequential selective extraction together with a mass-balance approach to strengthen the interpretation of weathering products.

Overall, I think this is a solid study that is suitable for publication after minor revisions.

We thank the reviewer for their constructive feedback. We agree with the reviewer's main concerns and have taken steps to address them. Our specific responses are detailed below.

Main comments

- The statistical analysis relies mainly on multiple pairwise tests. Please clarify whether a factorial analysis (treatment $\times$ depth) or a linear mixed-effects model was considered, as this may better reflect the experimental design.

We appreciate the suggestion and we've now updated the statistical analysis for comparisons that included treatment and depth. We have now implemented a linear mixed-effect model with experimental columns as the random intercept and post-hoc comparisons to assess pairwise treatment effects within each depth. For all other statistical comparisons, where depth was not considered, we implement a Wilcoxon rank-sum test (Mann-Whitney U). These changes better reflect the experimental design but have minimal impact on the results.

- Sequential extraction was not performed on the initial homogenized soil. Although the treatments were randomized, a brief discussion of how the lack of baseline fractionation may influence the interpretation of the results would strengthen the manuscript.

We agree with the reviewer that it would have been helpful to implement the sequential extraction on initial homogenized soils. The initial soil used for this study was homogenized, eliminating the heterogeneity between columns. It would have been useful to know whether base cations in the treatments go up or down relative to the initial soil, but not having those data does not change our understanding of the treatment effect. Furthermore, we do have other bulk-soil measurements that can be used to provide more context to the direction of change in the treatments versus the starting soil.

To address this question, we assembled bulk soil measurements for each treatment and the initial soils to construct an approximation of the same information presented from the sequential extraction (Table 1). For this comparison, we estimated calcium in carbonate from the measured bulk soil calcium carbonate equivalence (CCE). This assumes all carbonate was CaCO_3 and may therefore underestimate Mg in the carbonate fraction. We estimated the “som” pool from measured SOM abundance and the concentration of base cations measured in plant roots. The exchangeable cation content was measured on bulk soil. The bulk soil exchangeable data are strongly correlated with the equivalent measurements from the sequential extraction and for that reason were not described in the manuscript.

New Table Documenting Initial Soil Conditions

Table 1. Biogeochemical properties of the initial soil (SBX70) used in the experiment. See also supplemental Table S1 for bulk elemental chemistry from XRF.

Parameter	Mean $\pm$ SE	Unit
pH	7.13 $\pm$ 0.04	log[H ⁺]
SOM	5.67 $\pm$ 0.15	%
TC	2.57 $\pm$ 0.08	%
SIC	0.04 $\pm$ 0.004	%
SOC	2.53 $\pm$ 0.05	%
Ca _{exc}	3818 $\pm$ 81	mg kg ⁻¹ soil
Mg _{exc}	1701 $\pm$ 21	mg kg ⁻¹ soil
Na _{exc}	46 $\pm$ 2	mg kg ⁻¹ soil
K _{exc}	382 $\pm$ 8	mg kg ⁻¹ soil
CEC _{sum}	34.5 $\pm$ 0.6	mEq 100g ⁻¹ soil
CEC _{disp}	41.3 $\pm$ 0.7	mEq 100g ⁻¹ soil
Base Saturation	83.5 $\pm$ 2.0	%
Soil Texture	Silty Clay	NA

Despite differences in the approach, the patterns in the bulk data are generally consistent with the mass balance accounting from the sequential extraction (compare S12 below to Figure 6). Base cations Ca, Mg, and K all suggest greater availability in the MP1-treatments compared to UTC and the initial soil.

New Supplemental Figure

Bulk Soil Cation Mass-Balance

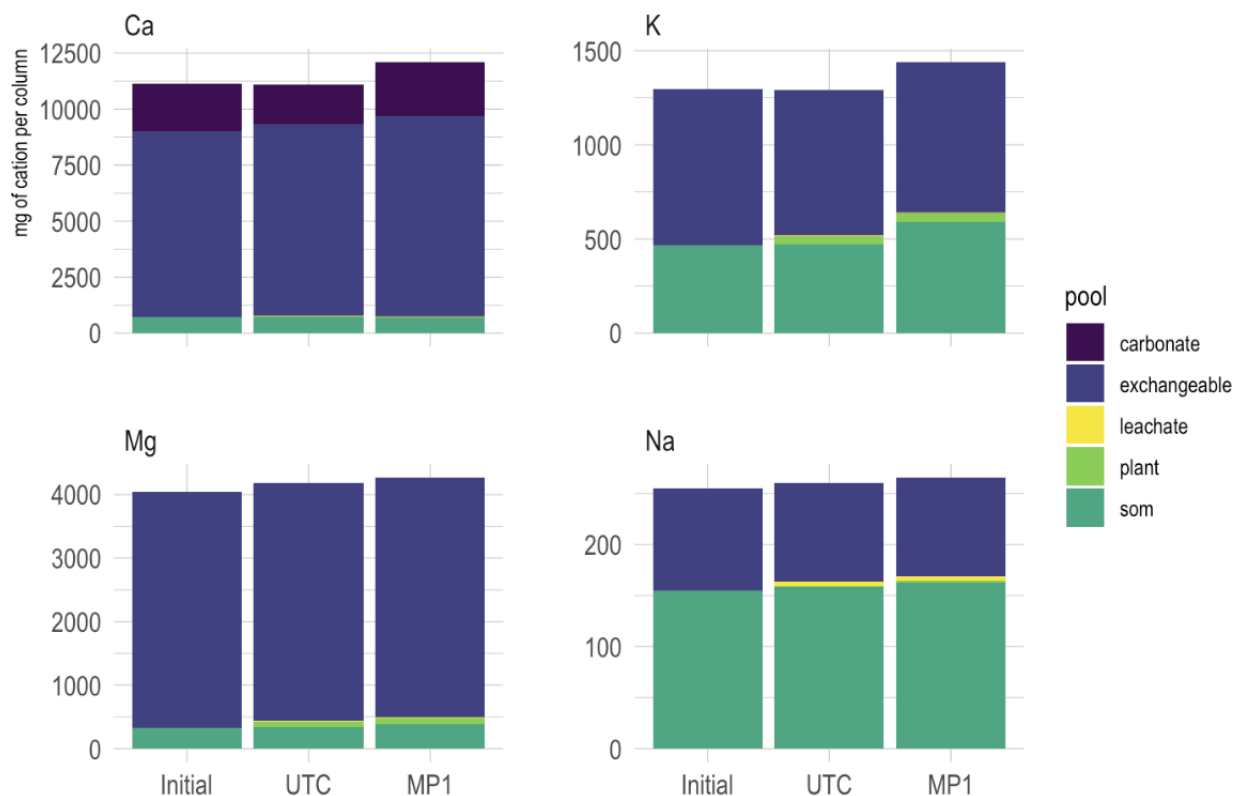


Figure S12: A reconstruction of the base cation mass balance (mg/column), including the initial soil, using bulk soil measurements. The carbonate fraction (purple) was estimated from measured CCE concentrations of bulk soil and assumes all carbonate as CaCO_3 . The exchangeable fraction cations (blue) were measured after extraction with 1M ammonium acetate at a pH 7.0. Leachate cations (yellow) are the flux corrected sums measured following the three rainfall events. Plant cations (light green) were calculated from measurements of root biomass and elemental concentrations. The SOM fraction (green) is estimated from the measured SOM content and elemental concentrations measured in plant roots. This plot is intended for comparison with the equivalent plot from the sequential extraction (Figure 6), which was missing data from the initial soil. These results confirm the pattern of treatment effects observed for Ca, Mg, and K from the sequential extractions and suggest that, relative to the starting soil, base cations in the treatments are either equivalent to or greater than the initial soil.

We do not intend for these data to replace the sequential extraction results. Sequential extractions are better suited toward constructing a mass balance because double counting of cations is not possible. However, this comparison substantiates our assumption that the amount of available base cations (i.e., base cations not locked in the mineral structure) either stay the same or increase relative to the initial soil, which

is what would be expected assuming that: (1) some amount of silicate weathering has occurred, which increases the overall abundance of base cations in the extractable pools and (2) there are no unquantified losses or gains from the system.

Minor comments

- In a few places, the wording could be slightly more cautious (e.g. replacing "ruled out" with "strongly suggests" or similar).

At the reviewers suggestion, we will make several changes to the text to dial back the wording to be more cautious.

- The manuscript is well written. I only noticed a few minor typographical or stylistic issues that can be corrected during revision.

Thank you for the feedback.