

# ***Interactive comment on “Decoupling silicate weathering from primary productivity – how ecosystems regulate nutrient uptake along a climate and vegetation gradient” by Ralf A. Oeser and Friedhelm von Blanckenburg***

## **Anonymous Referee #3**

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This ambitious study adds to the existing body of evidence that the relationships between plants and silicate weathering are complex, and that the concept of “biotic enhancement of weathering” in some cases is misleading. The starting point is that the 4 sites in the EarthShape project should provide evidence for an impact of vegetation on silicate weathering rate, due to the gradient in NPP and precipitation along the transect of similar lithologies and erosion rates. This is contingent on the premise that confounding factors associated with nutrient cycling by the different vegetation types along the climatic transect can be properly disentangled from silicate weathering rates.

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The theoretical framework for this has already been established in previous work, and the authors focus on the application. The authors find that there is no positive correlation between vegetation growth and silicate weathering rates, in spite of a strong precipitation gradient. They use this to infer that plants may have negative impacts on silicate weathering rates and that the global silicate-weathering cycle may not be driven by the impacts of plants on weathering. The results and conclusions drawn are certainly interesting and valuable, but they could be better served by a more concise data presentation. Only data that are needed to support the discussion and conclusion should be included, and reference to the tables instead of repetition of data in the text. Further, it would strengthen the discussion if the focus is on the main nutrients, as they are enough to support the main points of the paper.

Line by line comments: L11: “..these two drivers..”. It is unclear what is meant – is it biogenic vs. abiogenic?

L20: Ecohydrological controls of partitioning of water between drainage and evapotranspiration may explain some of this discrepancy

L25: Taylor 2009 gives a good review of biotic impacts on weathering

L27: “weatherability” should be defined, as it may mean different things in different contexts.

L36: plants possibly affect a negative feedback that is also there without land plants. Otherwise the silicate weathering thermostat would not have worked prior to the colonization of land by plants

L100: “along the” appears twice

L125: Santa Gracia is affected by livestock grazing, which would add to nutrient export. This should be considered in the discussion later.

L129: Eco-systems are primarily N-limited. What does this imply for P-weathering and P nutrient supply? Should be added in the discussion.

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L144: The sentence starting "They are thus towards the lower end of global cosmogenic nuclide-derived soil production rates. . ." should be clarified. Do you mean overall for all 4 locations?

L256: Sentence starting with "Because. . ." should be revised for readability, e.g. by removing ". . .throughout this article. . ."

L257: add "in" before Appendix A

L273: "kinetically limited weathering regime" is an interpretation and should be included in the discussion. Have you considered that it may be "thermodynamically limited" (Winnick and Maher 2018)?

L283: Probably not all nutrients are available to ecosystems, as some leave soils in dissolved form. The statement in line 610f should be included in some form in the main text.

L298: This paragraph is hard to read. Stick to describing the trends and exclude the numbers from the text. P and K being the most important nutrients should not be called an exception to a trend. It would clarify the message overall to focus on the most important nutrients and leave the evaluation of the other elements to the appendix.

L325: In my opinion the Sr ratios mentioned here are not distinct.

L392: Why does increasing P concentration along the gradient hint at P limitation? Where is P limiting? And what is the impact of livestock on the P budget in Santa Gracia?

L446-460: In Oeser et al 2018 it was concluded that the weathering is not limited by mineral supply. This does not necessarily imply kinetically limited weathering. Equilibrium with regolith fluid characterizes a thermodynamic limit (Winnick and Maher 2018). That being said, the Nahuelbuta site could be in a kinetically limited weathering regime. It would improve the manuscript to clarify this and what role plants may play in different weathering regimes.

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L577: “..to be limit...” - remove “be”.

L581: I would revise the end statement. It is a leap to upscale from a local/regional spatial study to the global temporal cycle. Plants are not the driver of the global silicate-weathering-carbonate cycle, only a modifier in as much as they affect the atmospheric CO<sub>2</sub> level at which the silicate weathering CO<sub>2</sub> sink balances CO<sub>2</sub> sources. Therefore biotic enhancement of weathering at the global scale does not increase silicate weathering rates (in steady state).

L618: GrowthRate should be defined

Figure 2: The left panel does not correspond to the text. Is litter layer and biota one box called plants?

Table 2: Eq(4) Does this assume no recycling internally in the plant?

Eq(6) is the notation tau\_x correct here?

References: Taylor et al 2009, Geobiology 7, 171-191 Winnick and Maher 2018, EPSL 485, 111-120

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