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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

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Final response

The interactive discussion in Biogeosciences has resulted in a two-faced impression. One anonymous reviewer and the short comment from Marjin van de Broek endorse our efforts in development of novel ways to quantify the relationship between rock weathering and nutrient uptake. These efforts are met with skepticism from two other reviewers. Given that what we do is a new way to look at a well-, but hitherto

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differently researched object, we are not surprised by this outcome. Yet we are grateful for all reviewers for such a detailed critique of our work, undoubtedly allowing us to design a better structured and much more accessible manuscript. Our aim is to make these new methods emerging from geochemistry aware to an interdisciplinary readership such as found in *Biogeosciences*. Time will tell whether these approaches lead to new trajectories in thinking about Critical Zone processes.

From the reviews, we identified several priority revision items. In particular these include the addition of *introductory text* aiming at clarifying the viewpoint of different disciplines and thereby avoiding the trap of misunderstandings apparent in some of the reviews:

- The comparison between fundamental concepts in weathering geochemistry and soil formation. Namely the concept of steady state (which we apply in our study) where regolith is constantly rejuvenated by regolith production at depth and its removal through erosion from above, and e.g. the “pedogenic threshold” or other more common soil science concepts which have mostly been developed for chronosequences, where the soils have a distinct age and undergo several phases of soil development.
- Key in this comparison is emphasis on the different time scales over which the various metrics integrate. Fluxes from the way we conduct weathering geochemistry integrate over millennia. The processes we decipher are thus long-term patterns set by the drivers that average or integrate over these time scales. This thinking differs (and likely might well lead to different views) from that of e.g. soil-ecological plot experiments where processes over the annual time scale can be monitored.

We further identified these potential modifications addressing major reviewer com-

ments:

- We are convinced by the referees' concern of over-interpretation of our data on plant stoichiometry. We will thus remove this section from the manuscript. This section is not essential for our analysis and the removal will not infer a loss in the conclusions.
- We will strongly clarify the misunderstanding in that we never suggested that plants to do contribute to silicate weathering. The question is how much do plants modify weathering under different degrees of plant cover and primary production. These relationships and their quantification are major unresolved issues in weathering Geochemistry and the weathering controls over the global carbon cycle.
- We are very much aware that resolving the interactions between ecosystem productivity and silicate weathering is not an easy task. However, we are convinced that our data set on chemistry in the weathering zone, soil, and plants in four study sites along the Earth's most extreme climate and biological gradient provides an excellent basis to tackle this task. We aim at addressing the involved confounding issues, in particular relief and erosion as the possibly stronger weathering flux driver, in a brief separate section.
- Because two reviewers were not convinced by the thrust of our interpretation, we will tune down the conclusion and rephrase the manuscripts' title as a question. For example: Do silicate weathering degree and flux depend on plant primary productivity?
- We note that some major reviewer comments are not justified. One reviewer was concerned by the lack of replication, which is wrong. We analyzed four replicate soil profiles at each site, and two of these in greater detail. There was concern over erosion being the larger control, inspired the high rate at one of the sites. We

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addressed this concern already by basing our main comparison on the two sites that are similar in erosion rate and relief. One comment questioned our choice of tau values, used to calculate elemental weathering fluxes. However, what we do is standard practice in weathering rate calculation. The input of seaspray was questioned, even though we address this by Sr radiogenic isotope ratios.

- However, we will strongly revise the text for clarity, brevity and logic, as suggested.

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