

Final answer to the reviewers

We first want to acknowledge both reviewers for their insightful comments. We are glad to see that the originality of the method presented in our manuscript (*i.e.* the use metal stable isotope composition of river material associated to mass balance equations, with direct comparison of ecosystem productivity) has been appreciated.

Nonetheless, bridging the gaps between Earth surface geochemistry and ecology is not an easy task. Indeed, reviewers highlight weaknesses in our interpretation of ecosystem nutrition pathways, leading to some overstatement and wrong generalization on the behavior of rock-derived nutrients. Also, in our manuscript the focus on "weathering" parameters (such as weathering intensity; W/D) to explain ecosystem nutrition was too strong.

According to the reviewers' comments and as explained in the separate replies, we will take the opportunity through this review to improve our manuscript. In particular:

- Qualifying Ba as a "nutrient" is wrong as Ba does not have any physiological role in plants. Thus, we would define it as having a "nutrient-like behavior" instead. From here, we will state as a working hypothesis the fact that the behavior of Ba only broadly reflects that of rock-derived nutrients (*e.g.* Ca, Mg, P...). More generally, throughout the manuscript generalization of our findings to rock-derived nutrients will be tuned down (revs. 1 and 2).
- The potential role of some important metrics for biological productivity such as precipitation and temperature has been ignored. We will give them a more important place within the discussion (rev. 1).
- The isotope-derived flux of net Ba uptake could be compared directly to a similar estimate from GPP (and the typical Ba concentration in biological material). We think that this is a good idea, although (1) the comparison should be made using $NEE = GPP - TER$, representing the net increase in biomass should be used because (2) it is more informative to compare the concentration of Ba in organic matter required for these two metrics to agree, and then to compare this concentration to independent estimates of Ba concentration plants. We will add a short discussion text accordingly (rev 1).
- A part of our discussion relies on the definition of the nutrient uptake through "geogenic" and "organic" pathways. The way we use these definitions was misleading, and we will clarify this in the next version of the manuscript (rev. 1).
- We will add error bars to the diagrams, where missing (rev. 2).