Geochronology Discuss., referee comment RC1
https://doi.org/10.5194/gchron-2022-5-RC1, 2022


# Comment on gchron-2022-5

Anonymous Referee #1

Referee comment on "Cosmogenic nuclide weathering biases: corrections and potential for denudation and weathering rate measurements" by Richard F. Ott et al., Geochronology Discuss., https://doi.org/10.5194/gchron-2022-5-RC1, 2022

This is a fascinating and useful study of the effects of target solubility on CRN concentrations in a weathering substrate. The authors clearly present the theoretical underpinning and build up a model of target mineral enrichment/depletion in the weathered substrate. They additionally show that multiple weathering proxies can be used to correct for enrichment/depletion for basin-wide studies, which will be of broad interest. Using the WeCode package in advance of fieldwork will certainly be of benefit as well. Overall, this is a well-written manuscript and an excellent contribution to the field. I do have some concerns and points of clarification that I hope the authors will consider.

The basic conceptual model requires a mixed and eroding regolith. This is illustrated in figure 2, but it would be worth highlighting this and discussing the potential pitfalls that researchers might run into if this assumption is violated (i.e mixed but not eroding, or eroding but not well mixed).

The variable k requires some extra discussion. It is defined on line 175 as a function of changing grain mass through time. I am guessing this is derived from the weathering rates? In any case, the manuscript could use a fuller discussion of how to derive k.

Line 124-126: why was radioactive decay ignored? As the authors point out, this is not likely a problem for $^{10}$Be, but $^{14}$C is becoming a common tool for quartz-based studies, especially in complex erosional settings where this technique will undoubtedly be used. Since the authors must have used some form of the nuclide production equation, I would think it should not be too difficult to put the decay term back in.

Table 1 is missing $m_g$, $m_i$, and k. (k is the most important)

Lines 183-185: I am struggling with the idea that the average grain residence time is always longer than the residence time of a parcel of rock. This is justified with equation 8, but this feels a bit like Zeno's paradox where you can never be shot with an arrow since it will always travel half the remaining distance. For soluble target minerals at low erosion rates, there must be a point where all that mineral has dissolved away before the original parent rock has moved through the regolith. It is possible that this is a function of the assumption of a mixed-eroding regolith. If so, that should be clearly stated.

It would be helpful to the reader to reiterate that $I_R$ and $I_B$ are mineral fractions and not concentrations.

The unknowable errors that are mentioned on lines 290-292 are potentially very large. These could be partially addressed by expanding on the implications of the model assumptions as mentioned above.

Line 307: 'corrected denudation rate' = input?

Section 5.2 could be focused a bit more to remove repetition from earlier.