Geochronology Discuss., referee comment RC1
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Comment on gchron-2021-34

Anonymous Referee #1

Referee comment on "Combined linear-regression and Monte Carlo approach to modeling exposure age depth profiles" by Yiran Wang and Michael E. Oskin, Geochronology Discuss., https://doi.org/10.5194/gchron-2021-34-RC1, 2021

This paper presents two approaches modelling concentrations of cosmogenic nuclide concentrations based on linear regression combined with a Monte Carlo approach.

Despite being in a field I really appreciate, I have some difficulties to judge what is the value added by this paper. This is probably by the fact that too many assumptions or to be more precise too many shortcuts are used to simplify the main equation governing the cosmogenic production equation as a function of denudation rate and time. Some of these shortcuts are dangerous and some other can be avoided with the used of numerical calculations. I will thus ask for a revision of this paper

In the entire paper I suggest changing erosion by denudation that is more appropriate for cosmo.

At the end of abstract you mention “compared to the error from omitting muogenic production…” I totally agree so, why do you present a linearization that ignores muons contributions?

Line 35-40: despite muons contributions are small at surface compared to the neutron one, ignoring their contributions and considering only neutrons will yield to multiple time/denudation pairs that can model a depth distribution.

Line 44: If you want to be totally objective you should live all parameters free and in a second step consider the solutions that can match the field observations. If you constrain at the first step your unknowns, time or denudation you may miss the real solutions.

Line 55 Legend of Figure 1: you should update the muon contributions; since Braucher 2003, these contribution have been updated (Braucher 2011,2013, Balco 2008, 2017). More it has been also shown that Heisinger muons contributions were too high. You should correct them in your matlab code and in the Hidy one.

Line 90-91: again do not omit muon contributions! In a high denudation environment, their contributions are far from being negligible.

Line 67: I think Nishiizumi, 2007 is not appropriate as in this paper he proposed a half-life of 1.36±0.07 Ma.

Line 100 and following paragraph: I think this is not the right approach. First I will have a look to the distribution as a function of depth (in g/cm2) to see within the first two meters what is the value of the "slope" of the exponential decrease. Lower than 250 g/cm2 will traduce a contribution mainly due to neutrons with moderate denudation rate. If higher muon contributions are more important due to higher denudation rate or can be due to a recent rejuvenation of the profile making deep samples to be now closer to surface. In this latter case, running an inversion model with density as free parameter will probably

propose high values for density >3 g/cm3 making clear that the profile has been perturbed. This can be the case when loess covers are rapidly eroded by wind deflation, so fast that the cosmo production cannot be at equilibrium.

Therefore I will let run the model with totally free parameters and then cut the Time/ denudation space by probable eroded thickness to reduce this space. By imposing since the beginning of the modelling a constrain as important as the eroded thickness may be dangerous to my point of view.

Line 108: which muon contribution do you used as T_{em}? Fast or slow? Is this choice important?

Please change the * by × in the tables. Please use uniform values for concentraions (at/g or 10^5at/g)

Line 174: why this denudation rate of 0.3±0.05 cm/kyr ?

With this loess covered surface, probably the use of two nuclides will be better than one.

Line 177: I am not convinced by the fact that you authorize inheritance to be negative. This is as you mentioned "non-physical". Therefore what will happen if you restrict the modelling to inheritance ≥ to zero? Is the overall space of solution affected?

Paragraph 4.2.5 : I agree but using variable production rates implies adding more uncertainties and this is not the fact in the actual calculators !

If you think to revise this contribution you should try to add a second nuclides (26Al for example) and try to remodel the depth profile with two nuclides. Inheritance can thus be variable and this can probably be a great value to the modelling of depth profile.