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Comment on gchron-2021-5

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Referee comment on "Erosion rates in a wet, temperate climate derived from rock luminescence techniques" by Rachel K. Smedley et al., Geochronology Discuss., https://doi.org/10.5194/gchron-2021-5-RC1, 2021

General comments

This paper presents a study on the erosion rate history of rock avalanche deposit using surface exposure datings from optically stimulated luminescence signals. The authors present luminescence signals of calibration sites and from rock boulder surfaces. The setting of the rock avalanche deposits is framed by terrestrial cosmogenic nuclide (TCN) dating from the litterature. The study is well organized and takes advantage of the previous work on this OSL application by using rock color and texture observations in order to choose the most appropriated calibration samples. The main innovation of this stsudy is the use of a multi-elevated temperature, post-infra-red, infra-red stimulated luminescence (MET-pIRIR) protocol (50, 150 and 225°C) allowing the identification of samples complexities and bringing more constrain to calculate exposure datings and erosion rate histories.

Overall the paper is well written, easy to follow but the figures lake in clarity and bring confusion to the reader. Indeed, Figure 7 is supposed to convince of the good quality of the inversion of the erosion history (erosion rate and time at which the erosion is switch on) from the experimental luminescence signals, but in its current form, the figure does not allow any visual inspection and validation of the results of erosion rate history.

Also, the auhors use an approach developped by Lehmann et al., 2019a, in which the use of OSL signals from bedrock surface allows to calculate an erosion correction over TCN dating. Here, this approach in not fully exploited. Erosion rate histories are determined but are not used to discuss the possible erosion correction of the TCN exposure dating.

Finally, this study brings important observations on the differences of bleaching depth according of the energy traps targetted by the OSL stimulation. The IR50 signals are bleached deeped than pIR150 which is bleached deeper than pIR225, in a way that the higher the temperature of stimulation is, the longer it takes to the light exposure to affect the OSL signal in depth. However, the discussion on the difference of bleaching rate of the different signal could have be brough further. Does the difference in bleaching depth of the different stimulations of a same sample could give us information about complex burial/exposure histories? Do the signals from different stimulations would have the same bleaching difference in a steady state or with a transient state with erosion?

Specific comments and technical corrections

Line 53: The authors should mentionned the work of Brown and Moon, 2019* and Brown, 2020**.

Line 90: The authors should mentionned the work of Brill et al., 2021***.

Lines 208-213: How do the raw data Lx/Tx were normalised (L0 determination)? Is it done for each core individually or for each sample (considering the same L0 for every core of a same sample)? Core 3 for IR40 signal of sample ROAD3 (Fig. 4D) for example, seems to be normalised too low. I would recommend to normalise each independly. The normalisation approach should also be mentionned the Fig. 4 caption.

Lines 219-221: The difference in depth of the bleaching front regarding the difference of ages of sample ROAD02 and ROAD03 could be explain also with the noise of the signal, the orientation of the sampled faces, difference at the rock surface.

Lines 214-221: How does the fit (black lines) in Fig. 4 are produced? This should be mentionned in the main text and in the caption of Fig. 4.

Line 229: "sample BALL01 was coarser grained than BALL02 and BALL03" this affirmation is not supported by the results shown in Fig. 3B where only the two first discs of sample BALL01 are coarser than the other samples BALLs but deeper into the signal BALL03 seems to has the coarsest grained texture.

Lines 232-233: "[…] lost during sample and/or sample preparation […]". Are there any ways to invalidate this experimental biais? During the sampling, did you mark the exposed surface with ink? Did you measure the core before and after slicing? Does the surface of the first disc look alike the surface of other 1st disc of other cores?

Lines 244-245: "sigmaphi0 and μ were calibrated using the known-age sample […]"

Reading this sentence I was confused that ROADs samples are the calibration samples. “ROAD samples” could be explicitly mentioned in this sentence to improve clarity.

Lines 253-258: There is no mention of the results for the calibration of sigmaphi0 and μ parameters. They should be explicitly written in the main text.

Lines 258-260: Note that the μ value for ROAD03 are not so different than the ones for ROAD02 even if the grain size are very different. Could you comment on that?

Lines 262-266: All the values mentionned in this section are different than the values in Table 3!

Line 305: The “(2018)” reference is wrong and it should “(2019a)”

Lines 271-281: Now that you inferred erosion history is determined for the two boulders, what are the consequences on the comso age of the deposit? Does the sampled boulders are the same sampled for TCN dating? If not, it would be interested to discuss the potential exposure age correction. Lehmann et al., 2019a approach does correct the TCN age with the inferred erosion history. It seems that the approach is not fully exploited here.

Lines 355-365: Do field observations of the deposit of weathered material on/in the ground/soil below the blocks have been done and would validate the hypothesis raised in this paragraph?

Figure 1: This figure could be highly improved by adding in Panel B, the oultine of the rock avalance deposit, the elevation isoline or two elevation points and the coordinates. In Panel C, the north or flow direction of the rock avalanche deposit.

Figure 2: The scale could be directly placed on the figure.

Figure 3: The direction of the y-axis label should be turned 180° to be consistent with other figures.

Figure 4: The incertainties of the inversion could be plot as an eveloppe using ±1sigma of the μ and sigmaphi0.

Figure 6: In every sub figure, an age is written in white, for example (0.01 a^{-1}) in Fig. 6A. Does unit [a^{-1}] is the correct unit? Also, the units are mentionned with “[ ]” but should be “( )” for consistency with the rest of the paper. Finally, the inversions for each stimulation of the ROAD01 sample appear to explore a truncated range of μ values, that is, the probabilities of 1 (yellow) reach the side of the inspection box. The μ values obtained will surely be much higher if the inversion will allow to explore the values of μ up to 5 or 6 mm^{-1}.

Figure 7: The formatting of this figure should be considerably improved. The panels A, B, C, G, H, I do not allow any visual inspection of the data and inversion qualities (for ex: the x-axis boundaries should be set between 0 and 20 mm). The inversions in C, G, H and I do not seem to fit to the experimental value. This figure should be THE figure of the paper, but in the current formatting, it removes persuasive force of the results on the erosion rate history and confuses the conveyed message by the study.

Figures S1, S4: These figures are too pixelised and should be improved.

Supplementary material: Raw data of Lx/Tx luminescence with depth for every core/sample could be shared in the supplementary material.

Formatting: In general, there is a lack in consistency between the labelling of figures (i.e. Fig. 4 A, B) in uppercase letters and its mention in the main text (i.e. Fig 4 a, b) in lowercase letters.

*Brown, N. D., & Moon, S. (2019). Revisiting erosion rate estimates from luminescence profiles in exposed bedrock surfaces using stochastic erosion simulations. Earth and Planetary Science Letters, 528, 115842.

**Brown, N.D. (2020) Which geomorphic processes can be informed by luminescence measurements?, Geomorphology, https://doi.org/10.1016/ j.geomorph.2020.107296

***Brill, D., May, S. M., Mhammdi, N., King, G., Lehmann, B., Burow, C., ... & Brückner, H. (2021). Evaluating optically stimulated luminescence rock surface exposure dating as a novel approach for reconstructing coastal boulder movement on decadal to centennial timescales. Earth Surface Dynamics, 9(2), 205-234.