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Comment on gchron-2021-17

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Referee comment on "Attenuation of beta radiation in granular matrices: implications for trapped-charge dating" by Alastair C. Cunningham et al., Geochronology Discuss., https://doi.org/10.5194/gchron-2021-17-RC2, 2021

Review of Cunningham et al. "Attenuation of beta radiation in granular matrices: implications for trapped-charge dating" submitted to the Journal Geochronology

The manuscript submitted by Cunningham et al. presents simulation results on the grain size dependence of the mean dose rate to dosimeter grains in a granular matrix. Additionally, the authors explore the effect of surface or whole grain sources on the dose rates to dosimeter grains. Experiments performed by the authors suggest that U and Th as radioactive sources are primarily being held on grain surfaces, whereas K seems to be a whole grain source. The manuscript shows the need of a refined model to account for variable grain size distributions of dosimeter and source grains. This refined model is presented in the manuscript and the authors provide an excel spreadsheet for potential users, who wish to make use of the new findings in their own research.

The manuscript by Cunningham et al. presents new simulation and experimental results on dosimetry issues in trapped charge dating and updated self-dose values for quartz and feldspar. I enjoyed reading the manuscript and it deserves to be published in the Journal *Geochronology* after some minor revisions. I hope that my suggestions will help the authors to improve the readability of the manuscript.

Minor comments:

Comment #1: Use of terms

In their manuscript the authors make use of various terms to describe their simulation setup as well as their results. Unfortunately, sometimes new words are introduced for things that have been described by a different term in previous sections. Using the same

term throughout the manuscript and explaining the used term on its introduction would help the reader in understanding the manuscript.

Here are some examples:

- Line 38 – 43: Here the terms inactive and inert are used. I would suggest sticking to one of these terms. Also here the term "inert" is used for the first time, whilst its meaning is explained later on (line 79 – 80).

- Line 85: "… external grains …". It is unclear what "external grains " are. I assume that here the authors use the term "external grains" as a synonym for the in line 82 described "… presence of other grains in the sediment …". I find the term "external grains" difficult, especially, because it is not used again at a later stage. I suggest using the term "inert grains", if this is what the authors actually mean.

- The use of the term "matrix" throughout the manuscript: In the beginning the authors use the term "matrix" for the homogenous surrounding of a dosimeter grain – as which the term matrix has been used in the literature previously. However later on (e.g. line 305-312) the term "matrix" is also used to describe the sediment grains simulated in section 4, including source and dosimeter grains.

Comment #2: Section 2 and section 3

Section 2 introduces the balanced energy model, whilst section 3 does not make use of this model. Additionally, section 2 refers to the tables generated using the simulations presented in section 3. I find this rather confusing, and I would suggest swapping section 2 and 3 for better readability of the manuscript. I also think that presenting section 3 before section 2 could help in justifying the contribution of this paper to the current body of knowledge when presenting the aims of this manuscript at the end of section 1.

Comment # 3: Self-dose values for K-rich feldspar grains

Table 3 is only mentioned once in the entire manuscript (line 165 in section 2). I assume it is generated using the simulations described in section 3, although this is not explicitly stated in this section. I would suggest to also refer to this table in section 3 and explain the simulation setup used for the K-rich feldspar grains, i.e. composition of the grains and matrix.

Comment #4: References needed for some statements

- Line 155 – 159: Here references are needed for the statements on U and Th as surface sources and the low likelihood of K as a surface source. Later on (section 7) references are listed and explanations are given. Maybe some of this could already be used in line 155-159?

- In line 215 the authors state that there is only "little difference in electron stopping powers between the main silicate minerals". A reference is needed for this statement.

- Line 291: Here a reference should be given for x = 1.2.

Comment #5: Figures

- I really like that the simulation geometries are shown in the manuscript. However, it would be useful if a legend would be given for each geometry used. This should include an explanation for the colours used in the box geometry as well as for the bars shown in the respective grains size distributions, as it is unclear to what distribution the filled and the non-filled bars refer.

- Figure 4: For consistency I would suggest using the same symbols as in figures 2 and 3. A better alternative would be to use different symbols and different colours for U, Th and K in all figures. This would make reading the figures more accessible to everyone, and it might be helpful should the manuscript be printed in greyscales.

- There are a few occasions where a reference to a figure would be helpful, e.g. in line

225, lines 381-384.

Comment #6: Minor typographical errors

- Line 191: $ð\square\square\square^{s}$ is given in the text, but in table 2 self-dose values for surface sources are denoted as $ð\square\square\square^{surf}$.

- Line 234: Here the abbreviation BEM is used for the first time. However, the abbreviation is not explained. Please spell BEM out on its first use.

- Line 311: Could you please check the phrasing of the sentence starting with “If conditions…”.