



EGUsphere, referee comment RC2
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Comment on egusphere-2022-1005

Christoph Glotzbach (Referee)

Referee comment on "A practical method for assigning uncertainty and improving the accuracy of alpha-ejection corrections and eU concentrations in apatite (U–Th)/He chronology" by Spencer D. Zeigler et al., EGU sphere,
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General comments

Dear Authors,

Overall, I found the manuscript well-written, and scientifically interesting and the data is of high quality. I still have some comments and suggestions that I would like to see addressed by the authors:

- I do not get why small grains (<50 μm) are initially considered and later on the results not included. Either include them in the interpretation or (my favorite) do not include them in the manuscript since as you said such grains are commonly not used for apatite (U–Th)/He dating.
- The manuscript provides a huge amount of CT data at a very high resolution, and I like to encourage the authors to do further analysis and explore the reasons for their overestimation and statistics of grain geometries.
- I do miss a discussion about the reasons this study found an overestimation in volume, F_T , and radius. The authors did only consider the maximum width and since grains are usually not symmetric perpendicular to the c-axis, their finding is not a surprise. They should have noticed this since they have very high-resolution CT data, which they could use to e.g. make some statistics from the extracted 3D volumetric data (comparing W1 and W2 of hexagonal grains and W1 and L of ellipsoid grains).
- Anyway, a simple additional measurement of the minimum width could correct the data and therefore no correction is required. In my study, I measured the minimum and maximum width and therefore could not find a systematic overestimation. In case you

have measured the minimum width (at least you stated this in your manuscript) please provide all geometric estimates based on the minimum and combined minimum and maximum (volume, F_T , and sphere-equivalent radius) measurements and a comparison with the CT data.

- The authors stated, that the provided corrections might be simply transferable to other labs/users. I doubt that this is that easy and only possible in case the protocol is similar. Since the authors have not at least provided information on the protocols of other labs, this is just a guess. I personally do not like that you suggest a protocol in which only the maximum width of grains is measured and afterward the overestimation is corrected. This does introduce scatter to the data. Instead, I would suggest measuring at least both the minimum and maximum width, which should remove the overestimation. Those that want to be even more exact can measure according to the 3D-He approach or even use CT scanning.
- It would be consequent and useful to show the consequence of your applied corrections for the cooling history. I would therefore suggest that you model cooling histories from the presented data before and after the corrections are done.

I hope you find my comments and suggestions helpful.

Technical corrections:

Line 52: Please make it more clear why you preferentially overestimate the grain size. My guess is that the grain will lay down with the c-b axis parallel to a horizontal. This can be easily corrected if you would use low-adhesive tape and rotate around the c-axis the measure also the a-axis.

Anyway, explain in Fig. 1, how you get to the red 'overestimated area'.

Line 131: I would say that according to present knowledge radiation damage does have a large effect in case of slow cooling or long stay in the PRZ.

Line 175: It is not clear at this point why it is important to analyze apatites from different

lithologies and ages? Please clarify.

Line 223: Maybe better say 'code' instead of 'single value'.

Line 254-255: I do see the benefit of having such a classification scheme, but it is not only useful for newcomers. Just say that this simple approach might be useful to easily report the overall morphological quality of grains in studies reporting apatite (U-Th)/He data.

Line 267: That is a very important point, the reported corrections are only applicable under these conditions. Therefore, I am not sure if your method is that 'simple and practical and even applicable retroactively. Please make this clear in the abstract and elsewhere.

Line 277: I agree that this is difficult on a glass slide only, but is quite simple with low adhesive double-sided tape. The extra work on doing this is at a maximum 1-2 minutes, nothing really difficult, and neglectable compared to the time needed to search and pick suitable grains. I also do not see why you are only using 'maximum width', which consequently results in an overestimation of volume, F_T and radius.

Line 351: I would suggest reporting a few of the reconstructed apatites.

Line 361: This procedure is not clear to me, you have selected grains $<50 \mu\text{m}$ in width and analyzed them and finally not considering them. Does not make sense to me. It would make sense to say from the start that you have not included grains $<50 \mu\text{m}$.

Line 364: Change to 'typically'.

Line 449: Please say what statistical value is that e.g. correlation coefficients?

Line 489: The reason why this study found an overestimation is not that more grains have been analyzed, but the reported measurements are based on the maximum width and assuming an idealized grain geometry. You state in the method section that you also did minimum width measurements. In case you have the data, I would like to see the resulting measurements for those too, or at its best to combine both maximum and minimum measurements.

Line 532-533: This is because I did the calculation based on the minimum and maximum width of grains or accurate measurements of the a, b and c axis.

Figures

Fig. 1: Please explain the occurrence of the overestimated area. Is this based on the assumption that W_1 is measured, but why in the ellipsoid example do you fit an asymmetric cross section (taking into account that W_1 and L are different)? Please clarify.

Fig. 4: Could you use a slightly different color for those grains in morphological categories 1 or 2.