Comments of the editor

The two reviewers have only minor comments on your Technical Note, which you have adequately addressed in your response letters. I am therefore happy to recommend publication of your paper in Geochronology pending these changes.

Dear editor, we thank for the recommendation as well as the additional comments. Please find our responses in the following. Please note that some of the requests have required testing the software and changing the code. Due to this work we have now added Aaron Mielke as a coauthor, because he found all the code mismatches and will in the future further develop this application. He is also an expert in Th/U dating and has helped revise the manuscript. Thus, we prefer to have him as a coauthor, rather than just thanking him for his help in the acknowledgements.

However, I would also like you to address a few additional points which I have found after reading the paper myself:

1. Lines 29 and 30 contain duplicate sentences and use the word “manifold” instead of “manyfold”.

Changed.

2. Equations 1 -3 are unnecessary. Standard deviation, standard error, interquartile range and median absolute deviation are commonly used terms that do not need explicit definitions in a paper of this kind.

We have shortened this section and deleted equations 1-3. The paragraph now reads as follows:

“In total, the software provides three different options for dispersion, including (i) the standard deviation (s), (ii) the interquartile range (IQR) (Tukey, 1977), and (iii) the median absolute deviation (MAD) (Leys et al., 2013; Huber, 2004; Rousseeuw and Croux, 1993). For the calculation of the MAD we assume normal distributed data.”

3. Line 245 states that your software uses means of ratios. This treatment has some undesirable statistical properties (as detailed by, for example, Ogliore, NIM-B, 2011 and McLean et al., G-Cubed, 2016). It would be useful to offer your users the ratio of the means as an alternative solution.

We agree with the editor that the ratio of the means may bias the results under very low count rates or fast changing signals, which is generally in optimized liquid MC-ICPMS analysis not the case. We propose to implement a further note and treatment of this aspect in the next version of the software. The text now reads in L276: The treatment of means of ratios may have undesirable statistical properties for low or fast changing signals (Ogliore, NIM-B, 2011, McLean et al. 2016), which could be taken into consideration when updating the software.

4. Line 297: What does “dft” stand for?

“dft” stands for distance from top. We have included the definition of this abbreviation now.

5. Sections 4 and 5.3 can be shortened. People will read your technical note to learn more about your software. Most of them probably won’t care so much about its application to Speleothem B1. As far as I can tell, Figures 4 and 5 were not generated by your software. I think they can be moved to the supplement.

We thank for the comment and have shortened section 4 and 5.3 as suggested. For example, we have moved both Figure 4 and 5 to the supplement as new Figures S3 and S4, and removed Figure S4 and the associated discussion of the isochron.

6. Line 338 suggests that means should be replaced by medians. However, Section 3.3 says that the software uses means (of ratios). Which is correct?

As outlined in section 3.2, the user has the choice to use either the mean or the median. This is possible in the “inspect” tab in the drop-down menu “mean”. The default setting of our software is the median.

7. Line 339 states that outlier rejection is done using box plots. Can you clarify how this works? The convention is that box plots define outliers as being more than 1.5 IQR above or below the median. Did you follow this definition?

We assume the reviewer refers to the sentence “Shao et al. (2019) had addressed this problem by implementing manual outlier removal by comparison to boxplots based on interquartile ranges. We opted for the automatic version as this is more time efficient for large datasets.”. Hence, we are not using box plots for outlier definition. For details of the software of Shao et al., we refer to their publication.

8. According to line 351: “The default method (2 standard deviation) does not remove all the systematic outliers”. What do you mean with “default method”? A 2 sigma cutoff is a very poor outlier detection criterion, as it rejects 5% non-outliers. This is called a “type-1” error in statistics. If your software includes a 2-sigma criterion, then please remove it.

For the calculation of the mean ratios, different mean and dispersion measures are available. We have removed this confusing sentence the editor refers to in this paragraph. The (dis-)advantages of different dispersion measures are discussed in more detail the following paragraph.

9. Line 384: Supplementary table S1 uses three widely different initial 230Th/232Th ratios (0.75, 11 and 75). One of these ([230Th/232Th] = 11) is based on drip waters. How were the other estimates obtained. Lines 62-71 mention isochrons and independent age constraints as alternative means of estimating the detrital component. Did you use those? Does your software perform isochron regression? If so, does it implement the Ludwig and Titterington (1994) algorithm. Some more details would be useful here.

Our software does not perform isochron regression. To prevent confusion, we have removed the isochron calculated for stalagmite PR-LA-B1 in the supplementary material and the related discussion.

The different mentioned ($^{230}Th/^{232}Th$) correction models are based on different previous constraints. The value of 0.75 follows the conventional approach assuming a upper continental crust $^{232}Th/^{238}U$ weight ratio of 3.8 (Taylor & Mvlennan, 1985) with an uncertainty of 50% (Ludwig & Paces, 2002) and $^{230}Th$, $^{234}U$, and $^{238}U$ in secular equilibrium for the detrital material to account for initial Th. The value of 23.7 stems from a previous analysis of Warken et al. (2020), who constrained the initial Th ratio by using an isochron approach on a speleothem from Larga Cave. We have added the relevant citations and references to the supplementary table S1, and have updated the explanations in the main text accordingly.

10. Although the Windows executable is useful, it would also be helpful if your code would work on other operating systems as well. However, when running your Python code on my computer (Ubuntu 22.04), I get the following error message:

```
Traceback (most recent call last):
File "/home/pvermees/temp/UTh_Analysis/main.py", line 259, in
GUI = Window()
File "/home/pvermees/temp/UTh_Analysis/main.py", line 40, in __init__
self.inputTab = InputTabWidget(self, self.ratioBuilder)
File "/home/pvermees/temp/UTh_Analysis/InputTabWidget.py", line 35, in __init__
self.initOverviewBox()
File "/home/pvermees/temp/UTh_Analysis/InputTabWidget.py", line 509, in
initOverviewBox
self.uTailTable.setVerticalScrollMode(QtGui.QAbstractItemView.ScrollPerPixel)
AttributeError: module 'pyqtgraph.Qt.QtGui' has no attribute 'QAbstractItemView'
```

We thank for this hint. We apologize for the inconvenience that the code did not run on your system. We have identified this error as arising from running the code on a different Python (and package) version. We have updated and tested the code and it should now run with the latest Python versions on different operating systems including MacOS, Windows and Linux.

Many thanks again for helping us to improve the manuscript and to make the code best available.

The authors