

We greatly appreciate the helpful and constructive comments and suggestions. In the following find our detailed Response

Response to Reviewer #2

This paper presents a Python-based program “U-Th Analysis” designed for U-Th isotopic data analysis for MC-ICPMS U-series dating. The program has a friendly graphical user interface and is open for the source code, which can be modified according to the measurement methods. This program comprises many automatic functions: e.g., to calculate U and Th tailing effects, identify outliers in isotopic ratios, correct for initial ^{230}Th contamination, as well as to load and save data. I support to accept this paper for publication, as a transparent data treatment algorithms is desired for each of dating laboratories.

I have a few comments:

U-Th isotopes can be measured using MC-ICPMS with different methods, and in many labs, the two elements were measured separately. In the Conclusion of this study, it was mentioned that the U-Th were measured simultaneously. I think the isotopic measurement method should be clarified before describing the program, probably in the section of “2.2. Chemical preparation and instrumentation”.

Many thanks for this comment, we will add a section expanding the method description in section 2.2, e.g.:

"The cup setting to collect isotope signals on masses 238 to 229 is shown in table 2 in Kerber et al. (2023). The first cycle collects all U isotopes for 2 seconds, with ^{234}U on the central detector (FC/SEM). The second and third cycle collect the Th isotopes for 2 seconds integrations time, with ^{230}Th and ^{229}Th on the central SEM. These cycles are repeated for an optimal number for each measurement."

Since reviewer #1 also commented similarly, we will add clarifying statements that the GUI in its present form is optimized for our setup, but can in principle be adapted for other protocols and instrumentation.

If I understand well, the “Input” tab performs corrections of blank, tailing, and hydride, the “Inspect” tab filters the outliers from isotopic ratios, and the “Analysis” tab calculates the U-series age and corrects for initial ^{230}Th contaminations. The combination of FC and SEM was used for U-Th measurements, so, I want to know how the SEM/FC yield is corrected, and how mass fractionation is corrected, and if the uncertainties of the two factors are considered in the program.

Many thanks again for this comment and we agree that this information has been missing. We suggest to add the following statement to section 2.2:

“Mass fractionation (or mass bias) is corrected via the natural ratio of $^{235}\text{U}/^{238}\text{U}$ due to the lack of natural Th isotopes. In our setup, the ratio of the artificial isotopes $^{233}\text{U}/^{236}\text{U}$ ratio in the spike is monitored for double checking the mass bias correction. The calibration of FC gain and SEM yield is described in detail in Kerber et al., (2023): While there is an internal electronic calibration function for the calibration of $10^{10}\ \Omega$ and $10^{11}\ \Omega$ amplifiers, the $10^{13}\ \Omega$ amplifier in our setup was in this study calibrated manually. For this, the gain factor was determined regularly by measuring ^{235}U alternately on the $10^{13}\ \Omega$ and $10^{11}\ \Omega$ amplified cup. In an analogous manner, the SEM yield is routinely determined by measuring ^{235}U alternating on the SEM and on a $10^{11}\ \Omega$ FC at a signal intensity of ~ 5 mV. Since HU-1 standards are measured with the same detector configuration in standard bracketing mode, the observation of the ($^{234}\text{U}/^{238}\text{U}$) values of HU-1 measurements allows monitoring and manual optimization of gain and yield values for each measurement sequence in the data analysis scheme.”

In line 211, it was mentioned that the instrument background is measured between all sample and standard measurements for 70 s. Is the background measured on SEM by peak-jumping or by the combination of SEM and FC? For the blank correction, are the outliers in the blank measurements filtered.

We thank for this comment. The instrumental background is measured by the combined protocol of SEM and FC. The same outlier correction is applied for both sample and blank measurements and is adjusted accordingly when changes are made in the “inspect tab”.

We will add a clarifying statement to the methods description:

“Samples, standard, and procedural blanks are measured with the same configuration.”

A few typos:

Line 30: The “manifold in geochemistry, archaeology, and climate science” was repeated.

We will change this accordingly.

Line 192: What is the “GUI (10)”?

We will change this leftover from a former version of Figure 3.

Line 205: It should be “Thorium tailing”.

We will change this accordingly.

Line 323; It should be “Figure 5”.

We will change this accordingly.

