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Interactive comment on "Exploring the advantages and limitations of *in situ* U-Pb carbonate geochronology using speleothems" *by* Jon Woodhead and Joseph Petrus

Anonymous Referee #2

Received and published: 30 September 2019

The manuscript presents a summary of U-Pb carbonate ages the authors have produced. The focus is on samples that have both isotope dilution (ID) and LA-ICP-MS data so the limits of in situ U-Pb carbonate geochronology can be explored. Part 1 compares LA-ICP-MS ages with ID U-Pb age data and concludes that the in situ technique produces reliably accurate ages. Part 2 is a discussion on the advantages and disadvantages of the in situ method when dealing with 'challenging' low U, low Pb, and young samples. Part 3 is the author's recommendations for future ID and in situ U-Pb carbonates geochronology studies.

The U-Pb LA-ICP-MS carbonate ages presented all fall within uncertainty of the ID U-

Pb data for all examples presented although the resultant common Pb compositions, or 207Pb/206Pb intercepts, do not always agree within error. The authors state that they have explored many explanations for the (sometimes) different common Pb compositions produced by ID and LA-ICP-MS methods. One potential explanation explored was inaccuracies in the 207Pb/206Pb and 238U/206Pb end members of WC-1, the primary reference material used for all in situ U-Pb analyses, but this was ruled out by the authors without further discussion. Instead the authors favor femtogram-level surface contamination as the explanation for the 207Pb/206Pb discrepancies even though each sample was thoroughly cleaned prior to analysis, each analysis location was cleaned prior to analysis, and the first few seconds of each analysis were not considered in data reduction.

Further comment on why the heterogeneous nature of WC-1 was eliminated as an explanation for variability of common Pb compositions defined by ID or LA-ICP-MS could be of potential interest to the larger U-Pb LA-ICP-MS community due to the fact that many studies presented in the literature do not use WC-1 to correct for any bias on measured 207Pb/206Pb ratios of unknown carbonates due to its heterogeneous nature. Instead, many investigations use analysis of a NIST glass to correct for any 207Pb/206Pb bias. Was using NIST to correct for 207Pb/206Pb bias explored by the authors and then results compared with the ID U-Pb ages? Including some discussion on using WC-1 or NIST to correct for any 207Pb/206Pb bias also allows the authors to expand the description of their data reduction procedure using VizualAge UComPbine DRS.

The authors conclude that U-Pb ID ages are still the gold standard for high precision U-Pb carbonate geochronology. Often upwards of 30 spot analyses are required to constrain an isochron due to the larger uncertainties associated with laser ablation data and precision still only approaches ID ages. The advantage of the in situ method is the high spatial resolution and low sampling volumes.

I found the writing to be quite clear and the paper well-organized. I would like to see

a data table with the U-Pb data presented in Figure 3 included in future publication. Minor specific comments on Figure and Tables are included below.

I recommend the submitted manuscript for publication with minor revisions.

Specific Comments: Figure 1 Caption: keep concentration units the same. Figure 3: Would it be possible to make the LA and ID isochrons different colors? Table 1: text in 'cell gas' description cut off

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