

Interactive comment on “High-precision ID-TIMS Cassiterite U-Pb systematics using a low-contamination hydrothermal decomposition: implications for LA-ICP-MS and ore deposit geochronology” by Simon Richard Tapster and Joshua William George Bright

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Manuscript number: gchron-2019-22 Title: High-precision ID-TIMS Cassiterite U-Pb systematics using a low-contamination hydrothermal decomposition: implications for LA-ICP-MS and ore deposit geochronology

The manuscript provides a clear, detailed, and well thought out study to determine a novel method that allows the complete digestion of cassiterite and its utilization in ore

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deposit geochronology. It is relevant to a broad community and this is the appropriate platform for publication. Overall, the science of this manuscript is of the highest quality and with minor revisions is suitable for publication. The authors do a great job discussing the current issues with U-Pb cassiterite geochronology and laying out a laboratory procedure for digestion, chemistry, etc. The updated ages for cassiterite reference materials and insights into the U-Pb systematics of cassiterite, this study will prove very useful for future in-situ studies. With a few changes, this manuscript should be ready for publication.

When I began reading this manuscript I was very excited to see the results and interpretation of the U-Pb cassiterite data; however, by the end I was left a little confused by the impact the results have on the overall interpretation of the geologic problem. For example, based on the geological relationships of the Cligga Head W-Sn deposit, we know that Sn ore formation occurred between the granite stock (285.163 \pm 0.097 Ma) and rhyolite porphyry dykes (283.21 \pm 0.32 Ma). Although the cassiterite age falls in this “age window”, there are too many variables associated with this age that it becomes difficult to put geologic implications or a direct process (i.e. cooling of the granitic stock and precipitation of cassiterite). We know roughly what age the cassiterite has to be, but it would be nice to directly link it to a geologic process, and unfortunately it seems impossible at this time. Based on this, are there any other phases you could determine the Pb isotopic composition of? What about the inclusions in the cassiterite that you dissolve during the HF leaching step? I think there is an interesting study looking at the Pb isotopic composition in these low T hydrothermal systems.

Based on the heterogeneity in Pbc seen in the Cligga Head cassiterite, do the authors believe that this could be the case for the two RM analyzed in this study? It is noted on page 15 for the Jian-1 cassiterite that domains with lower Pb*/Pbc were sampled, could there also be zones with variable Pbc isotopic composition? Thinking about in-situ work for this.

I would like to see a final figure that describes the finalized workflow the authors have

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determined to be the most effective way to dissolve cassiterite so that labs looking to adopt this method have something to follow. A modification of Figure 6A) would be nice to illustrate the full procedure. Do the authors think a pestle and mortar approach to cassiterite is a good option, or should individual grains or fragments of grains be analyzed? This is something that should be addressed in the conclusion.

The conclusions section needs to be reworked. The authors did a great job characterizing the issues with U-Pb cassiterite geochronology and make great strides forward in this field, but the last paragraph and concluding sentences of paragraphs leaves me curious of what the actual outcome of this manuscript is. The last paragraph in the conclusions should be removed entirely and replaced. The end of the abstract should be revisited by the authors to aid in writing a satisfactory conclusions section.

Line by line comments-

Line 12 - Change “the mineral” to cassiterite, add comma after “common Pb” Line 15 - delete “to date,” Line 17 - delete “,” after reference Line 26 - should be “demonstrates” Line 32 - delete “However,” Line 39 - add some references at the end of the first paragraph Line 46 - delete “Yet” Line 77 - delete “However, it” and replace with “This” Line 90 - add “in-situ” between resulting and ages Line 91 - This is a run on sentence, consider breaking these thoughts into two sentences Line 104 - Awkward sentence, needs reworking Line 107 - Again, a run on sentence, consider breaking these thoughts into two sentences Line 114 - delete “that” after 2) Line 115 - delete “That” after 3) Line 137 - delete “and at the time of writing was” and replace with is Line 138 - comma after “Pb”, delete “was” and replace “Likewise” with Similarly Line 141 - Delete “Furthermore” Line 150 - Give range for what is typically achieved for modern CA-ID-TIMS methods Line 152 - changed “indicate” to indicated Line 158 - delete “the study of” Line 159 - add comma after (1992) Line 164 - add reference Scoates and Wall, 2015. Geochronology of Layered Intrusions Line 167 - Delete “yet” before “been” Line 183 - delete comma after Br₂ Line 221 - delete “before the HBr is lost and becomes ineffective” Line 243 - The authors mention an HF leaching step; however, this leaching step is not described

anywhere in this preparation step. Is it the 120C overnight in 29M HF? If it is then explicitly say that and if it was in Parr vessels or on the hotplate. This is a paper outlining the proper way to digest cassiterite, be very specific about these details Line 255 - do you worry about the longevity of the PFA microcapsules? If there is degradation of the capsules at slightly higher temperatures do you worry about exposure to HBr over longer periods of use? These capsules can be very time consuming to clean before initial use Line 267 - Did the authors consider an HBr based chemistry for Pb? This would remove the HCl conversion step and reduce the laboratory blank slightly. Line 291 - What decay constant and isotopic compositions for U were used? Since this is a paper about method development and reference materials, this information is critical. Line 420 - Again, this was not described thoroughly in the methods section Line 424 - Were these HF leached as well? This treatment that the various cassiterite grains received are not well documented here, clarification is needed Line 436 - do the authors think this 7 ng blank for the one analysis is an inclusion? Line 439 - delete "Together they yield" and replace with "and yielded" Line 590 - a poor way to end a discussion session, try rewording this so it does not have such a negative tone to it. Maybe delete this sentence and end with the previous sentence Line 606 - this is a very troublesome sentence, how do the authors suggest combating this variable Pbc mixing or is it a problem that can be solved? If the latter is the case, then it severely hinders the interpretation of cassiterite U-Pb ages. Line 614 - Again, any suggestions on how to correct for this? Line 655 - delete "As" Line 696 - replace "cam" with "can"

Does the paper address relevant scientific questions within the scope of GChron? Yes Does the paper present novel concepts, ideas, tools, or data? Yes Are substantial conclusions reached? Yes Are the scientific methods and assumptions valid and clearly outlined? Yes, with modifications Are the results sufficient to support the interpretations and conclusions? Yes Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? Yes, with modifications Do the authors give proper credit to related work and clearly indicate their own new/original contribution? Yes Does the title clearly reflect the

contents of the paper? Yes Does the abstract provide a concise and complete summary? Yes Is the overall presentation well structured and clear? Yes Is the language fluent and precise? Yes Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? Yes Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? Yes (stated above) Are the number and quality of references appropriate? Yes Is the amount and quality of supplementary material appropriate? Yes

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