



EGUsphere, referee comment RC2
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Comment on egusphere-2022-72

Catherine Mottram (Referee)

Referee comment on "In situ LA-ICPMS U–Pb dating of sulfates: applicability of carbonate reference materials as matrix-matched standards" by Aratz Beranoaguirre et al., EGU sphere, <https://doi.org/10.5194/egusphere-2022-72-RC2>, 2022

Review of Beranoaguirre et al., 'In situ LA-ICPMS U-Pb dating of Sulfates: Applicability of carbonate reference materials as matrix-matched standards'. Catherine Mottram

Summary of paper

This paper builds on the approach of in-situ U-Pb carbonate geochronology to develop a methodological approach to dating sulfates. The authors explore the feasibility of using carbonate reference materials to date sulfates. The same approach as U-Pb carbonate dating is utilised where data are initially corrected for mass bias and drift using NIST614 followed by a secondary correction using the WC-1 carbonate reference material (Roberts et al., 2017). ASH-15D (Nuriel et al., 2021), B-6 (Pagel et al., 2018) and an in-house reference material were analysed as secondary reference materials (~1.5-2% reproducibility). Sulfates contained variable U which meant that the majority of samples were undateable. Sulfate was found to ablate faster than carbonates but the relatively offset was thought to be not significant and accounted for by the uncertainties. The five analysed samples reasonable dates were yielded given previous geochronological constraints.

Review

Overall, I think this is a useful contribution to the growing literature analysing new and unconventional geochronometers. The authors use up to date geochronological methods to yield a robust dataset, following established methods for carbonate geochronology. The methods are thoroughly presented following the recommendations of Horstwood et al., (2016) and the results are well presented in both tables and concordia plots. The authors present some useful discussion about the use of carbonate reference materials for analysing other geological materials. The paper is within the scope of the journal and will

be of interest to a range of geochronologists. I therefore think that this paper should be published subject to the corrections below.

Suggestions for edits

- **Applicability and flaws in the approach:** The discussion should be expanded to discuss the flaws with U-Pb sulfate dating- what is the potential wider scale applicability considering the relatively low success rate (5/32) for this study?
- **Are there any potential gypsum reference materials?** Can you include discussion of work being done to develop matrix matched reference materials?
- Can you include some background to the astrochronology method- how does this work and how do results compare with absolute radiometric dating methods?
- Suggestions for additions to the **supplementary materials:**
 - Grid references of samples
 - More thorough information about each sample include hand specimen, thinsection/puck, any sample characterisation- SEM images? CL? Image showing spot locations on the analysed material.
- Include laser conditions written out in the main methods
- Th-Pb data- did you analyse Th? If so, then please present this data and you could also use the 208-approach of Parrish et al., 2018
- Data table- expand to include more columns as per suggestions of Horstwood et al., 2016 and include comments on analysis location on materials.
- Can you plot data from the MC and SF on the same concordia for comparison?

Line comments

Line 30 – add Rasbury, E. T., & Cole, J. M. (2009). Directly dating geologic events: U-Pb dating of carbonates. *Reviews of Geophysics*, 47(3).

Line 31- Skarn garnet reference missing

Line 46- Can you outline best practice for evaluating suitability of non-matrix matched reference materials?

Line 46- Can you outline why one might want to date sulfates (or move lines 55-56 up)

Line 48- outline what astrochronology is.

Line 66- Where in the world is this?

Line 68- What is Astronomical tuning?

Line 73- 'mention' seems vague- make more specific

Line 91- How were samples pre-screened?

Line 97- average sensitivity based on what ablation conditions?

Line 106- state the carbonate reference material here and reference needed for NIST?

Line 112- how was downhole fractionation corrected?

Line 119- What is the in house reference material? Name and age?

Table 3- add unit to average U and Pb concentrations. Add column for whether successful or not.

Line 264- How does crater compare to NIST?