**Response to Tom Belgrano (R1)**

The paper presents the application of a suite of modern, robustly applied geochronological methods to two Australian impact crater case studies. The writing/presentation, especially the abstract, need some editing and a thorough proof read is needed throughout. Some more details are needed for completeness in the methods section, but these are minor revisions easily implemented, as the methods as employed seem rigorous. My only significant content request is to consider how accurate Rb/Sr corrections applied to the volcanic glass pellets are – whether matrix-matched glass or compositionally similar mica is more appropriate, and whether your data allow you to assess this. I would also like to see a more detailed explanation of what was propagated into the uncertainties, and to bring this into line with conventional external uncertainty reporting (if this is not the case already).

We would like to thank Tom Belgrano for his considerations on our manuscript. In the revised version, we include additional method information (including discussion on the error propagation approach) and address specific comments on matrix-matching. We hope this contribution will provide the means to expand the chronology of impact structures with in situ Rb–Sr dating.

**Section/Line by Line Comments.**

**Abstract:** The abstract is long at >400 words. Can this be refined into a more user-friendly length (i.e. <250–300 words)? It is also peppered with grammatical/style errors that need a go-over before resubmission.

The revised abstract has been shortened (down to 350 words) and revised thoroughly to eliminate grammatical errors.

L8. According to the journal rules, LA-ICP-MS/MS should be spelled out in the abstract and again at first use in the text.

We have defined the mentioned abbreviation in the revised abstract.

L10. The complete geochronometers need to be stated: mineral host and isotopic system.

We have added the complete information in the revised abstract.

L13/14. Which impact is the second sentence referring to?

The second sentence refers to the Gosses Bluff impact, which is now mentioned in the revised abstract.

L17. Misspelling of the symbol Sr? Enhanced precision is unlikely to be solely due to the amplification, as Faradays are generally similarly or even less sensitive than ion-counting QQQ detectors. The major precision jump derives from simultaneous, correlated detection of isotopes and higher ion yields.

Typo corrected. We agree that simultaneous isotopic measurements with higher ion yields would support greater precision through better counting statistics, which will be acknowledged in the revised version.

L30. It's difficult to foresee how Rb-Sr could inform research into the emergence of life. How many unmetamorphosed impact related rocks are there from the Eoarchean? The paper is justified well-enough without this claim, or perhaps 'extinction and diversification of life' is a better fit?

Fair point, we were point towards the potential link between impacting and developing suitable locations for complex prebiotic to perhaps ultimately biological geochemistry. In any case this is peripheral to our thesis here and we have removed this sentence.

**Section 2.**

Readers of this section would benefit from splitting into sub-sections labelled by each impact.

We have sub-divided this section into sub-sections as suggested.

L76. *The age of the Acraman structure

Fixed.

**Section 3.**

**L130.** More details are needed on the uncertainty propagation method. If only one uncertainty is reported, this should be the fully propagated external uncertainty including errors on the calibration materials, decay constants, inter-session variance, etc. following e.g. Rosel & Zack, 2022, Gilbert and Zack 2024.

We have expanded on the error propagation in the revised version. To clarify, the uncertainty propagation for U-Pb data was carried out using Iolite's MSWD approach as described in Paton et al. (2010), whereas the propagation for Rb–Sr follows the approach from Rosel and Zack (2022).

**L148 + L169.** State the reference values and how they were measured. The ages are missing units on L148.

Fixed.

**L174**. *Thermo Scientific. The acronym ICP-MS has already been introduced? Take the opportunity to introduce MC-ICP-MS/MS.

We have fixed this sentence.

**L216-217**. Need to state the results and reference values for the key secondaries here, as in the other method sections. Again, specify the uncertainty treatment (should follow the recommendations of Horstwood et al. 2016).

We have added the required information in the revised version.

Treatment of common Pb, even if uncorrected for, should be explained explicitly given the mix of minerals dated.

No common-Pb correction has been applied to any U–Pb data, as mentioned in the revised version.

Some Neoma labs experience ZrO-YO related interferences when analysing with NIST and biotite. This seems to have been overcome here, judging by the secondary ages, but its worthing mentioning why you are confident they are not an issue, as if present they would affect the standards but not the unknowns.

That is correct. We have observed a systematic influence of Zr-O oxide interference on the SrF peaks, which has been significantly reduced by the continuous flushing of the mass flow controller with ultrahigh-purity $N_2$. This has been added to the text accordingly.

Some discussion of is needed as to matrix correction and validation of the glass pellet ages. Surely NIST would be a better calibration material than a mica? Can the authors show some downhole patterns (e.g. in the supplement at least) to support this one way or the other?

I believe this might be a confusion, as we have not dated glassy, amorphous materials. Instead, we targeted neocrystallized fine-grained micas from melt-impact rocks. In this sense, the adopted approach using mica reference materials to calibrate the matrix effects is appropriate, returning expected ages for the Gosses Bluff impact.

**Section 4**

**Fig. 4./**QQQ data: Why not combined the two labs data into a third isochron? If uncertainties are propagated conservatively using the higher for each parameter from each session, this should be defensible and looks like it would yield better-constrained ages. The one outlying btu included analysis from Gosses bluff (Fig. 4c) could be justifiably rejected and would likely improve the age correspondence between the two samples? It looks like a postulated secondary isochron could even be fit to all those outlying analysis, probably recording a younger devitrification/alteration event.

We prefer to maintain the results from distinct labs separately to assess their reproducibility instead of trying to fit a single regression through a large dataset.

The mineral ‘aliettite’ is uncommon enough it needs introduction at first use.

Aliettite has been simply described in the manuscript at its first appearance (section 4.1).

**Section 5.**

**L342.** We have experienced the same, it’s worth setting out why explicitly – superior low abundance sensitivity of the QQQ compared to multi-collection but higher LOD by Neoma (or whatever the analysts attribute this to).

Fair point! This is now acknowledged in the revised version.

**L404.** What is meant by the lower mass resolution issues referred to here? I struggle to see how this would have an effect. Lower sensitivity and sequentially detected isotopic ratios are more likely culprits.

Thanks for pointing it out. We meant to refer to lower sensitivity instead of mass resolution, which is now fixed in the revised manuscript.

Sect. 5.3 is good, really useful stuff.

Thank you!

Sect 5.4. Worth pointing out the lack of mineral reference materials for some of the envisioned work.

Indeed, this is worth mentioning. We have added this warning in the revised version.