We thank Dr. Kirkland for the additional comments and concerns that help clarify the manuscript's writing.

I commend the authors for their thoughtful and thorough revisions in response to the initial review. The manuscript now presents a clearer and more impactful contribution to the methodological advancement of discordance modelling in U–Pb geochronology. Well done!

The manuscript generally offers a reasoned and balanced evaluation of the methodology, especially in regard to the improvements introduced by the authors. However, I recommend a few minor textual refinements to enhance clarity and precision, particularly in articulating the limitations and applicability of the proposed approach.

While we appreciate the concerns raised below by Dr. Kirkland, many of the comments in this round of revisions focus on the CDC method instead of the discordance dating method that is presented, benchmarked, and evaluated with natural data in the present manuscript. We do not completely agree with some of the framing of the CDC method outlined in these comments, but a full evaluation of all discordance approaches is well outside of the scope of the present manuscript. We wish to avoid, as much as possible, detailed analysis and discussion of that method, its variations, and the Reimink et al. 2016 construction (and its variations). Thus, we have generally addressed the below concerns by removing text that went further into the discussion of the CDC method than we would prefer, thereby alleviating the majority of the concerns raised in the minor comments provided below. All other concerns have been changed according to Dr. Kirkland's wishes.

Line 816: The current phrasing may unintentionally overstate the general superiority of the proposed method relative to the CDC approach. As the authors have previously noted, the CDC test is well-suited to datasets exhibiting complex Pb loss, particularly those containing concordant components. In contrast, the method presented here appears to perform best when applied to datasets with well-defined, single-component Pb loss trends (e.g. to a single time), whether or not they include concordant analyses. I recommend rewording this section to more clearly qualify that the improvement pertains to a specific class of data. Additionally, the authors might wish to acknowledge that with further development, the Reimink et al. method could potentially be adapted to better handle cryptic Pb loss. A more nuanced comparison would better reflect the diversity of datasets encountered in geochronology.

We have changed the wording in Line 816 to remove any unintended bias in our evaluation of the different methods.

KS test vs. peak fitting: The discussion on the performance of the KS test versus peak-fitting methods would benefit from acknowledging that the optimal approach is highly dependent on the data structure. Specifically, peak fitting may be preferable when the dataset exhibits clearly resolved trends, while the KS test may offer advantages in identifying multiple events or more cryptic distributions. A brief clarification of this point would help guide users in choosing the most appropriate analytical path.

To alleviate this concern we have chosen to remove the sentence that explicitly suggested using peak finding methods within the CDC method. As highlighted above, a full evaluation of other discordance approaches is outside the scope of the present manuscript. We have kept the limited discussion of the CDC method in Section 3.3, however, we wish to keep the discussion of the different methods at relatively superficial level because the goal of this manuscript is not to evaluate all options and their variations, it is to present and benchmark a new approach.

Figure 10A: I note that in my own analysis using a different underlying data distribution, I reproduced the inverse result to that shown in Figure 10A, with the CDC method more effectively recovering the expected geological signal. This observation reinforces the point that the dominant source of scatter in a given U–Pb dataset, be it due to discrete Pb loss events or complex, cryptic discordance will dictate which method yields the most geologically meaningful result.

We are not sure how to address this comment without access to the mentioned different data distribution. However, we prefer to leave a full evaluation of the reliability of other discordance modeling methods to future work.

Line 100: References are needed to support the claim made here.

These references are included in the paragraphs following this line, so we have simply added "as discussed below" to point the reader to the references outlined in the revised introduction.

Line 897: When referencing the "Tintic zircon data," it would be helpful to briefly and in words characterize the dataset's key features (e.g., some few words spent on the pattern of discordance and degree of Pb loss). Doing so would aid readers in assessing the generalizability of the method to other datasets with different characteristics.

We have added a clause stating "…, which experienced a discrete overprinting event ca. 30-24 Ma" to this sentence to clarify the data distribution.

Literature context (e.g., Kirkland et al. 2020): While I appreciate that citation decisions are at the authors' discretion, I would again gently suggest that omitting comparisons to

published studies where the CDC test has proven more effective (e.g., cryptic Pb loss in the Acasta gneiss) may give the appearance of a selective literature treatment, which I am sure is unintentional. Including such examples rather than weaking the findings in this study would rather further reinforce the conclusion that method performance is inherently data-dependent and would provide a more balanced context for readers.

We do not conclude that the performance of various methods is data dependent and neither do we agree with some of the conclusions outlined in Kirkland et al. 2020 regarding the performance of both classes of discordance modeling approaches. In the present work we do acknowledge that there is much work to be done to fully and rigorously evaluate the various classes of discordance treatment approaches, and their variations, across a range of geological settings (Line 914). However, to avoid any perception of selective literature treatment, we have included a citation of Kirkland et al. 2020 in the section introducing the CDC method.

Line 883; but some of the KS tests at higher % discordance cut off's do appear to return the 24 Ma age. Some minor editing is needed for accuracy.

We have added the clause ", except for minor, <24 Ma peaks when using very high (<30%) discordance filters" to this sentence to maintain accuracy.

Line 886; lack of resolution in a specific data distribution case.

We have changed this sentence to read: "This suggests that part of the reason for the lack of lower intercept age resolution for the Tintic formation detrital zircon data returned…" to make it more explicit that we are referring to the data provided in this manuscript.

Line 908; Likewise multiple Pb loss episodes would impart dramatic biases in reconstruction methods based on linear arrays.

We are not clear as to what is referred to by "linear arrays". Both the CDC method and the discordance dating approach use linear recalculations (calculations along linear chords in U-Pb space). These two approaches are very similar in that regard, with the main difference being in the evaluation of such reconstructed data (reconstructed ages compared to concordant data in the case of the CDC, and mapping of probability distributions independent of concordant data in the case of the discordance dating). Regardless, a full evaluation of the various merits of all classes and variations of discordance approaches is outside of the scope here.

In summary, I consider the manuscript nearly ready for publication. With these minor textual clarifications and an emphasis on maintaining consistency in the framing of

method applicability, it will serve as a valuable resource for the geochronology community. Thank you for giving me the opportunity to provide feedback which I hope has helped the authors.

These comments have helped clarify the manuscript and we thank Dr. Kirkland for the additional revision.

Sincerely, Chris Kirkland, Perth WA