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Interactive comment on "LA-ICP-MS U-Pb carbonate geochronology: strategies, progress, and application to fracture-fill calcite" *by* Nick M. W. Roberts et al.

Nick M. W. Roberts et al.

nirob@bgs.ac.uk

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"LA-ICP-MS U-Pb carbonate geochronology: strategies, progress, and application to fracture-fill calcite" is a well-organized, well-written manuscript that describes, in considerable detail, current methodologies and applications in dating calcite by laser ablation. It is likely to be a long-lived reference paper for anyone interested in dating calcite, as it contains many relevant examples, and an exhaustive list of our current understanding of the many aspects of calcite geochronology. I have a few minor comments that I believe could improve the original manuscript, but feel that the authors have already done a thorough job producing this work.

We thank the reviewer for these positive comments.

"The comments, related to line C1 numbers, are as follows: 122: Isn't point 2 the same as point 1? You need more sample to get higher sample/blank ratios."

Not exactly, the averaging effect of larger samples, is different from the effect of lowering the blank/sample ratio. We have reworded slightly to make this clearer.

"259: Is this really true? For example, do we know the absolute age constraints of WC1 better than Ash15 or Duff Brown? They are younger, but a 5% uncertainty on Ash15 is only 150kyr. Once counting statistics get better than a few percent, the increased precision is moot. It is true that secular equilibrium uncertainties can punish younger ages more in a relative sense; you may want to point to that part of the discussion here."

We're slightly unsure of the context of AKC's point here. The statements in our text are about theoretical precision in relation to the abundance of radiogenic lead compared to common lead. Our statements regarding this theory are correct – the fact that precision is limited in nature by other means is not relevant at this point.

"274: This is the main point here, which should be highlighted. When the data is closer to concordia, there is less variability in the intercept age no matter what the common component is. That is, your assumption on a fixed common value is less important when the samples are older. Nevertheless, if you can assume a fixed common component, or you have a large spread in μ, I'm not sure your confidence is better with an older sample (in an absolute age sense)."

Yes we agree that the point about not relying on the common lead composition when data is near concordant is important, so have added an extra sentence to this section. We did not claim that older samples have more confidence – we stated that older samples with a fixed mu will have a greater abundance of radiogenic lead – this will indirectly provide more confidence to the age determination (if all other factors are

removed).

“What might be nice in the figure is to show the relative and absolute age uncertainties on each isochron given either a fixed U concentration or fixed common Pb concentration. You could also use a fixed analytical percentage, but the younger samples might have worse analytical precision due to poor counts. Nevertheless, this addition would be more elucidating.”

The aim of this figure is simply to demonstrate the correlation between age and abundance of radiogenic lead – from speaking to a lot of different users in the community, this basic level of understanding of μ and ingrowth of Pb would benefit from simple explanation. If we add in uncertainties then this will add a layer of complexity that will take away from the message. To do this with synthetic data would in fact be rather difficult.

“296: Why do you say inaccurate here instead of imprecise?”

Good point. In general, imprecision is the problem. However, we probably hand in mind the many regressions we have seen that have slopes dominated by one or two data-points, that are likely inaccurate as well as imprecise. Since this is not quite what the statement is about, we have reworded to imprecise and even inaccurate.

“Figure 6: Here it would be nice to show a median value for other U- and Pb-bearing geochronometers as a comparison. I realize this is a tough ask, but you could take say apatite and or titanite from a paper that studied a range of samples.”

We have updated the figure with 2D KDE plots, with greater data density, and added median values for apatite and zircon.

“644: I presume this is after repolishing?”

Yes, but the maps only remove a few microns, so after a light polish to remove these troughs, the mapping is still deemed to be pretty accurate representation of the material.

“1062: This sentence is awkward.”

Reworded.

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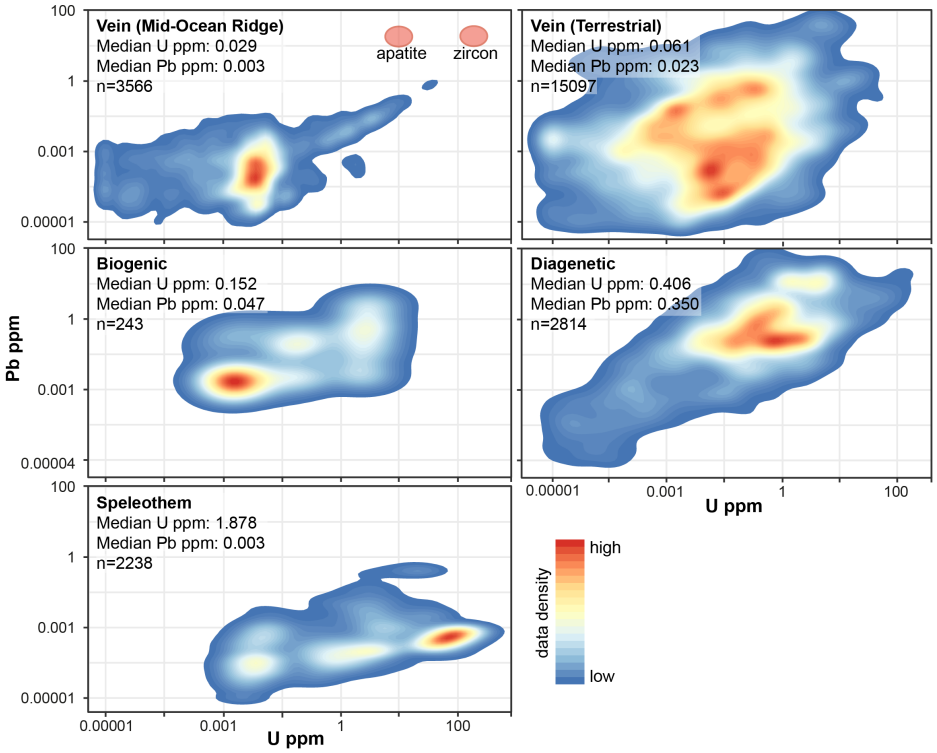

Fig. 1. Updated Figure 6