This contribution attempts to quantify the average alpha recoil displacement of ^{206}Pb in baddeleyite using atom probe tomography. Ejection of ^{206}Pb from the rims of baddeleyite grains has the potential to produce U-Pb dates that are too young in small baddeleyite crystals with high surface area-to-volume ratios. If the average alpha recoil distance can be measured, Pb ejection corrections can be applied to U-Pb datasets to improve the accuracy of baddeleyite U-Pb geochronology. The study is well designed, and atom probe tomography has the appropriate spatial resolution to address this outstanding question. However, the presentation of the background, results, and discussion should be clarified and expanded (especially Section 4). Specific comments are listed below.

27: By what benchmark are concordant baddeleyite $^{206}Pb/^{238}U$ dates younger than ~ 1000 Ma "too young"?

32: Radiation damage in zircon and baddeleyite cannot be deconvoluted into structure versus chemistry. The two are inherently linked. Baddeleyite is less susceptible to radiation damage because it typically incorporates less U than zircon, and oxides are more resistant to irradiation than silicates.

42: What is the closure temperature for Pb in baddeleyite? Is there Pb diffusion data available in the literature? Could younger baddeleyite U-Pb ages reflect Pb loss by volume diffusion?

60: How common is it to date baddeleyite crystals that are so small (10 - 15 µm) as to be affected by alpha recoil? Are larger baddeleyite grains not typically available?

Are there molecular dynamic simulation studies that have estimated alpha recoil distances in baddeleyite?

80: Are the quoted uncertainties 1 or 2 sigma?

124: Alpha recoils randomly redistributes U-daughters, not U.

126: Why would the largest U gradient be at the samples surface? Crystals can have all sorts of U-growth zonation. I assume you mean that recoil effects will be most apparent at the crystal surface, since recoil ejects a fraction of Pb atoms from the crystal causing a localized depletion in Pb relative to U.

134: What are the implications of no localized Pb depletion at the crystal surface if these are indeed crystal faces and not cleavage planes? This possibility should be explored further in the discussion before the authors move forward with their preferred interpretation. The SEM images of the Hart Dolerite crystal in particular really looks like a crystal face. Could you rotate the crystal and sample another face for atom probe?

173: Do not cite Wikipedia as a primary source.

194: the “modeled” $^{206}Pb/^{238}U$ profiles

198: Explain how you determined 40 nm to have the closest fit. Visual inspection or by some least squares parameter? What about recoil distances >40 nm?

201-204: I am confused by this sentence. Specify what you mean by observed profile. Do you mean projecting the end of the measured U profile downward improves the model fit to the measured $^{206}Pb/^{238}U$ profile?

205: While oscillatory growth zoning does commonly occur in some minerals, it is highly speculative to assume that this is the case here for a grain that is totally uncharacterized. Can the authors characterize the growth zoning in this grain or in a suite of other baddeleyite grains from the same sample?

225: Is the 40 nm value truly “robust” if models yielded high MSWD values? Nor can you really say that 40 nm is significantly higher than 24 ± 7 nm when you can’t place uncertainties on your modeled value.

Section 3.2: It is not obvious to me from Figure 3 that there are U clusters in M5, and no visuals for Fe and Ti clusters are presented in the manuscript. Can the authors provide a Figures that show this more clearly?? At a minimum, the Fe and Ti data should be included since the data are referenced in the text.

Section 4: There are many methods for correcting (U-Th)/He ages for alpha ejection for different grain geometries, grain sizes, and surface-to-volume ratios. Some (U-Th)/He alpha ejection models even incorporate radionuclide zoning. The literature is fairly extensive on the topic. The discussion here could be expanded significantly by applying some of these methods to the case of Pb ejection in baddeleyite. It is important for the authors to demonstrate – given their preferred 40 nm estimate for alpha recoil – in what scenarios should geochronologist expect Pb ejection from baddeleyite grains to have a meaningful impact on U-Pb dates and how to correct them. Can recoil adequately explain the “too young” baddeleyite ages that the authors cite in the introduction?

Figure 2 & 3: It would be helpful to add some labels to the figures indicating where the crystal surface is for readers less familiar with atom probe tomography.

Figure 4: Label the x-axes. Adding a line at the expected equilibrium $^{206}Pb/^{238}U$ ratio (0.53) would be helpful.

Figure 5: Label the y-axes. Personally, I find having the y-axis labels in the center of the figure to be distracting.

Figure 6: Label the y-axis in A and x-axis in B.

Figure 10: Why not also show the 50 nm case, since it is discussed in the text?

Figure 11 & 12: Why is distance negative in Figure 11 but positive in Figure 12? It may be useful to demonstrate how different R values produce similar model results in Figure 12. I would be helpful to add a line at 0.53 for a better visual of the expected equilibrium value.

Supplement: I appreciate the author's total transparency in sharing all their modeling scenarios, however, including an active workbook with a hundred plots that don't all have labeled axes or enough context may be overkill. It the workbook is to be included, please label everything.