

Interactive comment on “Towards *in-situ* U–Pb dating of dolomites” by Bar Elisha et al.

Bar Elisha et al.

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We thank the reviewer for his comments and suggestions for improving this manuscript. Please see below our response for each comment separately.

Comment: "I think that the manuscript, as it stands, suffers from a somewhat selective referencing of the literature. ...While the present manuscript certainly provides a more detailed analysis of relevant analytical issues I think it is important not to lose sight of the fact that previous work has been conducted in this area."

Response: We will include additional references on previous U-Pb dating of dolomite for both bulk method (Winter & Johnson, 1995; Hoff et al., 1995; Polyak et al., 2016) and also for recent LA-ICPMS U-Pb method (Burisch et al., 2018; Mueller et al., 2019; Salih et al., 2019; Hu et al., 2020, and Incerpi et al., 2020).

C1

Comment: "It is of course disappointing, but nevertheless important, that a number of the samples used in this study provide ages which are seemingly inconsistent with known stratigraphic relationships. I think that this part of the manuscript in particular would benefit from some further thought/exploration of potential mechanisms."

Response: In the revision, we will include a discussion on possible mechanisms for age results that are inconsistent with the known stratigraphic ages. Unfortunately, we don't think that our data can resolve this issue and a more detailed geochemical study is needed. We speculated that some of the analytical issues, such as the use of non-ideal reference material etc., contributed to this mismatch.

Comment: "The discussion of crater morphology is perhaps least convincing. ...Unfortunately, this is not a consistent observation in this study and many of the determined ages are in fact younger than anticipated, not older (with the exception of the two syngenetic Cretaceous samples). ...I can see how crater roughness might equate to ablation inefficiency but how does this translate into an age bias rather than simply larger age uncertainties? It would be very useful to have more discussion here..."

Response: Perhaps this section was not entirely clear in the text. Similar to the observations made by Guillong et al. (this issue), we also observed that micritic samples tend to produce older ages than expected. We also show that ablation rate might result in more than 10% off towards older ages than expected. We agree that our observations of crater morphology are non-quantitative, but we did see a relation between crater bottom morphology and the resulted ages, in terms of error and offsets. Our point was that crater bottom roughness provides an additional indication of inefficient ablation of the dolomitic material, which may result in large heterogeneity of particle size in the aerosols and possible fractionation of Pb and U isotopes. We will try to provide a more detail discussion on this issue. As for the younger ages, we argue that most of them probably represent a mixing of a young dolomitization event with an older stratigraphic age at various proportions.

C2

Comment: "It is also argued that mineralogical/textural controls may result in mixed ages but, once again, the evidence provided does not seem to back up these assertions. The inclusion of remnant (pre-dolomitisation) calcite grains (section 3.3) in the analysis would surely bias the ages towards the existing stratigraphic constraints, not make them younger than expected?"

Response: Indeed, the resulted age is both younger than the stratigraphic ages and older than the expected dolomitization events. We will rephrase this section and try to highlight that the younger ages are the result of mixing between the stratigraphic age, presented by the calcite remnants, and the dolomite overgrowths, which are younger. We then argue that it is difficult, and perhaps impossible under the current analytical resolution to separate between the stratigraphic age and the dolomitization event.

Comment: "I can't help but wonder in all of this if many of these younger ages are in fact analytically just fine – and simply reflect the time of closure during late-stage dolomitization ie. it is the existing interpretation of the timing of dolomitization (not stratigraphic age) that is incorrect?"

Response: It is indeed intriguing because this age of ~55 Ma repeats in different samples and we could just interpret it as the age of a true dolomitization event. But at the same time, there is no geological evidence to support a dolomitization event at that time and further studies with additional samples and comprehensive geochemical analysis are needed before we can declare such a statement.

All other comments regarding text clarification will be addressed accordingly.

Interactive comment on Geochronology Discuss., <https://doi.org/10.5194/gchron-2020-19>, 2020.