Author's response to review comments posted for manuscript egusphere-2024-751

Date 22.07.2024

Dear reviewers and dear editor,

we highly appreciate you both having taken time to review our manuscript and sent us valuable comments. We have tried to incorporate all your suggestions into the manuscript. Below we have compiled our point-by-point replies to all your comments in one document.

Comments of anonymous referee #1 (21.05.2024):

Reviewer comment:

This short report is an extension of the modelling described in Spotl et al. 2023, wherein fracture of cave stalagmites by cave ice processes was shown to be more likely caused by thermal expansion of the ice rather than by direct movement of the ice. The research reported here adds more conditions to the basic modelling, and shows that thermal expansion is confirmed as the most likely cause of stalagmite fracture and only in rare situations could fracture be attributed to ice flow dynamics.

The techniques used in the modelling appear to be sound and the conclusions justified. The paper is well written and clear. However, there is one glaring ambiguity in the examples shown to illustrate the process and asserted to be "examples of stalagmites damaged by ice during the last glacial period".

If a clear example is to be presented, then it must have ice action as the obvious and, ideally, only process that might have caused shattering. Figure 1 B and C are from Shatter Cave, Mendip, UK. Yes, this cave shows nice examples of cryogenic cave calcite deposits, so, yes, ice was present. However, attribution of the cause of the stalagmite shattering is very much compromised by the fact that the cave was only discovered, in 1969, as a result of quarrying, which started in the 1920s. It was named to commemorate the damage assumed to have been done by blasting. If this cave is to be used to support the idea of cryogenic fracturing, then I suggest it be made clear how the cryogenic fracturing differs from quarrying fracturing.

Secondly, the assertion of the timing (that the shattering had occurred during the last glacial period) requires more proof. These examples show no obvious post-shattering cementation with calcite and no dates are offered.

Authors response:

The reviewer is right in pointing out that Shatter Cave also shows speleothem damage due to the blasting activity in this now abandoned quarry. This anthropogenic damage, however, is confined to the

near-entrance part of this cave, where fresh looking fractures are indeed common. Once entering the inner part of this cave, these freshly fractured features disappear and many stalagmites (as well as some flowstones) show evidence of much older damage. The fact that these stalagmites are spatially associated with the presence of cryogenic carbonates (CCC for short) and that many of these formations show “healing” by younger layers of calcite indicates that they are very likely related to the former presence of ice. Unpublished U-Th dates obtained by our colleague Gina Moseley provide evidence that these CCC are late Pleistocene in age.
In response to the reviewer’s comment we changed the two images of Shatter Cave and replaced them by another one from this cave where white young calcite coats the damage, clearly showing the speleothem damage is much older than the quarrying. We do not have U-Th dates on this post-damage calcite from this cave, but this type of (locally actively forming) white calcite is well known and characterized in many other caves as Holocene in age.

We would like to express our gratitude for all the valuable comments.

Kind regards,
Alexander Jarosch on behalf of the authors