Geochronology Discuss., referee comment RC1
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Comment on gchron-2022-1

Anonymous Referee #1

Referee comment on "Cosmogenic ^{3}He paleothermometry on post-LGM glacial bedrock within the central European Alps" by Natacha Gribenski et al., Geochronology Discuss., https://doi.org/10.5194/gchron-2022-1-RC1, 2022

Gribenski et al. (2022)
Geochronology Review

In this manuscript, Gribenski et al. detail the methodology of using diffusion kinetics and cosmogenic ^{3}He measured in quartz crystals to quantify paleo-surface temperatures for two glacial valleys in the European Alps. Description of laboratory methods and diffusion systematics present an argument for how they can be theoretically used to decipher surface temperatures in paleo-environments. However, results from all samples indicate regional temperatures in the pre-Holocene colder than records from other regional proxy studies. Potential influences on this temperature discrepancy could come from issues with helium diffusion kinetics within the measured quartz crystals or geologic/paleoclimatic uncertainty of the sampled glacial surfaces.

This is manuscript is very thorough and comprehensive in describing the theory and concept of ^{3}He diffusion and use as a paleotemperature proxy, testing of results through modeling experiments, while acknowledging areas of misfit and uncertainty. The study presents a novel approach to determining a scientifically relevant problem valuable to the paleoclimate community – what are past surface temperatures? Detailed description of the methods and results allow for reproducibility and illustrate consideration by the authors of multiple variables/influences on the results. While the data presented do not result in a fully-realized and issue-free method of determining EDT, they represent an important step forward in achieving that goal. All interpretations and conclusions are supported by the data. Furthermore, by acknowledging areas of uncertainty and external influences (e.g., permafrost) the authors provide the groundwork for future studies to build off these results.

While the manuscript is written logically, the overwhelming number of analyses left me lost from time to time. In particular, in the results section, description of the modeling experiments had me revisiting earlier sections to recall why each experiment was being tested. Adding a synoptic sentence or two for each results section will assist the reader in appreciating the robust quality of the experiments within this study.

Below are a few minor comments/edits for the manuscript which should otherwise be accepted for publication:

Line 123 – Mention the two interpretations for glacial trimlines: ice-surface vs. thermal boundary. However, this is not mentioned again during the discussion of results, nor is one interpretation suggested over the other. With potential nuclide inheritance discussed later, could coverage by non-erosive, cold-based ice influence the EDT values for a particular site based on the thermal boundary interpretation?

Line 170 – Briefly describe the purpose of the tantalum packets for those unfamiliar with the lab methodology.

Line 176 – Is there a set increment of temperature increase? If so, it might be easier for the reader to interpret those changes rather than the number of increases within a time range.

Line 190 – How sensitive are the results for ^{10}Be ages and EDT calculations if a different scaling scheme is used (e.g., time-dependent LSDn)?

Line 196 – From where are the initial EDT temperatures initially derived and how? A little clarification is helpful.

Line 320 – The thinning data still overlaps within uncertainty and remains stratigraphically consistent. The biggest issue is the disagreement with the ^{10}Be ages.

Line 323 – There is a similar pattern of ^{3}He retention for both locations for elevations greater than 2150 m asl. Could it be discussed how this is, or is not, relevant?

Line 330 - *these

Line 337 – It might help to clarify that the approximate differences in EDT between high- and low-elevation samples are determined from the peak value for each probability distribution.