Dear Editor and Referees,

We sincerely thank the referees for the careful reading of our manuscript and for their thoughtful and constructive comments. We appreciate your recognition of the relevance of our study, as well as the positive evaluation of the manuscript's organization and clarity. We thank you for identifying areas where the manuscript could be strengthened.

Below, you find the replies to the comments and questions (original comments in black and replies in red). We have corrected the typos found and made the changes suggested. We also reviewed the discussion section and added a new subsection to discuss the differences between our experiments and nature.

On behalf of all authors,

Kind regards,

Danielle Silva Souza

**Referee #2 comments**

In this manuscript, Souza and co-authors investigate the influence of deviatoric stress on the nucleation and spatial distribution of antigorite dehydration products within the antigorite stability field (~530 °C, 3 GPa). They present deformation experiments on natural antigorite cores conducted under hydrostatic and deviatoric stress conditions using a six-ram multi-anvil apparatus. The results demonstrate that deviatoric stress affects the development of antigorite dehydration across different strain-rate conditions and suggest that localized dehydration is unlikely to be controlled by chemical or mineralogical heterogeneities. The authors conclude that intermediate-depth earthquakes are more likely to reflect a continuum of dehydration-assisted mechanical processes rather than a single classical dehydration embrittlement event.

The processes governing intermediate-depth earthquakes, and particularly the role of dehydration, remain incompletely understood. This study provides valuable new insights into the coupling between deformation, deviatoric stress, and localized dehydration. The manuscript is well written, logically organized, and supported by informative figures. I recommend publication after minor revision. My main comments are limited to two suggestions that could further strengthen the Discussion, followed by a few minor editorial comments.

Main comments

As I understand it, the deformation experiments are kinematically driven, with prescribed boundary velocities and strain rates. In contrast, deformation in a natural subducting slab is likely closer to a force-driven system, where slab pull imposes the driving force and weakening (as discussed in the manuscript) may result in accelerating deformation, potentially leading to runaway processes such as strain localization associated with shear heating and/or slab detachment. Therefore, the absence of pronounced brittle failure in the experiments may partly reflect the imposed boundary conditions. A brief discussion of how the experimental boundary conditions influence the applicability of the results to force-driven systems could strengthen the manuscript.

The manuscript refers to differential stresses, but it is not clear what stress levels are reached during the experiments or how these compare with those expected in nature. Likewise, the applied strain rates (~$10^{-5}$ $s^{-1}$) are substantially higher than typical geological strain rates. It would be helpful if the authors briefly discussed the extent to which the experimental stress and strain-rate conditions are representative of natural subduction environments, or whether extrapolation is required when relating the experimental observations to natural processes.

Reply: We agree with the referee that our experimental conditions diverge from natural settings, and we add a section to discuss it. Determining stress in our current experimental set up is unfortunately not a trivial task and could not be measured in our experiments. We estimated stress in our experiments using the power and exponential flow laws from Hilairet et al. (2007). This is also added this in the new discussion section.

Minor comments

Line 15: Superscript numbers are not formatted as superscripts.

Reply: Corrected.

Line 48: Maybe consider citing the relevant modelling study by Porkolab et al. (GRL, 2025; DOI: 10.1029/2024GL113865).

Reply: We appreciate the referee's suggestion for the missing reference. It is now added to the text.

Line 338: Parentheses should enclose only the publication year in the reference.

Reply: Corrected.

Line 340: Insert a space before the reference.

Reply: Corrected.

Line 395: The modelling study by Porkolab et al. (GRL, 2025) also demonstrates localized dehydration associated with elevated fluid pressure.

Reply: We thank the referee for indicating this missing reference and have added it to the text.