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Climate of the Past Discussions

Interactive comment on "Local artifacts in ice core methane records caused by layered bubble trapping and in-situ production: a multi-site investigation" *by* R. H. Rhodes et al.

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Reply to comments provided by J. Severinghaus on "Local artifacts in ice core methane records caused by layered bubble trapping and in-situ production" by R.H. Rhodes et al.

We thank Jeff Severinghaus for his positive assessment of our study and its importance for understanding how gas bubbles become trapped in ice cores.

The principal comment concerns our neglect of measurements carried out on firn air samples, rather than ice core gas bubbles. This is an oversight that we will address in our revised manuscript by adding relevant information and citations to the introduction

and section 3.5. In particular, we did not mean to assert that the firn pack contains no horizontal sealing layers that prevent vertical diffusion. Firn air studies have provided strong evidence for such layers within the lock-in zone, as pointed out by the reviewer. We would reword the second bullet point of section 5.1.2 to state that we do not find evidence for sealing layers (maybe caused by melt events or wind crusts) above the lock-in zone. We would also explicitly highlight that our results suggest that significant bubble closure must occur above the lock-in zone where vertical diffusion occurs, as suggested in the review.

Our apparent misunderstanding of the impurity-related densification theory of Hörhold and Freitag is unfortunate given that J. Freitag is a co-author on this manuscript. The description of this theory will be brought up-to-date in the revised version.

The remaining specific comments provided will be addressed with minor changes to the manuscript to add references, improve clarity or correct grammar. We are grateful for the attention to detail in the review.

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