

Interactive comment on “Diffusive equilibration of N₂, O₂ and CO₂ mixing ratios in a 1.5 million years old ice core” by B. Bereiter et al.

Anonymous Referee #2

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General comments:

I understand that it is very important for simulating whether the climate signals are saved in deep ice cores by using the information of gas diffusion currently available. The review of research works on gas permeation through ice is very useful. The authors seem to understand the uncertainties of available data, and they simulate under various possible conditions.

One of issues which the reviewer cannot be well understood is, however, that the authors used the one-dimensional ice flow model derived for ice sheets far away from ice divides and ice dome although they considered the vertical diffusion only. I think the authors' model should be fit for the ice without horizontal ice flow, but the results are insufficient (2.2).

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Another point which the reviewer feels strange is the evaluation of gas permeability based on the simulation used in this study. The information of gas permeability in ice used in this manuscript has been estimated by the computer simulation or by the observation of air hydrate growth. These estimations are come from the gas diffusion in the range of nanometer or at most micrometer order. When one wishes to extrapolate these parameters to the gas diffusion in the range of centimeter or meter order, it is very difficult to assume that the bulk ice is pure and homogeneous. Ice matrix is the complex of the layered structure with various impurities, grain morphologies, and so on, which are not considered in the present model as mentioned by authors, and each layer would have different sensitivity on pressure and temperature. Therefore, the gas permeation parameters are only available to estimate qualitatively the climate signal change by this model, but they are not able to be evaluated by this model.

Specific comments:

Authors should review the manuscript which unit they used for temperature, Kelvin or Centigrade.

As a reference, MS thesis (e.g., Haeberlin et al., 2012) is very difficult for the ordinary readers to refer to. Therefore authors must provide alternative articles for it.

Figures 7 and 8: Please check the unit of horizontal axes (Gas Age) because authors discussed these figures as 'Myr'-order unit in the text whereas the titles of these axes have 'kyr'-order unit.

Interactive comment on The Cryosphere Discuss., 7, 2029, 2013.

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