Clim. Past Discuss.,
https://doi.org/10.5194/cp-2020-127-RC2, 2020

Climate of the Past Discussions
Open Access
EGU

Interactive comment on "Snapshots of mean ocean temperature over the last 700,000 yr using noble gases in the EPICA Dome C ice core" *by* Marcel Haeberli et al.

Jeff Severinghaus (Referee)

jseveringhaus@ucsd.edu

Received and published: 25 December 2020

This manuscript describes a heroic effort to use noble gases from the full 700-kyr EPICA Dome C ice core to infer past mean ocean temperature, based on the well-known temperature dependence of noble gas solubility in the ocean. The method takes advantage of the fortunate fact that the total amount of N2, Kr, and Xe in the combined ocean-atmosphere system is remarkably stable over million-year timescales, at a sufficiently high level that they can be assumed to be unchanging.

The difficulty that had to be overcome by the authors is substantial. Many unforseen artifacts, such as gas loss and clathrate based issues, had to be wrestled with. This

Printer-friendly version

Discussion paper

work truly pioneered the use of noble gases in very deep ice cores where geothermal heat made the ice core rather warm, and depressurization effects upon core recovery were extreme. Transport issues further vexed the effort, including failures of the cooling system that allowed the ice cores to get warm. Fractionation mechanisms are still incompletely understood in ice cores, leading to small disagreements between the three gas pairs used.

Nonetheless, the authors persevered and the result is a spectacular advance in scientific understanding of the behavior of the planetary energy imbalance and ocean dynamics over the late Pleistocene ice ages. This is truly an excellent piece of science and a carefully and thoroughly executed and painstaking research tour de force. It goes without saying, then, that this manuscript should be published with only very minor revisions.

I have attached a copy of the manuscript with my suggested edits in red. One area that needs a re-write is the paragraph on air clathrates, which seems to have been influenced by prior work done on Greenland ice. Antarctic ice has lower impurity content (and thus clathrate nucleation sites) than Greenland ice, and therefore has clathrates that are fewer in number than the number of bubbles, requiring air to permeate some distance through the ice lattice from the air bubble to the (relatively rare) growing clathrate. This nucleation limitation effect is not seen in Greenland ice to my knowledge.

To the authors: well done! This is a beautiful piece of science and will no doubt have lasting value.

Please also note the supplement to this comment:
https://cp.copernicus.org/preprints/cp-2020-127/cp-2020-127-RC2-supplement.pdf

Interactive comment on Clim. Past Discuss., https://doi.org/10.5194/cp-2020-127, 2020.