

Response to Peter Neff: Assessing the potential for an ice core in the southern Antarctic Peninsula to elucidate Holocene climate history

The authors present a compelling case for the ABW divide site to provide a full Holocene and late glacial climate record for Ellsworth Land and the Bellingshausen and Weddel Seas (both bodies of water providing primary moisture delivery to the site, per Thomas and Bracegirdle, 2014). The modeling approach here is very reasonable and well-supported by the IRH tracing building on previous work by Bogart and coauthor Bingham, in addition to the existing shallow F10 ice core results. All the data assembled here make a compelling case for the site, although I will note the extraordinary effort required to collect more than 1000 meters of Holocene ice to access a scant ~150 meters of Glacial ice (albeit with annual layers indeed likely interpretable for some part of the very late Pleistocene ice). The authors are appropriately conservative in interpreting depth-age results near the bed, given uncertainty in geothermal heating, melt rates, etc. at depth.

Thank you for your comments on the manuscript.

I assume no other potential ice core sites were discussed due to the number of constraints at the F10/ABW site, but it is worth noting that the local triple-divide nearer to the Amundsen Sea (~150km east of Canisteo Peninsula)—although compelling due to its proximity to the fast-changing Amundsen Sea—is home to a subglacial tephra layer visible in 2018 IceBridge RDS data. The presence of such a subglacial feature likely complicates preservation of interpretable snow stratigraphy, at least for a brief period. The authors may wish to note this in their manuscript, and also consider the likelihood and utility of chemical evidence of this layer being identifiable at the ABW site.

Link to 2018 NASA OIB RDS data with (presumed) tephra:

https://data.cresis.ku.edu/data/rds/2018_Antarctica_DC8/images/20181116_02/20181116_02_035_1echo.jpg

Thank you for sharing this radargram and highlighting the tephra layer visible in the OIB IceBridge RDS data. Our initial investigation at ABW was from a glaciological/geophysical focus, utilising the abundance of existing airborne and ground-based radio-echo sounding data, to expand our dated radar stratigraphy archive across the WAIS. It was only once we incorporated the radar layers into the model at the triple-divide at ABW that we discovered this exciting shift in the accumulation regime since the mid-Holocene.

We can clarify that the (presumed) tephra layer in the OIB RDS 20181116_02_035 profile is not visible in the OIB data around ABW (e.g. flightlines 20181116_02_38 – 20181116_02_43). Although we acknowledge thick tephra layers will complicate the preservation of interpretable snow stratigraphy, the NASA OIB RDS data at ABW do not indicate that a layer such as the one seen in other OIB profiles closer to the Canisteo Peninsula is present at ABW.

Therefore, while we thank you for raising this interesting point, and we have considered it, our inclination is not to add this discussion into the revised paper.

I hesitate to self-reference, but one important point relating to feasibility/utility of an ice core at ABW is expectations for ice core quality below 400 m given past BAS ice core drilling experience in this zone of increasing bubble pressure and brittle ice fracture. Not only will the top 1000 m of an ABW ice core be restricted to the Holocene (yes, valuable to constrain recent thinning and decreasing snow accumulation) it will also likely exhibit some brittle fracture from 400 or 500 m depth to the bed (e.g. Neff, 2014). This will reduce core quality and the quality of many chemical

analyses if mitigating ice core handling procedures aren't implemented, and then some impacts may still remain. While this isn't an ice core drilling logistics paper, it is a key factor relating to ice thickness that will degrade the quality of the record.

Thank you for raising this important issue which we agree we should flag in the paper. We will include a section in the discussion to address the brittle zone and the implications this may have on the quality of the recovered ice at ABW.

Additionally, the authors might consider providing a rationale for the particulars of the ABW site with respect to reconstructing past atmospheric composition. What will the characteristics of this site make advantageous for resolving regional discrepancies in greenhouse gas records from Antarctic ice cores? The snow accumulation rate at present may be relatively similar to WAIS Divide, but the shallower ice thickness alters the preservation depth and presence relative to the brittle ice zone so may make ABW more/less advantageous for gas analyses.

We will consider adding some discussion on these points to the revised paper.

I have no specific edits to the paper, I think the methods employed to consider possible depth age distribution for the ABW site are very reasonable and just encourage some broader considerations for the site.