Review of CP-2025-1780

500-thousand-year-old basal ice at Skytrain Ice Rise, West Antarctic, estimated with the $^{36}Cl/^{10}Be$ ratio", by N. Kappelt et al.

The authors present the results of a study to estimate the age of old ice at the bottom of the ~650 m deep Skytrain ice core in West Antarctica, using the 36Cl/10Be method. I think the introduction could use a bit of historical perspective, since this method was first pioneered by Nishiizumi et al. (1983) for Antarctic ice from Allan Hills and then used by Elmore et al. (1987) for Greenland ice. Later measurements by Nishiizumi and Finkel (1998; Chinese Science Bull 43) showed that the $^{36}Cl/^{10}Be$ ratio varies systematically between ice cores (e.g. GISP2 vs. Siple Dome), so the method has not become a standard application to date old ice. The main challenge of the method is that it seems to require local calibration, as the authors have done in this study, so this seems a sound approach. Based on the measured 36Cl/10Be ratios in the top ~625 m of the core, which have been well dated, and a "climate correction" based on d18O, they used the climate-corrected $^{36}Cl/^{10}Be$ ratios in the bottom 24 m of the core to estimate their ages, yielding values increasing with depth from ~50 kyr to 550 +/- 110 kyr. This old age at the bottom is an important finding for the climate record of the Skytrain ice core; and the observation that the age increases monotonically with depth gives some confidence in the method. The authors have done a good job in explaining the experimental uncertainties in the measured 36Cl/10Be ratios as well as the systematic uncertainty in the 36Cl/10Be ratio of young ice,

However, I would like to see a bit more discussion of the 36Cl/10Be ages of the dated samples. For example, one sample in Fig. 2c (not sure what depth) has a 36Cl/10Be ratio of ~0.19, what age would that correspond to ? In fact, it would be illustrative to plot the 36Cl/10Be-derived ages of all 18 samples in the top 620 m of the core in Figure 3, just to give a sense of how much the ages scatter – given the uncertainty of ~100 kyr in the ages of the deeper samples I would expect them to plot within ~200 kyr of their true age. This may also give some insight into how reliable the climate correction is.

Secondly, I would like to see a bit of discussion on the implications of this old ice at the bottom of the core. What does it mean to see a ~400 kyr increase in age over 24 m of ice thickness? I am not a glaciology expert, but I seem to remember from the WAIS Divide core that the projected age at the bottom of the core depended on the geothermal flux, i.e., more heating from the bottom means younger ice. So does the old ice imply a low geothermal flux and is this consistent with what we know about West Antarctica or is this beyond the scope of this paper ?

In summary, this study provides a valuable contribution for the ice core and climate change community and is an interesting result that will probably be tested by other methods. I recommend publication of this manuscript in Climate of the Past after minor revision. Besides the two comments above, I have a few small edits and suggestions (listed below) that may help to further improve the clarity of this paper.

Minor edits/suggestions/comments.

L22 – Explain where the effective half-life of 384 kyr comes from. Audi et al. (2017) lists a half-life of 301 kyr for ^{36}Cl and 1.51 Myr for ^{10}Be, whereas the updated value of Chmeleff et al. (2010) is 1.387 Myr, so it is not clear which one was used. Later in the paper (L198) a value of 308 kyr is quoted for ^{36}Cl or is that a typo ?

L33-34. I'm sure the accumulation rate has varied in time, so may not always have been 13 g/cm^2/yr. So even though ^{36}Cl has not been lost in the past 100 yr, is it possible that it may have been lost in the past when precipitation was lower ?

L78. Was there a particular reason to add more Cl carrier to the deeper samples ? Did the authors take the Cl component of the ice itself into account when converting 36Cl/Cl ratio to 36Cl concentration or is this contribution negligible compared to added carrier. If so, it would be useful to mention typical Cl concentration in Skytrain ice samples.

L198. Check 36Cl half-life – 301 kyr ?