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The Cryosphere Discussions

Interactive comment on "Thickness of the divide and flank of the West Antarctic Ice Sheet through the last deglaciation" *by* Perry Spector et al.

Anonymous Referee #2

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This well-written and well-considered manuscript contrasts LGM ice thickness changes from the centre of the West Antarctic Ice Sheet with those closer to its margins. The authors reveal new cosmogenic nuclide-derived constraints on ice sheet thickness at two unstudied locations (Pirrit Hills and Whitmore Mtns) derived through 10Be surface exposure dating and novel interpretations of in situ 14C data. The authors find support for a post-LGM highstand in the centre of the ice sheet as a likely consequence of increased precipitation during deglaciation, followed by dynamic thinning that propagated upstream from the ice sheet margin. The idea is not new, and there are other field studies from interior regions of the WAIS (Steig et al., 2001; Ackert et al., 1999), the Ross Sea (Todd et al., 2010; Hall et al., 2015) and Weddell Sea (Hein et al., 2016) and that find similar evidence for this balance between oceanic and atmospheric con-

trols on ice sheet behaviour during deglaciation. The manuscript adds further support for this idea, obtained through novel application and interpretation of in situ 14C from a rare, interior WAIS location. The modelling of in situ 14C exposure histories is novel and will be of wide interest to those who work with cosmogenic nuclide data. The conclusions are supported by the data, and should be of wide interest to the readers of the Cryosphere. I recommend publication after addressing some minor points.

Specific comments:

- The mix of saturated and finite 14C ages on Mt. Seelig is perplexing and requires further discussion. The saturated 14C ages are used to "eliminate" the possibility that the WAIS was thicker than 190m (elevation of the lowest saturated age) during the LGM, without discussion on the reliability of those ages. It is worth discussing the reliability of those saturated ages given the recent study by Nichols et al. (2019), who repeated measurements of 14C in samples that were previously reported as saturated (Balco et al., 2016) and got finite ages. As the data come from the same lab, further discussion is warranted.

The authors consider the proximity to local ice caps and snowfields to explain the finite 14C ages at higher altitudes, with distances of 5-20m reported. However, it is not discussed whether the saturated samples are located further away from the snowfields? Is there any sort of correlation here that could be used to support this argument?

- The authors cite unpublished Al/Be/Ne data to support their argument for low erosion rates and long exposure of bedrock surfaces in the Whitmore Mtns. The authors should either publish this data within this manuscript, or remove reference to them.

- Comment on Section 5.1: the argument for simple monotonic post-LGM thinning of ice sheet margins despite a deglacial increase in snowfall is likely correct, but is overly simplified. In the Heritage Range, the competition between increased snowfall and dynamic thinning is argued to explain the delayed deglaciation at that site, which initiated in earnest only after ∼10 ka when dynamic thinning began to outpace deglacial

increases in snowfall (Hein et al., 2016). If correct, the influence of increased snowfall is more widespread than implied (i.e., it's influence extends beyond the divide), even though it may not have caused local thickening. Similar competition between processes has been suggested to explain ice histories in the Ross Sea sector (Hall et al., 2015; Todd et al., 2010).

Technical corrections:

- What is the distance of Pirrit Hills from the grounding line and the divide?

-p3 line 30- statement that no glacially-transported cobbles found contrasts with next statement on discovery of indurated till. Rewrite to clarify.

- P4L8 – replace "remove" with "minimize"

-P4L15 – Perhaps include in Table the distance of each sample to the present snow/ice cap and reference here.

-P4L19 –For clarity, state from where the ice margin elevation was determined at each site (given this can vary significantly around a nunatak).

- P8L10 – can't use unpublished data to support your argument.

- P9L35 – spelling of "ice"

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