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The Cryosphere Discussions

Interactive comment on "West Antarctic sites for subglacial drilling to test for past ice-sheet collapse" *by* Perry Spector et al.

Anonymous Referee #1

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General Comments In this paper, the authors outline the considerations required for successful cosmogenic nuclide sampling of the bed in order to test ideas for reduced past ice sheet extent. The authors outline and then apply a number of criteria to analyse the areas which would be most likely to record restricted ice extent histories. Criteria for successful sampling include an understanding of lithology which relies on knowledge of exposed outcrops and an estimation of whether sites have undergone subglacial erosion. Resulting potential sites are assessed via the use of numerical models of glacial-interglacial behaviour to determine those most likely to sensitively record the degree, timing and frequency of different minimal interglacial ice configurations whilst also being acceptable under the lithological and erosion criteria. Following these analyses, the authors report on a site survey driven by the above criteria and the

successful drilling to bedrock and extraction of a subglacial rock sample suitable for cosmogenic isotope analysis. This is a novel paper in that it applies the whole workflow from initial assessment to successful sampling. The paper is likely to be used as a framework for future approaches to sample planning, and will be relevant not only to those intending to do exposure age dating, but to those who seek to gain rock samples for a wider set of purposes. The paper is very clearly written. Initially when I read it I felt that the structure meant it was a paper of two halves, and I did wonder whether the site criteria and analysis should have been separate from the actual fieldwork. However, on re-reading I think that both should stay together because the field campaign does provide a test of the criteria. Overall I have a few relatively minor comments that I hope will be of use:

Specific Comments P13, line8: you say a core is successfully recovered but you should also mention the drill that was actually used to do this. You don't mention that on p2 line32 either. Between these two points in the paper you should at least mention the specific system although full details are not necessary. On page 3 lie 21 you also mention the potential that exists in extracting rock cores that extent several meters in length. I think it will be useful where you mention your drill to therefore indicate how long a core it may potentially be able to get. P5 line 18 you mention an overarching criteria that drill sites should be located in sites of largest thickness change. This criteria is in tension with the notion of looking for sites with minimal erosion because thickness is a key control on whether the base reaches pressure melting point (and this erodes). Therefore, you could consider this as a discussion point when you are discussing either erosion/preservation or when discussing thickness change. Page 6 line 15: Airbourne geophysical data was not mentioned as a potentially useful tool in the initial steps of analysis. Obviously it is not a replacement for more localised site survey, but could the use of RES flight lines be an additionally useful input to the analysis? Could it add to the context provided by bedmap2? Page 9 line 15. Does the technicue by Ross et al (2013, GSAB) help in any way for site selection? Ross uses MODIS and RADARSAT data to highlight where subglacial ridges lie. P12 lines 27-32: Could variability around stoss

and lee snow build up or scour cause complications when interprating exposure history in any rocks from just beneath the ice in such locations? Or are depth criteria relating to shielding also accounting for potential variability in scour and build up? P13 line 10: You might provide an indication of the length of rock core you recovered. In addition, can you say anything else about the actual subglacial conditions encountered? Is there any evidence, from the top surface of the rock, or erosion or weathering? In other words, were your criteria relating to ensuring no erosion etc. actually supported by the physical characteristics of the sample? As a final point, could you discuss anything that you would do differently following the field sampling. What did you learn that might alter any criteria in your initial analysis or site selection?

Technical Corrections: Fig 1: The variation in the orange colors in the lower panel does not really communicate clearly the variability in elevation. Can an alternative color scheme be used to illustrate topography more clearly? Fig 2: I would find it useful to also see a map of a modelled intermediate retreat as opposed to just seeing the most significant retreat. It would help illustrate the point that you select a site that is sensitive to the different scales of interglacial minima. In the lower panels of mass relative to present, you don't indicate what the white circles mean. Finally, in this figure/caption, it would be good to be clear about why you chose those particular breaks in time for the different colours in mass loss plots. Under this categorisation, and given you make the point in the text that during some glacials there is thinning and in some interglacials there is thickening, I wondered whether categorising in these 3 time bands was as useful as it could be. This is because I can't tell whether, in the Late Pleistocene for example, the thickening relates to interglacial or glacial parts of the time period. Instead, I wonder whether it could be more useful to show 3 different colours which relate to mass under either 'glacial', 'interglacial' or 'superinterglacial' conditions. This would provide a way to more easily compare site conditions under particular scales of retreat and would also allow us to see where both thinning or thickening during interglacials occurs (given you mention that growth occurs in some regions in interglacial times).

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