

Interactive comment on “Paleo ice flow and subglacial meltwater dynamics in Pine Island Bay, West Antarctica” by F. O. Nitsche et al.

Anonymous Referee #1

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Understanding the flow of meltwater under ice sheets is a major challenge in glaciology and this paper provides an important new dataset on the details of a major palaeo-drainage network. This paper is well structured and written and I only have a series of minor comments, below:

P4269

L2: it is mainly instead of most of the WAIS

L10: as recently observed under?

P4270

L17: Can the authors provide a few more details on the cosmogenic surface exposure

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ages – what dates, when was thinning greatest, do these agree with the marine dates?

L22: I think the authors need to briefly summarise the findings of Lowe and Anderson (2003) as this is the key work this paper builds upon.

P4271

L1: I find this sentence quite difficult to follow and therefore perhaps needs a re-write. Otherwise, I am not sure if it is needed at all.

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L20: I am not sure if striations is a useful term to use in this context as the authors are referring to a different scale of bedform. I would just stick to grooves or gouges as has been referred to in the past.

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L9: Refer to Fig. 7.

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L10-11: You refer to the undulating profile in the sentences below, so suggest: and are 200-400 m deep, 1-2 km wide and 10-15 km long.

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L5: Or is it a composite signal of the ice stream shifting around?

L17: The authors could refer to the review by Livingstone et al. (2012) in Earth-Science Reviews for some of these gross Antarctic comparisons.

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L3: in Fig. 2 the topography seems to have a series of smooth zones in-between rugged lineated substrate. This might hint at buried basins – especially given Fig. 6, which should be referred to at this point. Is there other acoustic data in this region,

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which would help support or disprove a buried basin-channel network?

L18: Or bedrock poking through the sediments?

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L24-25: The section on the retreat since 11 ka BP could probably go in a separate sentence to help distinguish between the modern observed record and that delineated by marine cores.

L25: . . . a stable grounding line. Could this relatively stable position be a function of a change in slope gradient (depths shallower than area 2 – p4272)? Or does the trough narrow at this point? Maybe worth expanding on possible mechanisms (as you start doing in L19-21).

4280

L14-15: Could channelization of meltwater along discrete portions of the bed not also maintain slow ice-flow (as opposed to broad sheet-flow)? Could also relate the spatially variable bed signature to research that has been done on sticky-spots.

L24: mechanism (without the s)

4281

L3: Why alternatively? Could water films (and shallow canals) develop when the sediment is no longer able to transmit all the meltwater downstream. See Noormets et al. (2009) for a detailed discussion.

L19: I find it interesting to think how these basins formed in the first place as well? Especially as they are also observed elsewhere around the continental shelf. Is there a geological control, and is it meltwater erosion or focused bedrock erosion (or both)?

L25: And frictional heating due to rapid ice flow.

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L4-6: But as the floors of the basins are sometimes lineated could erosion by ice also have aided enlargement/formation?

L13: delete indicates

L17: similar channels and basins instead of similar features

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L26: The authors do not just refer to meltwater networks on the Antarctic Shelf.

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L4-9: I find this section and especially the choice of references a bit odd here. The authors refer to only one example of a bedrock channel in North America, but do not mention the influence it has on ice-dynamics. A broader review of the meltwater channel geometries beneath the North American and European ice sheets would be more appropriate here. The Boulton and Hagdron (2009) reference refers to modelling of the British-Irish Ice Sheet, not terrestrial evidence of subglacial meltwater flow. Suggest deleting or expanding.

L9-11: It would be interesting to discuss this further, in terms of channel formation mechanisms.

L19: Analogous

Figures:

Fig. 2: I find the red annotations to be extremely difficult to see. Perhaps a white colour would stand out better?

Fig. 6: This figure needs explaining in more detail in the caption. I think the right hand panel should be on the left as it highlights the physiography of the region imaged. What are the dotted black lines? Instead of two-way travel time can this be converted to a depth scale?

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Fig. 7: Is this a generalised map of the mapped features? The basins are difficult to make out with the light blue - maybe try a different colour. It is also interesting to note the channels cutting across the basins. This is not mentioned in the text, but is an interesting feature, which perhaps deserves a comment.

Interactive comment on The Cryosphere Discuss., 6, 4267, 2012.