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Interactive comment on "Active lakes in Antarctica survive on a sedimentary substrate – Part I: Theory" *by* S. P. Carter et al.

A.M. Le Brocq

a.lebrocq@exeter.ac.uk

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The paper by Carter et al. make a claim a few times in their manuscript that the ice shelf channel features identified in Le Brocq et al. (2013) rely on subglacial water flowing in channels incised into the grounded ice. This claim forms the basis for one of the major discussion points as evidence to disprove that the ice shelf channels provide evidence of channelised subglacial water flow.

The mechanism which generates the ice shelf channels, described in Jenkins (2011) and used in Le Brocq et al. (2013) to explain features on ice shelf surfaces, does not rely on the assumption that subglacial channels are carved into the grounded ice, they could equally be generated by a subglacial channel occurring in soft sediment. As long as the subglacial water exits the grounding line in a 'focussed' manner it will strengthen

the buoyancy driven mechanism forming the ice shelf channels. In particular, line 15 on p2079 of Carter et al. states that Le Brocq et al. (2013) suggest the ice shelf channels originate from water thermally eroding grounded ice. This is not the case - we only assume thermal erosion beneath the floating ice, driven by the entrainment of ice shelf cavity water which is warmer than the subglacial water exiting the grounded ice sheet.

We appreciate that the calculation of the width of a potential R-channel in the main text of the paper could have led to this misinterpretation. The calculation of the width of an R-channel was carried out purely to demonstrate how wide a channel would be to drain the meltwater generated, and how it would be unlikely to appear in radar imaging over the drainage route beneath the grounded ice. The text from the main paper states: "Indeed, if the channel was incised into the ice, the subglacial channel need only be a few metres wide to drain the flux ($\sim$10m3s 1) under the pressure gradient (Supplementary Section S4) and so would not be easily imaged by radar data with an along-track spatial resolution of $\sim$10 m". The supplementary section, S4, then elaborates on this further, adding the caveat that the subglacial flux "...is unlikely to be sufficient to maintain a channel in the ice over a longer period of time due to creep closure acting to close the channel", and continues: "Ascertaining the nature of the channel (in ice or sediment) requires further investigation.".

From the main text of Le Brocq et al 2013:

"Radar measurements upstream of the MIS grounding line are inconclusive about the presence of a subglacial channel under the grounded ice (Supplementary Section S3, also ref. 17), suggesting that any channel is small in comparison with the channel it feeds beneath the ice shelf. Indeed, if the channel was incised into the ice, the subglacial channel need only be a few metres wide to drain the flux ($\sim$10m3s 1) under the pressure gradient (Supplementary Section S4) and so would not be easily imaged by radar data with an along-track spatial resolution of $\sim$10 m."

Supplementary Section S4:

"This calculation simply illustrates the size of channel needed to drain to meltwater flux if it were a channel incised in the ice. The Möller ice stream subglacial flux is low in comparison to other ice streams at 9.3 m3s-1 and is low in comparison to Greenland meltwater fluxes (e.g. ref 9) and lake outflow discharge7 and is unlikely to be sufficient to maintain a channel in the ice over a longer period of time due to creep closure acting to close the channel. Ascertaining the nature of the channel (in ice or sediment) requires further investigation."

Reference:

Jenkins, A. (2011) Convection-driven melting near the grounding line of Ice Shelves and Tidewater Glaciers. J. Phys. Oceanogr. 41, 22792294.

Interactive comment on The Cryosphere Discuss., 9, 2053, 2015.