The Cryosphere Discussions

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Comment on tc-2021-8

Anonymous Referee #1

Referee comment on "Antecedent control on active ice sheet retreat revealed by seafloor geomorphology, offshore Windmill Islands, Antarctica" by Alexandra L. Post et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2021-8-RC1, 2021

Review on: Antecedent control on active ice sheet retreat revealed by seafloor geomorphology, offshore Windmill Islands, Antarctica by Alex Post et al.

Dear Editor, thank you for the opportunity to read and review this manuscript. The paper is the second paper to present a high resolution bathymetry dataset from shallow areas around the Windmill Islands, Wilkes Land, East Antarctica after Carson et al (2017).

The primary result of the paper is a re-interpretation of some glacial landforms from being recessional moraines to crevasse-squeezed ridges which the authors link to a new model of glacier retreat, with thin fingers of ice stepping back between longitudinal crevasses produced due to the underlying bed topography and steering of thin marginal ice.

Overall, I find few significant additions to the work of Carson et al (2017) and I find that the re-interpretation of the longitudinal ridges and new model lacking. As a result, I cannot recommend publication of this paper in its present form. I have some more general comments that the authors could address, but I feel that much work would need to be done with a much healthier/relevant discussion before it could be published in The Cryosphere. Please note that I have not provided detailed comments on the figures at this stage.

Besides the 80+ comments I have made in the attached annotated PDF, I have some more general recommendations. Many of these are also described in the PDF. In no particular order, these are:

- Although the form analogy between crevasse squeeze features in Evans et al (2016) and these ridges is interesting I did not feel it was substantiated by the data presented. I would like to see arguments for and against the interpretation of the longitudinal ridges as lateral shear margin moraines (as per Carson et al.), lobate recessional moraines (as per Todd et al. 2016 and other examples in the Atlas of Submarine Glacial Landforms by Dowdeswell et al., 2016) and as CSRs. What are the metrics (heights, lengths etc) for the Iceland examples and how does that compare to your landforms? What about the other examples in the literature, how do they compare? You have high resolution bathymetry data, please provide many more profiles over the "CSRs" to show the change in form between the push moraines and these features. Presumably there is a very clear change in profiles (asymmetric to symmetric, transition to sharp crested, change in scale?) as you go around the corner from the push moraine in to the CSR?
- I found the discussion rather disappointing and, in my opinion, this section requires work. Several directions could be taken here. What are the ice thicknesses observed in Iceland and for surging glaciers on Svalbard that produce CSRs, can this tell you how thick the ice was around the Windmill Islands? What other evidence is there for ice thicknesses at the time (observations on islands, numerical models etc). If these are longitudinal CSRs then they are quite unusual in the marine realm. In terrestrial examples longitudinal radial crevasses form on splayed out lobes of ice (piedmonts) so what conditions are required to get these features here – how shallow does it have to be (related to ice thickness), was there a surge and then stagnation? If there is no stagnation phase then how are the CSRs formed and preserved, how did ice retreat away from the CSRs so that they were preserved plastered up against the sides of troughs – what happened to the ice on the bank side of the trough? You mention several times how this area was sensitive to climate variations – how? What was the climate doing at the time that you had this thin but advancing (surging?) ice margin? What was driving overall retreat – and how does the spacing of retreat ridges compare with examples from Svalbard, for example where annual retreat ridges have been documented? Could these features be annual or are they more likely to form on decadal timescales?
- I missed a section at the start of the paper on the Glacial History of the area. This was only given in Section 5.3 and this led to some issues when reading the earlier text on, for example, the origin of the "marine sediments" in the deeper seafloor areas. An expanded section on Glacial History early in the paper would set the scene for the data and the authors could also describe the climatic setting at the time of the hypothesised readvance of Law Dome that could then be discussed later.
- In Section 4 (Results and Interpretation), I found that landforms were immediately described as glacial lineations or CSRs. I would have preferred to see the descriptions as Elongate ridges and Straight sharp-crested ridges. The former might be OK if you were relying on the interpretations of Carson et al (2017) but you are re-interpreting landforms here and then do not provide substantial or systematic arguments for their interpretation (more comments in the text).
- There are a number of sentences that are vague and could be improved. I have noted these on the PDF.
- The authors should clearly distinguish what is new in this paper from what was presented by Carson et al (2017) as many of the concepts appear similar (without having read Carson et al in detail).
- I would imagine there is more that could be done with the backscatter data - can you compare to other backscatter mosaics over glacial landforms, at least qualitatively. What are the differences in response on the boulder ridges compared to the moraines.

Please also note the supplement to this comment:

https://tc.copernicus.org/preprints/tc-2021-8/tc-2021-8-RC1-supplement.pdf