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The Cryosphere Discussions

Interactive comment on "Past ice sheet-seabed interactions in the northeastern Weddell Sea Embayment, Antarctica" *by* Jan Erik Arndt et al.

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Response to review of Chris Clark

In the following we mark reviewer comments with (1), our responses with (2), and our changes to a revised manuscript with (3).

(1) Overview The paper is exceptionally well written and presented and shows some wellknown landform types on the seafloor that are used to build a reconstruction of the ice stream and ice shelf and their flow pattern and retreat. Some dating control is presented to anchor the reconstruction in time. This part of the paper forms a useful and important contribution to the growing field of glacial history surrounding Antarctica. The paper also shows some landform systems that appear to differ and are therefore

thought of as a new type. Using the modern context of an ice shelf with icebergs glued together by sea ice, they build a conceptual interpretation suggesting how these might have been formed. This aspect is more speculative, but interesting and is worth presenting, although I nudge at it with an alternative view in case the authors think it is worth noting. I make a suggestion for a further figure, which would help the impact of the paper. Abstract and introduction do a good and comprehensive job of setting up the context from the literature and the geographic and glaciological backgrounds.

(2) We are grateful to Chris Clark for his evaluation of our study and his suggestion for a further figure.

(1) Section 4.2. The interpretation here is supported by the observations and presumably sensibly influenced by the modern observations of icebergs in a melange of sea ice. This is neat. In this story I suppose icebergs calve off and rotate and once buoyant produce angular keels that can accomplish ploughing some grooves. Upstream of these parallel grooves however (in fig 6) are ridge-grooves that you call MSGL. It is striking that they look similar in orientation and scale, with MSGL possibly leading into iceberg grooves (maybe you could check in your data). I wonder if worth considering if the keels transited the whole system and that is not necessary for individual icebergs to make the grooves; ie keels made the MSGL and the class B ploughmarks. This is something I noted in the Norwegian Channel ice stream making the link that the keels produced both landforms across a transition from grounded ice to lightly grounded to floating ice(Clark et al' 2003 J- Glacial see fig 11 which looks similar to me). This is not critical to your reconstruction but I suggest worth asking if the grooves can actually be traced from one type to the other. This interpretation might also be relevant for your class H ramps – and class E grooves (fig 4) in section 4.4 rather than basal crevasses and the shearing. Perhaps all the lineations (C, D, B, and E) are the same thing but with different degrees of grounding. Not all of you E landforms are sinuous and in fact look very similar to MSGL in places. In this interpretation, you class H ramps and its smeared ridges are the same thing as GZW with grooved MSGL leading to iceberg

grooves. The only difference being orientation of ice flow and perhaps ice velocity. I mention all this as an alternate interpretation in case you want to consider it.

(2) These are interesting thoughts and the mapped parts of transition from Class C to Class B features share some similarities with the features in Figure 11 of Clark et al. (2003). However, the main problem preventing us from investigating this further is the lack of data in the zone, where these features transition into each other. Figures 6a and 6b present all the swath bathymetric data available from regions, where such transitions might occur. In Figure 6a only few Class B features are present. These either do not show a continuation upstream, or swath bathymetric data from further upstream is unavailable due to ice-shelf coverage. In Figure 6b, where Class C features are identified, no Class B features are observed directly downstream in inferred ice flow direction. This area looks rather "flattened" or smeared, probably due to sediment reworking by other icebergs at a later stage. Class B features occur in Figure 6b, i.e further downstream and closer to the northern end of the Stancomb-Wills Trough, but again no swath bathymetric data is available directly upstream due to permanent/regular ice shelf coverage of this area. Therefore it is not possible to check, if these Class B features continue upstream, become more linear/parallel and turn into Class C features. The same problem of swath bathymetric data lacking upstream due to ice-shelf coverage exists for most of the Class E grooves (see Figure 4). For the few Class E grooves, where data is available upstream, no continuation into MSGLs is observed. Therefore, also in this case it is either impossible to check the hypothesis, that Class E grooves develop from MSGLs, or such a transition is not observed. In summary, where data is available upstream of Class B and Class E features, we were not able to trace these back to MSGLs, but in most cases ice-shelf coverage is responsible for the lack of data, making it impossible to trace these features further upstream. Therefore, our data unfortunately is not suitable for verifying the hypothesis of these features evolving into each other.

(3) We decided not to incorporate a related discussion in the manuscript because a)

our data either do not show such a transition between different feature classes or are unsuitable for investigating this, and b) this is not critical for our further interpretations, as it is also stated by the reviewer.

(1) Section 5.2.3. The reconstruction of ice stream, ice shelf, glued icebergs and their extent and geometry is described and I could visualise with reference to the map in Fig 2. I would consider making this easier for the reader by providing a new figure showing the reconstructed cartoon-map of palaeo geography that you describe. This could make the paper more accessible to those interested in the glacial history and increase its impact.

(2) We agree that a visualisation of this reconstruction would be very valuable for communicating our thoughts to the reader. Initially, we refrained from creating such a cartoon because the chronology of the two described glaciological regimes is not clearly resolved (see lines 512-522). Therefore, we thought such a figure may oversimplify our knowledge of the glacial history in the study area and thus may potentially mislead the reader.

(3) We created a schematic cartoon illustrating the two reconstructed glaciological regimes in the study area and added this as a new figure to the revised manuscript.

(1) Minor points In abstract it is stated that S-WTrough was main drainage for EAIS. Clarify if this is what you mean ie. whole ice sheet or if you mean in your studied sector. Line 155 and many places elsewhere, probably better to call them landforms rather than bedforms. To many, the latter term has a more restricted use such as MSGL, drumlins etc. Para 415 stresses that - space needed 470 Fig 96 not 8 a

(2) We agree with the reviewer on all his 'minor points'.

(3) We changed the manuscript accordingly.

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