Late Cenozoic seismic geomophology offshore NW Greenland

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Research project summary and major outcomes

One of the key motivations for investigating the stability of marine-based ice sheets is the potential for abrupt changes in ice sheet dynamics. The marine ice sheet instability theory suggests that if an ice sheet grounding-line is perturbed from a steady-state position, the ice sheet can advance, retreat, or possibly even collapse without the need for external forcing (Weertman, 1974). There is evidence suggesting that this may have previously happened in West Antarctica at ~1.07 Ma (Pollard and DeConto, 2009), and Greenland at ~400 ka (Raymo and Mitrovica, 2012). With at least ~150 million people living within just 1 m of present day sea level, the retreat of these ice sheets in the geological record is significant because, combined, they contain a sea level equivalent of ~20 m. There is growing observational evidence showing that both ice sheets are currently experiencing mass balance losses and vulnerability to atmospheric and oceanic warming. Thus, there is a contemporary need to project how these ice sheets will evolve in the future and their potential sea level contributions. To have confidence in the models projecting ice sheet evolution, the same models must recreate the past. However, instrumental records are not long enough and in order to fully understand how ice sheets and sea level might evolve in the future we have to look at palaeo-records. This allows us to potentially view the rates and styles of environmental changes across long- and short-term timescales.

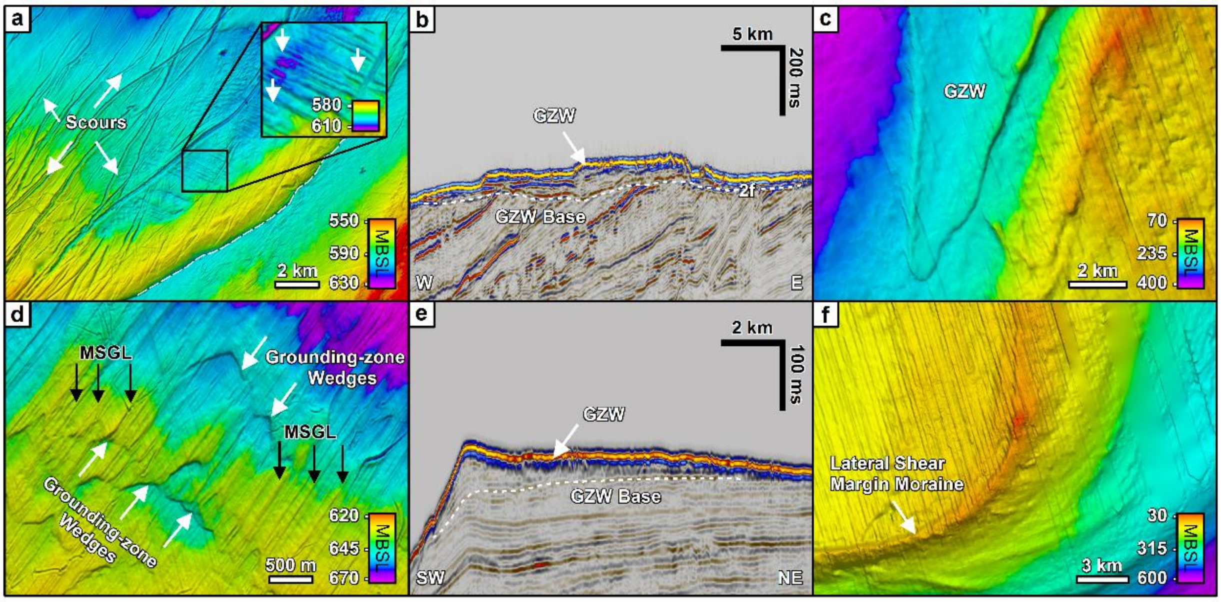

Figure 1: Examples of seafloor geomorphological features from Newton et al. (2017). (a) Mid-shelf grounding-zone wedge (GZW) with iceberg scours and corrugation ridges (inset) observed on top. White dashed line shows the base of the leeside of the wedge. (b) Cross section of the mid-shelf GZW. White dashed line shows the base of the wedge. (c) GZW on the southern flank of the study area. (d) Series of stacked GZWs on the mid-shelf GZW and mega-scale glacial lineations (MSGL). (e) GZW at the shelf edge. White dashed line shows the GZW base. (f) Lateral shear margin moraine on the northern flank of the Upernavik Trough.

The £500 BSG grant provided support for me to spend time at The Geological Survey of Denmark and Greenland (GEUS) in 2017. The opportunity to spend time at GEUS allowed for collaboration to take place on several avenues of research related to the long-term history of the NW Greenland Ice Sheet. Some of this work investigated the geomorphological record from the most recent glacial cycle and has been published in Geophysical Research Letters (Newton et al., 2017; Fig. 1). This landform record showed that during the last glacial cycle, the Greenland Ice Sheet extended to the shelf edge offshore NW Greenland. During retreat the ice margin is thought to have stabilised in the Younger Dryas before retreating rapidly across the overdeepened inner shelf. These findings have implications for how ice streams evolve when the bed that they rest on dips towards the coast. Further synergies were also developed with complementary geomorphological work in progress. The time spent at GEUS was also used to discuss a proposal for an IODP drilling campaign in the study area. Without the support from the BSG, developing such synergies and research outputs would have been considerably more difficult and I am very grateful for the opportunity that they helped facilitate.

References

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