Geophysical Research Abstracts
Vol. 18, EGU2016-1126, 2016
EGU General Assembly 2016

Seafloor glacial geomorphology in a cross shelf trough: insights into the deglaciation of the Melville Bay Ice Stream

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Compared to other glaciated margins such as offshore mid-Norway and Svalbard, the Greenland continental shelf has, until recently, been the subject of only a limited amount of academic and industry research. This has been mainly due to the difficulty and expense of obtaining data in such harsh and operationally complex settings. Climate amelioration and technological advance has, particularly in recent years, allowed both academics and industry to substantially increase data collection across the many glaciated continental shelves in the Northern Hemisphere. Baffin Bay has been one of the primary regions of interest for the hydrocarbon industry which has sought to operate in the frontier basins offshore Greenland. As a result of these industry operations, a large database of geophysical and geological data has been collected. Some of this data has been made available to glacial scientists and provides a unique opportunity to investigate the seafloor geomorphology for regions where the majority of previous work has been hypothetical rather than grounded in geological evidence.

In the work presented here we present a landform record offshore NW Greenland in the Melville Bay cross-shelf trough. This is one of the largest troughs on the entire Greenland shelf and measures up to 140 km in width. Shallow-marine cores collected in the coastal part of the trough show bedrock of Miocene age and indicate that a significant cover has likely been removed from the shelf by ice streams operating through the Late Cenozoic. This material has then been deposited at the shelf edge as a trough mouth fan. Using multibeam and seismic reflection data a large number of glacial landforms are observed and mapped in the trough. These include mega-scale glacial lineations, grounding-zone wedges, iceberg scours, and iceberg grounding pits. These landforms are used to reconstruct the ice dynamics of the Melville Bugt Ice Stream at the last glacial maximum and during its deglaciation. The observed grounding-zone wedges suggest that initial retreat was punctuated with two still-stands of long enough duration to accumulate material at the grounding zone. As the ice sheet decayed further, a rapid retreat of over 30 km occurred before the grounding line margin was stabilised again. Understanding the nonlinear rate of grounding-line retreat such as that presented here is crucial for the future modelling of not just the evolution of the Greenland Ice Sheet but also those elsewhere.