Geophysical Research Abstracts
Vol. 21, EGU2019-7659, 2019
EGU General Assembly 2019

The history and dynamics of the northwest Greenland Ice Sheet over the last 2.7 million years

Andrew Newton (1), Paul Knutz (2), Mads Huuse (3), and John Hopper (2)

(1) School of Natural and Built Environment, Queen's University Belfast, Belfast, United Kingdom (a.newton@qub.ac.uk), (2) Geological Survey of Denmark and Greenland, Copenhagen, Denmark, (3) School of Earth and Environmental Sciences, University of Manchester, Manchester, United Kingdom

The potential sea-level equivalent of the Greenland Ice Sheet (∼7 m) has led to an ever-increasing interest in how the ice sheet has responded to warmer temperatures in the geological past. This has resulted in contrasting models where Greenland is thought to have been both nearly ice-free and persistently ice-covered. This contradiction is due to a lack of long-term geological or ice core records that go significantly beyond the last glacial cycle. Much of the Greenland margin is composed of thick sedimentary successions, including km-thick glaciogenic wedges. In this work, we first used a grid of high-quality 2D seismic reflection data offshore northwest Greenland to develop a large-scale model for the glaciogenic evolution of the Melville Bugt and Upernavik Trough Mouth Fans (TMF). This is constrained by a simple age model and provides insight into a major glacial outlet from the northwestern Greenland Ice Sheet over the last 2.7 million years. A number of progradational units are separated by onlapping surfaces that record eleven major cycles of ice sheet advance to the (palaeo-) shelf edge and subsequent retreat. The large-scale sedimentary architecture indicates that prior to the Middle Pleistocene Transition (MPT) deposition was evenly distributed along strike. After this, during the MPT, the depositional pattern was replaced by focusing and separation into two individual ice stream flows through the two contemporary cross-shelf troughs. This likely indicates a change in ice sheet geometry and dynamics through the MPT. In the second part of this study we investigated 3D seismic reflection data from the Melville Bugt TMF that capture ice sheet history through and after the MPT. Seismic geomorphological analysis provided further support for the transition to focused ice stream flow with the observation of five sets of buried mega-scale glacial lineations (MSGL). These landforms are indicative of ice streaming and demonstrate marine-based glaciation, palaeo-ice flow, and sediment transport pathways prior to the last glacial cycle. The age model suggests that the MSGL were formed during several glacial stages since the onset of the MPT. These observations provide the first 3D evidence for ice stream landforms anywhere along the Greenland continental margin prior to the Last Glacial Maximum. Such records supplement limited proxy data and are essential for constraining the spatio-temporal configuration and longevity of the Greenland Ice Sheet.