High-resolution mapping of onshore-offshore glaciogenic features in Melville Bugt, northwestern Greenland

Francis Freire1, Richard Gyllencreutz2, Sarah Greenwod1, Larry Mayer3 and Martin Jakobsson1,2

1Department of Geological Sciences, Stockholm University, Stockholm, Sweden, 2Center for Coastal and Ocean Mapping, University of New Hampshire

Background

Studies of glaciogenic landscapes help us understand the dynamics and variability of past glacial cycles. We present here the result of a high-resolution offshore geophysical mapping combined with onshore satellite imagery analysis to study the glaciogenic landscape in the coastal waters off Melville Bay, northwestern Greenland. The high resolution geophysical survey resulted in a spectacular overview of the seafloor in the region where we observe the interactions of glacial and perhaps glacial-fluvial processes within the complex bedrock structure. The landscape in both offshore and onshore study areas can be described as highly rugged, glacially eroded bedrock that resembles a ‘croc-and-lochan’ terrain. Different erosional features in both landscapes are mapped and interpreted.

Methods

- Quickbird Satellite Data
  - Two sets of satellite images both pan-sharpened and multispectral acquired from DigitalGlobe Foundation
  - 20 images were taken during late summer covered an area of approximately 150 km
  - Resolution of approximately 2m
- Kongsberg EM2040
  - Deployed in the water column at 500 m
  - Operated at 200-300 kHz for a max depth of ~500 m
  - Produced bathymetric grids at 4 m
- Quickbird Satellite Data
  - 2D images were taken during late summer covered an area of approximately 320 km
  - Operated at 4 knots
  - Produced bathymetric grids at 4 m

Findings and Conclusion

- The high resolution dataset reveal an areally scoured landscape, which is a consequence of glacial activities acting on the tectonically modified bedrock. Pre-glacial tectonic processes served as important controls on the erosional potential of glacial processes, but the extent of glacial modification cannot be discerned.
- The offshore erosional landscape is suggested to be a consequence of a strong meltwater outflow pulse from the adjacent ice margin.
- Palaeo-iceflow analysis indicate that past ice flow direction was NW to SE towards the direction of the Melville Bugt, one of the biggest cross shelf troughs in western Greenland. Iceberg scourmarks in >300 m water show the presence of large icebergs in the study area.
- Landscape features in the offshore study area reveal differences in the spatial erosional pattern, because of differences in rock lithology or to some degree, differences in preglacial erosional processes.

Acknowledgement

The VEGA 2013: Expedition Greenland was organized by Olia Skinnarmo. Captain of Explorer of Sweden was Niklas Russelius. The AUV was provided by University of Iceland and operated by Tomas Thorsteinsson and Arnar Steinsson.

1 Department of Geological Sciences, Stockholm University, Stockholm, Sweden; 2 Center for Coastal and Ocean Mapping, University of New Hampshire.