High-resolution marine geophysical mapping of glaciogenic landforms off the western coast of northern Greenland

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Introduction

A high-resolution marine geophysical mapping survey, the Vega 2013 Expedition, was undertaken in 2013 to collect scientific data on submarine glaciogenic features and continental shelf/fjord interactions off Baffin Bay in the western coast of northern Greenland. The expedition's aim was to find *SS Vega*, the sunken research vessel of A.E. Nordensköld, and at the same time, map the sea floor of the area at high resolution to understand the geology of the area. High resolution datasets from both ship-mounted shallow-water MBES (EM2040) and a GeoSwath interferometric sonar mounted on the Gavia-Autonomous Underwater Vehicle (AUV) was collected and processed to characterize glacigenic seafloor features in the area. The total survey area covered 160 square kilometers

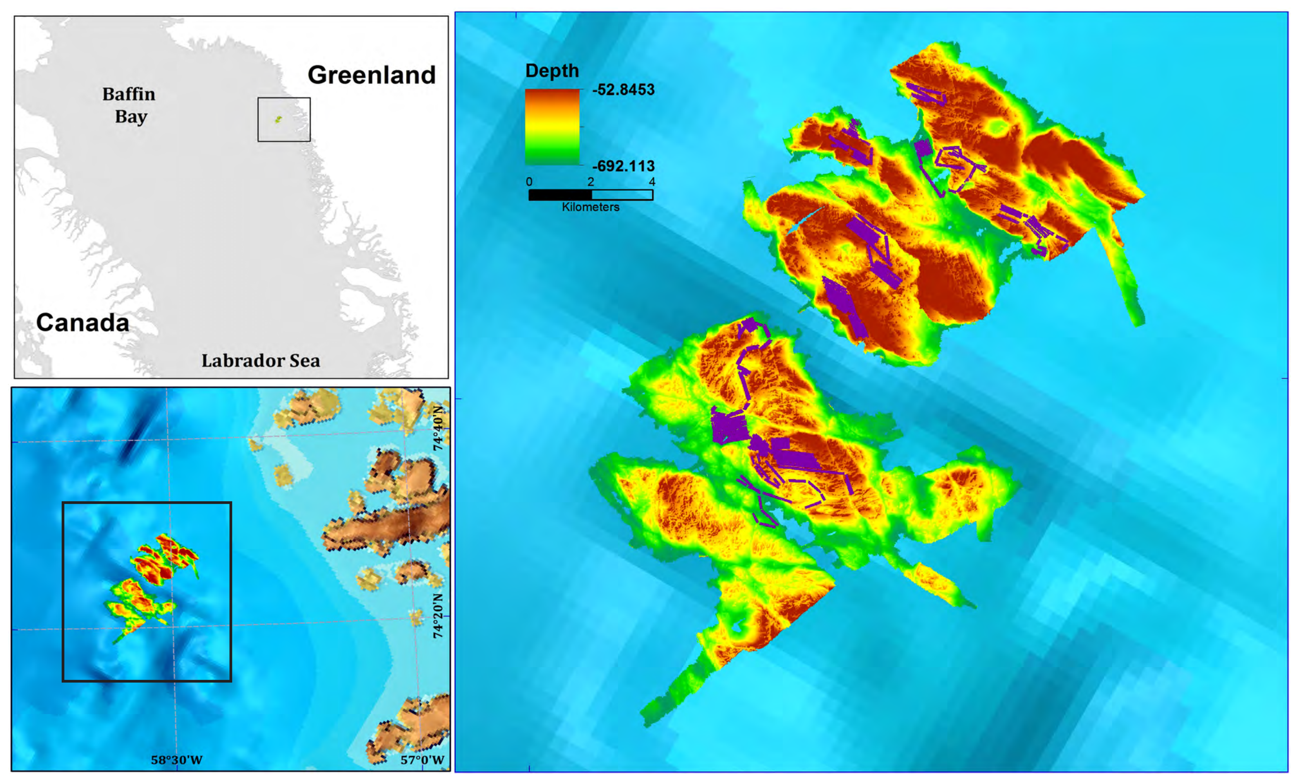

Figure 1: Map of the Study site off the northwestern coast of Greenland. Purple polygon is the extend of the AUV survey.

Figure 2: The sailing research vessel Explorer of Swededn with the bow-mounted EM 2040 MBES system. Deployment of the Gavia-AUV

Method

The sailing research vessel *Explorer of Sweden* was fitted with a bow-mounted high resolution EM2040, 200-400 kHz multibeam for floor mapping and was supplemented with a Gavia-AUV equipped with a dual frequency 600/1200 kHz side-scan and GeoSwath interferometric swath bathymetric sonar.

MBES data was acquired with Kongsberg SIS and transferred to Caris HIPS & SIPS software for cleaning processing to produce 5 m bathymetric grids. Fledermaus suite from QPS was used for backscatter processing and analysis. Geoswath Interferometric bathymetry and backscatter data was processed using Caris while analysis was done using ESRI and Fledermaus. Seafloor characterization was undertaken using expert and machine

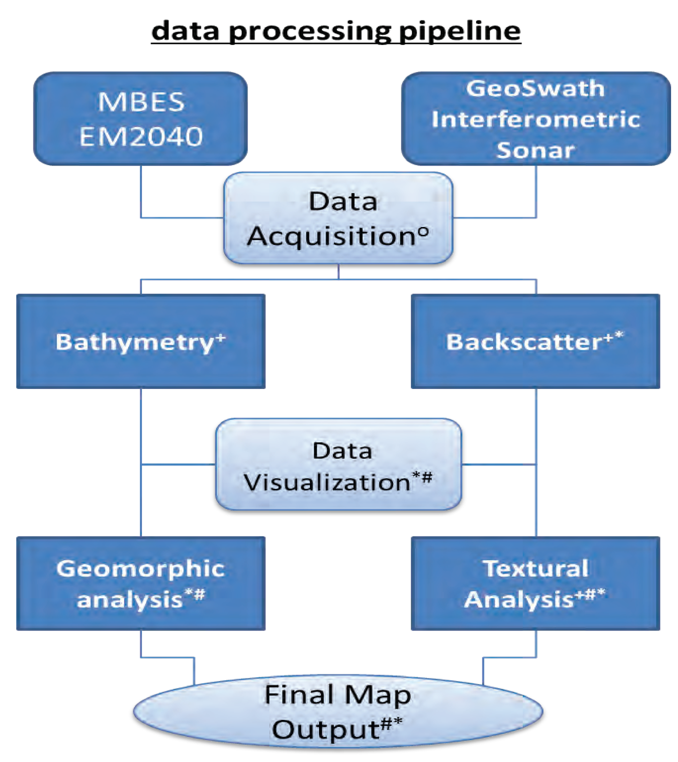

Fig. 3: data processing pipeline. symbols represent the softwares used (o) - acquisition software; (+) Caris HIPS&SIPS; (*) Fledermaus suit; (#) ESRI-ArcGIS

Results - Geomorphic analysis

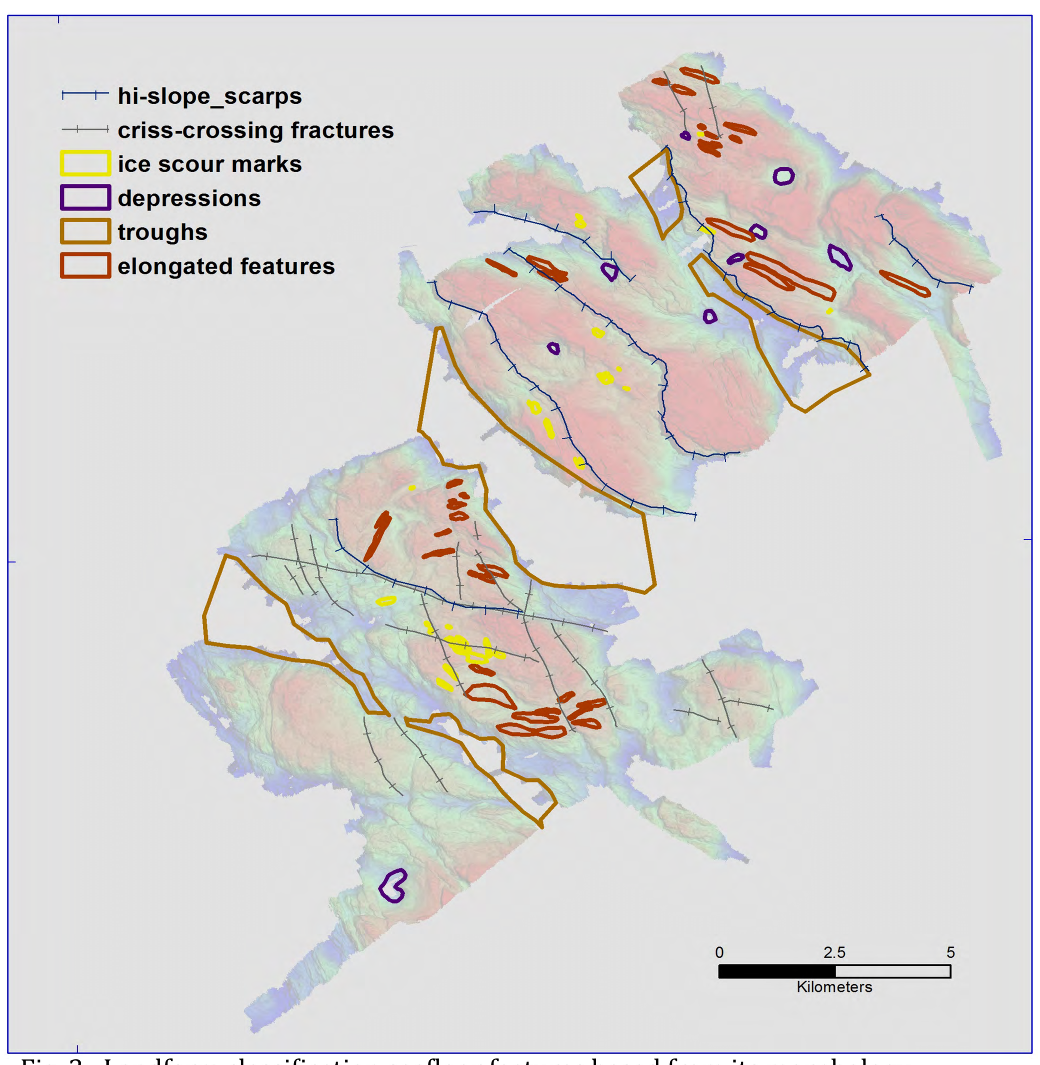

Fig. 3: Landform classification seafloor features based from its morphology. Arrows show the proposed direction of the ice-flows

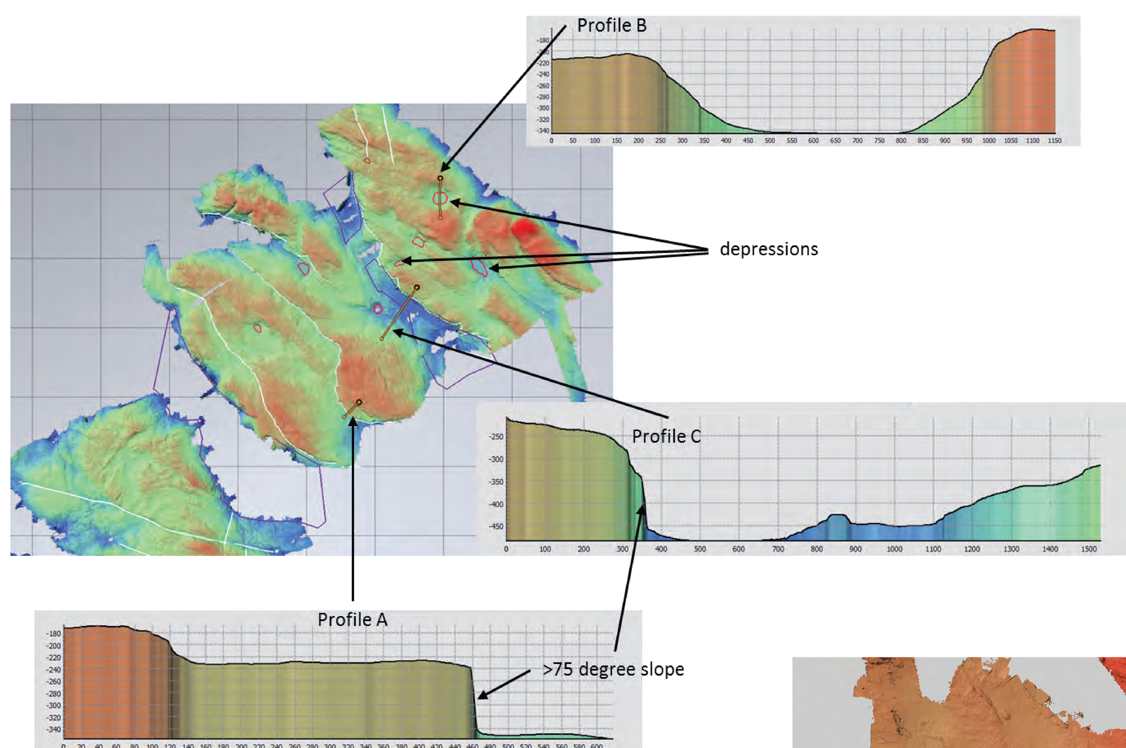

Fig. 3: profiles of different striking morphological features

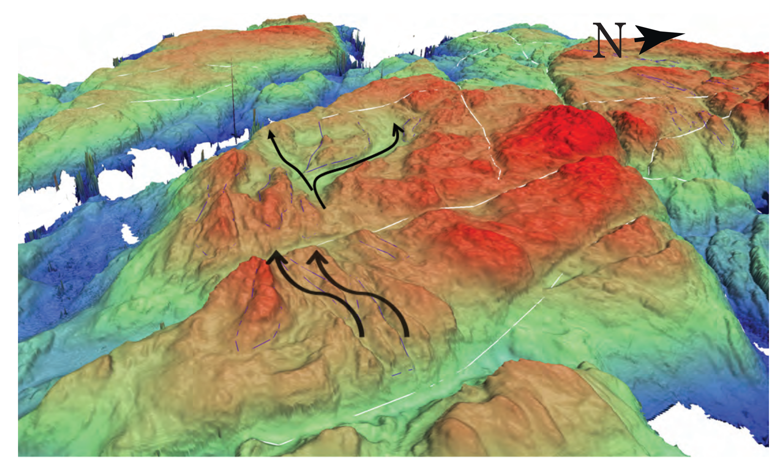

Fig. 3: Oblique view showing pathways of ice flows over the bedrock

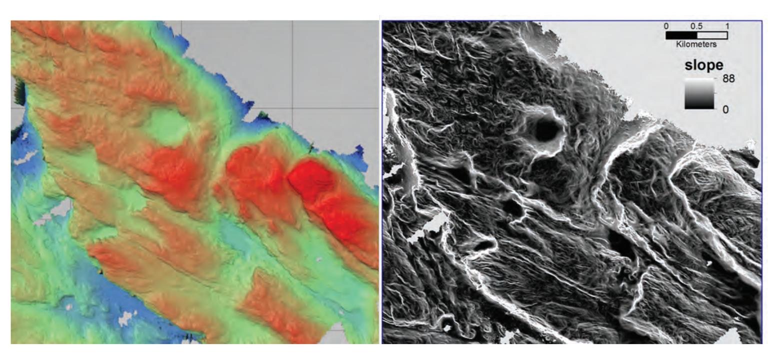

Fig. 3: Spherical depression in the bedrocks

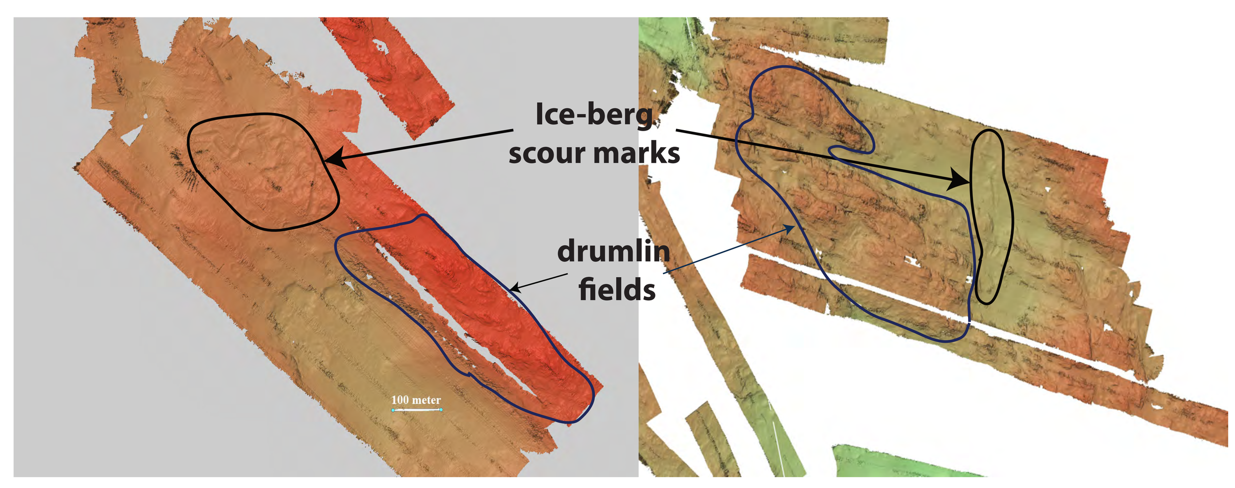

Fig. 3: Bathymetry from the Geoswath interferometric sonar gridded at 1 m with scour markds and drumlins

Results - Textural analysis

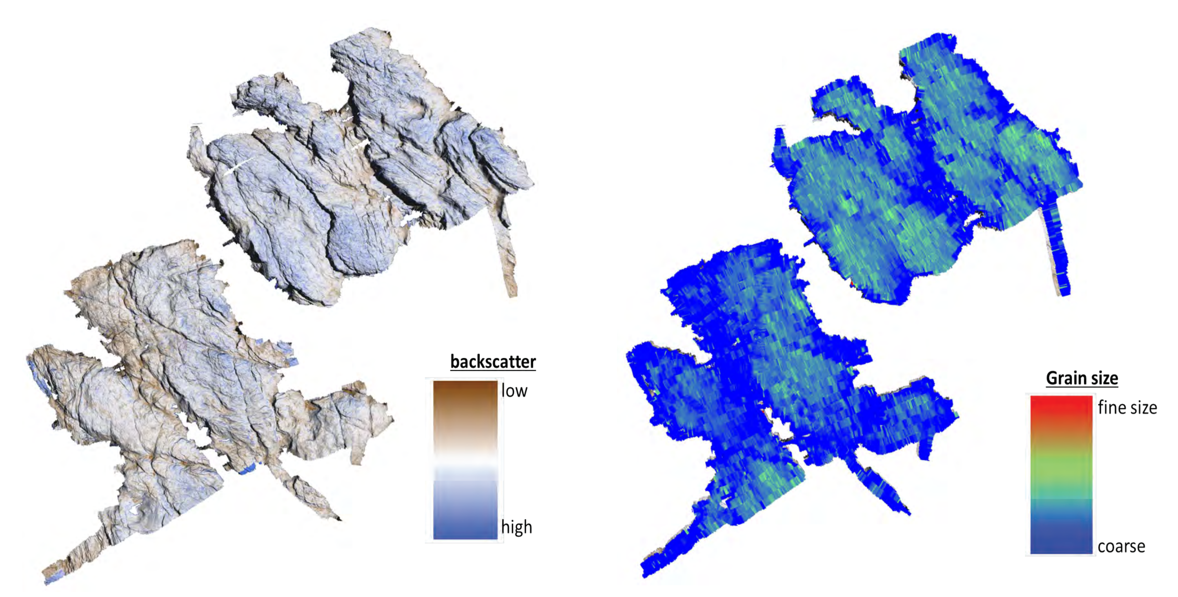

Fig. 3: Textural analysis of the backscatter from EM 2040 multibeam data.

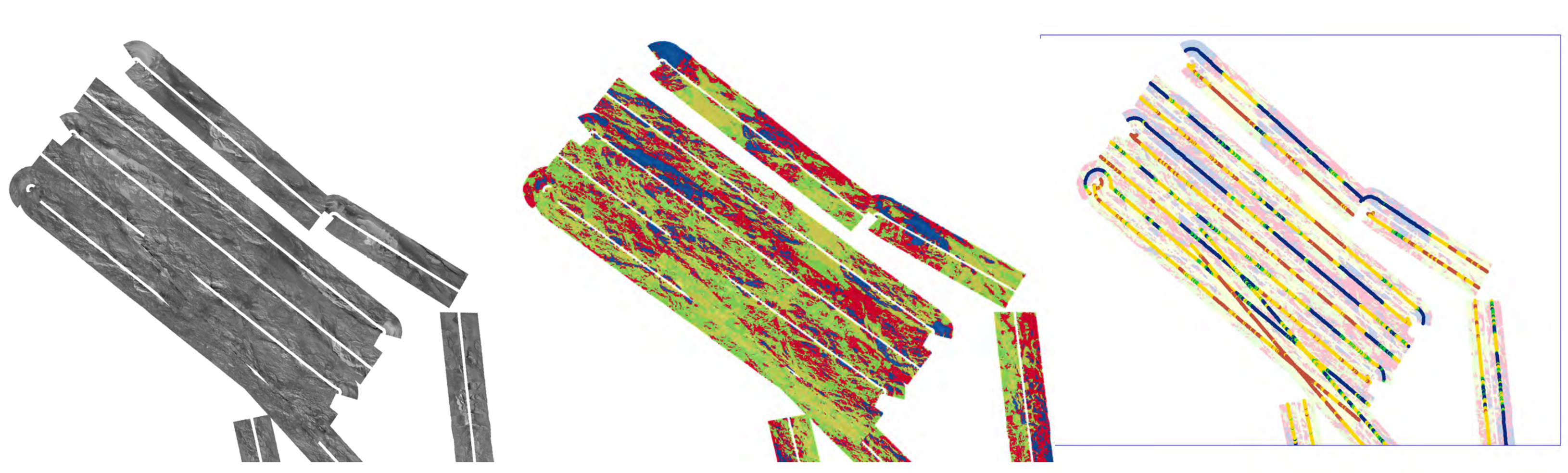

Fig. 3: Textural analysis of the backscatter from GeoSwath data. (A) shows backscatter in Grayscale, (B) classified backscatter intensity values using isocluster algoritm and (C) results from

Discussion and Conclusion

the high resolution geophysical survey resulted in a spectacular overview of the seafloor in the region and of the interactions of glacial and perhaps glacial-fluvial processes with a complex bedrock structure. These include deep troughs, high slope scarps, criss-crossing bedrock fractures and depressions probably carved by ice-moving over the bedrock. Higher resolution interferometric data allowed the identification of ice scars and drumlin fields. Textural analysis of the EM2040 backscatter data using ARA analysis produced general trends. However, the high-resolution backscatter data from the GeoSwath interferometric system produced patterns of sediment distribution that can be used in understanding the spatial variability and dynamics/processes of sedimentation.

The EM2040 MBES data proved to better in producing high quality bathymetry although at a slightly lower resolution than the GeoSwath bathymetry. Bathymetry from the GeoSwath interferometric was still full of system artifacts even with considerable time devoted to cleaning the data. However, backscatter information from GeoSwath was superior compared to MBES and was good enough for small scale sediment dynamics analysis.

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