



Glacial geomorphology of the foreland of Nordenskiöldbreen, Svalbard

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The Nordenskiöldbreen (78°39'N, 16°55'E) is the only one tidewater glacier in the Billefjorden area, central part of Spitsbergen. Since the end of the Little Ice Age, the glacier margin retreated by 1490 m (north wing) and 3100 m (south wing). Glacier recession exposed complex landform assemblages including moraines, flutes and bedrock expositions.

Glacier recession and landforms' development in the terrestrial parts of the foreland were quantified using time-series of orthophotos and digital elevation models (generated based on 1961, 1990, 2009 aerial photographs) and high resolution satellite images from 2013. Additionally, detailed analyses of a case study area were performed based on unmanned aerial vehicle (UAV) imagery (3 cm resolution). A time-series of 1:5,000 geomorphological maps of the whole foreland, together with 1:300 map of a sample area of non-linear flutes and results of sedimentological analysis, enable us to assess the evolution of glacial landform assemblages.

The maps reveal outer zone of latero-frontal moraine arcs and inner zone comprising bedrock draped by linear and non-linear flutes. North wing is characterised by a very limited supraglacial debris cover, which allows for exhibition of subglacial till (partly deposited in subaquatic condition). The pattern of landforms, including cross-cutting linear and non-linear flutes, suggests complexity and overlapping of subglacial processes during the glacier advance. The following recession of the glacier with very limited debris cover allows for preservation of the large part of this landform assemblage. Geomorphology of the southern part of the glacier foreland is more complex and, in addition to flutes, comprises areas of ice-cored moraines, small eskers and debris ridges networks, interpreted as infilling of crevasses due to ice hydrofracturing. This can be related to the potential surging activity or blocking of meltwater under a warm-base part of the polythermal glacier by its frozen margin.

The strong contrast in geomorphology between the northern and southern parts suggests that glaciers dynamic was also very different. Therefore, the terrestrial proglacial areas of the Nordenskiöldbreen constitute an example of landforms development in front of polythermal glacier characterized by highly diversified internal dynamic.