

Controls on morphometry and morphology of alluvial and colluvial fans in the high-Arctic setting, Petuniabukta, Svalbard.

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The Petuniabukta (78°42' N, 16°32' E) is a bay in the northern part of Billefjorden in the central part of Spitsbergen Island, Svalbard. The bay is surrounded by six major, partly glaciated valleys. A numerous alluvial and colluvial fans have developed within valleys as well as along the fiord margins. Distribution and characterization of morphometric parameters of fans were investigated using time-series of orthophotos and digital elevation models (generated based on 1961, 1990, 2009 aerial photographs) and high resolution satellite imagery from 2013. In addition, a very detailed DEM and orthophoto (5 cm resolution) have been produced from unmanned aerial vehicle (UAV) imagery from 2014 and 2015, covering three fans characterised by different types of surface morphology.

A 1:40,000 map showing the distribution of almost 300 alluvial and colluvial fans (ranging in area from 325 km² to 451 275 km²), together with time-series of 1:5,000 geomorphological maps of sample fans enabled an assessment of the spatial and temporal evolution of processes responsible for delivery and erosion of sediments from the fans. The relationship between terrain parameters (e.g. slope, exposition) as well as geology was also investigated. Many of the studied alluvial fans were at least partly coupled and sediments were transferred from the upstream zone to the downstream zone, either due to debris-flow or channelized stream flow. In other cases, coarse sediments were stored within fans, and fines were transported downstream by sheet flows or sub-surface flows. In most of smaller colluvial fans and debris cones, sediments were delivered by mass movement processes (mainly rockfalls and snowfalls) and did not reach lower margin of landforms. Analysis of historical aerial photographs indicated recent increase in the activity of debris-flow modification of surface morphology of fans.

Fans located outside limits of the Little Ice Age (LIA) glaciation are dominated by the secondary processes, which do not cause significant aggradation, but can substantially modified surface morphology. In contrary, surface morphology of fans located inside the limits of the LIA glaciation and along contemporary glaciers is dominated by the primary processes of deposition.

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