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The landform and sediment assemblage produced by multiple surges of a large tidewater glacier system in Van Keulenfjorden, Svalbard

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The geomorphology produced during tidewater glacier surges in Svalbard is often well-preserved on fjord floors, and recent studies utilising swath bathymetry data have helped to characterise these submarine landsystems at various locations. However, in order to capture the full geomorphological record of surging in glaciomarine environments, it is also important to assess the landforms and sediments deposited at the terrestrial margins of such systems. We present mapping and sedimentological data from Nathorstbreen, a large tidewater glacier system at the head of Van Keulenfjorden which is currently surging and has advanced approximately 12.5 km since 2008. The active glacier margin is bordered by a saturated mud apron which has encroached onto the older moraine areas and contains a number of large stranded icebergs. This is interpreted as a low-gradient mobile push moraine composed of soft fjord-floor sediments which have been bulldozed in front of the glacier as it advances, resulting in a significant shallowing of the fjord. The lateral moraine areas are thought to be associated with a previous surge in ca. 1870. They are characterised by sharp-crested ridges and hummocky, ice-cored topography composed of poorly-sorted diamict, interspersed with a large number of pools. At the distal margin of the ice-cored topography there are smoother, more-rounded ridges composed primarily of deformed sands and marine clays. These are interpreted as proglacially-pushed shallow marine and fjord-floor sediments which have been elevated into a terrestrial position. The detailed analysis of coastal sections reveals two transitions from subglacial (poorly-sorted diamict) to proglacial (sands and clays) sediment sequences within the moraine area, indicating that there were at least two separate advances prior to the ongoing surge. This interpretation appears to be supported by initial re-analysis of historic maps and swath bathymetry data. This work demonstrates that detailed sedimentological work, combined with aerial photograph mapping, can be used to identify multiple advances of tidewater surge-type glaciers beyond the observational record. If used in conjunction with dating techniques, it is anticipated that these observations could provide additional information about the frequency and magnitude of surges of Nathorstbreen during the Holocene.