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Debris-rich structures within a High-Arctic tidewater surging glacier: Tunabreen, Svalbard

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The mechanisms controlling the incorporation of large volumes of debris into glacier ice during High-Arctic surges are important for a number of reasons. Firstly, they may provide an indication of basal conditions beneath the glacier. Secondly, the relationship between debris layers and ice can present evidence of the tectonic regime active during a surge. Thirdly, assessing the manner in which debris is entrained, transported and deposited may help to improve our understanding of the formation of ice-sediment-landform assemblages associated with surging. Collectively, these three points may provide an insight into surge mechanisms and the palaeo-record produced by surges. We present initial fieldwork results from Tunabreen, a 35 km-long tidewater glacier in central Spitsbergen which surged in the 1930s, 1970s and 2003-2005. During the most-recent surge the glacier advanced c. 2 km into Tempelfjorden. Since surge termination Tunabreen has calved back c. 1 km, revealing evidence of englacial debris inclusions and debris-rich ice. These are best exposed in two sections in the tidewater ice cliff, located at the NW and SE margins of the glacier front and thought to delimit the lateral extents of active ice during the surge. Both sections contain debris-rich structures, including both up- and downglacier dipping and near-vertical features. Large volumes of debris can often be seen at the base of these, particularly at the SE section. The debris within the structures at both sections is a matrix-supported, muddy diamicton containing predominantly sub-angular to sub-rounded clasts displaying evidence for subglacial transport (striations, grooves, gouges and facets). Both sections are also characterised by complex layering of debris-rich and debris-poor ice units as a result of deformation. We offer some preliminary interpretations of this evidence and its links to surge dynamics. This work forms part of a wider project investigating the ice-debris-landform signature of surging glaciers in Svalbard.