



Controls over the spatial distribution and characteristics of basal ice facies at a temperate Alpine and polythermal Arctic glacier.

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Basal ice is ice that has acquired a distinctive suite of characteristics as a result of processes operating at or near the bed of an ice mass. At Glacier de Tsanfleuron, Switzerland, (temperate) and Midre Lovénbreen, Svalbard, (polythermal) basal ice types have been classified into several key facies to allow generalised mechanisms of formation to be investigated and proposed. The margin of each glacier was mapped at a spatial resolution of 1 m laterally and ~ 1 cm vertically. Basal ice samples were retrieved from areas of the margin and subjected to chemical and sedimentological analysis.

The geology of bed at Glacier de Tsanfleuron (calcium carbonate based deposits) appears to exert a sub-glacial control on basal ice properties and formation. It is likely that the changes in basal ice spatial distribution and characteristics are largely related to a geological change of the bed. Areas of the margin at Glacier de Tsanfleuron appear to have: i) a greater overall thickness of basal ice facies; ii) a more frequent abundance of Dispersed facies ice; iii) Stratified and/or Solid ice and iv) basal ice facies with a higher sediment concentration.

The basal ice mapped along the margin of Midre Lovénbreen was observed as follows: i) only the east and west lateral margins of Midre Lovénbreen were found to have Solid facies ice up to several metres thick; ii) basal ice possibly related to flute formation emerged at the middle frontal section of the margin and iii) the only basal ice facies that was not restricted to a particular location at the margin was a facies similar in appearance to Clotted ice. In contrast to Glacier de Tsanfleuron, basal thermal regime is interpreted as being responsible for the spatial distribution and characteristics of basal ice facies at this glacier. The location, thickness and extent of Solid facies at the lateral margins could be related to exterior cold based bed areas. Whereas, the basal ice related to fluting is likely to be associated with a warm based bed in the interior of the glacier.

This study indicates that the spatial distribution and character of basal ice facies has the capacity to inform of physical conditions in inaccessible upglacier areas of the ice-mass bed (such as basal thermal regime), and influence the flow-response of an ice mass (through its distinctive rheology).