

Internal structure and drainage conduits in a cold Svalbard glacier

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A combination of speleological exploration and high-resolution radar survey was applied to investigate the englacial and subglacial drainage system of Longyearbreen, a cold glacier in Svalbard. Direct observations were compiled with remotely-sensed data in a 3D visualization of the glacier system using Petrel software package. In addition, a radar survey covering the entire glacier provided information on changes in the glacier thermal regime over time.

Previous studies assumed that, in cold glaciers, no englacial and subglacial drainage systems form because cold ice acts as a barrier to water flow (Hodgkins 1997; see also the classical model of the evolution of the englacial meltwater system of Shreve 1972). However, the meltwater conduits present in Longyearbreen show that englacial and subglacial drainage channels indeed can develop in an un-crevassed, cold glacier, and we suggest that they formed through the cut-and-closure process as in the conceptual model of Gulley (2009).

In the view of the present global temperature rise, investigating whether meltwater may reach the bed through a cold surface layer is vital for the understanding of glacier dynamics and stability. Valley glaciers in Spitsbergen such as Longyearbreen are potentially important contributors to the near-future sea level rise (Meier et al. 2007).

References:

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