



Direct exploration of subglacial drainage systems

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Glaciological ideas about the characteristics of subglacial drainage systems have been strongly influenced by idealized theoretical models, partially constrained by proxy data such as dye trace returns. However, few direct observations active subglacial drainage systems are available. Using speleological techniques adapted for glaciers, we have entered and surveyed seven subglacial drainage systems in polythermal glaciers in Svalbard. The maximum depth reached below the ice surface was c. 90 m. The systems are variously fed by moulin developed along vertical fractures, channels at the ice-bed interface, or deeply incised supraglacial streams. All carry substantial discharges of surface-derived meltwater in the summer months.

The geometry of the drainage systems is highly variable, and differs in some important respects from generally accepted models. Most importantly, three of the systems consist of downstream-bifurcating or anastomosing channel networks, contrary to the downstream-converging arborescent geometry predicted by standard theory. Channels were variously incised up into the ice, down into the bed or both, and in some cases all three types were found within a single system. In the deeper parts of four of the systems, the ice-bed interface was temperate, but in a number of cases the bed was frozen showing that channelized drainage can occur in sub-temperate ice in some circumstances.