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Subglacial conduits in sediments

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Much of the current understanding of subglacial hydrology is based on the R-channel type model, in which turbulent dissipation and melting causes a roughly semi-circular incision upwards into the ice. The prevalence of such R-channels beneath the Greenland and Antarctic ice sheets is poorly known. Beneath sediment-based ice, distributed water flow may prevail, or some form of conduits may still form due to a combination of upwards melting as well as downwards erosion into the subglacial sediments (often referred to as a canal). This study examines the dynamics of such conduits, and implications for large-scale subglacial drainage.

Although a relatively standard set of equations has developed to model the evolution and efficiency of R-channels, models of sediment-floored conduits are much less well established; previous models assume steady state, or make ad hoc assumptions about the balance of processes controlling the channel walls. In this study I suggest a (relatively) simple model analogous to that for an R-channel. The model requires consideration of the energy balance that results in melting of the ice roof, and also the erosion, deposition, and creep of the sediments.

Implications for the evolution of large-scale drainage systems over subglacial sediment will be discussed, for subglacial floods in Antarctica, and for subglacial erosion and landform development.