Geophysical Research Abstracts, Vol. 7, 03691, 2005
SRef-ID: 1607-7962/gra/EGU05-A-03691

Channelized drainage over erodible glacier beds

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Subglacial drainage plays a central role in controlling the sliding motion of glaciers and ice sheets, and in shaping subglacial landscapes. The classical theory of channelized subglacial drainage, first enunciated by Röthlisberger (1972), predicts that discharge in a channel is an increasing function of effective pressure, and therefore favours the formation of an arborescent drainage network at low water pressures. This is at odds with the mechanics of ice streams, which require high water pressures over wide areas of the ice stream bed. Indeed, field observations from ice streams (Engelhardt and Kamb, 1997) suggest that drainage there may take the form of a distributed network of shallow 'canals' incised partly into erodible sediments. In this presentation, we investigate the behaviour of such canals, based on earlier work of Ng (1998) suggesting that discharge in a canal should decrease with effective pressure as a result of sediment transport processes controlling canal width. The novelty in our theory is that we account explicitly for the onset of erosion at a critical (Shields) stress, which ensures that very small canals behave essentially as Röthlisberger-type channels, whereas larger ones behave as Ng-type canals. We explain how this could lead to a preferred canal size and discuss its implications for distributed subglacial drainage and for the geomorphological imprint of such a drainage system.

References

Röthlisberger, H. 1972. Water pressure in intra- and subglacial channels. *J. Glaciol.*,

11(62), 177-203.

Engelhardt, H. and Kamb, B. 1997. Basal hydraulic system of a West Antarctic ice stream: constraints from borehole observations. *J. Glaciol.*, **43**(144). 207–230.

Ng, F.S.L. 1998. Mathematical Modelling of Subglacial Drainage and Erosion. D.Phil thesis, Oxford University.