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Hydraulics of supraglacial channels: effects of sinuosity and discharge on longitudinal dispersion: implications for bed rock channel evolution

K. Richardson (1) and **P.A. Carling** (2)

(1) Hydrodynamics and Sedimentology Laboratory, The Lancaster Environment Centre, Lancaster University, Lancaster, LA1 4YQ, UK (2) School of Geography, University of Southampton, Southampton, SO17 1BJ, UK (p.a.carling@soton.ac.uk/Fax: +44 23 8059 3295)

The hydraulics of supraglacial channels cut in ice are little known and in this study the dispersion characteristics of two channels cut in ice are explored using dye dispersion studies and an aggregated dead zone (ADZ) modelling framework. The geometry of ice channels can adjust rapidly, even at the diurnal scale, and as such they can provide a surrogate environment in which to explore how channels cut in resistant bedrock might evolve over long time scales. Field studies were conducted over two days on the Lower Arolla glacier near Sion in Switzerland during August 2005. The channels differed in terms of cross-sectional geometry, sinuosity and gradient. Both exhibited an inner and an outer channel similar to some bedrock channels and one contained transient boulder bars which formed and broke up several times during a diurnal melt cycle. As discharge increased there was a threshold response in some hydraulic parameters and in storage terms in particular. The most likely explanation for this behaviour is related to distinctive changes in the nature of bulk flow within a channel sectional geometry that varied as stage changed and which led to distinctive changes in the development of hydraulic retentiveness. The implications for bedrock channel studies are considered.