# Mapping thermal and hydrological conditions beneath a polythermal glacier with radio-echo sounding

**Luke Copland and Martin Sharp**
Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, Alberta T6G 2E3, Canada. Email: luke.copland@ualberta.ca; Tel: (780) 492 4156; Fax: (780) 492 7598

## ABSTRACT

Spatially contiguous patterns in residual bed reflection power ($BRP_r$) are used to map the thermal and hydrological conditions at the base of a high Arctic polythermal glacier. Residual bed reflection power represents the difference between measured and predicted bed reflection powers, once the influence of dielectric loss with ice depth has been accounted for. Areas with crevassing and other englacial features were removed from analysis since large internal reflections may reduce the power that reaches the glacier bed. Most surveys were made in the spring, while the snowpack was dry, to minimize the influence of variable coupling between the antenna and glacier surface. Correlation plots show that bed slope does not have a significant effect on $BRP_r$.

Based on our findings, several conclusions can be made about the thermal structure of the glacier. Positive $BRP_r$ and the presence of an internal reflecting horizon over the glacier terminus suggest a warm basal layer in this region. In comparison, positive $BRP_r$ and the absence of an internal reflector in overdeepened and valley bottom areas in the upper ablation zone suggest that the pressure melting point is only reached at the glacier bed. Finally, negative $BRP_r$ and the absence of an internal reflector in all other regions are indicative of cold ice. Within the positive $BRP_r$ regions, variability in $BRP_r$ shows patterns similar to subglacial hydrological reconstructions and observations. Maximum $BRP_r$ values occur in areas where drainage is predicted, and an elongated area of high $BRP_r$ occurs directly upglacier from an artesian fountain which brought large volumes of turbid meltwater to the glacier surface. These observations imply that water at the glacier bed is a major control on $BRP_r$. This is probably because water has a higher dielectric contrast with ice than any other subglacial material.