Geophysical Research Abstracts, Vol. 8, 01470, 2006
SRef-ID: 1607-7962/gra/EGU06-A-01470

Field observations of heterogeneous deformation within basal ice: implications for glacier behaviour

Sean Fitzsimons

Department of Geography, University of Otago, P.O. Box 56, Dunedin, New Zealand
(sjf@geography.otago.ac.nz / Fax +64 3 4799037 / Phone +64 3 4798786)

Because basal ice forms the lower boundary of glaciers it acts as an important control of glacier behaviour. In addition the physical and chemical properties of basal ice have the potential to yield important information about the processes beneath inaccessible parts of glaciers and ice sheets. Despite the importance basal ice in regulating glacier behaviour its mechanical properties remain poorly understood. The research described in this paper examines basal velocity and strain patterns in cold glaciers produced by variability in the rheological behaviour of different ice facies. Deformation of the basal zones of five glaciers in the McMurdo dry valleys were measured using a combination of plumblines, displacement transducers, potentiometers and strain arrays installed in tunnels excavated at the glacier beds. All velocity profiles consist of linear sections that have different gradients and parabolic sections separated by thin shear zones and/or sliding interfaces. Maximum velocities 4 m above the bed range from 250 to 1350 mm.a^{-1} and maximum sliding velocities are around 200 mm.a^{-1}. The data demonstrate that deformation is not homogenous and that Glens's flow law does not provide a good description of the deformation of the basal ice. The compound velocity profiles are expressions of contrasts in basal ice rheology controlled by the physical characteristics of distinctive basal ice facies. The main controls on the rheology of basal ice appear to be the concentration of solutes and solids in the basal ice and possibly also the size and orientation of ice crystals. These results show that models of glacier behaviour based on uniform deformation of isotropic ice are likely to be erroneous.