Geophysical Research Abstracts, Vol. 7, 10619, 2005
SRef-ID: 1607-7962/gra/EGU05-A-10619

A laboratory study of ploughing: preliminary results

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Basal motion of glaciers that rest on soft beds is by some combination of sliding and subglacial sediment deformation. A transitional state between sliding and bed deformation entitled 'ploughing' can occur when clasts that protrude into the glacier sole are dragged through the upper layer of the sediment. If a glacier slides sufficiently fast over an impermeable sediment bed, excess pore-water pressures may develop downglacier from ploughing clasts such that sediment there weakens and provides little resistance to glacier motion. Thus, the ploughing process may help ice–bed decoupling and affect glacier flow.

A large scale laboratory apparatus (rotary ploughing device) was constructed to investigate this process systematically under realistic subglacial conditions. Ploughing experiments are carried out by dragging an instrumented tip at different velocities through glacial sediment subject to different normal stresses. The drag force on the tip and the pore-water pressure in the adjacent sediment are measured simultaneously. The goal is to explore the influence of ploughing velocity and effective pressure on excess pore-pressure generation and sediment strength. Preliminary results of experiments performed with basal sediment collected in the recently deglaciated forefield of Unteraargletscher, Switerland, are presented.