Geophysical Research Abstracts,
Vol. 10, EGU2008-A-06246, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-06246
EGU General Assembly 2008

The thermal conductivity related cooling effect of coarse blocks

S. Gruber and M. Hoelzle

Glaciology, Geomorphodynamics & Geochronology, Department of Geography, University of Zurich, Switzerland (stephan.gruber@geo.uzh.ch)

Coarse blocks are a widespread ground cover in cold mountain areas. They have been recognized to exert a cooling influence on sub-surface temperatures in comparison with other types of surface materials and are employed in man-made structures for ground cooling and permafrost protection. The contrast in heat transfer between the atmosphere and the ground caused by thermally driven convection in winter and stable stratification of interstitial air during summer is usually invoked to explain this "thermal diode" effect. Based on measurements and model calculations we propose an additional cooling mechanism that is independent of heat advection/convection and solely functions based on the interplay of a winter snow cover and a layer of coarse blocks with low thermal conductivity. Measurements on and around the rock glacier Murtèl in Switzerland indicate significantly lower temperatures near the snow-ground interface and lower mean annual ground surface temperatures on the coarse blocky surface of the rock glacier than on bedrock nearby, having otherwise similar conditions. At the same time, clear signs of advection of heat by moving air are absent. The thermal conductivity of a block layer with 40% porosity is reduced by about a factor of 10 as compared with solid rock. This explains the lower temperatures and higher temperature fluctuations at the base of the snow cover because the heat conduction through the snow has a higher relative importance as compared to that through the ground. The warming effect of a winter snow cover is widely discussed in the literature and recognized to be caused by a larger thermal resistance of the snow-covered ground during winter than during summer and thus more effective heating than cooling of the subsurface. Here, a layer of coarse blocks reduces this contrast by lowering

the summer time thermal conductivity. Coarse block layers reduce the warming effect of the snow cover and result in a cooling of blocky surfaces in comparison with surrounding areas.