Geophysical Research Abstracts, Vol. 9, 10666, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-10666
© European Geosciences Union 2007

Interactions between air circulation within talus slope and permafrost evolution - results from temperature monitoring and time-lapse electrical resistivity tomography

C. Hilbich (1) and R. Delaloye (2)

(1) Institute for Physical Geography, University of Jena (Christin.Hilbich@uni-jena.de), (2) Geographical Institute, University of Fribourg

Talus slopes are characterised by loosely connected blocky material with a distinct microclimatic air circulation which can favour the formation and preservation of permafrost. Ventilation within the talus slope acts through the porous material depending on the contrast in air temperature between the interior of the scree and the surroundings. As a consequence, the ascent of relatively warm air towards the top of the scree in wintertime facilitates the aspiration of cold air deep inside the talus slope. A gravity discharge of cold air may then occur during summer.

The Lapires talus slope at the foot of the Pointe des Lapires summit (2973 m a.s.l., Valais, Swiss Alps) has been investigated intensively since 1998 in order to map the permafrost distribution and to understand its controlling factors. A borehole drilled in summer 1999 records ground temperatures down to 19.6 m depth. Further information are provided by air temperature and radiation measurements near the borehole location and by BTS, ground surface temperature and electrical resistivity values for the whole talus slope. Air circulation within the talus slope has been evidenced as one of the key factor controlling the permafrost distribution (Delaloye & Lambiel 2005). In August 1998 and 1999 respectively, a comprehensive survey of vertical electrical soundings (VES) and electrical resistivity tomography (ERT) was performed on several sections of the talus slope. Near the borehole and exactly at the position of one of these previously measured ERT profiles, a fixed electrode array was installed in summer 2006 in order to monitor long-term permafrost evolution at this site. Up to now, ERT monitoring data are available for August 1999, August 2006, October 2006, December 2007

and January 2007. Results from this data set clearly illustrate resistivity increase in the upper part of the profile during late autumn and early winter as well as resistivity decrease in the lower parts of the profile. The first is attributed to cooling from above, whereas the latter is assumed to confirm the winter ascending air circulation through the blocky material of the talus slope. Ground truth from temperature monitoring is limited since the zone with resistivity decrease, suggesting warm air circulation, lies below 20 m (maximum borehole depth).

Subsurface temperature evolution since 1999 indicates a remarkable change of temperature range since summer 2003. It is expressed on the one hand by the increase of active layer depth from about 3.7 m before to about 4.5 m after 2003 and, on the other hand, by a permafrost cooling consecutive to the cold ground surface temperature in the winter 2004/05 and 2005/06. Both changes are evident from the ERT measurements.

Continuous monitoring of the electrical and thermal properties of the talus slope is believed to shed additional light on the processes responsible for this unique interaction between microclimatic circulation, ground ice occurrences and its temporal evolution.

Delaloye, R., Lambiel, C. (2005). Evidence of winter ascending air circulation throughout talus slopes and rock glaciers situated in the lower belt of alpine discontinuous permafrost (Swiss Alps). Norwegian Journal of Geography, 59/2, 194-201.