Geophysical Research Abstracts, Vol. 9, 09884, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-09884

Geophysical 2D and 3D-monitoring of permafrost in rock walls

M. Krautblatter (1), C. Hauck (2), S. Wolf (3)

(1) University of Bonn, Germany, (2) Institute for Meteorology and Climate Research, Karlsruhe, Germany (3) University of Erlangen, Germany, (michael.krautblatter@giub.uni-bonn.de / Fax: +49 (0)228 739099 / Phone: +49 228 739098)

Spatial information on the distribution of rock permafrost is crucial for the assessment of permafrost degradation in steep environments and is a prerequisite for stability analysis of permafrost rocks. Besides temperature logger data, borehole information and rock temperature modelling approaches, geophysical applications provide a new tool for the spatial analysis of rock permafrost. The applicability of ERT and refraction seismics to rock permafrost was tested in 2005/2006 at the Steintälli (3050-3150 m a.s.l., Matter/Turtmann-Valley, Switzerland). Mean surface layer resistivities of transects were calibrated in summer/autumn 2005. They respond to air temperatures below 0˚ C with a rapid increase by a factor of 1.4 to 2.9 from values of 11.8 – 15.0 kΩm (unfrozen) to values of 21.6 – 30.7 kΩm (frozen). Repeated 2D-ER-tomographies were recorded at four transects (NE, NW, E and S) in the Steintälli in 2005 and 2006 and document shifts of the freezing front in response to short-term (weekly) and mid-term (seasonal) temperature paths. Permanently frozen bodies are only apparent in the NW, NE and E Transect while only transitionally frozen bodies occur in Transect S. Maximum seasonal thaw depth above permafrost is about 6 m, while deep-reaching cleft water systems appear to be persistently thawed. In 2006 a 3D-array consisting of 5 N-S-trending 2D-transects was additionally installed. The 3D-array was measured repeatedly applying ER-tomographies, P-wave and S-wave refraction seismics. ERT provides basic information on 3D-distribution of frozen rock bodies while P-wave and S-wave seismics yield additional information on properties of frozen and unfrozen rock. The potential and problems of a combination of ERT and refraction seismics for quantitative modelling of ice-content (“4-phase model” according to Ch. Hauck) will be discussed. ER-tomographies in frozen carbonate rocks at the Zugspitze (2800-2962

m a.s.l., Germany) in 2006/2007 display significantly different patterns of frozen rock distribution, which will be compared to those found in gneissic siliceous rocks at the Steintälli study site. The results of the geophysical 3D monitoring of rock permafrost confirm basic findings of rock permafrost models, but emphasize the role of local heat transfer in water-filled clefts. Possible improvements for measurement and modelling of rock permafrost will be addressed briefly.