Geophysical Research Abstracts,
Vol. 10, EGU2008-A-10455, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-10455
EGU General Assembly 2008

Thawing regime and response time of present-day and relict bedrock permafrost revealed by monthly geophysical monitoring (Zugspitze, German/Austrian Alps)

M. Krautblatter, S. Verleysdonk

Institute of Geography, University of Bonn, Germany (michael.krautblatter@giub.uni-bonn.de / Fax: +49 228 739099 / Phone: +49 228 739098)

It is generally acknowledged that thawing of rock permafrost during summer is a key factor for the preparation and detachment of permafrost-related rockfalls. Previous studies have demonstrated that warm summers correspond to a high frequency of permafrost-related rockfalls. However, these studies provided evidence that the culmination of rockfalls in early summer 2003 did not coincide with maximum thaw depth that is not accomplished until late summer 2003. This underlines the importance of a temporally highly-resolved understanding of thaw line propagation in permafrost rocks. The observed Zugspitze limestone rock wall section is especially instructive due to the presence of karstic features and cleft water flow adjacent to a permafrost body. Moreover, the availability of continuous meteorological data since 1900, and observations of ice extension inside the galleries since 1928 in combination with the recently drilled rock permafrost borehole provide insight into longer-term temporal behaviour of rock permafrost.

ERT-measurements were conducted in February, May, June, July, August, September and October along 4 transects in galleries adjacent to the Zugspitze North Face at about 2800 m a.s.l.. We applied high-resolution 2D-arrays with up to 1100 datum points for each transect including Wenner, Schlumberger, Gradient and Dipole type arrays. In addition P-wave refraction seismic was measured in June and July and discontinuity parameters were assessed. The time sections are compared using time-lapse inversion

methods. Rock wall temperature loggers in a side gallery at 2.5m, 5m, 10m, 15m and 20m from the North face provide hourly temperature values corresponding to the ERT-tomographies.

The monthly tomographies and temperature data presented here show seasonal fluctuations surrounding a 20 m * 40 m permafrost lens that extends at a distance of 10 m from a vertical north face section of the Zugspitze at 2800 m a.s.l.. Fractured zones with higher cleft water permeability seem to have a significant impact on permafrost distribution and are held responsible for the lateral extent of the permafrost lens. The favourable conditions in winter 2006/2007 were observed to strengthen the permafrost lens in terms of size and temperature. Moderate summer temperatures only resulted in a thaw depth of about 5 m in the core area in August/September 2007. Spatial and temporal variations in the propagation and regression of the freezing line were observed to influence spatio-temporal shifts of the permafrost core area. Response times to repeated rock surface cooling and warming were observed directly by ERT transects in side galleries perpendicular to the north face and are referenced by rock temperature measurements.

These measurements are prone to contribute to the systemic and spatial understanding of sensible, latent and advective heat propagation in permafrost-affected bedrock. Measurements in galleries 300-400 m below the Zugspitze summit (2962 m a.s.l.), provide some evidence that relict permafrost, decoupled from present-day thermal regimes, may also exist in the core of the Zugspitze rock summit.