Name of research institute or organization:

Laboratory of Hydraulics, Hydrology and Glaciology (VAW), ETH Zürich

Title of project:

Permafrost temperature monitoring in alpine rock walls

Project leader and team

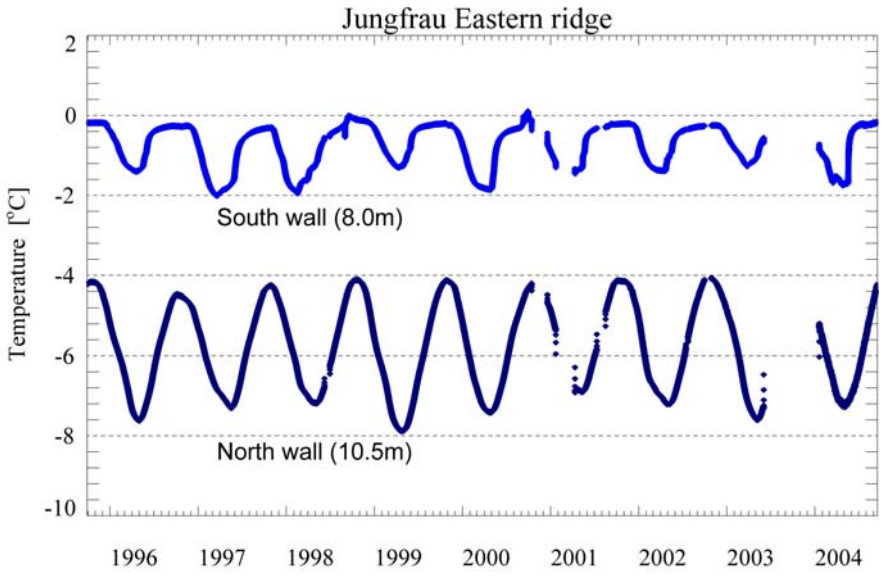
Prof. Martin Funk, project leader
Dr. Tetsuo Sueyoshi

Project description:

Monitoring of the response of the permafrost to the climate change is of special interest, because progress of the thaw in the mountain permafrost has the correlation with the stability of steep slopes and rock faces.

Due to the effect of radiation and water content, rock temperature in high mountain area has the wide range of local variability, strongly depending on the topography. As a result, distribution of mountain permafrost can only be estimated by the empirical rules and parameterizations. The actual measurement has the importance, therefore, not only for understanding of the current condition but also for the verification of such estimation.

Since 1995 temperature and deformation of the rock wall have been observed continuously at the tunnel in the eastern ridge of Jungfrau. Two 20m-deep boreholes are drilled outwards from the inner tunnel, on both of north and south sides of the ridge, in which 8 thermistors and 6-point extensometers are installed. These measurements are unique for having deep borehole in the rock wall of high Alps and measuring both of north and south wall of the same ridge.



Temperature variations of ca. 10m-depth (from the surface of rock wall) thermistors are shown in the figure. It has a distinct difference in temperature between north and south. North wall has the lower value of temperature and the larger amplitude of

seasonal variation. Cause of the difference in amplitude is considered to be the effect of water content (i.e., latent heat in freezing and thawing). Larger snow accumulation during winter produces more water content on the south wall. Noteworthy on the south wall data is that the maximum temperature is close to zero, and it sometimes even exceeds freezing point at 10m depth. This means that the thaw depth can be as deep as 10m, which may cause an instability of the wall to a large extent.

In 2004, many efforts were devoted for maintenance of damaged devices and installation of the new thermistor chains. Datalogger and extensometers were severely damaged by an enormous lightning event in July 2003. Since thermistor chains were not damaged, temperature measurement was restarted in January 2004 after the replacement of the datalogger, but the deformation measurement was terminated. Using the old boreholes for extensometers, new thermistor chains were prepared and installed in October 2004 in both of north and south sites. Because the old thermistor chain is buried in the rock (i.e., not be able to re-calibrate), newly-installed thermistors will be used for the cross-check of measured value by the old chain.

Key words:

permafrost, temperature, rock wall, borehole, climate change

Internet data bases:

http://www.unibas.ch/vr-forschung/PERMOS/

Scientific publications and public outreach 2004:

Data books and reports

Vonder Müll, D., J. Nötzli, K. Makowski, and R. Delaloye, Permafrost in Switzerland 2000/2001 and 2001/2002, Glaciological Report (Permafrost) No. **2/3**.

Address:

Versuchsanstalt für Wasserbau, Hydrologie und Glaziologie (VAW),
Gloriastrasse 37/39 ETH Zentrum CH-8092 Zürich, Switzerland

Contacts:

Tetsuo Sueyoshi
Tel.: +41 1 632 4123
Fax: +41 1 632 1129
e-mail: sueyoshi@vaw.baug.ethz.ch
URL: http://www.vaw.ethz.ch/people/gz/tetsuos