Name of research institute or organization:

Versuchsanstalt für Wasserbau, Hydrologie und Glaziologie (VAW), ETH Zürich

Title of project:

The Polythermal Structure of Gornergletscher (Valais)

Project leader and team:

Prof. Martin Funk, project leader
Dr. Martin Lüthi, Dr. Andreas Bauder, Claudia Ryser

Project description:

The Gorner-/Grenzgletscher system is located in vicinity of Zermatt. It is the largest polythermal ice mass in the Alps. A glacier is called polythermal if zones of temperate ice at the pressure melting temperature (PMT) coexist with zones of cold ice below the PMT. The ice masses are separated by the cold-temperate transition surface (CTS).

In alpine glaciers a polythermal structure is restricted to glaciers with a high elevation accumulation area. In the case of Grenzgletscher the accumulation area on Colle Gnifetti and Seserjoch is located 4500m a.s.l..

The tongue of Grenzgletscher has long been famous for its blue meltwater lakes and a persistent network of melt water streams in the lower ablation area, which indicate impermeable cold ice close to the surface. Such deeply incised melt water streams are not found on any other glacier in the Alps.

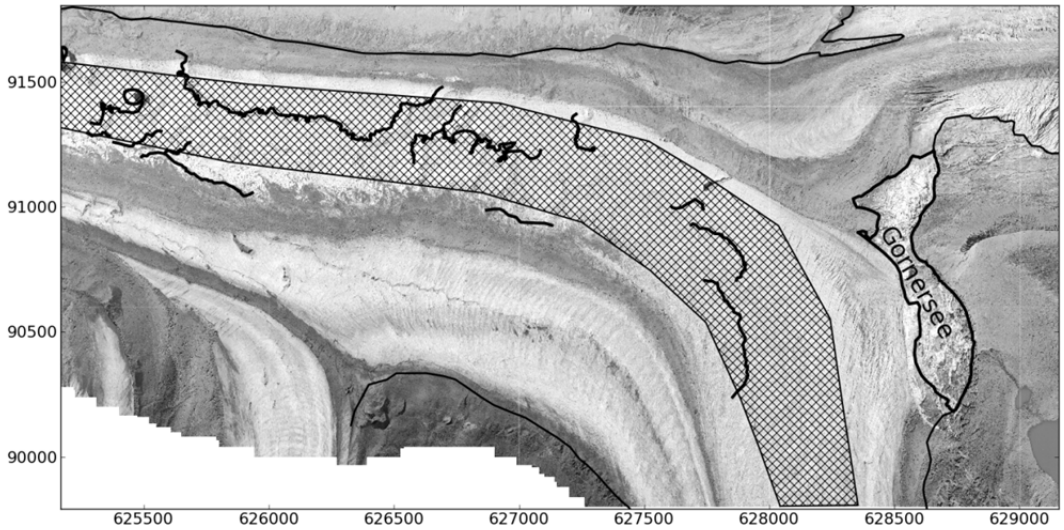

Fig. 1: Hashed area: Spatial extent of the cold ice in Grenzgletscher determined by airborne ice radar in 2008. Highlighted are the deeply incised meltwater streams.

Knowledge of the thermal structure of glaciers is crucial for modeling their future evolution, as temperature strongly influences ice viscosity, and therefore ice deformation patterns and mass flux. In addition, zones of cold ice affect glacier hydrology by blocking meltwater fluxes, which are limited to discrete flow paths in cracks and channels. Due to the impermeability of fracture-free cold ice, deeply incised and persistent melt water streams and lakes at the glacier surface are indicators for cold ice.

To measure ice temperature several boreholes were drilled already in the years 2005 to 2008. To get a detailed picture of the thermal structure of Grenzgletscher and especially of the location of the CTS three more boreholes were drilled in summer 2010. The measurements are still in progress.

Key words:

Gornergletscher, thermal structure, cold and temperate ice

Internet data bases:

http://www.vaw.ethz.ch/people/gz/funk/projects/data/gz_142_outburst_glacierdammed_lake

Scientific publications and public outreach 2010:

Refereed journal articles and their internet access

Riesen, P., Sugiyama, S and Funk, M., The influence of the presence and drainage of an ice-marginal lake on the ice flow of Gornergletscher, Switzerland. Journal of Glaciology, **56(196)**, 278-286, 2010.
http://www.igsoc.org/journal/56/196/t09J112.pdf

Roux, P.F., Walter, F., Riesen, P., Sugiyama, S and Funk, M., Observation of surface seismic activity changes of an alpine glacier during a glacier-dammed lake outburst. Journal of Geophysical Research, **115(F3)**, F03014, 2010, DOI:10.1029/2009JF001535.
http://dx.doi.org/10.1029/2009JF001535

Sugiyama, S., Bauder, A., Riesen, P. and Funk, M., Surface ice motion deviating toward the margins during speed-up events at Gornergletscher, Switzerland. Journal of Geophysical Research, **115(F3)**, F03010, 2010, DOI:10.1029/2009JF001509.
http://dx.doi.org/10.1029/2009JF001509

Walter, F., Dreger, D.S., Clinton, J.F., Deichmann, N. and Funk, M., Evidence for near-horizontal tensile faulting at the base of Gornergletscher, a Swiss alpine glacier. Bulletin of the Seismological Society of America, **100(2)**, 458-472, 2010.
http://bssa.geoscienceworld.org/cgi/content/abstract/100/2/458?stoc

Werder, M.A., Schuler, T.V. and Funk, M., Short term variations of tracer transit speed on alpine glaciers. The Cryosphere, **4**, 381-396, 2010.
http://www.the-cryosphere.net/4/381/2010/tc-4-381-2010.html

Theses

Ryser, LC., The Polythermal Structure of Grenzgletscher, Valais, Switzerland, PhD Thesis, ETH Zürich, 2009.

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