

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:

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Project description:

The Gorner-/Grenzgletscher system in the vicinity of Zermatt 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 at 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.

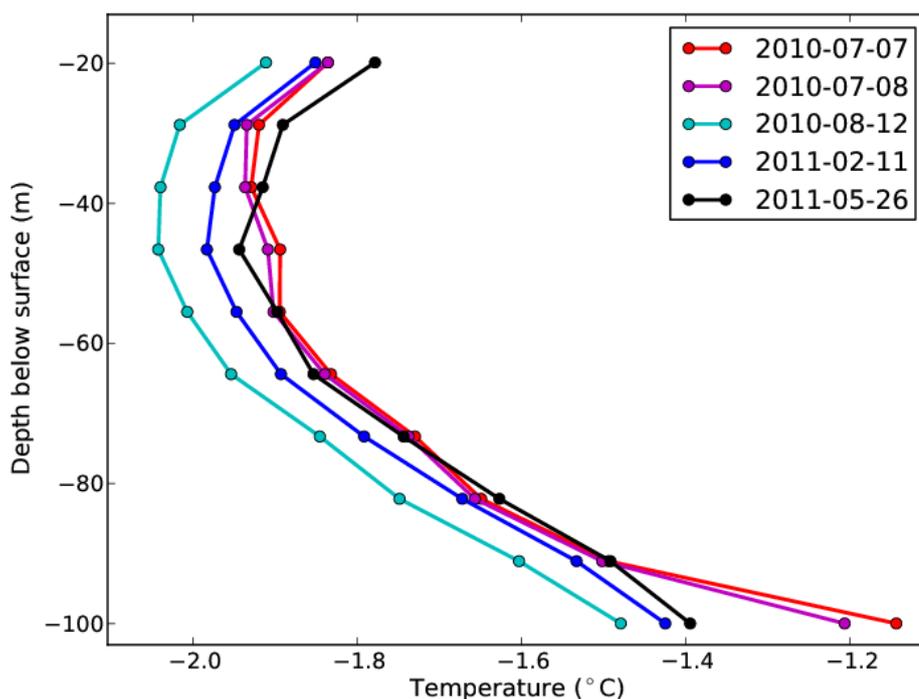


Figure. Measurements of temperature profiles in a borehole drilled in 2010. In the year of drilling the ice temperature is cooling down after the disturbance from drilling. Then the ice becomes warmer due to heat advection and 3D flow effects.

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. In that sense, Grenzgletscher is representative for many glaciers in the Arctic as well as the Greenland Ice Sheet, but with the advantage of easy accessibility.

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/archive/gz_142_outburst_glacierdammed_lake

Scientific publications and public outreach 2011:

Refereed journal articles and their internet access

Riesen, P., Strozzi, T., Bauder, A., Wiesmann, A. and Funk, M. Short-term surface ice motion variations measured with a ground-based portable real aperture radar interferometer. *Journal of Glaciology*, 57(201), 53-60, 2011.

<http://www.ingentaconnect.com/content/igsoc/jog/2011/00000057/00000201/art0000>

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Theses

Riesen, P. Variations of the surface ice motion of Gornergletscher during drainages of the ice-dammed lake Gornersee. Technical Report 216, Mitteilungen der Versuchsanstalt für Wasserbau, Hydrologie und Glaziologie der ETH Zürich. ETH PhD no. 19642, 2011.

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