

Seismic activity during Gornersee jökulhlaups of summers 2004 and 2006

Fabian Walter*, Nicholas Deichmann**, Martin Funk*, Andreas Bauder*, Shin Sugiyama*** & Mauro Werder*.

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

**Schweizerischer Erdbebendienst, ETH Zürich, Switzerland

***Institute of Low Temperature Science, Hokkaido University

As part of a glaciological study to investigate the jökulhlaups of Gornersee, a glacier-dammed lake in the Swiss Alps, passive seismic measurements were conducted. The goal is to link the seismic activity to the lake drainage. This will offer new insights into the relationship between glacier hydrology and the ice dynamics related to the drainage process. Since the lake drains within the glacier or at its bed, deep seismic sources are of particular interest.

Every spring, Gornersee is formed by surface meltwater at the confluence of Gornergletscher and Grenzgletscher. In the following summer, the entire volume (on the order of 10^6m^3) drains within a few days, typically in June or July, producing peak discharges of about $20\text{-}50\text{m}^3/\text{s}$. Whereas more dramatic examples of jökulhlaups exist, the Gornersee is particularly suitable for a study, due to its accessibility and regular yearly drainages. The VAW has been conducting comprehensive field studies in the summers 2004, 2005 and 2006 in order to investigate the physical processes involved in the lake drainage (for an overview map see abstract of Werder et al., Gorner jökulhlaups: Results of the field campaigns 2004-2006). This study has a hydrological (tracer, glacial water pressure and temperature, lake dynamics), a dynamic (inclinometers, surface velocity measurements, flow modelling), a climatic (local weather station, mass balance measurements, melt modelling) and a seismic component (active and passive). Furthermore, lake and glacier geometries have been investigated via radar and photogrammetry techniques.

Up to several thousands of icequakes per day were recorded with seismic networks consisting of between 14 and 24 three-component seismometers, all located on or inside the glacier ice. Only a small fraction of these are due to deep sources. The source times of icequakes belonging to clusters near the glacier bed were compared to basal water pressures measured in boreholes. Our analysis suggests that these basal clusters are particularly active during times of low water pressure.