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Rock avalanche dating in the Valais, Switzerland

Dr Tim Sands, University of Hertfordshire

The Saaser Vispa valley in the Valais, Switzerland, is a deglaciated valley in the Alps that has been affected by ancient rock avalanche (Bergsturz) events, see Figure 1. These rock avalanches have mainly occurred on west facing valley sides, due to rockslides along discontinuities within mica schists dipping at around 40º into the valley. The avalanches have modified the steep glaciated 'U shape' valley side into less steep slopes that have enabled forestry and pastures for cattle. The avalanche deposits have been colonised by vegetation including larch trees *Larix decidua*. The avalanches are probably due to paraglacial adjustment following deglaciation of the valley. The removal of glacial ice buttressing and resulting stress relief cause discontinuities to open, into which snowmelt and rainwater initiate weakening of the steep rock slopes until catastrophic failure occurs, resulting in rockslides and avalanches. It is probable that the rockslides have occurred within the last several thousand years. Lichenometry and dendrochronology are being used to estimate the age of the rock avalanche deposits.

Figure 1. The Saaser Vispa glaciated valley (middle of photograph), with steep U shaped slopes on LHS and less steep V shaped slopes on RHS, made of four old rock avalanche deposits covered in trees, with rockslide scars above.

Background

Dendrochronology and lichenometry can be used to date the exposure of fresh rock surfaces following events such as rock avalanches (Deline & Kirkbride, 2008). However, the time lag between exposure and colonization by trees and lichens may be unknown. Dendrochronology has been used to determine a 7,000 year oak chronology and the lichen *Rhizocarpon geographicum* can grow for thousands of years (Lowe & Walker, 1997). Dating of the exposure of fresh rock surfaces can be estimated using lichen growth curves, where the diameters of the largest lichens are plotted against substrate exposure of known age, e.g.: known glacier recession. Lichen growth is affected by: latitude, altitude, temperature, day length and snow cover, therefore growth curves are specific to an area.

The 1991 Randa rockslide in the nearby Matter Vispa valley, totalling nearly 30 million m3 of avalanche debris (Sartori et al., 2003), highlights the risk of further avalanches in the Saaser Vispa valley and it is therefore important to determine the age of these events.

Aims and Objectives

The aim of the research is to use dendrochronology and lichenometry to date the rock avalanches. The objectives include producing a lichenometry growth curve using known glacial retreat of the Feegletcher, Saas Fee (Curry, Sands & Porter, 2009) and using this to date the lichens growing on the avalanche deposits.

Methodology

The known retreat of the nearby Fee glacier has been used to date substrate exposure and correlated with dendrochronology and lichenometry to determine lag times. The diameters of the 5 largest *Rhizocarpon geographicum* were measured on each substrate of known exposure age and the averages plotted.

Results and Discussion

Tree ring data show lag times of a few years, however the oldest larch trees on rock avalanche deposits are rotten inside and of limited use. The original trees may have been felled for use as building materials or fuel. Lichens are not directly affected by anthropogenic activities, but larch needle drop may cover them and reduce growth rates. Lichen growth rates appear to reach a constant, at an average of around 0.20 mm/year, see Figure 2. Results indicate that some avalanche deposits are probably at least 500 years old.

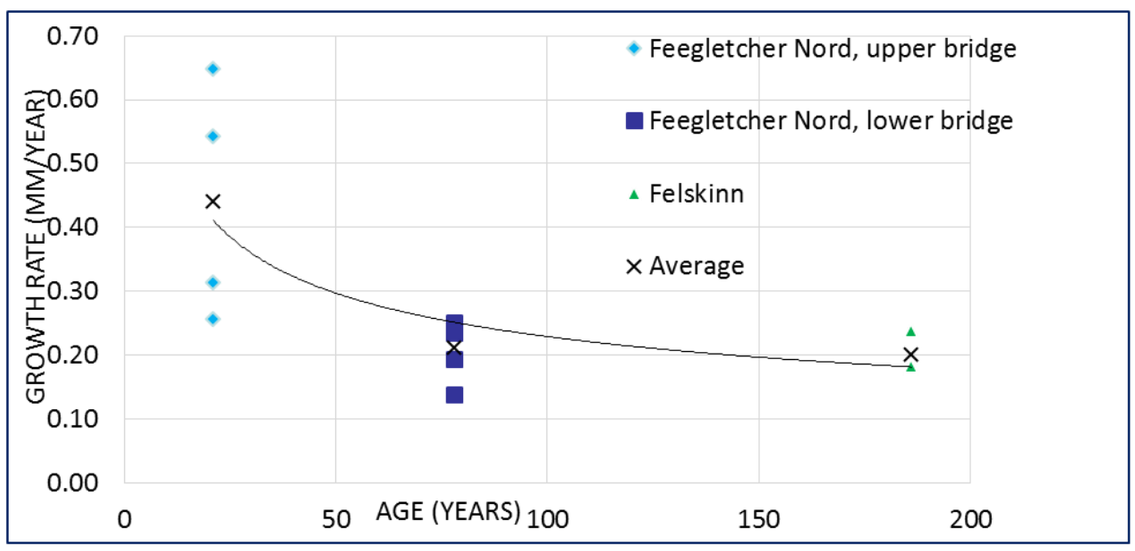

Figure 2. Growth rates for *Rhizocarpon geographicum* using glacial retreat of Feegletscher Nord.

Conclusions

Dendrochronology has been found to have limitations, whereas lichenometry may prove more reliable. Tree and lichen selection is critical to obtain the oldest specimens, but newer processes may obscure the age of the avalanche event.

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