Frost-cracking experiments on samples collected across a shear zone

Cyril Zurbrügg, Marco Herwegh, Flavio Anselmetti and Ferdinando Musso Piantelli

Institute of Geological Sciences, University of Bern, 3012 Bern, Switzerland

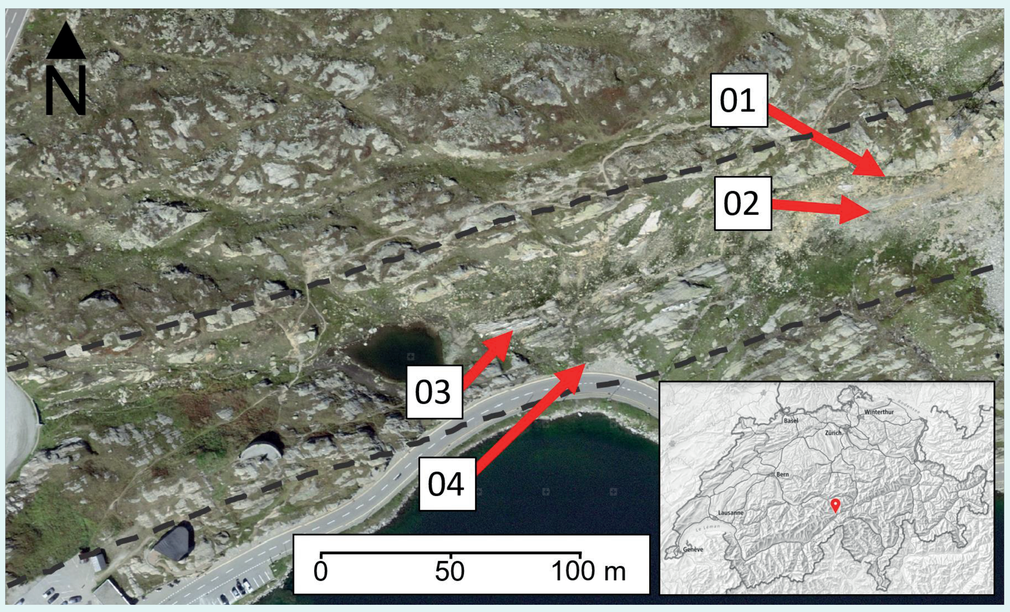
Introduction and aims

Frost-wedging counts as a physical weathering process, which mostly occurs in cold and humid climate with freeze-thaw cycles. It is a critical process that affects rock-slope stability by fracture propagation through rock bridges. This can result in sediment production or in a large scale even rockfalls (Musso Piantelli et al., 2020). The understanding of frost-wedging processes is important to know where and under which conditions it can lead to larger events.

Here we want to look at the microscale of the frost-wedging process. So, this study is designed to experimentally investigate microfracture propagation of frost-cracking in tectonites with variable deformation. Therefore, the crack propagation along a strain gradient through a shear zone (granite-ultramylonite) will be measured over multiple freeze-thaw cycles.

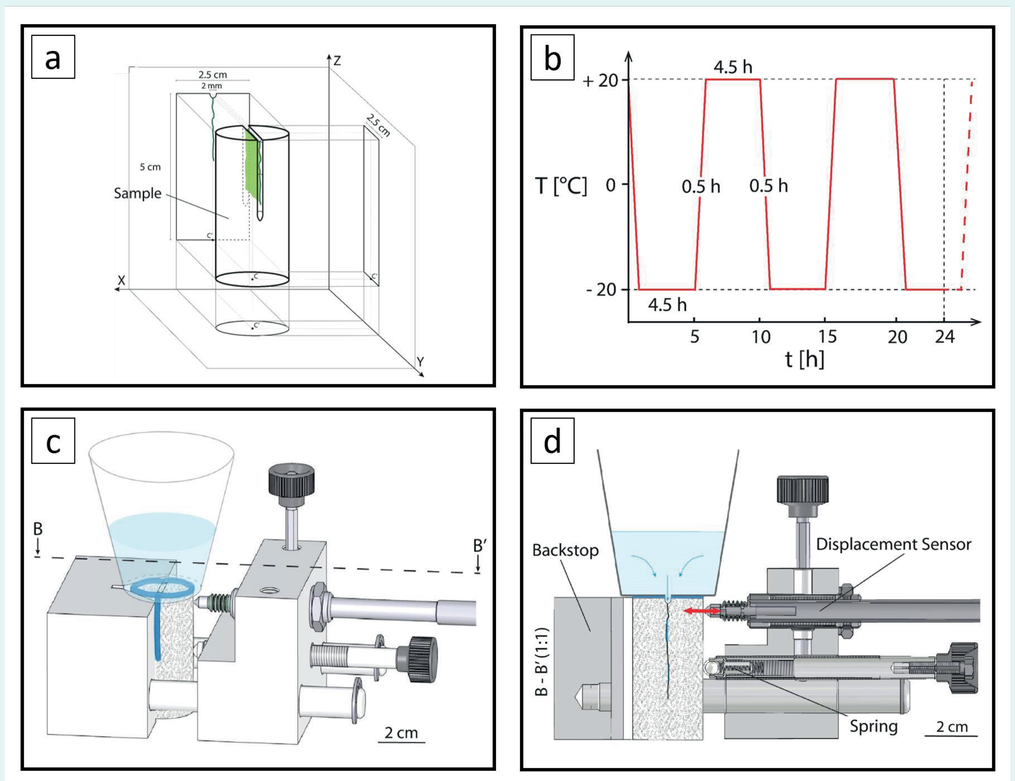
Field site

The samples for this study were collected from a shear zone on the Grimselpass. Here we have a shear zone with a granitic protolith and a strain gradient from north to south.



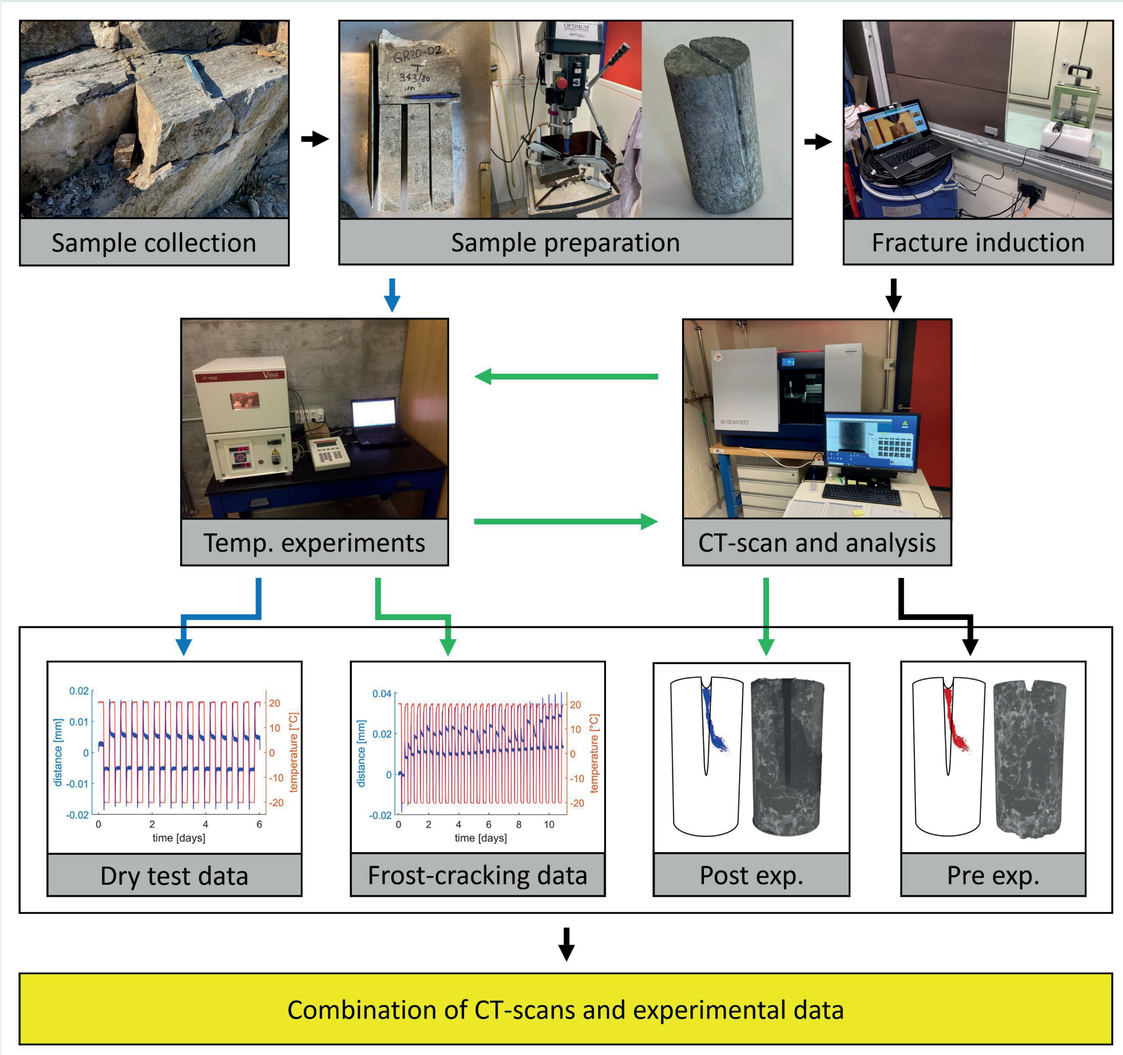
Grimselpass shear zone (between the two dashed lines) with locations of samples: 01 granite, 02 ultramylonite, 03 mylonite and 04 gneiss.

Experimental design



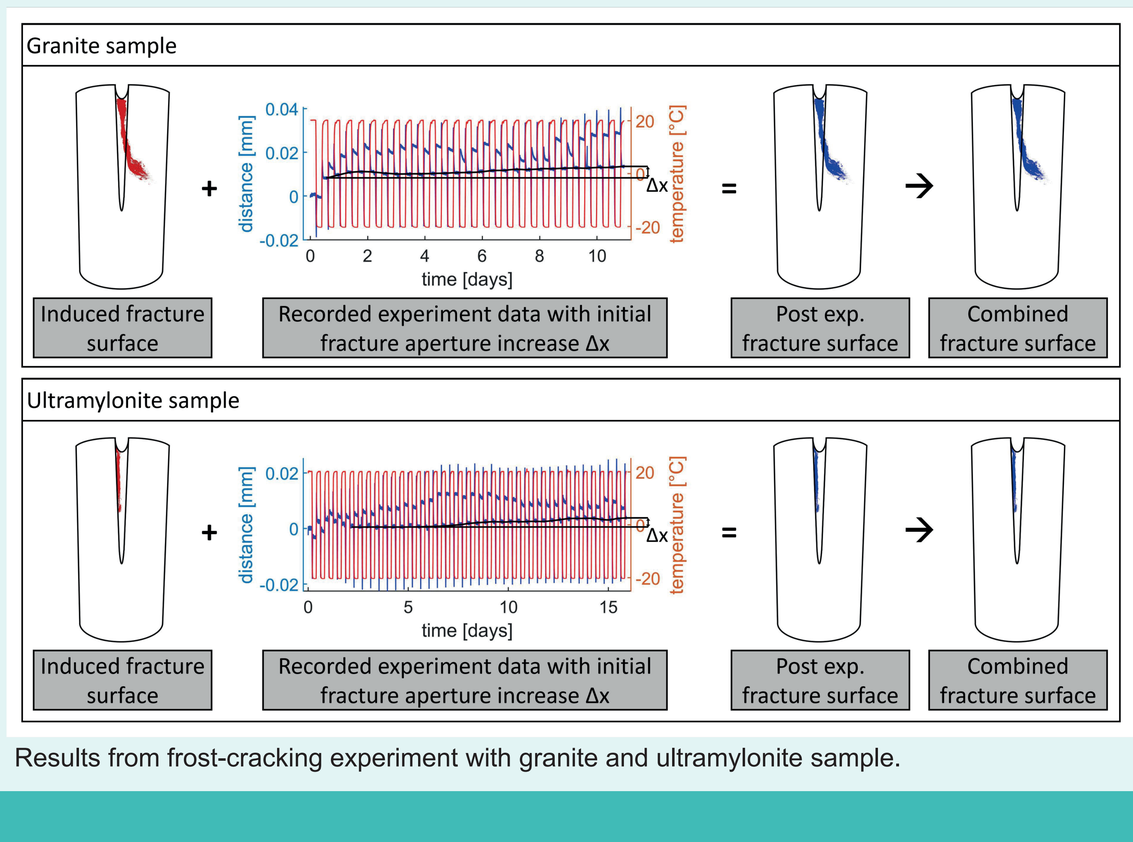
Experimental design with: a) specimen proportions, b) freeze-thaw cycle temperature curve, c) 3D technical drawing of experimental setup and d) B - B' cross section of technical drawing (Musso Piantelli et al., 2020).

Workflow



Workflow diagram for frost-cracking experiment and evaluation.

Results



Results from frost-cracking experiment with granite and ultramylonite sample.

Conclusion and outlook

By analysing the data of the first experiments, there can be expected a small fracture length increase because of the initial aperture increase. Still there is no propagation visible in the CT-scans, which means that the propagation is beyond the CT-resolution.

This study will be continued with further experiments. First the water infiltration method into the sample will be improved to have a total saturation of the fracture from the beginning of the experiment. Then the samples are run through further freeze-thaw cycles and the results will again be analyzed.

References and acknowledgements

Musso Piantelli, F., Herwegh, M., Anselmetti, F.S., Waldvogel, M., and Gruner, U., 2020, Microfracture propagation in gneiss through frost wedging: insights from an experimental study: Natural Hazards, v. 100, p. 843–860

I would like to thank Pierre Lanari for his support with the CT-scans and David Mair for his advice on the choice of the new temperature chamber.