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# Simulation and field monitoring of moisture in alpine rock walls during freeze-thaw events

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Detachment of rock fragments from alpine rockwalls is mainly assigned to frost weathering. However, the actual process of frost weathering as well as the contribution of further weathering processes (e.g. hydration, thermal fatigue) is poorly understood. Rock moisture distribution during freeze-thaw events is key to understanding weathering.

For this purpose, different measuring systems were set up in two study areas (Dachstein – permafrost area (2700m a.s.l.) and Gesäuse – non permafrost area (900m a.s.l.), Styria, Austria) within the framework of the research project ROCKING ALPS (FWF-P24244). We installed small-scale 2D-geoelectric survey lines in north and in south facing rockwalls, supplemented by high resolution temperature and moisture sensors. Moisture is determined by means of resistivity measurements which are difficult to calibrate, but provide good time series. Additional novel moisture sensors were developed which use the heat capacity of the surrounding rock as a proxy of water content. These sensors give point readings from a defined depth and are independent from soluble salt contents. Pore water pressure occurring during freeze-thaw events is recorded by means of pressure transducers (piezometers). First results from the Dachstein show that short term latent heat effects during the phase change have crucial influence on the moisture content.

These results are cross-checked by simulation calculations. Based on meteorologic and lithologic input values, the simulation routine calculates, in an iterative procedure, the hourly energy and water transport at different depths, the latter in the liquid and in the vapor phase. The calculated profile lines and chronological sequences of rock moisture allow – in combination with temperature data – to detect possible periods of active weathering. First simulations from the Gesäuse show that maximum values of pore saturation occur from May to September. The thresholds of the “classical” frost shattering theory (high number of freeze-thaw cycles and 90% pore saturation) are achieved predominantly in spring and autumn and in north-facing rock walls. The time spent within the effective “frost cracking window” (-3 - -8°C) is also higher for north-facing sites.