The role of freezing-thaw cycling in rock samples topography evolution and rock cliff retreat

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Freezing-thaw weathering is recognized as one of the most significant factors in the fatigue of rock mass in areas where the temperature periodically fluctuates around the freezing point.

A one-year monthly SfM monitoring program from December 19, 2019, to January 7, 2021, was done to detect rockfall activity on a rockslide cliff composed of marl-sandstone at La Cornalle, Switzerland. More than one hundred rockfall events were detected during this period with the volumes varied from $0.005m^3$ to $4.85m^3$.

We texture all the rockfalls on the 3D SfM model. It is shown that most of them are mainly located in three areas: the top of the cliff, the foot of the cliff, and the medium-left part of the cliff. The common feature of these three parts is that the layers are more or less overhanging with dense fractures around them. At the same time, the meteorological data collected by a weather station on site is correlated with the rockfall events to figure out the relationship between each other. Actually, about 30% of total rockfall volume fell during winter on this site. The triggering factor of rockfall during winter is related to freezing-thaw cycling. This kind of weathering can be understood as an interplay between rock properties and its dynamic environment.

In order to make clear the role of freezing-thaw played on the rockfall generation, an on-site 24h monitoring measurement program that consists of two crack meters, one rock thermal sensor, and thermal camera monitoring is installed in January 2021. Those datasets will help to understand how the crack grows with the changing temperature. In addition, freezing-thaw cycling laboratory experiments for the rock samples taken from different areas of the cliff will be done with an environmental test chamber. The topography of the rock samples before and after the experiments will be acquired by a 3D handheld scanner. This work will benefit to reveal the rock surface evolution during the freezing-thaw cycling in a dynamic environment with varied humidity and number of cycles.

In conclusion, the combination of on-site measurements and laboratory freezing-thaw experiments will provide a good basis for a better understanding of the rockfall triggering mechanism led by physical weathering.