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Small scale tests on the progressive retreat of soil slopes

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In this paper, the influence due to the presence of cracks on the morphologic evolution of natural cliffs subject to progressive retreat induced by weathering is investigated through small scale laboratory tests. Weathering turns hard rocks into soft rocks that maintain the structure of the intact rocks, but are characterised by higher void ratios and reduced bond strengths; soft rocks are transformed into granular soils generally called residual soils. A number of landslides develop in slopes due to weathering which results in the progressive retrogression of the slope face and the further degradation within the weathering zone. Cracks, that are widely present, can be a result of weathering and they can cause a significant decrease in their stability, as they provide preferential flow channels which increase the soil permeability and decrease the soil strength.

The geological models employed until now are mainly empirical. Several researchers have tried to study the stability of slopes through experimental procedures. Centrifuge modelling is widely used to investigate the failure of slopes. Small scale tests are also an important approach, in order to study the behaviour of a slope under certain conditions, such as the existence of water, as they allow the observation of the infiltration processes, the movement of the weathering front, deformation and failure. However, the deformation response of a slope subject to weathering is not yet thoroughly clarified.

In this work, a set of experiments were conducted to investigate weathering induced successive landslides. Weathering was applied to the slope model by wetting the slope crest through a rainfall simulator device. The moisture content of the soil during the tests was monitored by soil moisture sensors that were buried inside the slope model. High resolution cameras were recording the behaviour of the slope model. GeoPIV was used to analyse the frames and obtain the deformations of the slope model during the tests. After a short time of rainfall, vertical cracks appear in the slope model and significant vertical deformations start to occur around the crack, until the first failure is reached, the procedure carries on until a second failure is observed. Experimental results indicate that there is a strong connection between moisture content and the occurrence of a landslide. A prediction model of slope failures can be introduced based on the observed moisture content response of the slope models.

KEYWORDS: slopes, cracks, landslide, weathering, small scale test