
Experimental investigation of dissolution patterns created by a free-surface runoff flow

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Erosion by dissolution is in addition of mechanical erosion, an important process shaping small-scale landscape morphology [1]. On the surface of soluble rocks like gypsum, salt (halite) or limestone, characteristic patterns known as Rillenkarren can be observed, when the dissolving surface is inclined and subjected to a thin run-off flow usually fed by rain. On different natural examples, rock surface is incised by nearly parallel channels (rills) directed along the main slope like the runoff flow. These channels present also a regular wavelength in the transverse direction. This common shape with different materials, suggests a physical mechanism at play. Nevertheless appearance of this pattern remains incompletely understood to our knowledge [2]. Only one experimental simulation has been reported by Glew and Ford in 1980 [3], presenting few experiments with gypsum under rain, without hydrodynamics flow characterization or dynamic measurement of the eroded solid surface. A modelling approach was carried out by Perne in 2009 [2], but simulations of the model fail to produce Rillenkarren patterns.

We perform new experiments on dissolution patterns produced by a runoff water flow on an inclined solid and soluble surface. This flow can be generated by a homogeneous artificial rain or by a water flowing film of controlled flow rate. As we expect that a general physical mechanism can explain the observed shapes, we use materials whose dissolution speed with water is large. 3D shape of the eroded surface will be quantitatively reconstructed a different steps during the dissolution process. Finally, we will discuss if the characteristic length scale can be predicted by a simple linear stability analysis.



Figure 1. (left) Rillenkarren on gypsum in Vaucluse, France. (Credits <http://planet-terre.ens-lyon.fr/>).

(right) Rillenkarren on halite in Valle de la Luna, San Pedro de Atacama, Chile.

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