Toy-model for the formation of rillenkarren by rainfall

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Rillenkarren are dissolution features, adorning the inclined faces of bare soluble rocks, *e*.g. limestone or gypsum, appearing as an array of regularly-spaced grooves along the incline (fig. 1a). A compelling viewpoint on their formation is that of the raindrop statistics conspiring to carve a coherent structure [1]. We suggest that the transverse pattern would then be owed only to the anisotropy, caused by the incline, of the drops' dissolution "fingerprints" and to a simple steepest-descent-like coupling between raindrop paths and substrate morphology.

We propose a numerical experiment, in which a unique shape is arbitrarily chosen to encode the effect of a drop rolling down the soluble surface. One by one, random impact positions are drawn uniformly and raindrop sizes drawn from Marshall and Palmer's distribution (1948) [2] ; the fingerprint shape is rescaled according to the drop's size and remapped along the path of steepest descent from the impact point. These basic ingredients appear as sufficient for the seeked transverse pattern to emerge (fig. 1b).

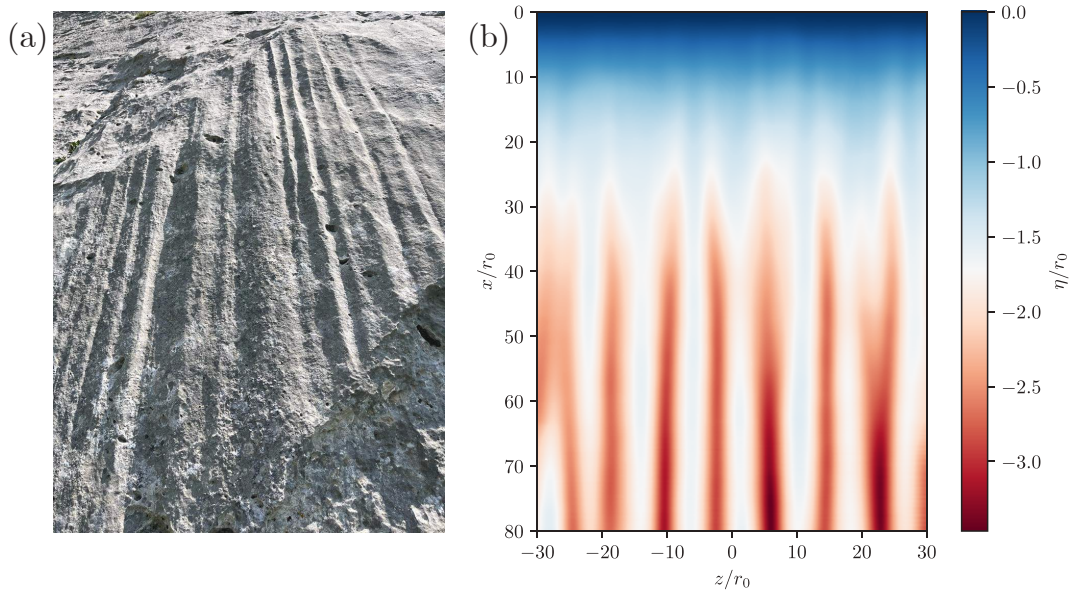

Figure 1. (a) Natural rillenkarren near *La Dent d'Oche* in the Chablais Alps. (b) Surface topography η after 2×10^5 impacts or around 100 h under a rainfall of 3.6 mm/h. Distances are rescaled by the mean raindrop radius $r_0 \approx 0.2$ mm for the same rainfall rate. Here, the solubility is that of gypsum, meaning that each drop can dissolve 10^{-3} of its volume from the solid.

Références

1. J. R. Glew and D. C. Ford, *Earth Surface Processes*, **5**, 25–36 (1980).
2. J. S. Marshall and W. M. Palmer, *Journal of Meteorology*, **5**, 166 (1948).