SCALE SELECTION IN COLUMNAR JOINTING: INSIGHTS FROM STEARIC ACID EXPERIMENTS AND NUMERICAL SIMULATIONS

A. Christensen[1], C. Raufaste[2], M. Misztal[1], F. Celestini[2], M. Guidi[1], C. Ellegaard[1] & J. Mathiesen[1]
[1]*The Niels Bohr Institute, University of Copenhagen, Denmark*
[2]*CNRS, Université Nice Sophia Antipolis, France*

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Many natural fracture systems are characterized by a single length scale, which is the distance between neighboring fractures. Examples are mudcracks and columnar joints. In columnar jointing the origin of this scale has been a long-standing issue. Here we show that the diameter of columnar joints is a non-trivial function of the elastic and thermal parameters of the system. From a model of fracture propagation in a thermally contracting elastic material, we determine the shape of this function analytically and show that it is in agreement with numerical simulations, field data and experiments on a new model system for columnar jointing: stearic acid. As opposed to the widely studied corn starch model system, columnar jointing in stearic acid is driven by thermal contraction and not by dessication. If better experimental control of the temperature evolution is gained, we suggest that the stearic acid experiments can be used as a model system for igneous columnar jointing in order to gain insight into the effect of an initial surface crack pattern, entablature formation and scale selection.

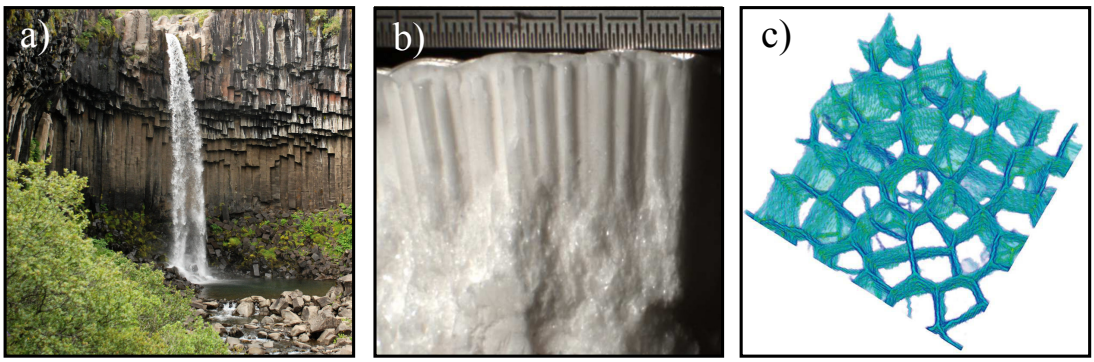

Figure 1. *a)* Exposed columnar joint formation at Svartifoss, Iceland. *b)* Columnar joint formation in stearic acid. The columnar joints are formed when the initally hot and fluid stearic acid cools and solidifies. *c)* Discrete element simulation of columnar jointing.