

Scale selection in polygonal fracture patterns

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ABSTRACT

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 and physical experiments in a parameter range relevant for columnar jointing in igneous rock as well as in model systems such as corn starch and stearic acid.

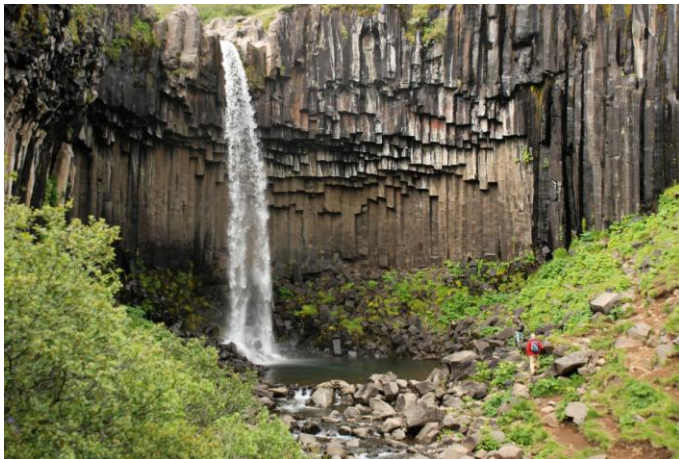


Fig. 1: Exposed columnar joint formation at Svartifoss, Iceland.

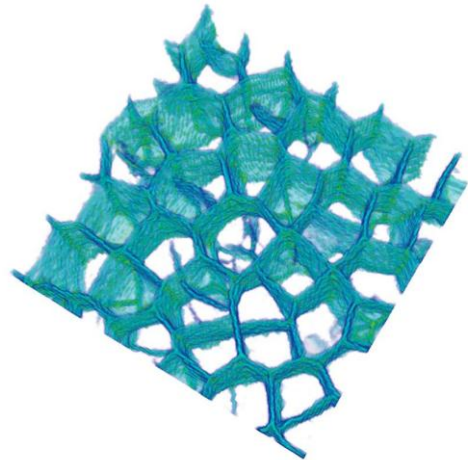


Fig. 2: Discrete element simulation of columnar jointing.