MAR07-2006-003275

Abstract for an Invited Paper
for the MAR07 Meeting of
the American Physical Society

Scaling in Columnar Joints[1]

STEPHEN MORRIS, University of Toronto

Columnar jointing is a fracture pattern common in igneous rocks in which cracks self-organize into a roughly hexagonal arrangement, leaving behind an ordered colonnade. We report observations of columnar jointing in a laboratory analog system, desiccated corn starch slurries. Using measurements of moisture density, evaporation rates, and fracture advance rates, we suggest an advective-diffusive system is responsible for the rough scaling behavior of columnar joints. This theory explains the order of magnitude difference in scales between jointing in lavas and in starches. We investigated the scaling of average columnar cross-sectional areas in experiments where the evaporation rate was fixed using feedback methods. Our results suggest that the column area at a particular depth is related to both the current conditions, and hysteretically to the geometry of the pattern at previous depths. We argue that there exists a range of stable column scales allowed for any particular evaporation rate.

[1]Work done with Lucas Goehring and Zhenquan Lin.