Aerofractures In Confined Granular Media

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ABSTRACT

We will present our ongoing study of the granular fracturing patterns that form when air flows into a dense, non-cohesive porous medium confined in a Hele-Shaw cell - i.e. into a packing of dry 80 micron beads placed between two glass plates separated by ~1mm. The cell is rectangular and fitted with a semi-permeable boundary to the atmosphere (blocking beads but not air) on one short edge, while the other three edges are impermeable. The porous medium is packed inside the cell between the semi-permeable boundary and an empty volume at the sealed side where the air pressure can be increased and kept at a constant overpressure (1-2 bar). Thus, for the air trapped inside the cell to release the overpressure it has to move through the solid. At high enough overpressures the air flow deforms the solid and increase permeability in some regions along the air-solid interface, which results in unstable flow and fingering patterns. These patterns are thought to be an analogue to hydrofractures, and an advantage of performing such experiments in a Hele-Shaw cell is that the fracturing process can be optically observed in the lab. Our experiments are recorded with a high speed camera with a framerate of 1000 frames per second. In the analysis, by using various image processing techniques, we segment out and study the fracture patterns over time, looking at growth dynamics, fractal dimension and characteristics such as average finger thickness as function of depth into the solid. In addition, by performing image correlation on two subsequent frames, we estimate displacement fields to investigate the displacement- and strain fields in the solid surrounding the fractures. Several experiments are performed with varying overpressure, and we compare the results. In a directly related project [1], acoustic emissions from the cell plate are recorded during experiments, where we aim to correlate acoustic events and observations.

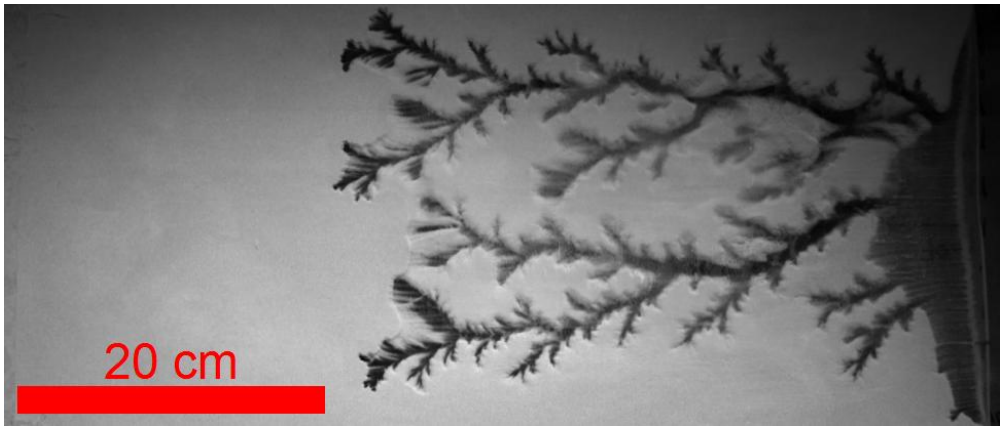

Fig. 1 : Top-down view of aerofractures in the Hele-Shaw cell

[1] Turkaya S., Toussaint R., Eriksen F.K., Zecevic M., Daniel G., Flekkøy E.G. and Måløy K.J. (2015) *Bridging aero-fracture evolution with the characteristics of the acoustic emissions in a porous medium.* Front. Phys. 3:70. doi: 10.3389/fphy.2015.00070