The critical behavior of the clogging process in a porous medium

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Flows through porous media can carry suspended and dissolved materials. These sediments may deposit inside the pore-space and alter its geometry. In turn, the changing pore structure modifies the preferential flow paths, resulting in a strong coupling between structural modifications and transport characteristics. Here, we compare two different models that lead to channel obstruction as a result of subsequent deposition.

The first model randomly obstructs pore-throats across the porous medium, while the second model always blocks the pore-throat with the highest flow rate. By subsequently closing pores, we find that the breakdown of the permeability follows a power-law scaling, whose exponent depends on the obstruction model. The pressure jumps that occur during the obstruction process follow a universal power-law distribution with the same scaling exponent as the avalanche size distribution of invasion percolation.