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The role of competition and transport on wormhole growth

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Wormholes are highly conductive flow channels generated by dissolution that constitute preferential pathways to flow. Although the growth of a single wormhole is a local pore scale process, while the wormhole grows it affects the flow field, so its effects propagate to the Darcy scale.

Wormhole growth can be viewed as a competition for water flow among wormholes in which the capacity of a given wormhole to grow is determined by its ability to take water from its surroundings. In this work we want to show that the final dissolution pattern is determined by this competition among wormholes for flow. To this end we built a model based on the wormholes capture areas, defined as the ratio between the flow rate that a wormhole is able to carry and the natural flux. The growth model uses an empirical expression to determine the wormholes capture areas and the corresponding flow rates. Then, the concentration in each wormhole is computed analytically with the obtained flow rate and the dissolution rate is calculated at the wormhole tip and walls to update the wormhole geometry.

We apply the above model to generate wormhole patterns and study the effect of competition under different Pe/Da ratios on the final structure of the patterns.