Investigating the pore scale mechanism of miscible phases mixing in porous medium 2D

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Abstract

The process of a fluid replacing a separate miscible fluid in a porous medium is present in many industrial and natural systems, such as enhanced oil recovery, CO2 sequestration and salt-fresh water interfaces in the ground. While the replacement can be approximated with the Darcy law, the mechanisms of the miscible phases mixing to the displacement remains unclear, specifically as the heterogeneity of the domain increases. As this mixing influences the reaction pattern between the fluids, it is important to estimate it using indirect measurements that are available, such as pressure and flux measurements. We propose a set of experiment that allow us to observe and measure the displacement and mixing process in high resolution and with the use of image analysis we can distinguish between the mechanisms. We can clearly see how the heterogeneous rate of the pore structure influences the mixing pattern, rate, and duration. Surprisingly, we found a clear and typical “mark” of the mechanisms on the flow rate, under constant pressure, which allows us to relate heterogeneity level of the structure to the ratio of displacement to mixing.