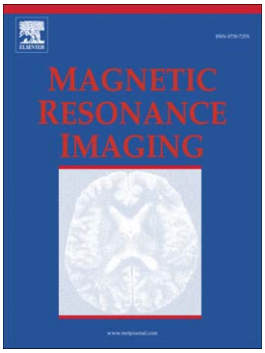

A visualization study on two-phase gravity drainage in porous media by using magnetic resonance imaging

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A visualization study on two-phase gravity drainage in porous media by using magnetic resonance imaging

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Abstract: Gravity drainage characteristics are important to improve our understanding of gas-liquid or liquid-liquid two-phase flow in porous media. Stable or unstable displacement fronts that controlled by the capillary force, viscous force, gravitational force, etc., are relevant features of immiscible two-phase flow. In this paper, three dimensionless parameters, namely, the gravity number, the capillary number and the Bond number, were used to describe the effect of the above mentioned forces on two-phase drainage features, including the displacement front and final displacing-phase saturation. A series of experiments on the downward displacement of a viscous fluid by a less viscous fluid in a vertical vessel that is filled with quartz beads are performed by using magnetic resonance imaging (MRI). The experimental results indicate that the wetting properties at both high and low capillary numbers exert remarkable control on the fluid displacement. When the contact angle is lower than 90°, i.e., the displaced phase is the wetting phase, the average velocity V_f of the interface of the two phases (displacement front velocity) is observably lower than when the displaced phase is the non-wetting phase (contact angle higher than 90°). The results show that a fingering phenomenon occurs when the gravity number G is less than the critical gravity number $G' = \Delta\mu/\mu_g$. Moreover, the higher Bond number results in higher final displacing-phase saturation, whereas the capillary number has an opposite effect.

Keywords: wettability; displacement front velocity; gravity number; capillary number; Bond number; displacing-phase saturation