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Pore-scale Modeling of Dynamic CO2 Dissolution in Natural Porous Media with different Wettability

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In oil-gas-water three-phase systems, CO2 can be distributed either as a non-wetting phase, or as an intermediate-wetting phase. The morphology and distribu-tion of CO2 clusters under different wetting sequences are different, which has a complex influence on CO2 dissolution process. Based on phase distribution ob-tained from three-phase flow experiment, we constructed the physical models of initial CO2 phase distribution, subsequently simulated the CO2 dissolution pro-cess when CO2 is non-wetting phase and intermediate-wetting based on the VOF framework and CST method. The dynamic evolution of CO2 clusters and dis-solved CO2 distribution during dissolution process was tracked. The effect of wettability on CO2 dissolution trapping in three-phase systems was revealed. The characteristic parameters of CO2 dissolution process were also analyzed quantita-tively. Our results showed that CO2 clusters exhibited different dissolution states under different wetting conditions in three-phase systems. When CO2 serves as intermediate-wetting phase, the initial phase distribution is more dispersed, and the size of CO2 clusters is smaller, the CO2 saturation decreases more within the same time period, indicating that CO2 has a higher dissolution ability. The initial CO2 saturation determines the final CO2 concentration in the other phase. Disso-lution caused the originally connected large CO2 clusters to decompose into mul-tiple small clusters. When CO2 serves as intermediate -wetting phase, the mass of dissolved CO2 is higher, and thus the dissolution ability is higher.

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Primary authors: WANG, Jinlei; Prof. YANG, Yongfei (China University of Petroleum (East China))

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