Transport characteristics of CO_2 tracer in a two-phase flow system

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To mitigate greenhouse effect on global warming, the carbon dioxide (CO_2) geosequestration has been widely studied for decades. The success of CO_2 storage depends on the measurement, monitoring and verification of *in situ* transport of injected CO_2. To achieve the goal that reflects the potential pathway of CO_2 plume without damage to the environment, nonreactive chemical tracers such as sulfur hexafluoride (SF_6) and noble gases have been applied as CO_2 tracers. In this study, a core-scale experiment and multiphase, multicomponent simulations were constructed to characterize the breakthrough curves (BTCs) of tracers and their transport behavior in a two-phase ($scCO_2$ and water) flow system. The features of the BTCs expressed as the first arrival time (t_0), peak arrival time (t_p), peak concentration (c_p), and tailing pattern were controlled by the degree of gas saturation in the core. The features of the BTCs showed distinct difference depending on whether the domain was previously swept by CO_2. When the tracer is released before CO_2 sweeps the formation, the tracer plume is narrow concentrated in the vicinity of the CO_2-water transition, and the BTCs reflect the effect of local heterogeneity. A decrease in both c_p and pressure during the CO_2 injection period can be described by changes in gas saturation even without any physical property changes in geologic media. This study contributes to design tracer tests in the field and provide better interpretations of observed tracer data with measured pressure data.

Keywords : breakthrough curves (BTCs), CO_2 tracer test, two-phase flow system