Enhanced CO_2 Sequestration Taking Account of Aqueous Solubility

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In this research we have shown that the solubility of CO2 has a significant impact on the two-phase flow characteristics of CO2 and water. In the core experiments it was observed that the residual CO2 saturation increased as successive drainage and imbibition cycles were performed, whereas in the N2 case the residual gas saturation remained constant after the primary drainage run. This effect is considered 'active phase change' to reflect the dynamic equilibrium that is maintained between thermodynamic and capillary forces. The concept of active phase change was confirmed visually using a silicon micromodel of Berea sandstone, where the transport of CO2 through the pore network by dissolution and bubble nucleation was observed and recorded.

The concept of active phase change was also evaluated theoretically by examining the physics of phase change and coupling that with a simple relative permeability model. Considering a single-component steam-water system, active phase change transport can be very significant for the vapor phase at high liquid saturations.