Gas-Cap Impact on CO_2 Plume Migration for Long-Term Storage in Saline Aquifers

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ABSTRACT

Injection of CO_2 in a hydrocarbon-rich area significantly impacts CO_2 plume behavior. Migration of CO_2 injected into the reservoir is of special concern because of associated liability and safety issues. This study assesses CO_2 plume properties in saline formations typical of the Gulf Coast area under the presence of a gas cap and its consequences for long-term storage. A synthetic reservoir model is used to perform a sensitivity analysis by means of an advanced compositional equation-of-state reservoir simulator. Multiphase flow modeling ensures better understanding of CO_2 plume distribution under different operational and reservoir conditions. Changes in gas-cap volume, composition, residual-gas saturation, and injector-gas-cap distance are studied, among others. Under typical pressure and temperature for CO_2 storage, brine is nearly incompressible, causing extent and shape of the CO_2 plume to be determined by CO_2-brine density difference and gas-cap compressibility. The CO_2 plume extends farther as gas-cap volume increases and distance to the gas cap decreases. Residual-gas-saturation conditions in a depleted gas cap are not expected to affect the plume extent as much as in cases where water is residual. Pressure changes within the formation affect gas-cap compressibility and, consequently, plume maximum lateral extent. Appropriate assessment of gas-cap impact on CO_2 plume distribution and on aquifer-pressure buildup is fundamental to determining a regulatory area of review, project technical risks, and economics.

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