

Identifying Residual Oil Zones in the Williston and Powder River Basins Using Basin Modeling

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Abstract

The Energy & Environmental Research Center (EERC) is working on a 3-year project to identify and evaluate residual oil zones (ROZs) in the Williston and Powder River Basins. These atypical reservoirs have relatively high oil saturations (25%–40%) but are at irreducible oil saturation levels with respect to water, as these reservoirs have been effectively waterflooded by natural processes. However, with the use of carbon dioxide (CO₂), large amounts of oil could be recovered that may not be economically producible by other means. As with conventional CO₂ enhanced oil recovery (EOR) operations, CO₂ flooding of ROZs can store significant quantities of CO₂.

The objectives of this project are to identify the presence, extent, and oil saturation of ROZs in the Williston and Powder River Basins; estimate the ROZ oil in place and the CO₂ storage potential; attempt to determine the feasibility of CO₂ EOR in these ROZs; and develop a robust and repeatable methodology for the identification of ROZs in other sedimentary basins.

The project goals will be accomplished by reservoir basin evolution modeling in 1-D, 2-D, and 3-D applications (including Schlumberger PetroMod); simulation of hydrocarbon generation, migration, and trapping; and calibration of models by comparing simulation results to existing reservoirs (location, volumes, and relative percentages of hydrocarbons). A sensitivity analysis will be conducted using Monte Carlo simulations to examine the influence of key variables in the 3-D simulations. Models will be validated using pulsed-neutron saturation and temperature logging. ROZ fairway maps of calculated high, mid-, and low oil in place will be produced, and the feasibility of CO₂-based hydrocarbon recovery will be estimated, along with the CO₂ storage resource potential of each evaluated ROZ in the Williston and Powder River Basins.

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