

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

Matthew E. Burton-Kelly<sup>1</sup>, Neil W. Dotzenrod<sup>1</sup>, Wesley D. Peck<sup>1</sup>, Jason R. Braunberger<sup>1</sup>,  
Andrew J. Gorz<sup>1</sup>, Scott C. Ayash<sup>1</sup>, Charles D. Gorecki<sup>1</sup> and John A. Hamling<sup>1</sup>

## 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 (CO<sub>2</sub>), large amounts of oil could be recovered that may not be economically producible by other means. As with conventional CO<sub>2</sub> enhanced oil recovery (EOR) operations, CO<sub>2</sub> flooding of ROZs can store significant quantities of CO<sub>2</sub>.*

*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 CO<sub>2</sub> storage potential; attempt to determine the feasibility of CO<sub>2</sub> 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 CO<sub>2</sub>-based hydrocarbon recovery will be estimated, along with the CO<sub>2</sub> storage resource potential of each evaluated ROZ in the Williston and Powder River Basins.*

<sup>1</sup>Energy & Environmental Research Center, University of North Dakota, United States

**Dr. Matthew E. Burton-Kelly** is a Research Scientist at the Energy & Environmental Research Center (EERC) at the University of North Dakota (UND), where he develops geophysical models of the subsurface, performs regional geological characterization, and manipulates data within geographic information systems. He holds Ph.D. and M.S. degrees in Geology from UND and a B.S. degree in Geology from Saint Lawrence University, Canton, New York.

Dr. Burton-Kelly's principal areas of interest and expertise include invertebrate paleontology, including freshwater mussels and arthropod trace fossils; stratigraphy; paleogeography; CO<sub>2</sub>-based enhanced oil recovery; and data management.