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**The Bakken-An Unconventional Petroleum and Reservoir System**

**DE-NT0005672**

**Goal**

The goals of this project are to accurately assess the hydrocarbon potential for the Bakken stratigraphic interval on a sub-regional basis and to construct an integrated exploration model for the Bakken; and to build a fully integrated three-dimensional reservoir geo-model for the Middle Bakken reservoirs in the Elm Coulee area.

**Performers**

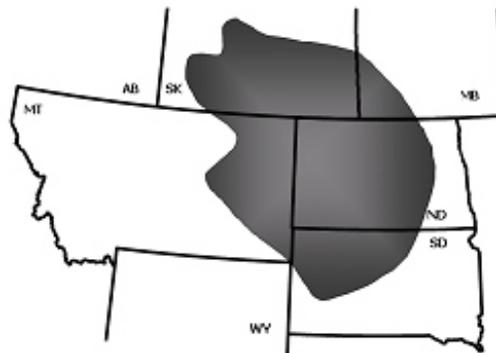
- Colorado Energy Research Institute, Colorado School of Mines, Golden, CO
- Fidelity Exploration Company, Denver, CO
- Samson Resources Company, Denver, CO
- The Discovery Group, Denver, CO
- Idaho National Laboratory, Idaho Falls, ID

**Background**

The Bakken resource play is a significant emerging play throughout the Williston Basin, Rocky Mountain region. The USGS has recently estimated that the Bakken contains 3-4.3 billion bbl of undiscovered, recoverable oil. The Bakken Petroleum System contains all the aspects of a large resource play (e.g., widespread source and reservoir rocks). It contains reservoir rocks, organic rich source beds and abundant seals. The various productive lithologies are all low porosity and permeability. Sedimentation occurred throughout the Phanerozoic, and the thickness of the stratigraphic section is approximately 16,000 feet. The Devonian-Mississippian Bakken Formation of the Williston Basin has been the focus of several cycles of exploration activity since the 1950s. The discovery and development of the Elm Coulee area of Montana is the latest and most significant of these cycles to date. Expansion of the play into North Dakota is currently underway and has resulted in new discoveries, including the Parshall Field. The new discoveries in North Dakota suggest the existence of an extremely large resource play; however, currently, no predictive hydrocarbon system or reservoir geo-model exists for this play.

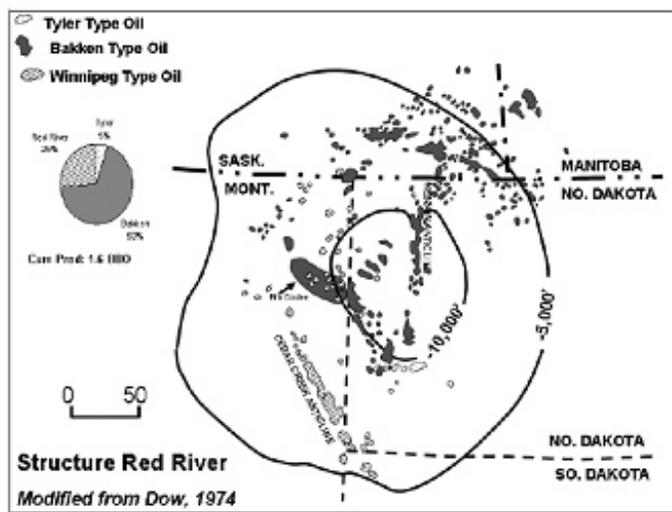


## Williston Basin



Location of Williston Basin, which is semi-circular in shape and a site of subsidence through much of Paleozoic time

Elm Coulee, a new field, has produced in excess of 41 million barrels of oil and 24 BCF gas from over 400 horizontal wells. The field is being developed using horizontal drilling in the middle member of the Bakken. The Bakken is generally fracture stimulated with gelled water and sand (~5,000 bbl gelled water and 400,000 pounds of sand per horizontal lateral). The area was targeted for vertical drilling in the late 1990s and horizontal drilling began in 2001. The middle Bakken in this area is interpreted to be a dolomitized carbonate bar complex. The reservoir is developed over a large area (450 square miles) and has relatively low porosity (8-10%) and permeability (average of 0.05 md). Natural fracturing is thought to contribute to production. Initial production from wells ranges from 200 to 1900 BOPD. The field is being developed on 640 and 1280 acre drilling and spacing units. The Elm Coulee area has many of the characteristics of a resource play (i.e., continuous accumulation, large areal extent, predictable, repeatable, technology driven, etc.). Estimated recovery per well is 350 to 600 MMBO. Estimated ultimate recovery for the field is greater than 200 MMBO (Walker et al., 2006).



Index map of Williston Basin showing fields and the various petroleum systems, note the position of the Elm Coulee Field

### Potential Impacts

The successful results of this study will develop an initial alpha version of a predictive exploration model that could be used for future identification of high potential fairways and traps for the Bakken hydrocarbon system. The initial model is to be based upon the integration of a sub-regional stratigraphic and reservoir characterization, rock physics calibrated seismic attribute analyses, and acoustic impedance developed for different levels of organic richness and maturity. The model is to also include a secondary permeability potential that will be derived from a fracture analysis. Finally, validation of and revisions to the model shall be conducted to compare predictive attributes to known seismic, log and core data throughout the Williston Basin.

### **Accomplishments**

The Bakken Project has just been awarded; therefore, there are no accomplishments to report at this time.

### **Current Status**

The project is currently revising the Project Management Plan (Task 1), and is working to establish the Bakken Consortium, and to complete a Bakken technology status assessment. Tasks to be completed in the first budget period are as follows:

- Initial development of a sub-regional sequence stratigraphic framework for the Bakken that will serve as the context for reservoir characterization.
- Commence reservoir characterization and include high-resolution SEM analysis, using QEMSCAN®, of a test set of thin section- and core-sized samples, to determine pore system geometries.
- Calibration of the seismic response of reservoirs and source intervals.
- Initiate a sub-regional fracture analysis from outcrops, core, and FMI logs, and that will include data from Elm Coulee and Parshall fields.
- Determination of the textural and rock physics controls on the acoustic impedance of organic rich shales, utilizing the SAM (scanning acoustic microscope) data combined with the rock physics analysis.

**Project Start:** October 1, 2008

**Project End:** September 30, 2011

**DOE Contribution:** \$1,480,815

**Performer Contribution:** \$851,878

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