Surface Microseismic Study of a Bakken Fracture Stimulation
Contract No. G-013-026

This is a project submitted by Marathon Oil Company. Total cost of the project is $212,580 with $106,290 provided from the Oil and Gas Research Fund. The purpose of this project is to conduct a surface microseismic study of a hydraulic fracture stimulation of a middle Bakken well in Dunn County. The project is designed to identify the orientation of subsurface fractures created during the fracture stimulation of a well. Data gathered will be compared to data collected in a tiltmeter study during the fracture stimulation from a well, also in Dunn County. The tiltmeter study is also designed to identify the orientation of subsurface fractures created during the fracture stimulation of a well. The facies (rock type) of the middle Bakken in Dunn County is one of the most common if not the most common in North Dakota. Surface microseismic data is much less costly to collect than microseismic survey data collected from nearby observation well bores at depth. Success in data collection would prove the validity of the application, reducing the risk of using the technology in a larger area of other operators. *The results from this project will be held confidential until September 30, 2008.*

January 10, 2008
The draft final report has been received.

December 1, 2008
The following is Marathon's written summary of the project. In addition to this written summary, detailed data is available electronically on the Industrial Commission website to be downloaded by interested parties.

Marathon Oil Company is greatly appreciative of the support given to this project. The purpose of the project was to acquire surface microseismic data of a Bakken fracture stimulation so that a map of the affected area could be made and the understanding of the Bakken stimulations improved. More effective and economical Bakken stimulations are expected out of this improved understanding.

The microseismic study was performed on the Marathon Kevin Buehner 11-18H well in Dunn County, North Dakota. This well was drilled to a measured depth of 20,265' MD with a 9434' horizontal section in the Middle Bakken. The fracture stimulation on the well was performed on October 12, 2007. The stimulation was monitored with a geophone line array that radiated away from the surface location for over 3 miles. The large area coverage, over nine square miles allow for imaging the minute earth cracking that was taking place over 10,000 feet below the surface of the earth where geophones were placed.

The microseismic data that was acquired in the fracture stimulation is considered good for generating the map that describes the timing and pattern with which the Bakken formation was affected. Time laps video of the events depicts the progression and changes of the earth cracking underneath the geophone array as the fracture stimulation was pumped. Microseismic Inc. processing of the data is necessary to provide an image of the affected area. The understood limitation of the technology to resolve the vertical effect of the stimulated rock is recognized in this data set. The final data set shows that minute earth cracking took place along the well path and away from the well path in a complex geometry. This data and subsequent interpretations of the data are being applied to fracture stimulations performed by Marathon.