

Surface Microseismic Study of a Bakken Simultaneous Fracture Stimulation
Contract No. G-015-029

This is a project submitted by Marathon Oil Company. Duration of the project is six months. Total project costs are \$415,100 with \$207,550 provided from the Oil and Gas Research Fund. This project involves a surface microseismic study of a simultaneous hydraulic fracture stimulation on two newly drilled, closely spaced North Dakota Bakken horizontal wells. The purpose of this study is to understand the mechanics of a simultaneous fracture stimulation in the Bakken between two parallel horizontal wells (each with 9000' horizontal wellbore drilled in the Middle Bakken) drilled in the same 1280 acre drilling and spacing unit and compare the results to a microseismic study of a single well stimulation. This study is directed to identify the effect of artificial fractures that are created between two drilled horizontal wells. This knowledge will allow for better optimization of the wellbore azimuth in future horizontal Bakken wells and field development. The results will also provide improved future stimulation methods. This type of fracture stimulation has been used successfully elsewhere, including in the Barnett Shale play in Texas. *The results of this project will be held confidential until May, 2009 (one-year following the release of the Data Analysis Complete report)*

The March 31, 2008 status report has been received. The simultaneous fracture stimulation of the two wells in Dunn County (Marathon Grant Carlson 14-34H and Marathon Grant Carlson 24-34H) has been completed without difficulty. The microseismic data was also collected without difficulty. Data analysis has begun with preliminary results expected in early May.

The final report has been received. The detailed results of this project will be held confidential until May, 2009. Marathon has released the following information:

Marathon Oil Company is greatly appreciative of the support given to this project. The purpose of the project was to acquire a surface microseismic data set of Bakken simultaneous 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 Grant Carlson 24-31H and Grant Carlson 14-31H wells in Dunn County, North Dakota. The wells were drilled to measured depths of 20,138' MD and 24,463' MD, respectively. Each well has over 9000 feet of open horizontal section in the Middle Bakken unit of the Bakken Shale Formation. The fracture stimulations on the wells were performed on March 29, 2008 to both wells with the jobs occurring simultaneously to help complement the stresses generated in both wells. The completion type was in a 6 inch open hole section using a slick water frac fluid for both wells. The stimulations were monitored with a geophone line array centered between the surface locations of each well then radiating away from this point for over three miles. The large area coverage allows for imaging the minute earth cracking that was taking place over 10,000 feet below the surface of the earth where the geophones were placed.

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

The final report was released in May, 2009. It is available on the Industrial Commission/Oil and Gas Research Program website.

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