

Gas Production Forecasting from Tight Gas Reservoirs: Integrating Natural Fracture Networks and Hydraulic Fractures

PROJECT FACT SHEET

Program

2007 Unconventional Resources Program

Project Number

07122-44

Start Date

September 2008

Duration

49 Months

RPSEA Share

\$1,055,502

Cost Share

\$267,216

Prime Contractor

The University of Utah

Participants

Utah State University; Utah Geological Survey; Golder and Associates; ITASCA; Anadarko Petroleum Corporation; Windriver Energy

Contact Information

Dr. Milind Deo

Charlotte Schroeder
cschroeder@rpsea.org
281.690.5506

Reports and Publications

Research Objectives

The following objectives have been set forth to address these significant tight gas production issues.

1. Existing and new geologic data will be used to create fracture network maps.
2. Propagation of hydraulic fractures given the natural fracture system and the existing stress condition in the system will be examined.
3. Gas production from these systems will be studied by combining the natural and hydraulic fractures into multiphase discrete fracture network reservoir models.

Approach

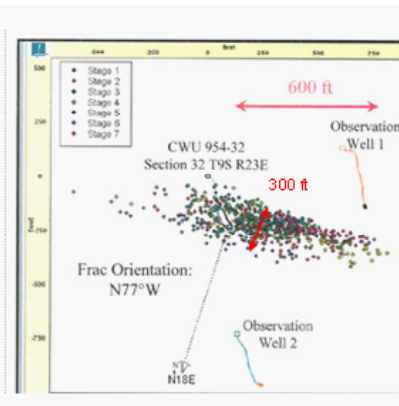
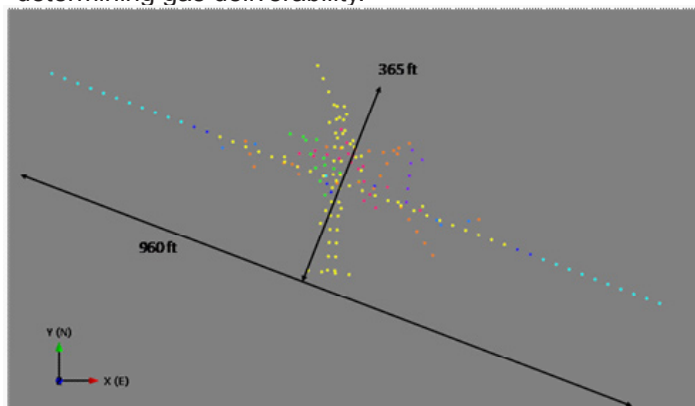
Outcrop, log and other data will be used to create static fracture models, which will be evolved into dynamic models by considering well tests. State of the art geomechanical tools will be used to obtain hydraulic fracture geometries, given the fracture/stress state of the reservoir. These geometries will be represented explicitly in The University of Utah discrete-fracture network reservoir simulators to obtain realistic assessments of gas production from tight gas reservoirs. The project team will develop a protocol for creating field-wide natural fracture networks, given static and dynamic reservoir information. Tools will be developed to determine more realistic hydraulic fracture geometries in vertical and horizontal wells. This will provide better understanding of designing hydraulic fractures to intersect existing natural fractures. Reservoir simulation of these realistic features will help optimize drainage and minimize costs.

Accomplishments

The gas-bearing Mesaverde formation was described using logs, cores and outcrops. The fracture system in Section 21 in the Natural Buttes natural gas field was characterized by using a variety of geologic data including FMI, logs and core supplemented with findings from the outcrop field studies. Validation of the fracture network was carried out by simulating microseismicity for a multistage hydrofrac conducted at nearby Chapeta wells. This validation produced reasonable correspondence between simulated and observed microseismic clouds. The geometry was also simulated in a geomechanical simulator capable of incorporating natural fractures. This geometry was transferred to an unstructured grid flow simulator. A new geomechanical tool was built into reactive transport flow simulator.

Significant Findings

Multiple pathways of incorporating geologic data to create natural fractures, embedding hydraulic fractures in this complex geometry and performing multiphase flow simulations were demonstrated. It was shown that microseismic information can be used to validate a hydraulic fracture created in a natural fracture environment. Flow simulations were used to show that partial closing of some of the fractures will significantly affect gas flow rates. Multiphase phenomena, such as water-gas relative permeabilities and water blocks, also are critical in determining gas deliverability.



Comparison of the microseismic cloud created in the model (FRACMAN) with the data from Chipeta Well. Orientation of microseismic clouds are nearly identical. Length and width of microseismic clouds are very similar (600 ft vs. 480 ft. horizontal half-length extent; 300 ft vs. 365 ft width of affected zone perpendicular to HF)