

# Barnett Shale Symposium III

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## **Worlds Collide: Case Histories of Barnett Shale Drilling Operations within Incorporated Cities and Master-Planned Communities, Environmental and Permitting Considerations**

**Ron Edington, P.G., Huitt-Zollars, Inc., Dallas, Texas**

### **ABSTRACT**

As Barnett shale exploration and production operations encroach closer to densely populated areas and municipal entities, operators have been faced with a variety of challenges and opportunities as they attempt to coexist. Municipal permitting requirements such as residential setbacks, environmental issues like floodplains, forested areas, wetlands, noise and illumination must be addressed. This presentation will address actual case histories where the surface owners, residential and commercial developers, design engineers, geoscientists, and operator personnel have worked closely to achieve optimal use of the surface and mineral resources. We will discuss design of a 3-D seismic program within a developed community, placement of pad sites, incorporation of future surface development plans, drilling and completion operations in close proximity to residents, and production operations such as centralized compression and produced water collection

### **Current State of Barnett Technology**

**Brad Curtis, Dan Steward, and Nick Steinsberger, Republic Energy, Dallas, Texas**

### **ABSTRACT**

Republic technical staff prepared a Barnett Poster Session for the 2004 AAPG convention entitled "The Barnett Shale: Not So Simple After All." When this poster was prepared Barnett expansion into non-core areas had begun but very little data was available to evaluate it. This poster therefore dealt with Barnett complexities as we in industry understood them at the time. Significant increases in drilling have occurred since and, as of April 6, 2005, there have been a total of 6,183 Barnett permits issued in 18 counties, with 1,000 of these in non-core areas. More significantly, industry operators have obtained 1,245 permits for horizontal wells with one-third of these permits located in the expansion area of the play. Production data is available on approximately 300 of the horizontal wells in the total play with 100 wells having greater than 12 months production.

In the three years since Devon initiated a program of horizontal drilling, industry has learned a lot, but we have really just scratched the surface. Technology advances are being made in the application of 3-D seismic, micro- seismic, frac mapping, horizontal drilling and completion techniques. A better understanding of these technologies and their interaction will surely improve horizontal well quality and expand the play into thinner, shallower, gas mature areas.

The poster is included in PDF format on this website.

## **Hydraulic Fracture Monitoring In the Barnett Shale Formation: How to Improve Reservoir Management?**

**Dr. Joel Le Calvez and Sandy Conners, Schlumberger Inc., Dallas, Texas**

### **ABSTRACT**

Understanding the created fracture geometry is key to the effectiveness of any stimulation program. However, almost all predictive models used by reservoir and production engineers to estimate recovery in stimulated wells are based on assumptions that naturally lead to oversimplified fracture geometry. Several published and unpublished microseismic monitoring campaigns reveal that in most cases, hydraulically induced fractures are asymmetric (e.g., one wing of the fracture system is predominantly longer than the other). This asymmetry is also observed in the vertical plane. This has deep implications on reservoir management. For example, if one knows where most of the depletion occurs (e.g., how does the induced fracture geometry relate to the overall existing drilling and producing field geometry), a production team can improve its infill drilling program and flood to improve production. Micro-seismic is one of the latest and most accepted technologies allowing reservoir engineers and geoscientists to understand hydraulically induced fractures as well as naturally pre-existing fracture networks in three dimension. It uses one or several arrays of sensitive and high-vector fidelity geophones in one or several observation wells at a monitoring distance from the well to be treated. These geophones record the microseismic events generated while the formation ruptures following the hydraulic treatment. These recordings being performed along a continuous time-line, microseismic locations can be determined (as well as other source parameters) and mapped to document how the hydraulically induced fracture system propagates within the pay zone. Understanding this geometry is not only helpful to improve large-scale reservoir management but also to design effective stimulation programs specific to a reservoir.

## **Shale Gas Potential of Source Rocks along the Ouachita Thrust Front**

**Dr. Dan Jarvie, Humble Geochemical Services**

### **ABSTRACT**

The Barnett Gas Petroleum System is a fully self-contained petroleum system, whereby the source rock serves as the trap and seal and all the related processes such as generation, adsorption, and oil cracking, occur within the source-reservoir rock itself. Source rocks that serve as reservoir rocks are not uncommon for oil production, e.g., the Monterey Formation of California and the Bakken Formation of the Williston Basin, and the Bazhenov Formation of Siberia. However, until the Barnett Shale, thermogenic gas production from a source rock was nonexistent since a source rock does not exhibit typical reservoir rock properties such as good porosity and permeability. However, the Barnett Gas Petroleum System has proven to be a highly viable commercial source of natural gas. As such the Barnett Shale of the Ft. Worth Basin provides an excellent geochemical model for evaluation of shale gas plays around the world. Using an extensive database and experimental techniques on low maturity Barnett Shale samples, geochemical characteristics of the Barnett Shale have been elucidated in terms of what geochemical criteria must be met for a thermogenic shale gas play to be successful. While gas flow rates are determined by a multitude of factors, it is certain that commercial flow rates require a

minimum conversion of organic matter (kerogen and generated oil) to yield high volumes of gas-in-place. Organic matter (kerogen) conversion is determined by the maximum thermal exposure of the organic matter. Geochemical risk in shale gas plays can be determined by proper interpretation of visual and chemical analyses of these rocks. Nonproprietary data from other source rocks along the Ouachita Front and other geologic provinces also show good potential for thermogenic gas.

## **Barnett Shale Update: Non-Core Confidence Rises**

**Stephen Thornhill, Morgan Stanley, Dallas, Texas**

### **ABSTRACT**

What's changed? Increasing confidence in non-core viability

Until recently, the industry was skeptical that the Barnett could be economically developed outside the core area of the play, where DVN dominates. But the latest results from horizontal pilot programs have given participants increased confidence in non-core prospectivity.

Key Hurdle: Overcoming geological risk in non-core area

Across the non-core area, the lower frac barrier that offers protection against water is absent while pockets of the Barnett are too fractured (naturally) to be stimulated without encountering water from below.

Keys to success: Drilling horizontally, avoiding areas of excessive natural fracturing and designing an effective frac that yields economic rates of production and eludes lower water-bearing formation.

Growing evidence that horizontal drilling can work

While horizontal drilling results have been mixed, we've learned of several successful horizontal wells drilled in the non-core area with reserve sizes/production rates on par with those of core-area wells. As such, we're seeing aggressive leasing of non-core lands with acreage prices/landowner royalties reaching all-time highs.

It's still early, but 2004 will be a pivotal year

Success in the non-core area could translate into several TCF of new nat. gas reserves, in our view, but it's still early. Production history is limited, infrastructure is lacking and most producers are still in the trial-and error stage of optimal frac design. But with non-core activity rising we expect to learn a lot in the coming quarters about how well horizontal drilling works.

Who's got leverage?

Within our universe, DVN, EOG, BR, XTO, and ECA each hold positions in the Barnett, but DVN and EOG are most exposed to non-core potential. By our estimates, successful non-core development could provide 6-10% of equity price upside for DVN and EOG.

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## **Barnett Shale Exploration Techniques Using 3D Seismic**

**Barry Weinman, Weinman Geoscience, Dallas, Texas**

### **ABSTRACT**

A small < 10 sq mi three dimensional seismic survey was acquired after two unsuccessful drilling efforts in the Barnett shale over the client's acreage. The resulting seismic data was tied to well control with synthetic seismograms and several critical horizons were interpreted. These maps showed areal Barnett time structure and fault locations. Seismic attributes were calculated for determining additional fault and fracture patterns not revealed in the initial interpretation. Also seismic amplitude was mapped and related to Barnett lithology. As a result two additional wells were drilled. Further investigations using seismic inversion and seisfacies classification techniques show waveform patterns in the Barnett that maybe related to porosity variations. These results suggest that an integrated seismic interpretation and attribute approach should improve drilling results by orienting directional drilling to avoid faults and fractures and penetrate Barnett porosity fairways.

## **Finite Difference Simulation of the Barnett Shale**

**Dr. Richard Strickland, The Strickland Group, Fort Worth Texas**

### **ABSTRACT**

Valid finite difference numerical simulation of the Barnett Shale provides valuable insight into reservoir description, reservoir mechanics and future expectations for both recovery and development. For vertical wells I will show early simulation matches with subsequent production updates. For vertical and horizontal wells I will describe the effective parameters governing a history match along with sensitivity analysis and a discussion of uniqueness. I will also discuss the limitations of this analysis technique. I will conclude the presentation with a discussion of reserves and recovery estimates, effective drainage, the potential for infill drilling and re-fracturing horizontal wells.

## **Cost/Benefit Analysis and Challenges of Drilling in Urban Environment for the Barnett Shale**

**Dr. John Baen, University of North Texas, Denton, Texas**

### **ABSTRACT**

Oil and gas drilling and production have increased greatly throughout the U.S. due to higher oil and gas prices as well as improvement in technologies that are both economic and reduce negative impacts to the surface estate. The Barnett Shale gas field has become the largest and most productive in Texas

over a four-year period with 3,800 well being completed; however, the gas field is located in the DFW Metropolitan area, which is one of the fastest growing real estate markets in the United States. The cost-benefit analysis of urban/suburban drilling from the standpoint of land use efficiencies, economic impact, environmental impact and property taxes is considered. The paper concludes that variable long-term financial and environmental benefits to communities, surface owners, mineral/royalty owners and oil companies far exceed the direct and indirect costs of gas wells that are professionally planned and operated.

Key words/concepts: oil and gas valuation methods, need for education by real estate related professional, planners and city administrators, city drilling ordinances, land-use efficiencies.

The complete presentation is included in PDF format on this website.

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