Wednesday, April 28, 2010

Petroleum Club • 800 Bell (downtown)
Social 11:15 AM, Luncheon 11:30 AM

Cost: $30 pre-registered members; $35 for non-members & walk-ups; Emeritus/Life/Honorary: $15; Students: FREE

To guarantee a seat, you must pre-register on the HGS website (www.hgs.org) and pre-pay with a credit card.
Pre-registration without payment will not be accepted.
You may still walk up and pay at the door, if extra seats are available.

HGS General
Luncheon Meeting

Penny E. Patterson
ExxonMobil
Production Company

Piceance Basin Tight Gas: Integration of Geoscience and Engineering Technologies in Development of an Unconventional Resource Play

The Piceance basin, located along the northwestern slope of Colorado, contains trillions of cubic feet of natural gas trapped within more than 4000 feet of complexly interbedded sandstone and mudstone strata. The Piceance Basin resource play is a showcase of ExxonMobil's mission statement of "Taking on the world's toughest energy challenges" through the integration of geoscience and engineering technologies that enable improved production and recovery rates of natural gas from deeply buried, tight sand reservoirs at lower production costs.

The primary reservoir interval in Piceance basin is the Upper Cretaceous Williams Fork Formation of the Mesaverde Group that consists of a thick succession of alluvial strata composed of fluvial sandstones, floodplain mudstones and coals. Sequence stratigraphic concepts, first developed by ExxonMobil geoscientists, were largely based on shallow-marine depositional systems. An early phase in the understanding of Piceance Basin tight gas reservoirs was the refinement of sequence stratigraphic concepts to include alluvial depositional systems. In addition, a hierarchical approach for characterization of these strata was developed to provide a systematic method for the description of alluvial strata. This approach facilitated the spatial and temporal comparison of alluvial systems and enabled delineation of the intrinsic and extrinsic controls on alluvial deposition.

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An integrated subsurface and outcrop study of the Williams Fork Formation reveals a hierarchical arrangement of these alluvial strata that defines a sequence stratigraphic framework, which, in part, influences the presence and distribution of hydrocarbons throughout the basin. The sequence stratigraphic architecture is expressed in these non-marine successions by variations in stratal stacking patterns that are characterized by differences in net to gross sand/shale ratios and reflect relative changes in rates of accommodation and sedimentation.

In the Williams Fork Formation, four composite sequences are interpreted that define the basin-scale alluvial architecture of the Upper Cretaceous strata in Piceance. Composite sequences are

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composed of a basal sandstone-prone amalgamated or semi-amalgamated sequence set element comprised principally of fluvial sandstones stratigraphically overlain by a mudstone-prone non-amalgamated sequence set composed largely of floodplain deposits. The stratigraphic architecture of the composite sequences is one of the primary controls on hydrocarbon distribution within the basin. Amalgamated and semi-amalgamated sequence sets exhibit moderate net-to-gross sand/shale ratios and typically possess significant fractures that result in higher flow rates that have an increased risk of water production. Conversely, non-amalgamated sequence-set elements display lower net-to-gross sand/shale ratios and generally possess numerous natural fractures that more commonly contain gas-bearing zones with low water production.

At the basin-fill scale, the basal sequence-set elements of the four composite sequences display a progressive increase, stratigraphically upward, in the extent of vertical and lateral amalgamation and a concomitant increase in net to gross. This variation in stratal stacking pattern is inferred to reflect decreasing rates of accommodation relative to sedimentation during deposition attributed to onset of the Laramide Uplift.

Engineering technologies that have been developed in the Piceance basin include Multi-Zone Stimulation Technology (MZST) and the Just-In-Time Perforation (JITP) system. These two technologies work in conjunction during the well-bore stimulation process and enable completion of up to 50 gas-bearing intervals in one well. Well-bore stimulation technology begins at the base of a well and moves upward, sequentially fracturing and stimulating up to 10 zones identified by the geoscience and

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engineering team. The use of MZST and JITP technologies in Piceance basin tight-gas reservoirs has provided maximized well-bore stimulation efficiency, increased recovery rates, and lower stimulation costs. In addition, drilling efficiency in the Piceance basin is facilitated by drilling up to nine wells from a single surface location.

Biographical Sketch

Penny Patterson is a Geological Advisor at ExxonMobil U.S. Production in Houston, Texas. She received her B.A. and M. S. degrees in geology at the University of Colorado in 1976 and 1981, respectively. Penny worked for the Research Planning Institute in Boulder, Colorado from 1981 to 1986, specializing in near-shore marine, fluvial, and aeolian strata. In 1990, she earned her Ph.D. in fluvial sedimentology and stratigraphy, sandstone diagenesis, and geophysics at the University of Colorado. Penny then joined Exxon Production Research Company in Houston, where her research focused on development of next-generation concepts of sequence stratigraphy and process sedimentology and their application to alluvial and shallow-marine depositional systems based on integration of outcrop field studies, subsurface reservoir investigations, and experimental stratigraphic studies conducted at the University of Minnesota.

Penny works closely with ExxonMobil's exploration, development, and production affiliates in resource assessment and capture of conventional and unconventional plays. She has written over 60 scientific publications on sequence stratigraphy, experimental stratigraphy, sedimentology, and computer modeling of alluvial and shallow-marine depositional systems. In 2006, Penny received the RMAG best speaker award for her work on Piceance basin tight gas reservoirs. She is a member of AAPG, SEPM, and HGS.