Shale Reservoirs - Simiar, Yet So Different

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Recent estimates of recoverable gas from unconventional shale reservoirs in the US exceed .5 qcf(quadrillion cubic feet) (USGS 2009) with potential for another .1 qcf in Canada (NEB). While broadly distributed, North American shale gas basins generally follow a trend of thrust belts and a Mississippian/Devonian shale fairway from Western Canada and into the Western, Southern and Eastern United States. The Laramide Thrust Belt bounds the Horn River and Montney Play in British Columbia and Alberta, as well as many of the Western US shale gas fields, including Jonah and Pinedale. Starting in South Texas, the Ouchita Thrust Belt bounds Southern US gas basins including: Eagle Ford, Barnett, Woodford, Haynesville and Fayetteville. Finally, the merger of the Ouchita and Appalachian Thrust Belts define the broad extents of the Marcellus shale gas basin.

North American shale gas reservoirs currently rank as 6 of the largest 22 global gas fields, based upon estimated recoverable reserves, with average recovery factors of about 20%. Innovations in horizontal well drilling and completions, supported by 3D seismic, microseismic, FMI/FMS and other measurements, are unlocking North American gas supplies for the decades ahead. However, volatile commodity markets and dramatic variability in well production rates make economic shale gas production a challenge. This large well production variability, even within the same field, challenges our intuition about the simple, consistent nature of shale formations and the gas within..

With a motivation to understand why "all gas shales are not created equal" - this study integrates published data, type logs, accessible seismic and microseismic data along with 5 years of experience across most significant North American shale gas basins. Our tabulation of shale gas reservoir characteristics and well log analysis highlights key production differentiators including depth, thickness, porosity, pressure and TOC . While basins and reservoir characteristics clearly vary - this does not explain significant well-to-well gas production variations. Part of this variability in production performance is related to evolutionary and company-to-company differences in fracturing "best practices". Surprisingly, after nearly 30 years of development and over 10,000 wells, wellbore lengths and completions parameters in the Barnett Shale of Texas can vary by factors of two or more - pointing to the challenge and non-uniqueness of production optimization.

It is our work with 3D seismic and microseismic, however, that clearly supports the concept of shale gas "sweet-spot" fairways and converse "dead zones". Whether it is faulting in the Woodford, karst collapse chimneys in the Barnett, natural fracturing in the Marcellus or clay/silica content in many plays - seismic and microseismic data provide valuable calibration and prediction tools for mapping productive/nonproductive fairways. Multiple data examples from key North American shale gas plays will be used to illustrate the unique characteristics of the most and least prolific gas producing regions.