[PS]Wolfberry Play, Midland Basin, West Texas*

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Abstract

The Wolfberry Play is an unconventional oil play characterized by heterogeneous lithologies, low permeabilities, and reservoirs and source rocks in close proximity. A combination of abundant oil in place, favorable rock mechanical properties, permeable thin beds, and modern well stimulation techniques has opened the entire Lower Permian and Upper Pennsylvanian basinal intervals to production. The paleogeographic setting was a deepwater ocean basin surrounded by shallow carbonate platforms. Basin-floor stratigraphy comprises alternating layers of calcareous and siliciclastic lithofacies having widespread lateral continuities. In siliciclastic intervals, such as the Spraberry, sandstone turbidites and laminated siltstones are interbedded with organic-rich mudrocks. In calcareous intervals, such as the Wolfcamp, carbonate debris flows are interbedded with carbonate turbidites and organic-rich calcareous mudrocks. Since the late 1990s, more than 8,700 Wolfberry oil wells have been completed and have produced 216 million barrels of oil and 544 billion cubic feet of gas. Initial well production averages 30 to 125 barrels of oil per day, and ultimate per-well recovery is estimated at 100,000 to 140,000 barrels of oil equivalent. We used wireline logs to correlate and map Wolfberry intervals and cores to characterize lithofacies and calibrate logs for lithofacies identification and extrapolation beyond cored wells. This poster presents regional stratigraphic and lithologic information as a context for exploration and development of a multi-billion barrel oil resource. Wolfberry production statistics are also presented.

WOLFBERRY PLAY, MIDLAND BASIN, WEST TEXAS: REGIONAL STRATIGRAPHY

Bureau of Economic Geology

STARR — State of Texas Advanced Oil and Gas Resource Recovery

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WHAT IS THE WOLFBERRY?

Wolfberry = unconventional oil play in Midland Basin and northern Val Verde Basin

Wolfberry formations = Spraberry and Dean sandstones + Wolfcamp and Upper Penn calcareous lithofacies + ?

Early Permian paleogeographic setting = deepwater ocean basin surrounded by carbonate platforms

Wolfberry composition = abundant organic carbon + brittle calcareous mudrock + thin permeable beds

Wolfberry stratigraphy = alternating siliciclastic and calcareous intervals having widespread continuity on basin floor

Sea-level lowstand = exposed platforms and siliciclastic sediment input directly into basin = **siliciclastic intervals**

Sea-level highstand = flooded platforms and carbonate shedding into deep basin = **calcareous intervals**

Siliciclastic intervals = lower Wolfcamp, Dean, lower and upper Spraberry

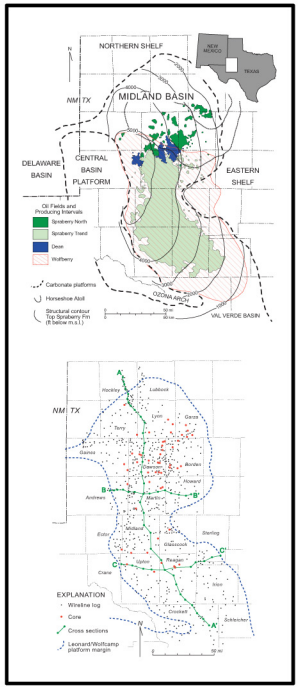
Calcareous intervals = Upper Penn, upper Wolfcamp, lower and middle Leonard, middle Spraberry

Wolfberry vertical completions = massive multi-stage frac jobs + 1,000-3,000 feet gross perforated interval

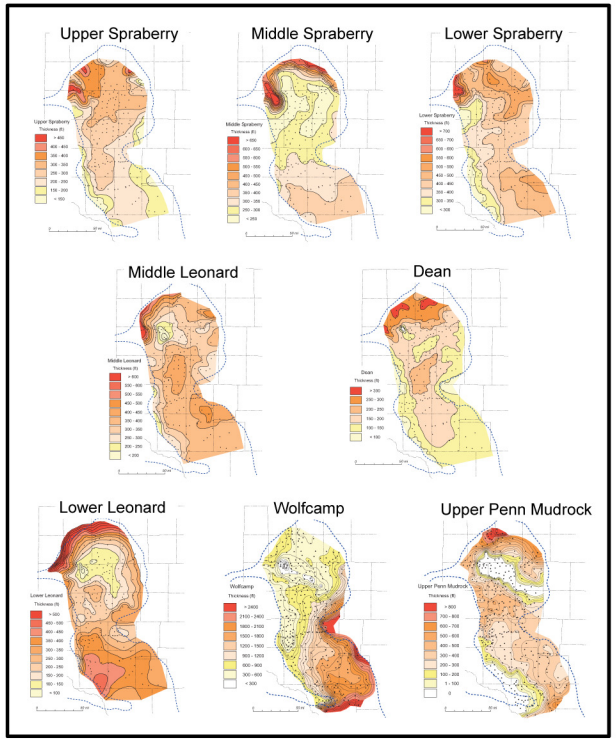
Wolfberry horizontal completions = recent development targeting organic-rich lithofacies, Wolfcamp + Lower Leonard

Wolfberry production = 232 MMBBL oil + 592 BCF gas from 1998 to 2011 (>50 MMBBL oil in 2011)

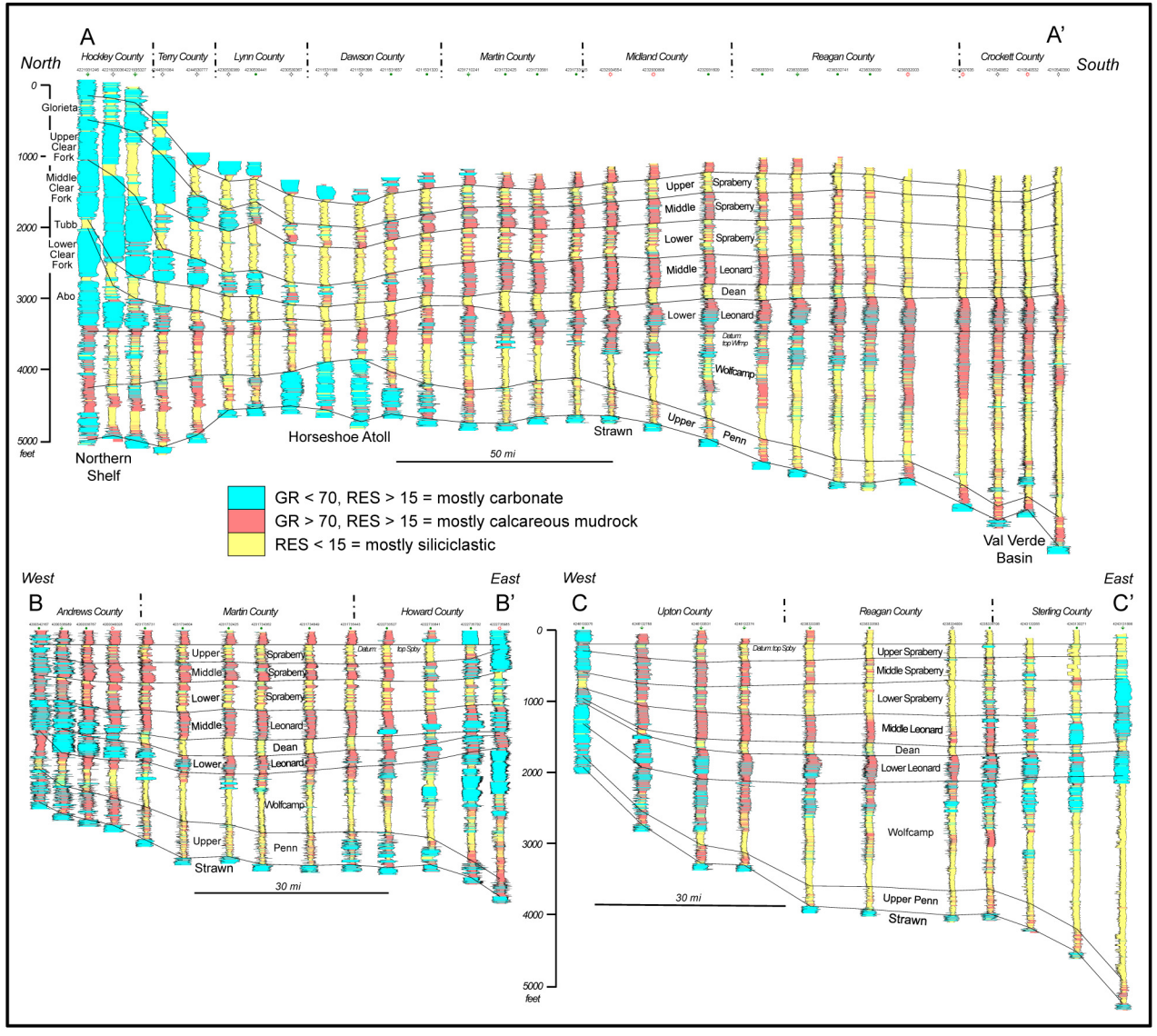
BASE MAPS



INTERVAL ISOPACH MAPS



WOLFBERRY REGIONAL CROSS SECTIONS SHOWING "QUICK LOOK" LITHOLOGY FROM GAMMA-RAY AND RESISTIVITY LOGS



WOLFBERRY PLAY, MIDLAND BASIN, WEST TEXAS: LITHOFACIES AND PRODUCTION

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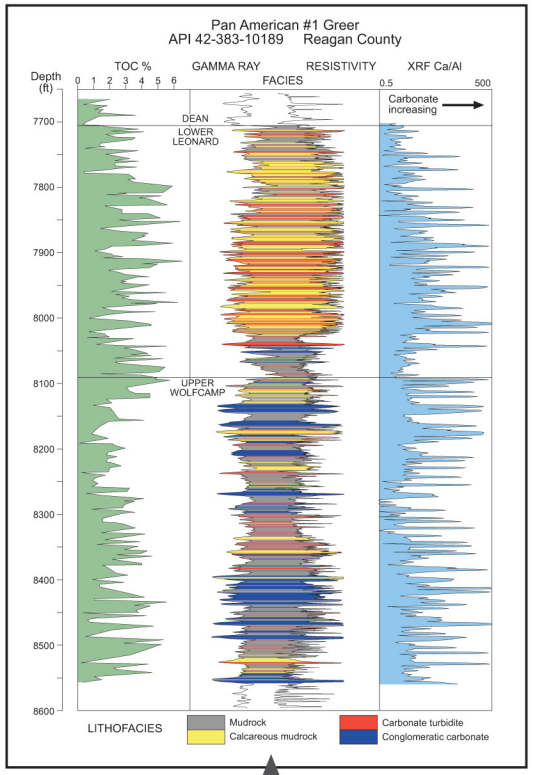
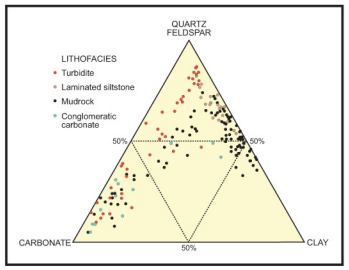
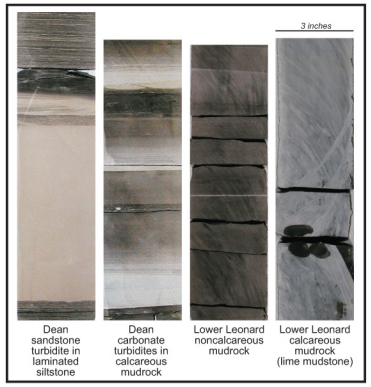
LOWER LEONARD AND WOLFCAMP CORE SOUTHERN MIDLAND BASIN



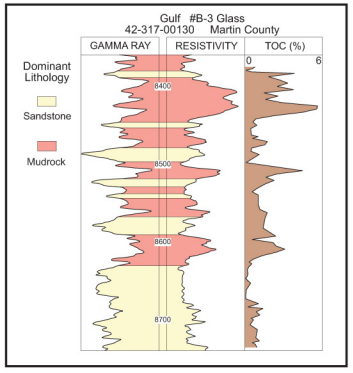
LEONARD AND WOLFCAMP CORE XRD MINERAL COMPOSITION



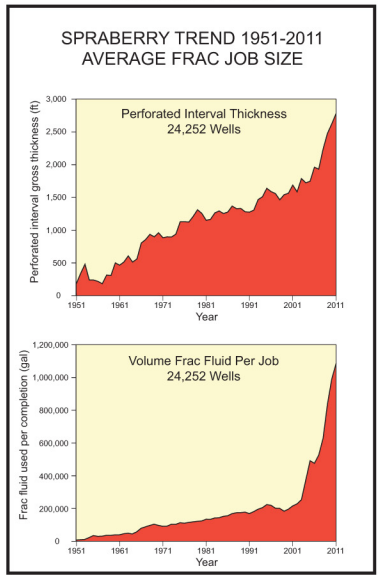
LEONARDIAN LITHOFACIES - CORE EXAMPLES



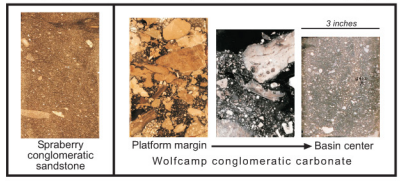
LOWER SPRABERRY CORE TURBIDITE SANDSTONES AND ORGANIC-RICH MUDROCKS



Wolfberry began in Spraberry Trend But when did it start?

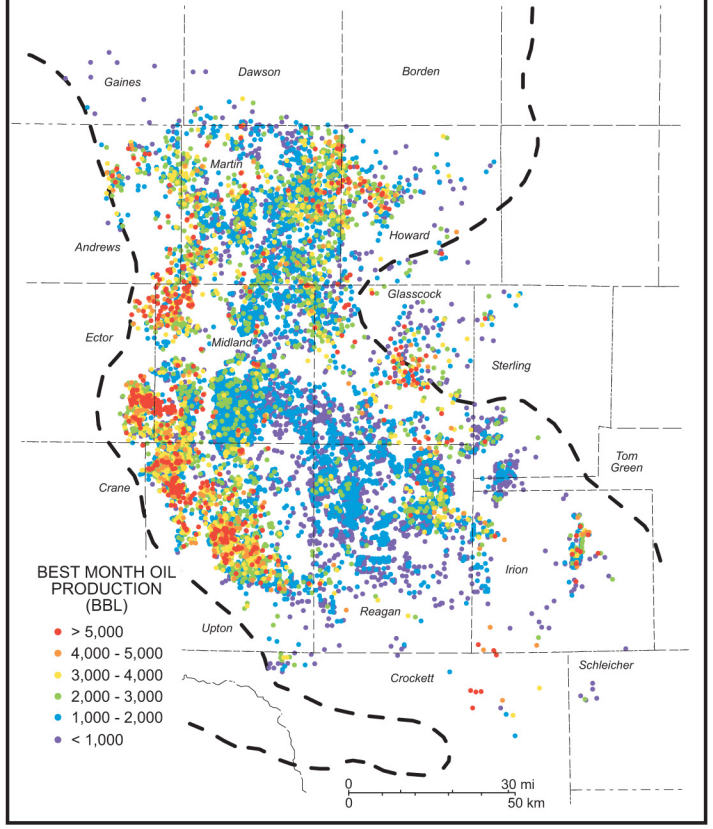


CONGLOMERATIC LITHOFACIES = DEBRIS FLOWS



Best Wolfberry wells are concentrated near platform margins where carbonate-clast debris-flow lithofacies are best developed. Horizontal wells in the south are also good producers.

WOLFBERRY PLAY BEST MONTH OIL PRODUCTION 9,640 WELLS 1998-2011



WOLFBERRY PLAY PRODUCTION TRENDS 1998-2011