

# **Wolfcamp Horizontal Play, Midland Basin, West Texas\***

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## **Abstract**

A total of 116,302 wells have been drilled for oil and gas in the Midland Basin of West Texas, including 96,894 oil and gas producers, a success rate of 83%. Productive portions of the Basin are in the south and center of the Basin; the northern portion has had comparatively little production. The Wolfcamp Formation (Wolfcampian-Leonardian) exists across the entire Midland Basin and was first drilled as a vertical oil play in the 1950's. Various operators experimented with horizontal wells in the Wolfcamp during 1990 — 2001, and the results of these early efforts were inconsistent. No wells were drilled in the play until 2007-2010 when six wells were drilled. Activity accelerated in 2011 when 57 wells were drilled in this resource play, and with the success of those wells, interest in the play has increased dramatically. Stratigraphically the Wolfcamp Formation is complex, consisting of mostly shale and argillaceous carbonates, with sand and sandy intervals near the basin edges, and facies that exhibit abrupt lateral changes. The Wolfcamp has stacked pay potential, with six possible target zones in which to direct horizontal wellbores, designated top-down as the A, B, C (upper and lower), and D (upper and lower) zones. The most drilled targets to date are the A and B zones in the section. Depths to the Wolfcamp in the Midland Basin vary from 4,000 feet in the east along the Eastern Shelf to 10,000 feet along the basin axis near the western basin edge. Gross thickness varies from about 700 feet to over 4,000 feet thick, with an average thickness of 1,663 feet. Structure does not appear to be an influence in this play. The total number of horizontal wells in the Midland Basin is 5,114, with 3,017 completed in the Wolfcamp interval. Wolfcamp horizontal wells can exhibit substantial initial potentials. To date, 24 wells have had IP's greater than 2,000 BOPD, with an average IP of all Wolfcamp horizontal wells of 680 BOPD. Although this play is still in the juvenile stage, cumulative production to date is 181 million BO. Porosity of the Wolfcamp Formation varies between 4% and 12% and averages 7%. Permeability is as low as 10 mD, necessitating multistage fracs. The Wolfcamp Shale has excellent shale rock properties; it

fractures well and has a good range of total organic carbon, between 2% and 7%. The Wolfcamp horizontal wells were drilled and completed by 61 operators, with the top three being Pioneer Natural Resources, Apache Corporation, and Laredo Petroleum; 20% of these 61 operators have drilled 80% of the Wolfcamp horizontal wells. Recent drilling has increased lateral lengths to 13,000 feet, with Pioneer leading this effort. Average lateral length for the Wolfcamp horizontal wells is 7,107 feet, and 122 wells have laterals greater than 10,000 feet. Estimated ultimate recovery is greater than 500,000 BOE per horizontal well, which increases with increasing lateral length. Based upon areal extent, thick and abundant source rocks, and multiple producing horizons, the Wolfcamp Play is one of the largest resource plays in the world, particularly when combined with the overlying Spraberry Formation. Total recoverable reserves may exceed 35 billion BOE for the Wolfcamp horizontal play.

### **References Cited**

Blakey, R.C., 2008, Pennsylvanian-Jurassic sedimentary basins of the Colorado Plateau and Southern Rocky Mountains: in Miall, A.D. (ed.), *Sedimentary Basins of United States and Canada*. Elsevier, Amsterdam, p. 245-296.

Baumgardner, Jr., R.W., H.S. Hamlin, and H.D. Rowe, 2014, High-Resolution Core Studies of Wolfcamp/Leonard Basinal Facies, Southern Midland Basin, Texas: Search and Discovery Article #10607, Web Accessed November 21, 2016, [http://www.searchanddiscovery.com/documents/2014/10607baumgardner/ndx\\_baumgardner.pdf](http://www.searchanddiscovery.com/documents/2014/10607baumgardner/ndx_baumgardner.pdf)

Fu, Q., 2011, A synthesis of the Wolfcampian platform carbonate system in the Permian Basin Region: Presentation at West Texas Geol. Soc., March 8, 2011, Bur. Econ. Geol., Univ. Texas at Austin, Web Accessed November 21, 2016, <http://www.wtgs.org/media/files/None/Synthesis-of-the-Wolfcampian-Platform.pdf>

Galloway, W.E., T.E. Ewing, C.M. Garrett, N. Tyler, and D.G. Bebout, 1983, *Atlas of major Texas oil reservoirs: The University of Texas at Austin, Bureau of Economic Geology Special Publication*, 139 p.

Pioneer Natural Resources, 2013, Used Slide 30 of 43 from an investor presentation given in 2014. This investor presentation is no longer available through the Pioneer website. It was originally accessed on 1/20/16.

Roberts, J., 1989, *GDS Geological Column: Geological Data Service*, Dallas, TX, 1 p.



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# **WOLFCAMP HORIZONTAL PLAY, MIDLAND BASIN, WEST TEXAS**

AAPG-PS/RMS Meeting, Las Vegas, Nevada, October 4, 2016

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# Agenda

- Introduction
- Play History
- Data Summary
- Geologic Characteristics
- Source Rock Characteristics
- Play Particulars
- Summary
- Question & Answer

## Play History – Santa Rita No. 1

- 1923 – Drilled and completed. It was one of the first producing oil wells in the Permian Basin. Santa Rita is the patron saint of impossible dreams.
- 1958 - The original production equipment was restored and moved to the Univ Texas Austin campus, corner of San Jacinto Blvd and Trinity Street.
- 1990 - Marathon plugged the well after 67 years of production.

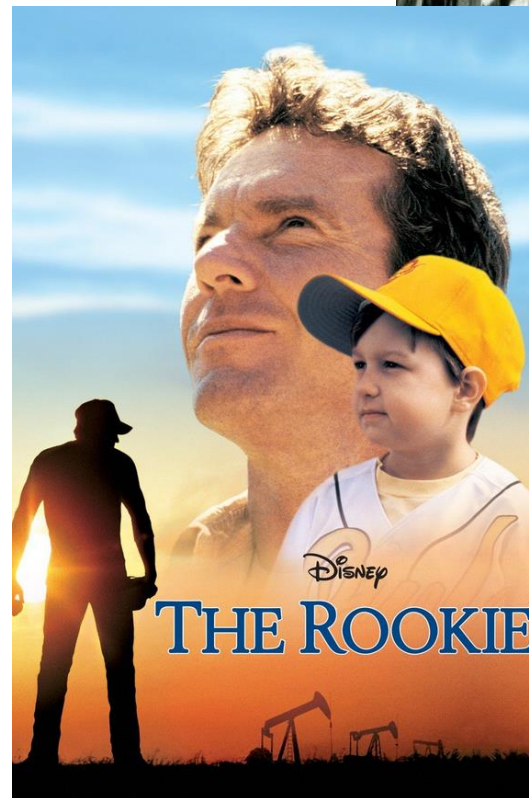


Photo by Rachael Moreland



## Play History – Santa Rita No. 1

- The Santa Rita No. 1 played a role at the beginning of the 2002 film, “The Rookie”, starring Dennis Quaid.



# Midland Basin Summary

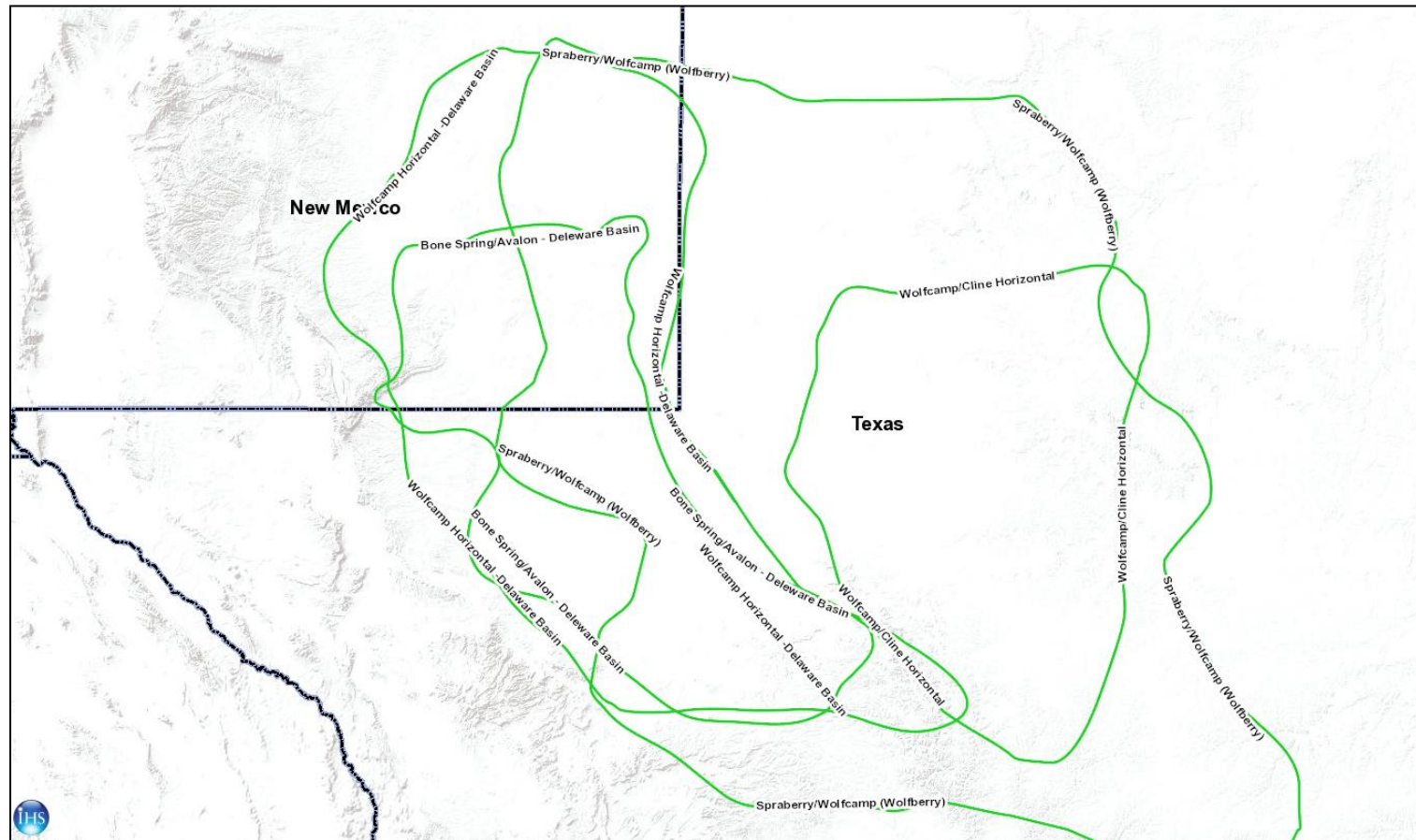
- 116,302 Total wells drilled in the Basin
- 96,894 Wells have produced oil & gas
- Success Rate = 83%
- South & Center portions of Basin are the most productive
- 5114 Total Horizontal wells drilled

## Data Summary

- Enerdeq – Greater Permian Basin  
571,119 wells
- IHS Interpreted Formation Tops  
284,945 wells
- Wolfcamp Shale Bench Correlations  
6,200 wells



# Play Map – Greater Permian Basin

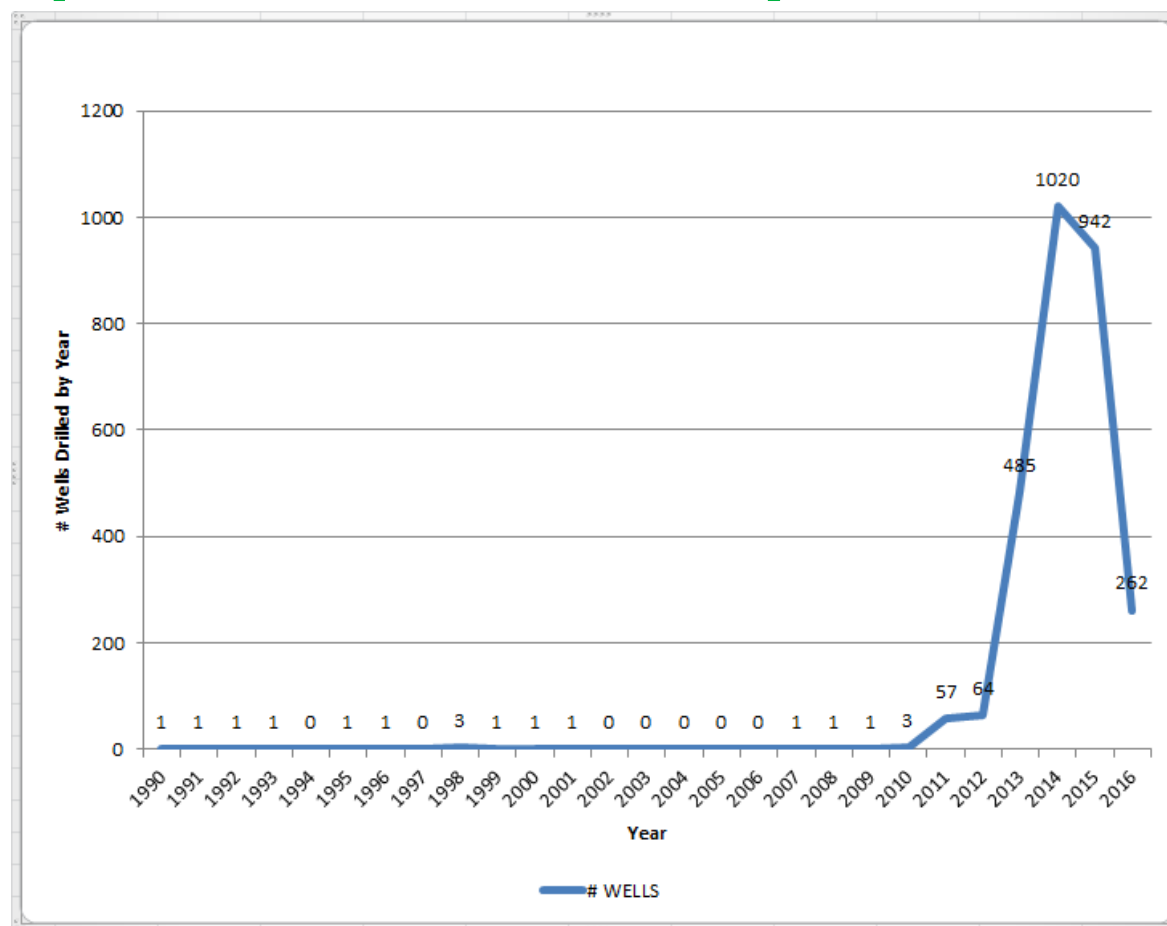


From IHS Enerdeq (2016)

## Play History

- 1950-1990 - Vertical play  $\pm$  Spraberry; 27,114 wells drilled
- 1990-2001 - 12 HZ wells drilled
- 2002-2006 - No HZ wells drilled
- 2007-2010 - 6 HZ wells drilled
- 2011 - 57 HZ wells drilled
- 2012 - 164 HZ wells drilled
- 2013 - 485 HZ wells drilled
- 2014 - 1020 HZ wells drilled
- 2015 - 942 HZ wells drilled
- 2016 - 262 HZ wells drilled (thru May)

# Wolfcamp HZ Wells Drilled by Year



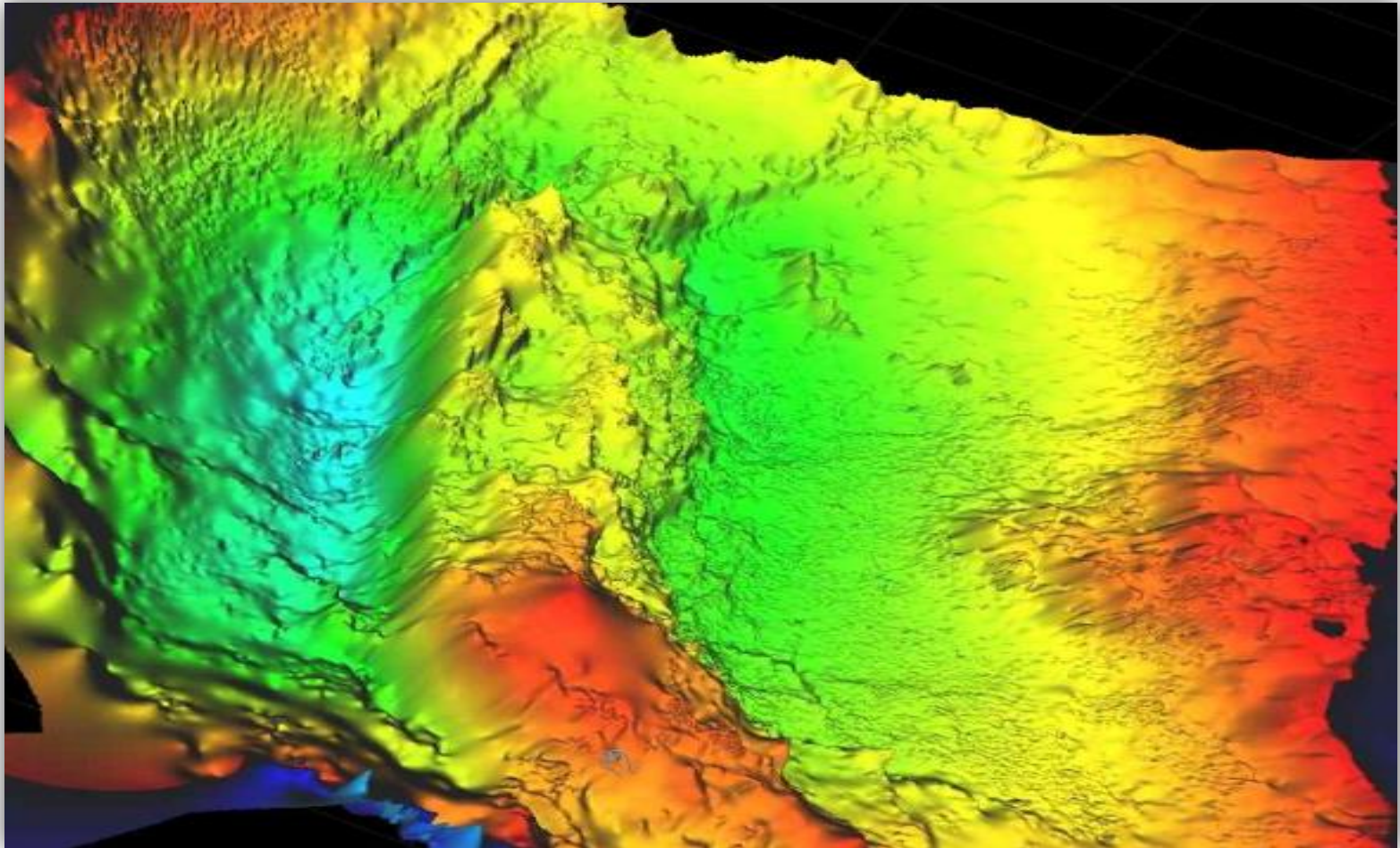
## Notes

- Data thru August 2016
- Source: IHS Enerdeq (2016)

# Geologic Characteristics

- Depths: 4,000 – 10,000 ft
- Thickness: 700-4,000 ft
  - > Average thickness: 1,663 ft
- Porosity: 4% - 12%
  - > Average porosity: 7%
- Permeability: as low as 10mD

# Permian Basin 3D Wolfcamp Structure

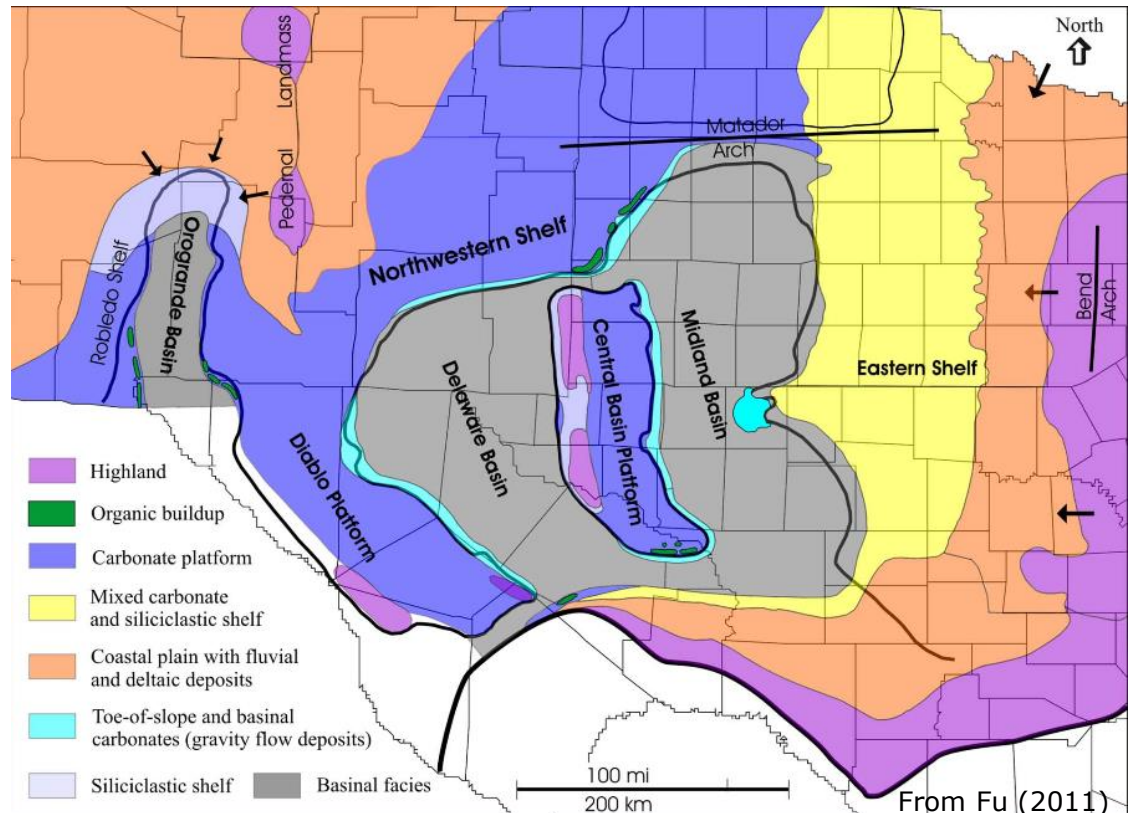


Note: Generated from 110,000 Wolfcamp tops; view is to the north. From IHS Formation Tops



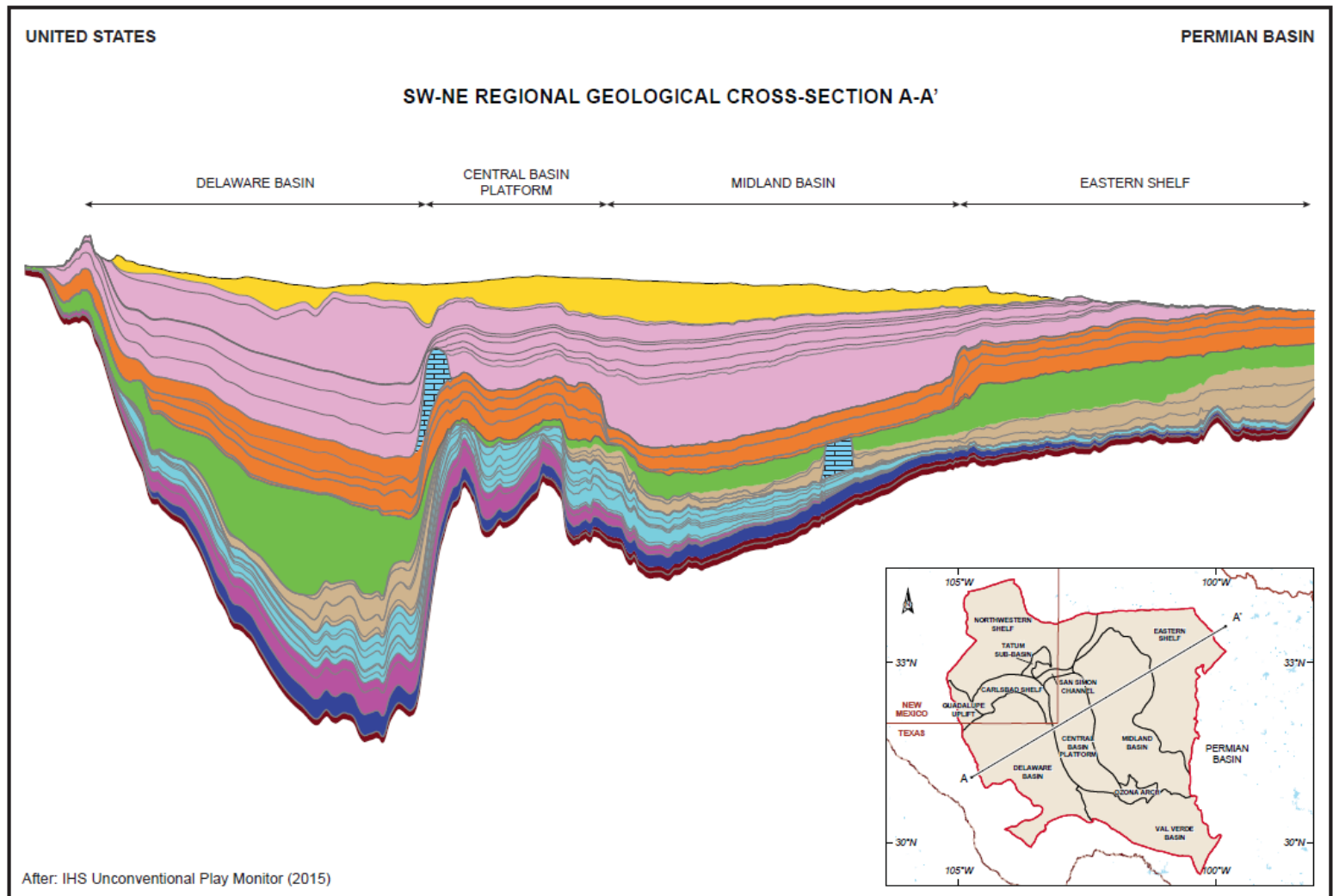
# Age - Wolfcampian

- Geological Setting
- Late Wolfcampian paleogeography in the Greater Permian Basin

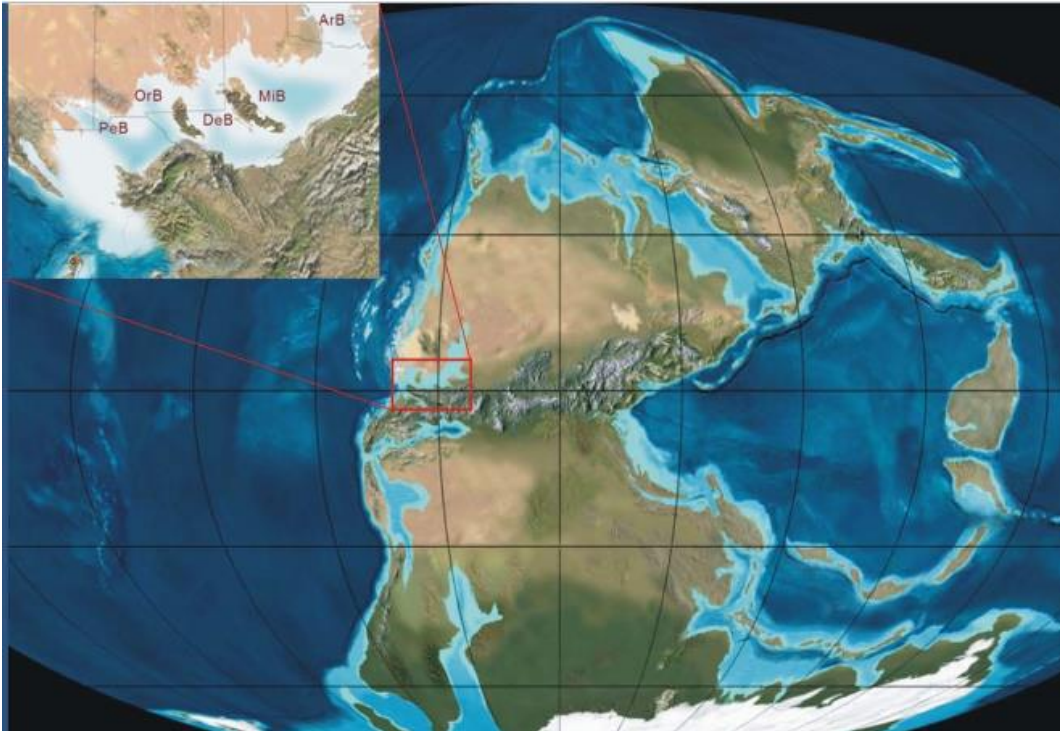




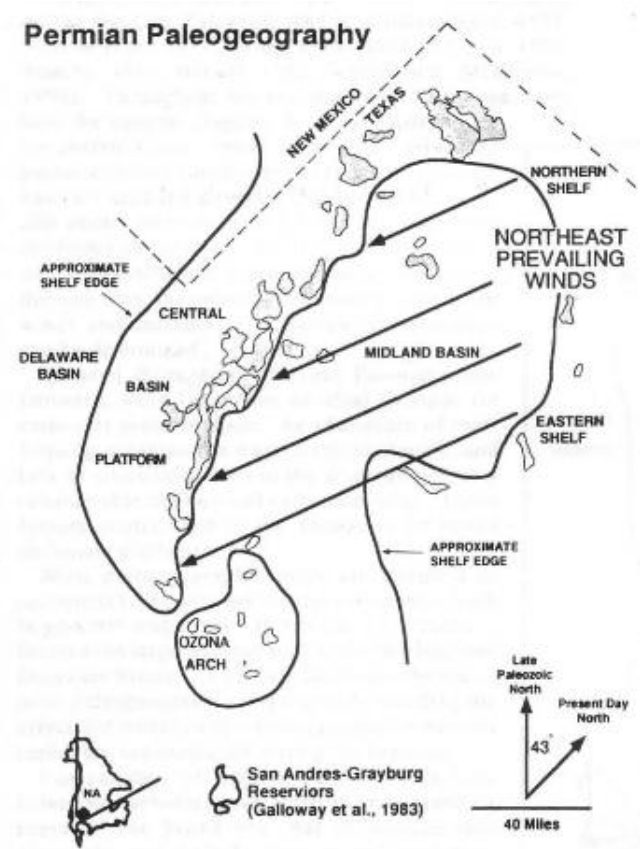
# Greater Permian Basin Cross Section



# Wolfcampian Paleogeography of the Midland Basin



From Blakey (2008) and Fu (2011)



# Regional Stratigraphy

- Stratigraphy of Midland Basin consists of thick Permian & Pennsylvanian sections
- Several productive plays; focus here is on the Wolfcamp
- Wolfcamp has been an active vertical play in the Midland Basin since the 1950's
- Wolfcamp is now an unconventional play

GDS DATA BASE		MIDLAND BASIN	
SYSTEM	SERIES	CENTRAL BASIN PLATFORM	MIDLAND BASIN
Permian	Ochoa	Dewey Lake	Dewey Lake
		Rustler	Rustler
		Salado	Salado
	Guadalupe	Tansil	Tansil
		Yates	Yates
		Seven Rivers	Seven Rivers
		Queen	Queen
		Grayburg	Grayburg
		San Andres	San Andres PI marker
	Leonard	Glorieta	Glorieta
		Holt	Upp. Spraberry
		Clearfork	Lwr. Spraberry
		Tubb	Dean
		Wichita Albany	
	Wolfcamp		
Pensylvanian	Cisco	Cisco	Cisco PPRF
	Canyon	Canyon	Canyon Horseshoe Atoll
	Strawn	Strawn	Strawn
Pennsylvanian	Atoka	Atoka	Atoka
	Morrow	Morrow	Morrow
	Springer		

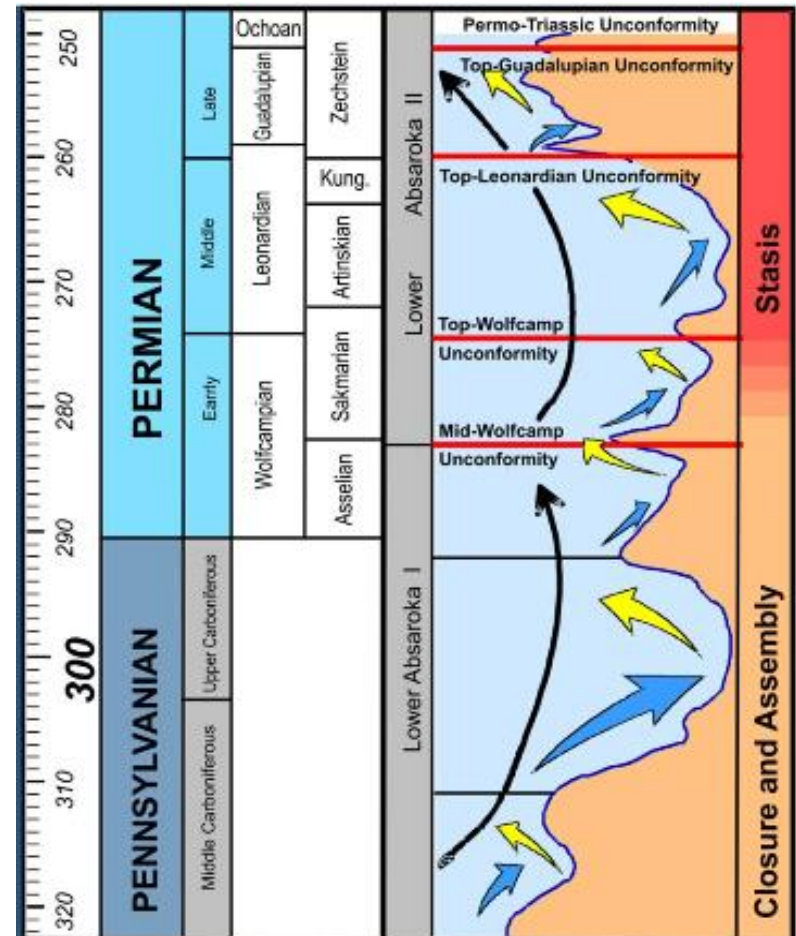
From Roberts (1989) and IHS Formation Tops

# Stratigraphy

- Lithology: Mostly shale and argillaceous carbonates
- Some sand and sandy intervals near basin edges
- Facies exhibit abrupt lateral changes
- 6 shale zones are targets

# Midland Basin Sequence Boundaries – Permo Penn

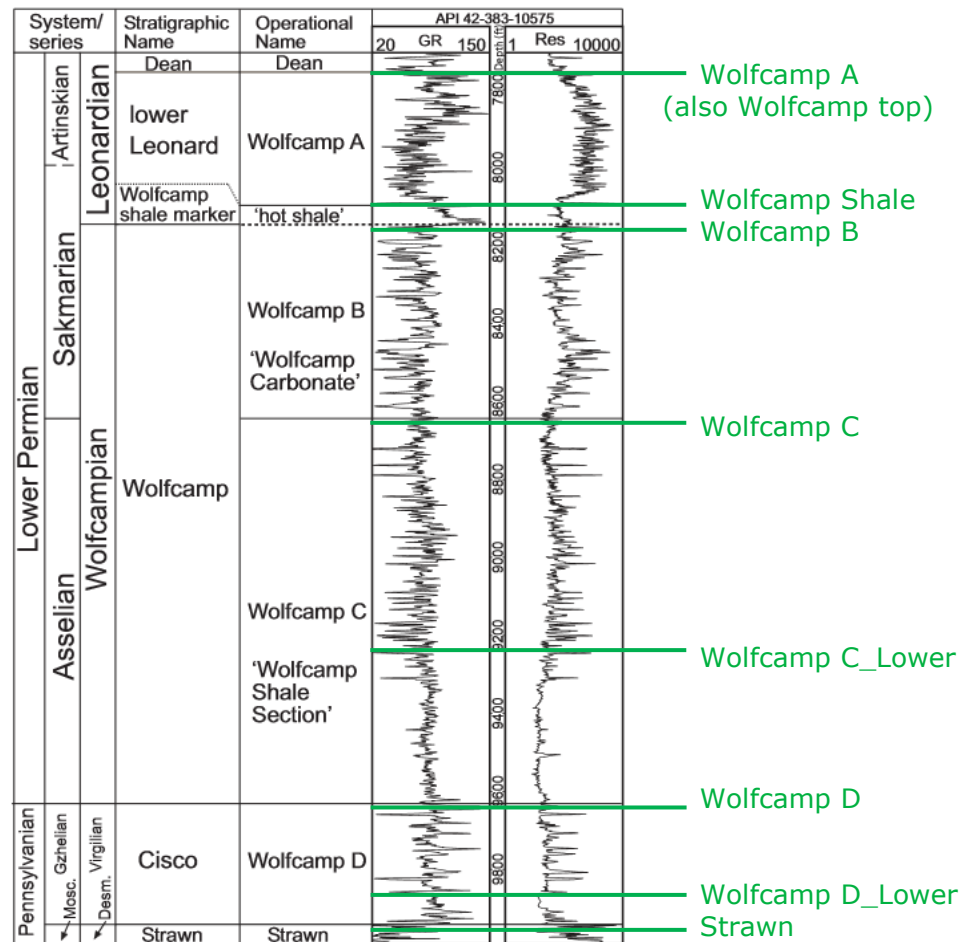
- Sequence boundaries related to transgressive and regressive seas
- 2<sup>nd</sup> Order Sequence boundaries present during Wolfcampian time



From Fu (2011)

# Wolfcamp Shale Benches - Type Log

- Type log for the Wolfcamp Section in the Midland Basin
- Clinton Oil #2 O. L. Greer  
API# 42-383-10575
- These 7 Wolfcamp Benches correlated in 6,200 wells in Wolfberry Trend in Midland, Glasscock, Reagan and Upton Counties
- Also tied these correlations to over 2,800 HZ wells

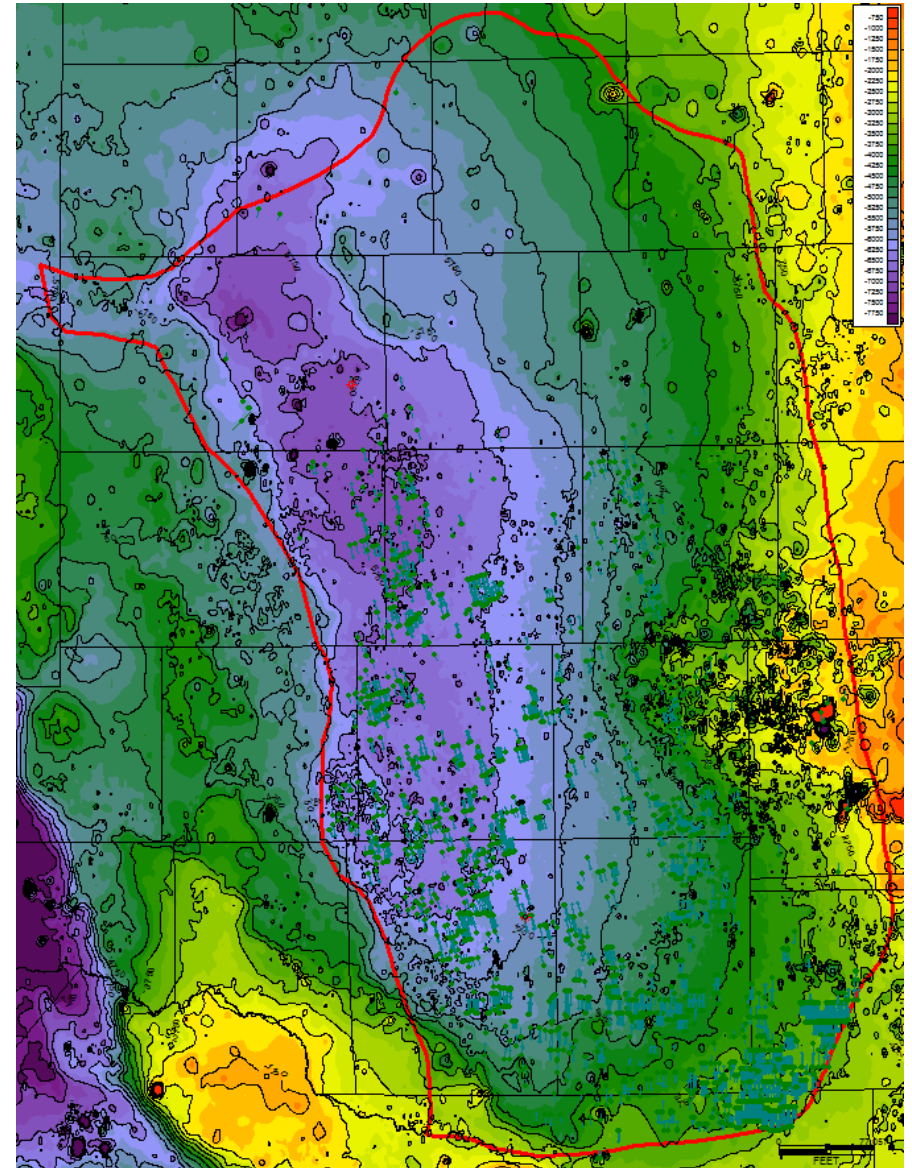


Data from IHS Energy (2016) and Baumgardner, et al (2014);  
Modified Feb 2016



# Wolfcamp Structure

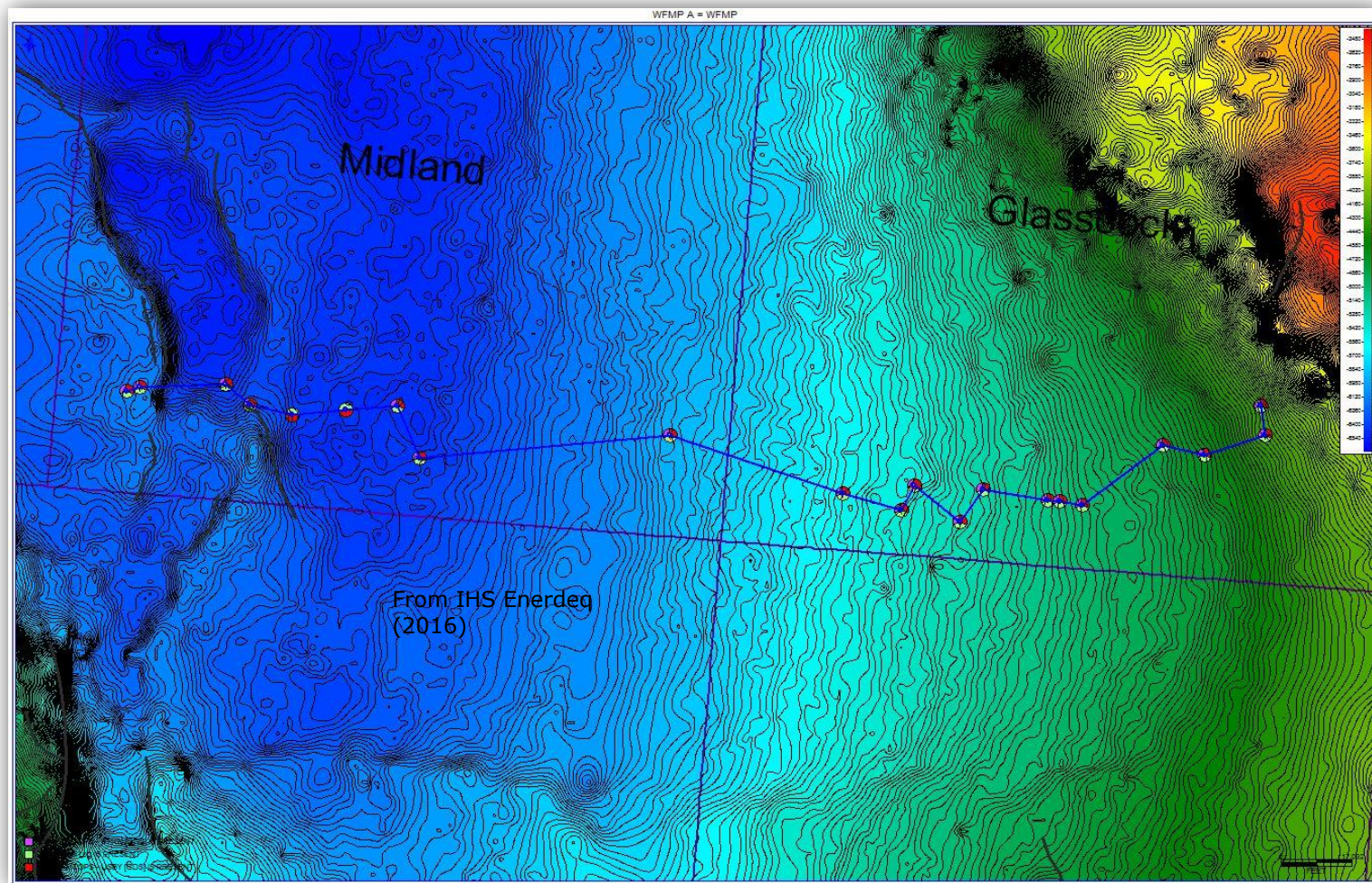
- Contoured top of Wolfcamp Fm
- Contour Interval = 500 ft
- Wolfcamp is 1000 - 4000 ft thick
- Tops from GDS correlated tops data (272,000+ correlated wells in Permian Basin)



From IHS Enerdeq (2016)



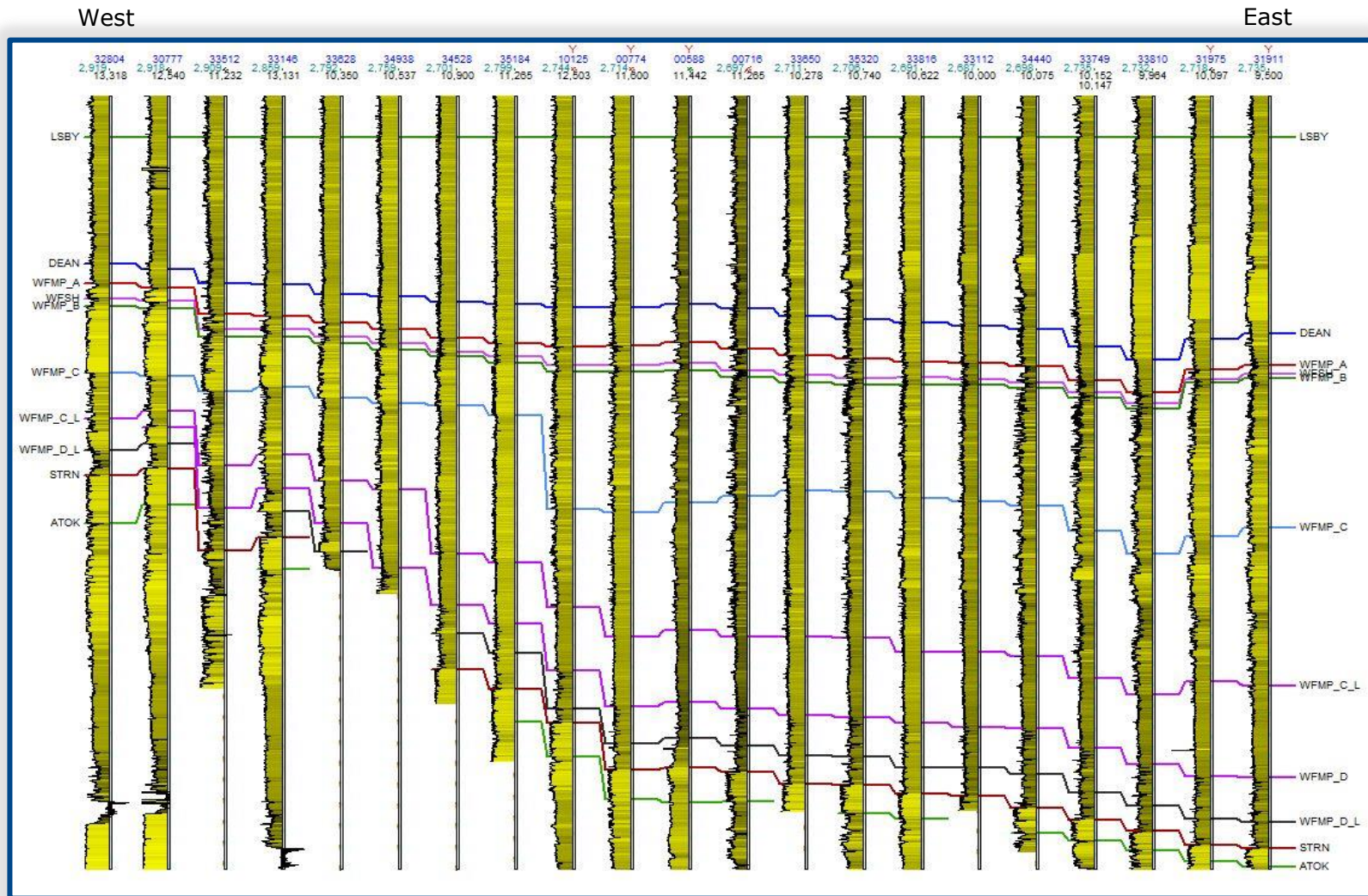
# Wolfcamp Structure



Contour Interval = 25 feet



# Cross Section with Wolfcamp Shale Benches



# Source Rock Characteristics

- Several thick shales: A, B, C upper, C lower, D upper, and D lower
- TOC: 2% - 7%
- Zones most drilled to date: A and B
- Shales respond well to fracture stimulation



## Play Particulars

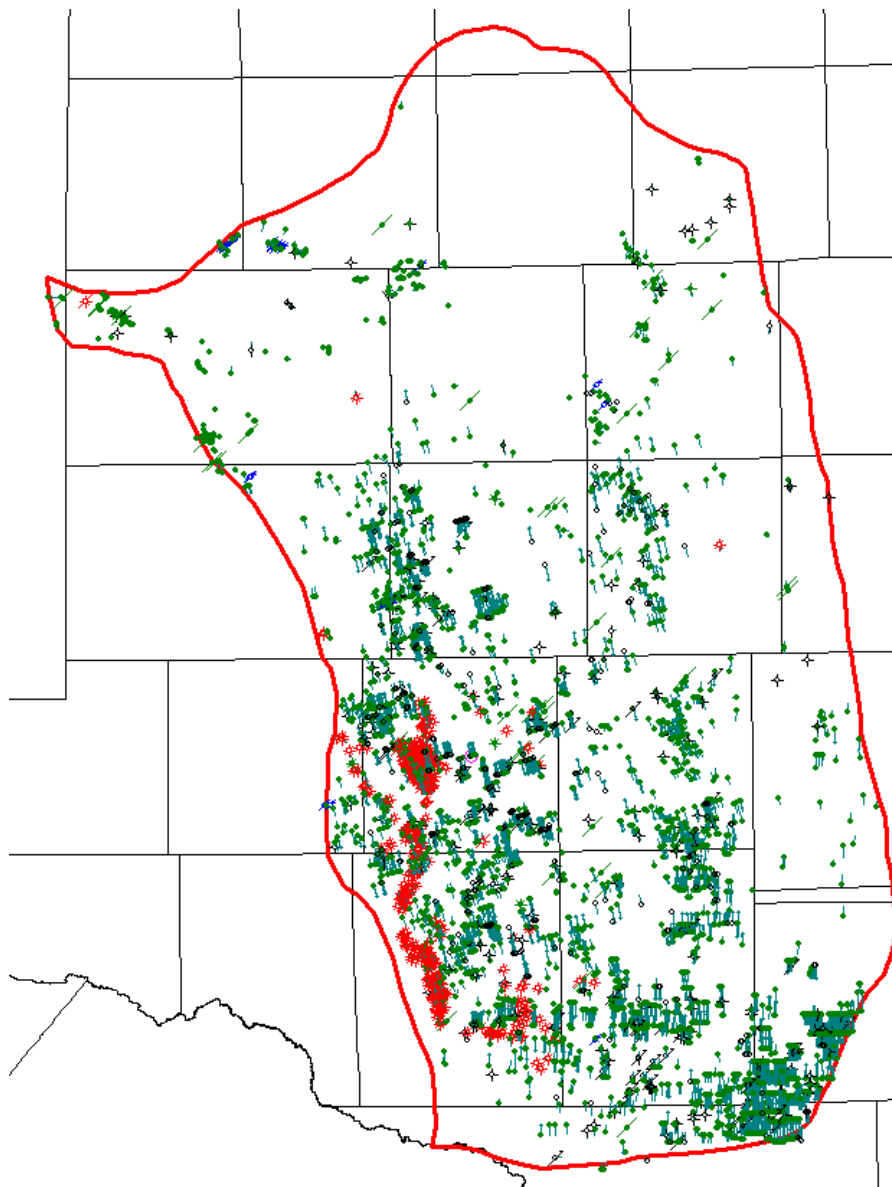
- 5,114 HZ wells drilled in Midland Basin
- 3,017 HZ wells Wolfcamp;
  - drilled by 61 operators
  - 20% ops drilled 80% of wells
- Top 3 operators are:
  - Pioneer Natural Resources
  - Apache Corp
  - Laredo Petroleum





# Play Particulars

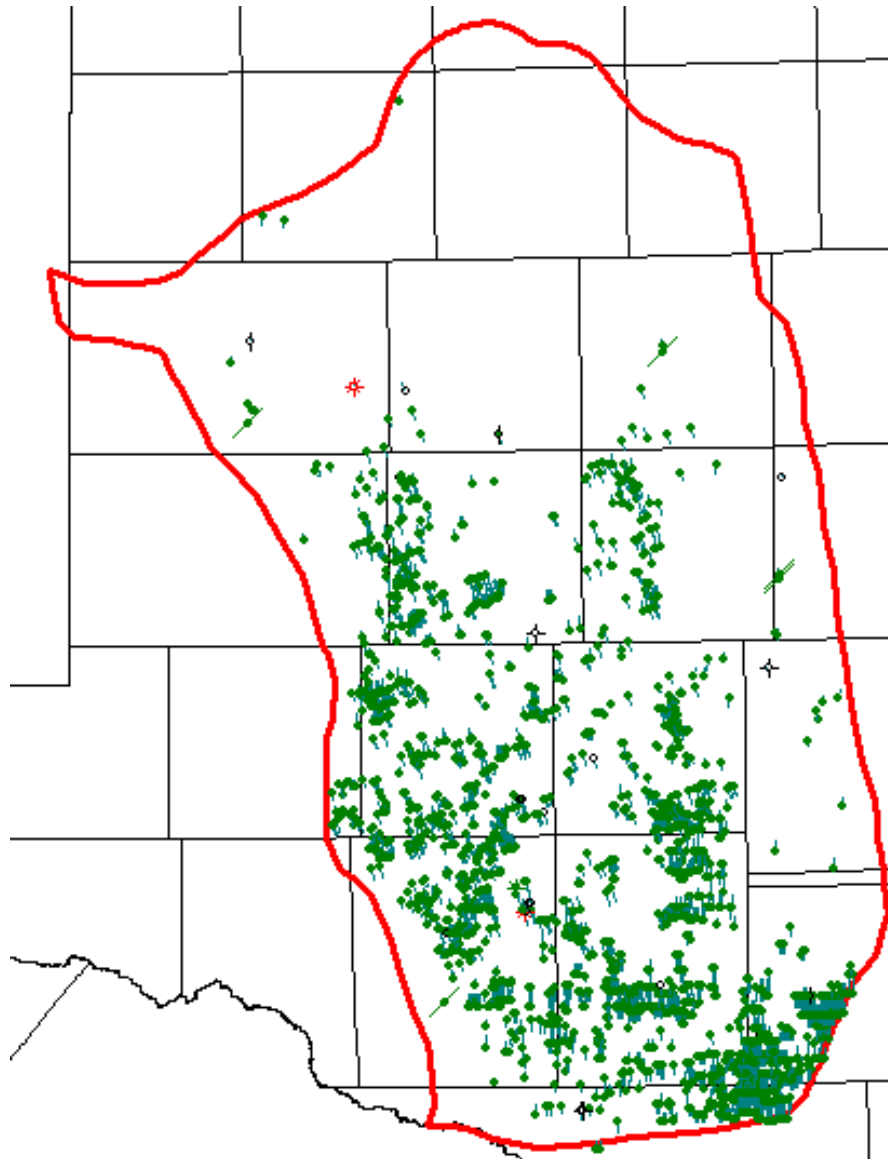
- 5,114 total HZ wells drilled in Midland Basin



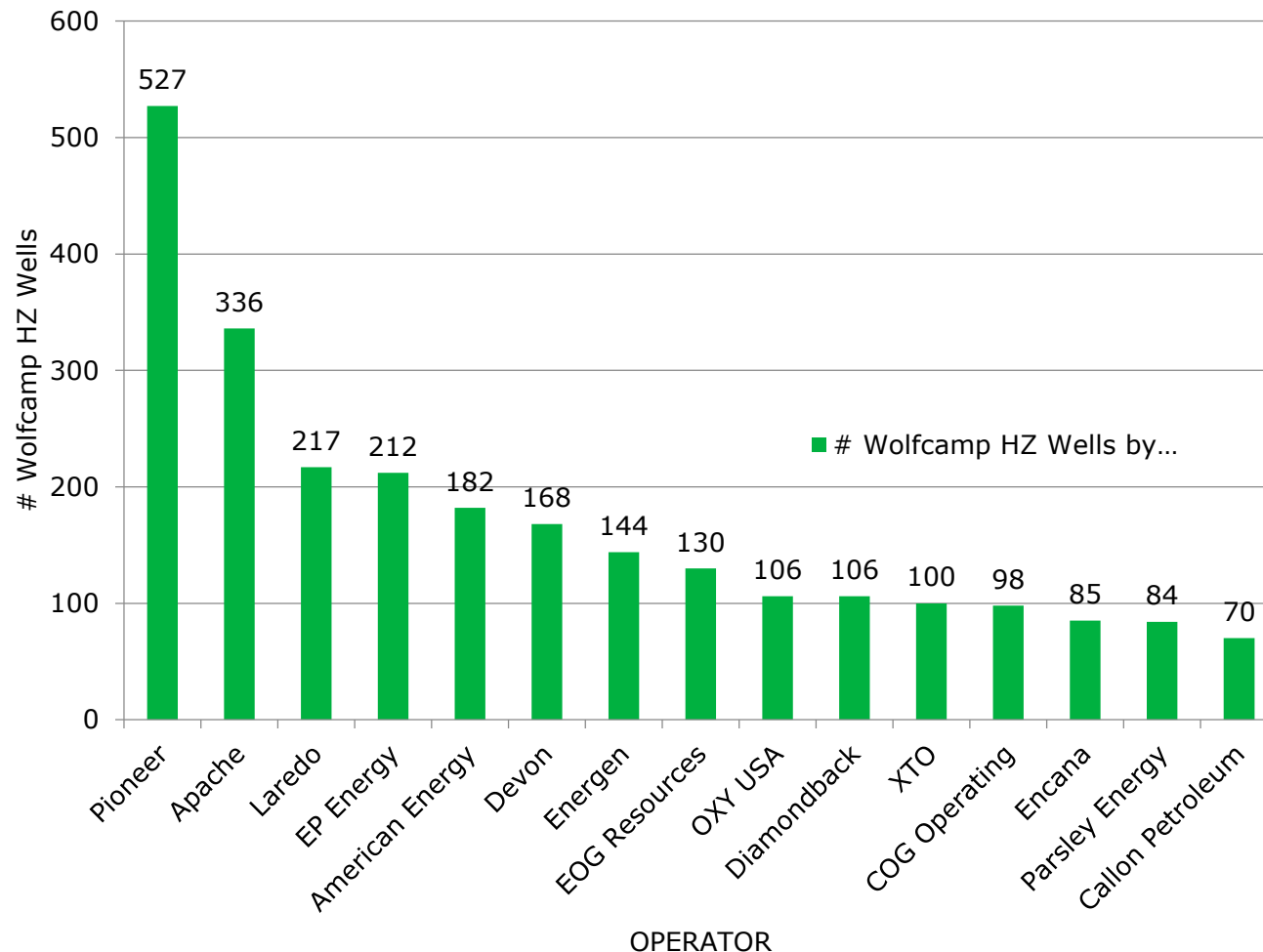


## Play Particulars

- 3,017 total HZ wells drilled in Wolfcamp Formation

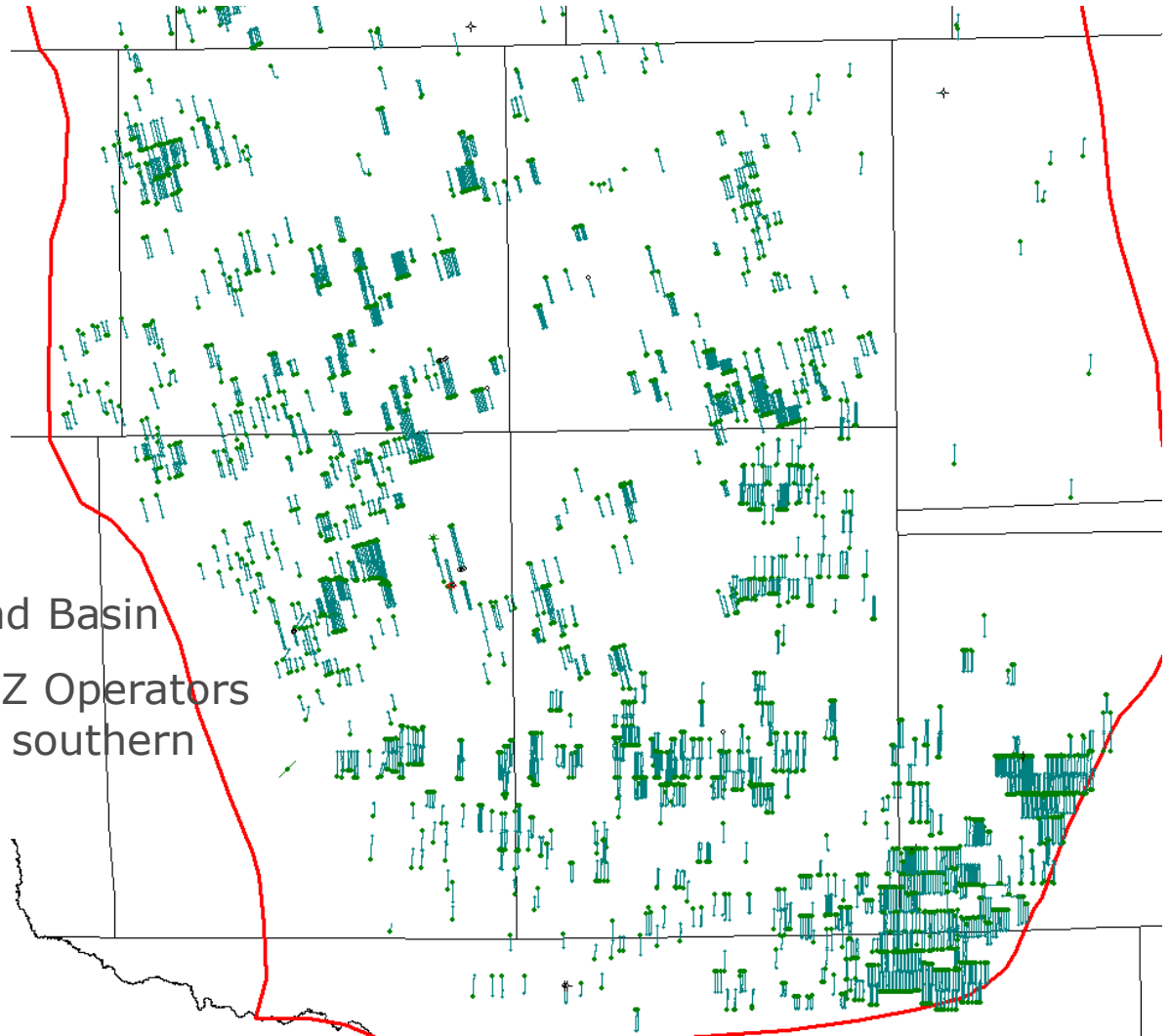


# Wolfcamp HZ Wells by Operator



Note: Data from Enerdeq thru May 2016

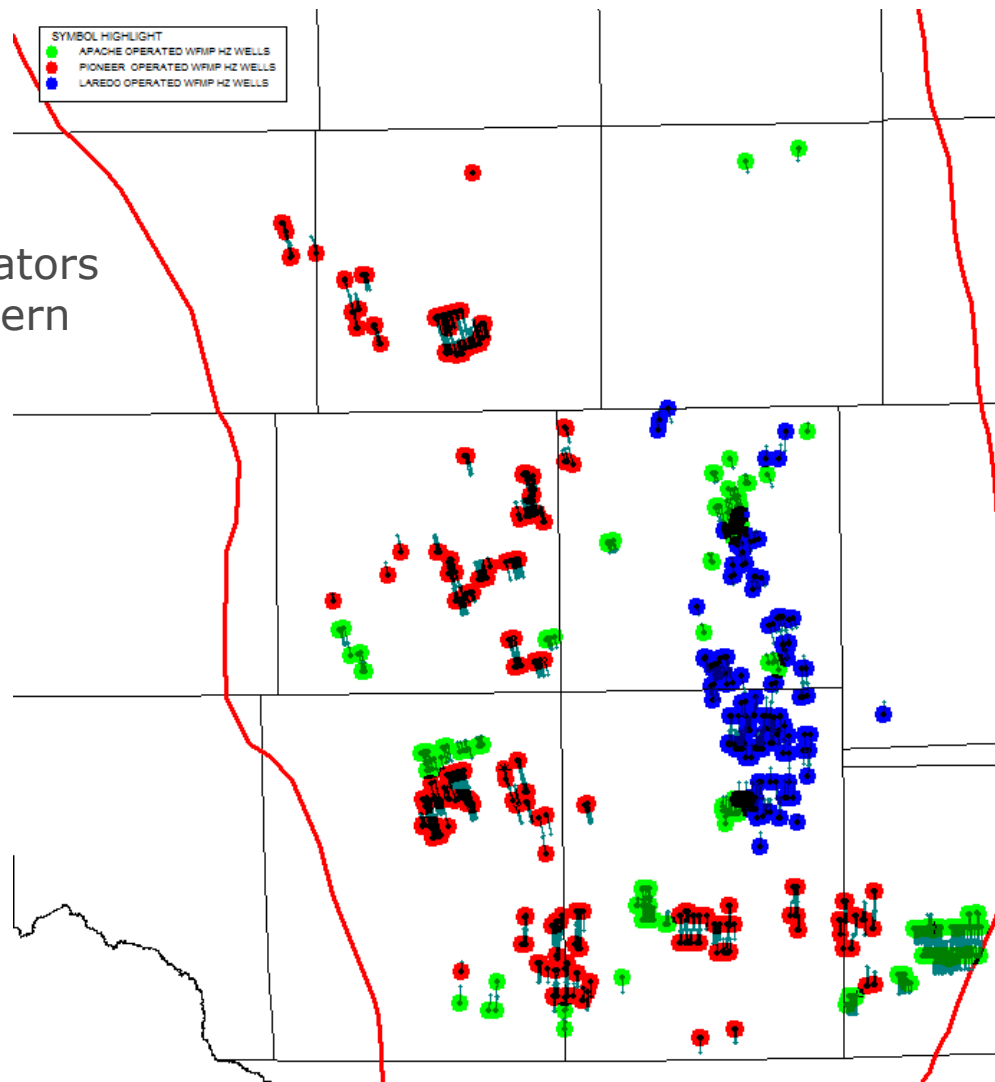
# Top 15 Wolfcamp HZ Operators - Midland Basin



- Map of Southern Midland Basin
- The top 15 Wolfcamp HZ Operators have 2,510 wells in the southern Midland Basin

# Top 3 Wolfcamp HZ Operators - Midland Basin

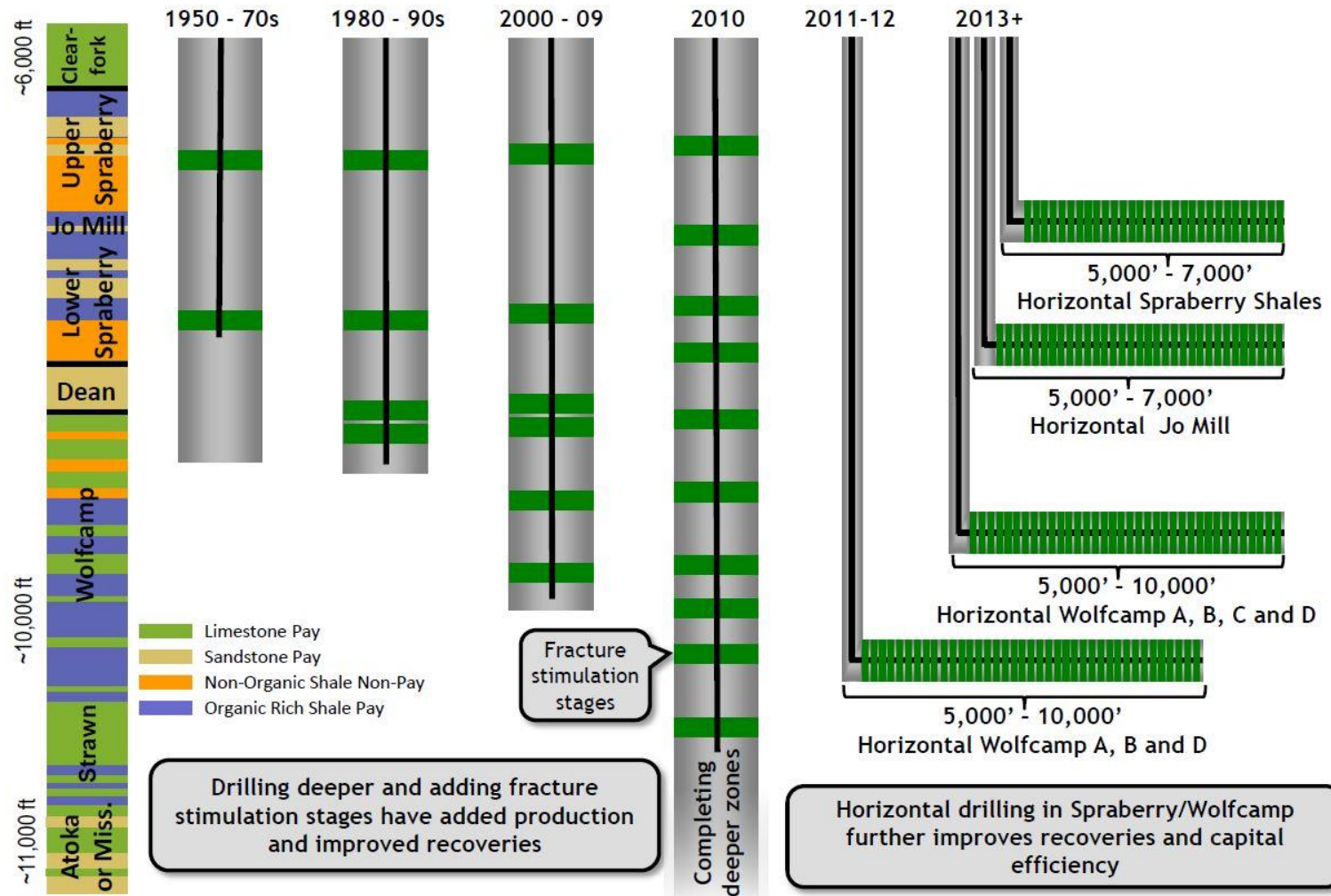
- The top 3 Wolfcamp HZ Operators have 1,080 wells in the southern Midland Basin
- These include:
  - > Pioneer Natural Resources
  - > Apache Corporation
  - > Laredo Petroleum



# Play Particulars – Lateral Lengths

- Total Wolfcamp HZ = 3,017 wells
- Average Lateral Length = 7,107 ft
- 122 wells with laterals > 10,000 ft
- Laterals now being drilled > 13,000 ft
  - i.e. by Pioneer

# Wolfcamp Play



From Pioneer Natural Resources (2013)



## Summary

- Based upon areal extent, abundant and thick source rocks, and stacked pay zones, the **Wolfcamp Play is one of the largest resource plays in the world.**
- When Wolfcamp and the overlying Spraberry Formation are combined, i.e. The Wolfberry Play, this may be the largest resource play in the world.
- Total Recoverable Reserves for the Wolfcamp Play may exceed 35 billion barrels oil.



# Questions?

