

Stratigraphy and Hydrocarbon Production from Pennsylvanian Age Granite Wash Reservoirs in the Western Anadarko Basin, Oklahoma and Texas

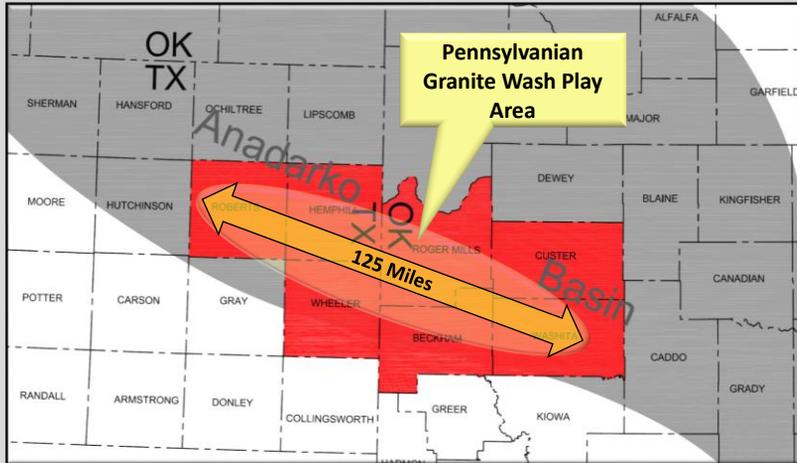


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November 13, 2014

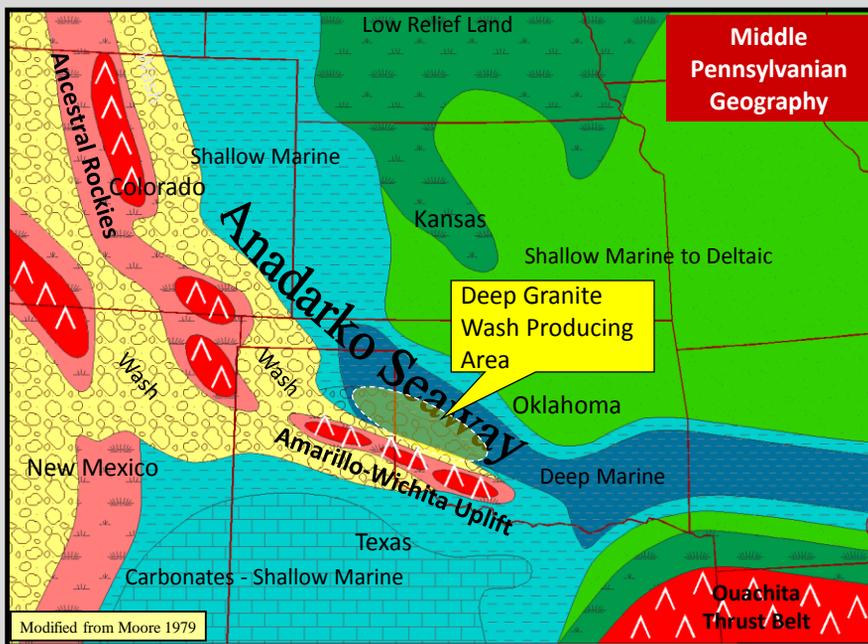
KEY POINTS

- Play extends over 125 miles from Roberts County, TX to Washita County, OK
- Granite Wash reservoirs derived from erosion of Lower Paleozoic igneous and sedimentary rocks on adjacent Amarillo-Wichita uplift
- Sandstone and conglomerate reservoirs are 8,000 to 14,500 feet deep
- Sedimentary column 2,500 to 5,000 feet thick
- Reservoirs in arkosic sandstones & conglomerates 20 to 200 feet thick
- Reservoirs mainly deposited in southwest to northeast trends
- Stratigraphic traps are dominant trap type
- Play limited on southwest by faults & water bearing massive sandstones; limited on north/northeast by thinning of reservoirs into distal silt facies
- Oil/gas source for Granite Wash believed to be Pennsylvanian age shales
- The western Anadarko Basin horizontal Pennsylvanian Granite Wash play has had 2,092 horizontal wells drilled since 2002, mostly since 2010
- More than 85 million barrels of oil and 1.8 TCF of gas produced from over 1600 horizontal wells *primarily over the last three years*
- 2013 horizontal Granite Wash well production of 22.5 MMBO and 426 BCFG
- Est. horizontal well daily production in March 2014 of 51,000 BOPD, 1.1 BCFGPD & 110,000+ BWPD

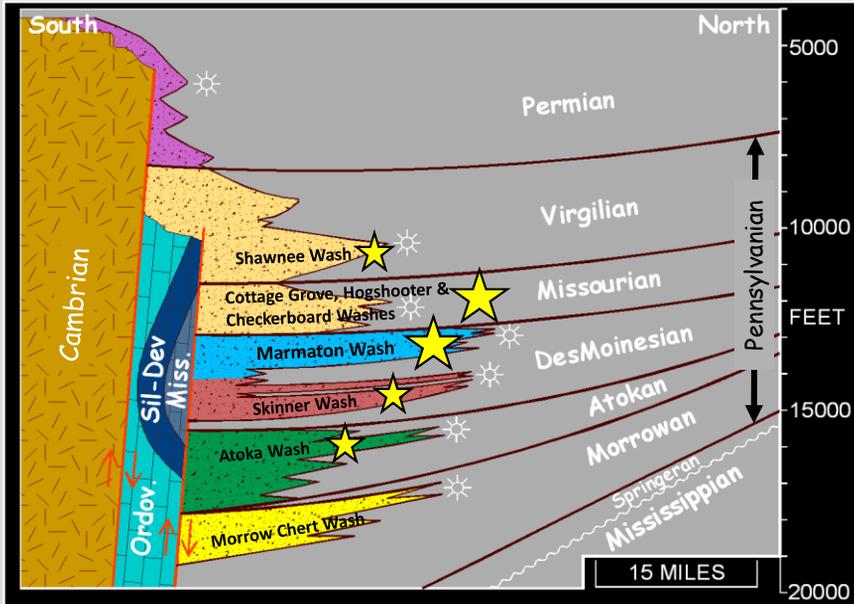
GRANITE WASH PLAY LOCATION MAP



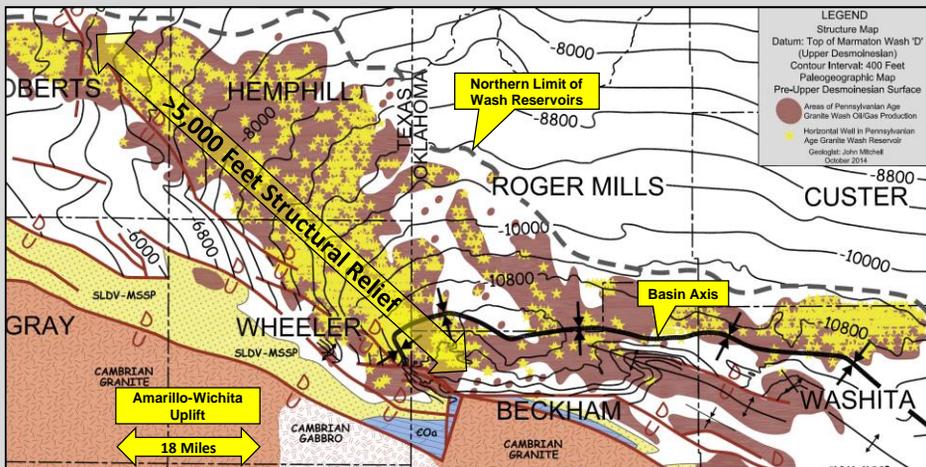
GRANITE WASH PLAY PALEOGEOGRAPHY



GRANITE WASH PLAY SCHEMATIC CROSS SECTION



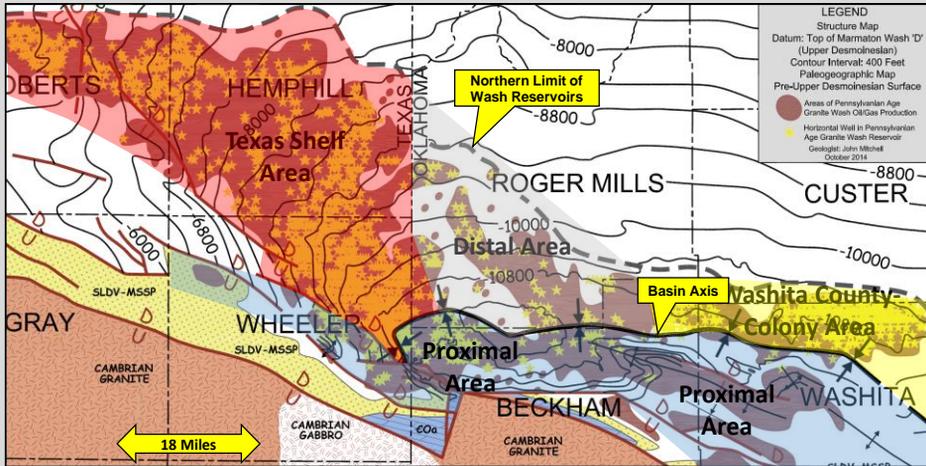
GRANITE WASH PLAY MAP: HORIZONTAL WELLS & DESMOINESIAN STRUCTURE



Areas in dark red show locations of Pennsylvanian Granite Wash oil & gas production
 Stars show locations of horizontal Granite Wash wells in September 2014
 Shaded areas note sub-play types in Granite Wash play (Mitchell, 2011)

MITCHELL

GRANITE WASH PLAY MAP: FOUR DISTINCT PLAY AREAS



Areas in dark red show locations of Pennsylvanian Granite Wash oil & gas production
 Stars show locations of horizontal Granite Wash wells in September 2014
 Shaded areas note sub-play types in Granite Wash play (Mitchell, 2011)

THE STRATIGRAPHIC COLUMN

STRATIGRAPHIC CHART			
SYS.	SERIES / STAGE	GROUP	UNIT
PENNSYLVANIAN	VIRGILIAN	Shawnee/Cisco	★ Shawnee Wash Heebner Sh
		Douglas/Cisco	Haskell Sh ★ Tonkawa Ss
	MISSOURIAN	Lansing/Hoxbar	★ Cottage Grove Wash
		Kansas City/Hoxbar	★ Hoxbar Wash/Shale ★ Hogshooter Wash ★ Checkerboard Wash ★ Cleveland Wash
			Marmaton
	DESMOINESIAN	Cherokee	★ Upper Skinner Shale ★ Upper Skinner Wash Lower Skinner Shale (Pink Ls Marker) ★ Lower Skinner Wash ★ Red Fork Ss & Sh
			Atoka
		Morrowan	Morrow

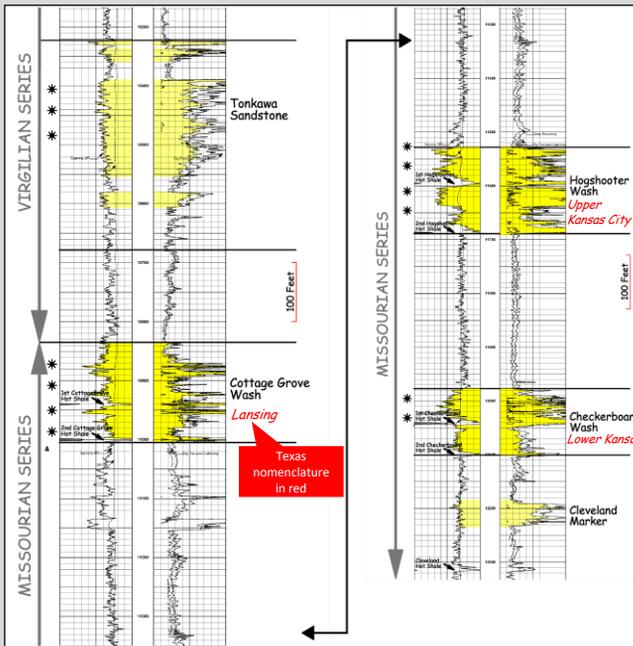
ANADARKO BASIN - MOUNTAIN FRONT - OKLAHOMA

Translation Chart for Texas Wash Stratigraphic Nomenclature

Missourian Stage:
 Cottage Grove = Lansing
 Hogshooter = Upper Kansas City
 Checkerboard = Lower Kansas City

Desmoinesian Stage:
 Marmaton "B" = Carr
 Marmaton "C" = Caldwell/Britt
 Marmaton "D" = Granite Wash "A"
 Marmaton "E" = Granite Wash "B"
 Marmaton "F" = Granite Wash "C"
 Upper Skinner = Granite Wash "D"
 Lower Skinner = Granite Wash "E"

THE STRATIGRAPHIC COLUMN

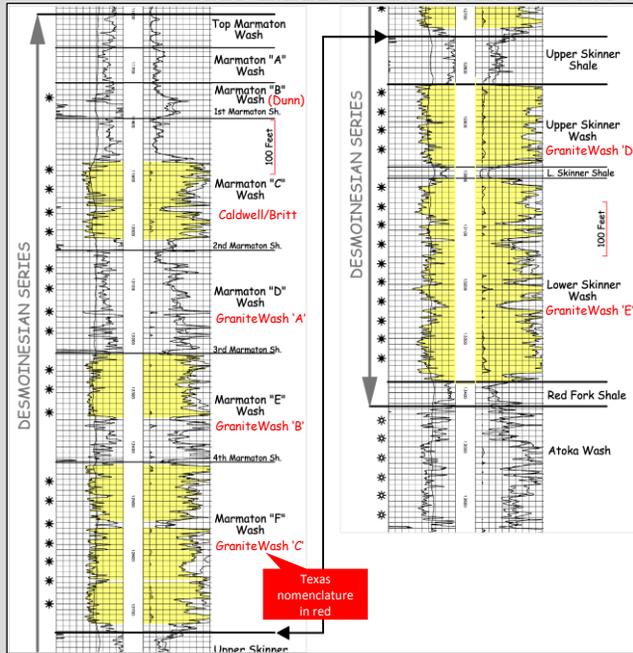


Type Log in the Missourian Wash, Deep Anadarko Basin, Texas & Oklahoma; Chesapeake #1-28 Mary K well, Sec. 28, T11N R23W, Beckham Co., Oklahoma

1300+ feet of Missourian Series Granite Wash section

Missourian Wash Has Produced 23.4 MMBO and 103 BCFG from 378 Horizontals Since 2010

THE STRATIGRAPHIC COLUMN



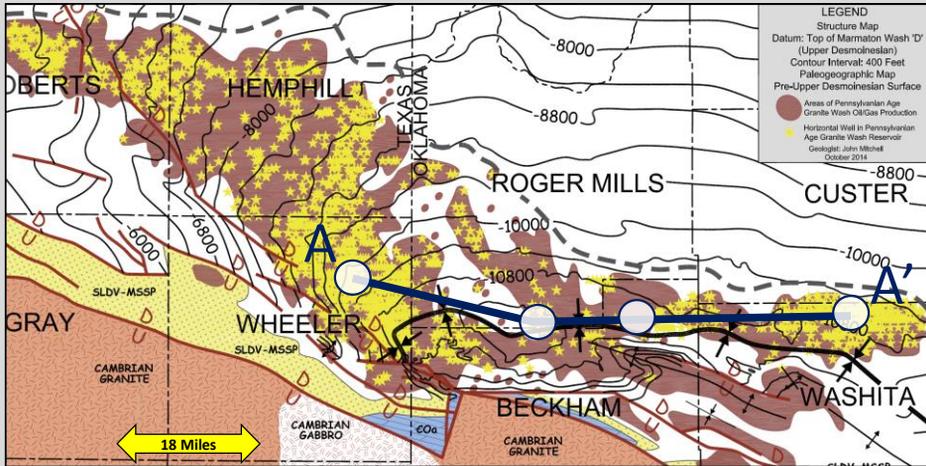
Type Log Desmoinesian Wash, Deep Anadarko Basin, Texas & Oklahoma: Devon #16-4 Truman-Zybach, Sec. 16, Block R&E Survey, Wheeler Co., Texas

1500+ feet of Desmoinesian Series Granite Wash section

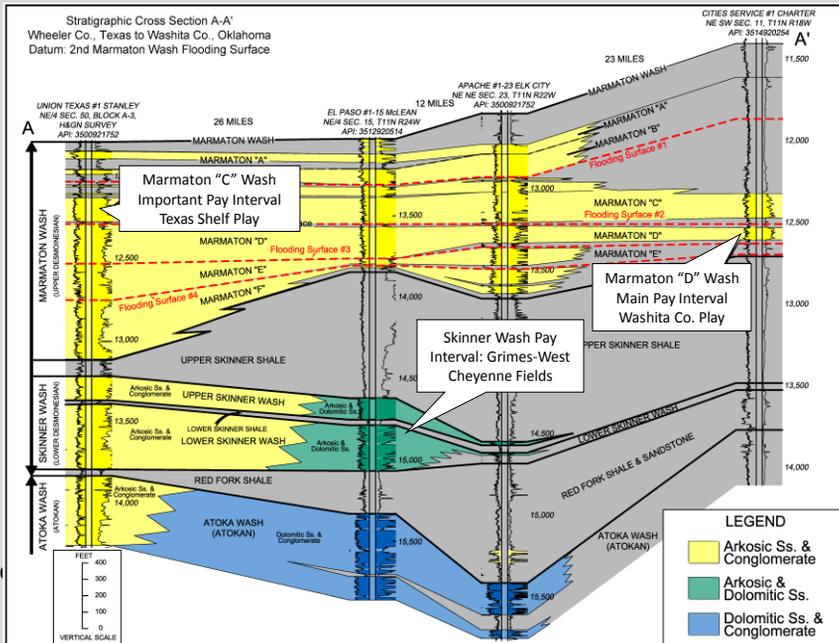
Desmoinesian Wash Has Produced 54 MMBO and 1.4 TCFG from 1,205 Horizontals Since 2002

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HORIZONTAL GRANITE WASH PLAY CROSS SECTION INDEX MAP



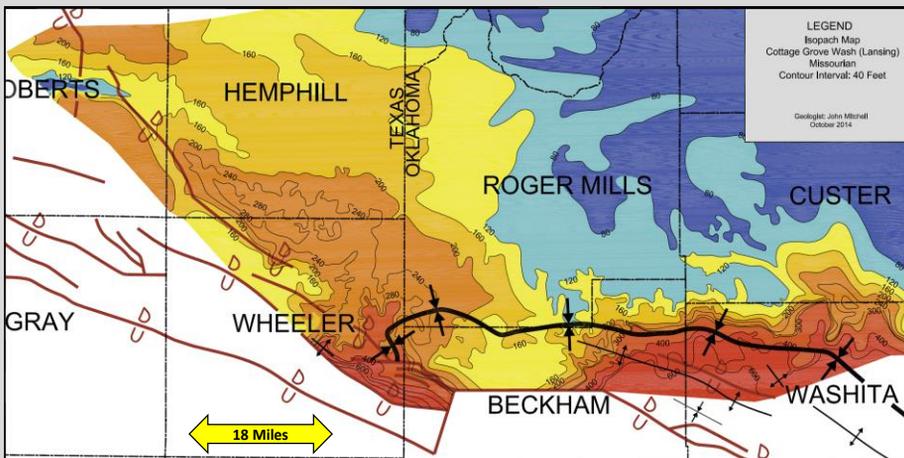
Areas in red show locations of Pennsylvanian Granite Wash Oil & Gas Production
Stars show locations of horizontal Granite Wash wells in September 2014



Stratigraphic cross section A-A', Desmoinesian & Upper Atoka Wash, Wheeler Co., TX to Washita Co., OK; Datum: 2nd Marmaton shale

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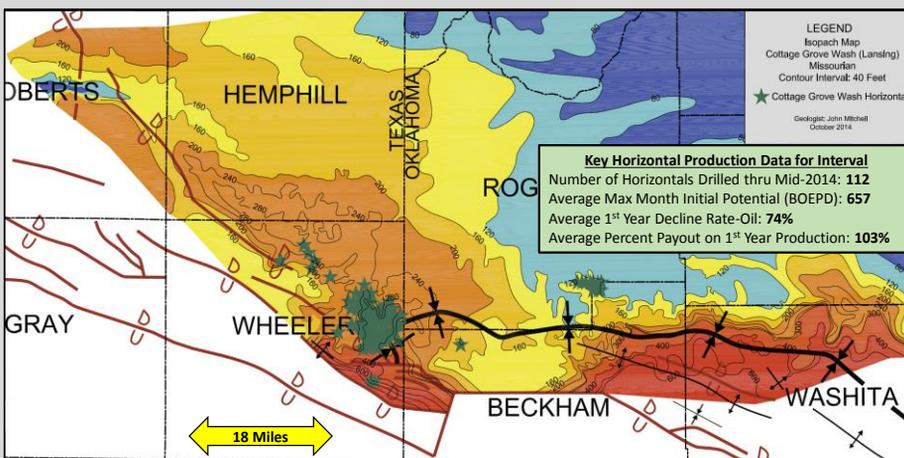
HORIZONTAL GRANITE WASH PLAY COTTAGE GROVE WASH ISOPACH MAP



Cottage Grove Wash = Lansing Zone in Texas Usage

*Interval Isopach Map
Contour Interval: 40/100 Ft*

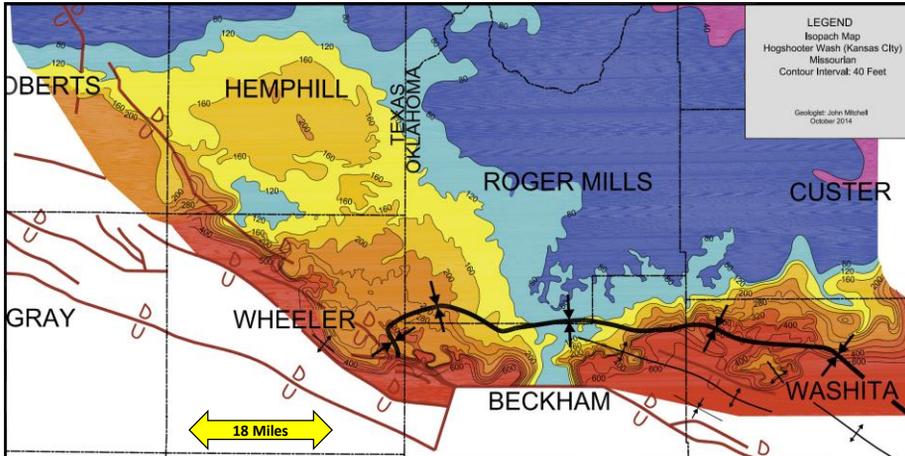
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Cottage Grove Wash = Lansing Zone in Texas Usage

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Contour Interval: 40/100 Ft*

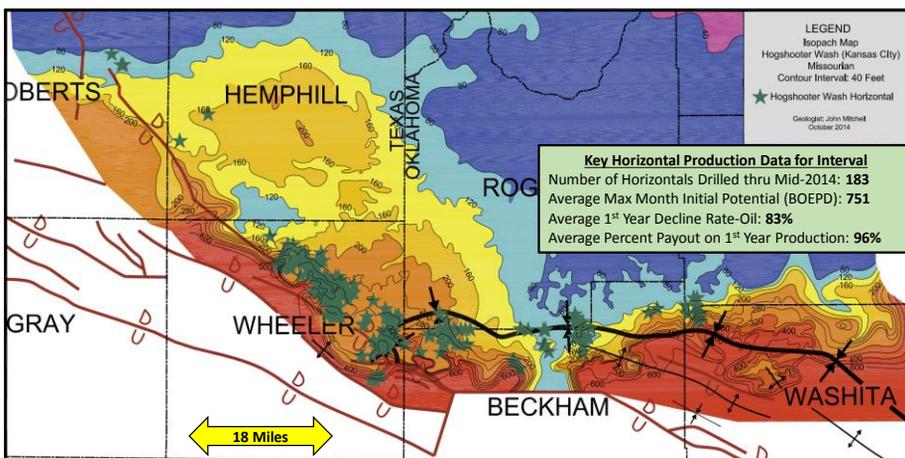
HORIZONTAL GRANITE WASH PLAY HOGSHOOTER WASH ISOPACH MAP



Hogshooter Wash = U. Kansas City Zone in Texas Usage

*Interval Isopach Map
Contour Interval: 40/100 Ft*

HORIZONTAL GRANITE WASH PLAY HOGSHOOTER WASH ISOPACH MAP

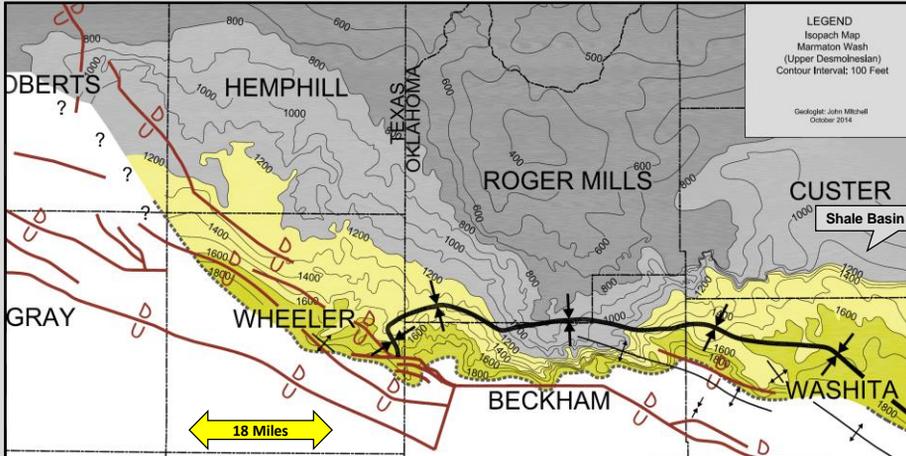


Key Horizontal Production Data for Interval
 Number of Horizontals Drilled thru Mid-2014: **183**
 Average Max Month Initial Potential (BOEPD): **751**
 Average 1st Year Decline Rate-Oil: **83%**
 Average Percent Payout on 1st Year Production: **96%**

Hogshooter Wash = U. Kansas City Zone in Texas Usage

*Interval Isopach Map
Contour Interval: 40/100 Ft*

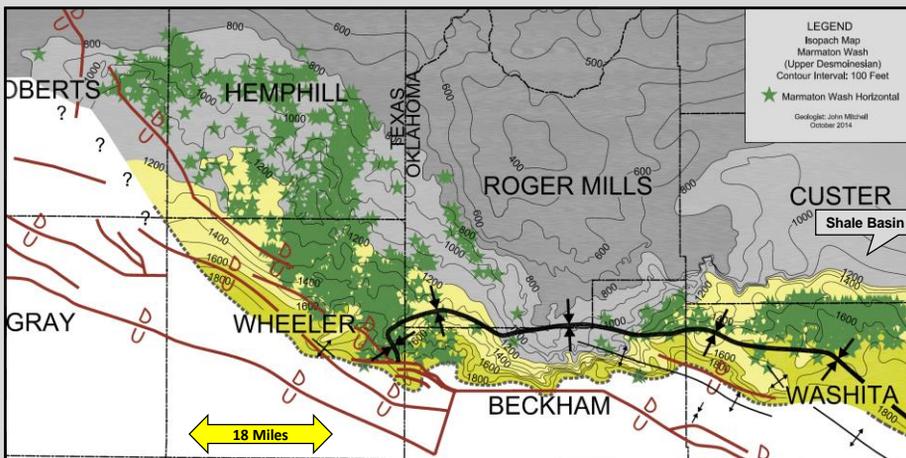
HORIZONTAL GRANITE WASH PLAY MARMATON WASH ISOPACH MAP



Marmaton Wash is Upper Desmoinesian in Age

Interval Isopach Map
Contour Interval: 100 Ft

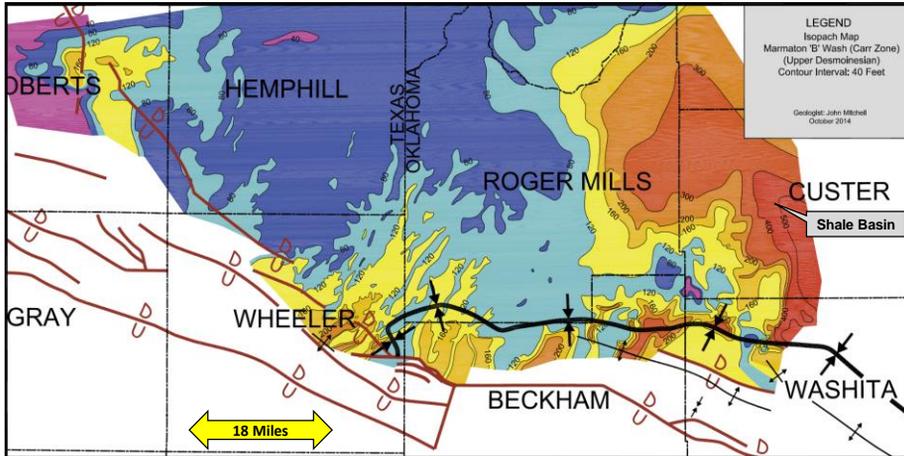
HORIZONTAL GRANITE WASH PLAY MARMATON WASH ISOPACH MAP



Marmaton Wash is Upper Desmoinesian in Age

Interval Isopach Map
Contour Interval: 100 Ft

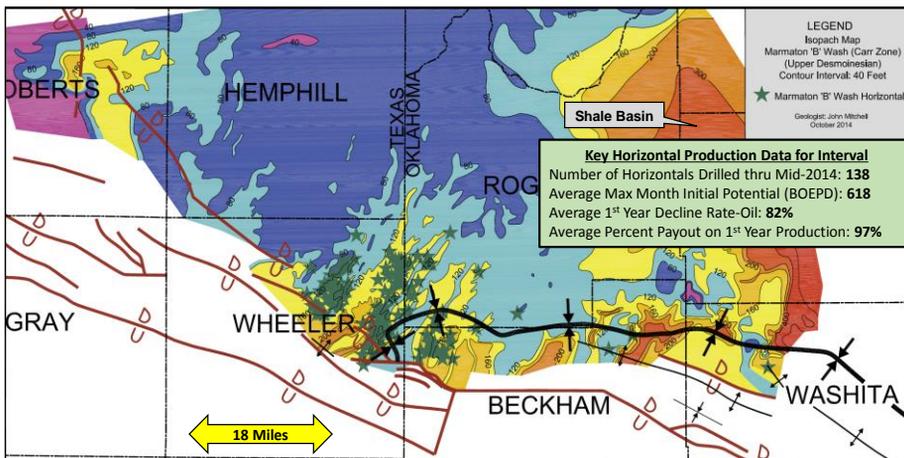
HORIZONTAL GRANITE WASH PLAY MARMATON 'B' WASH ISOPACH MAP



Marmaton 'B' Wash = Carr Zone in Texas Usage

*Interval Isopach Map
Contour Interval: 40/100 Ft*

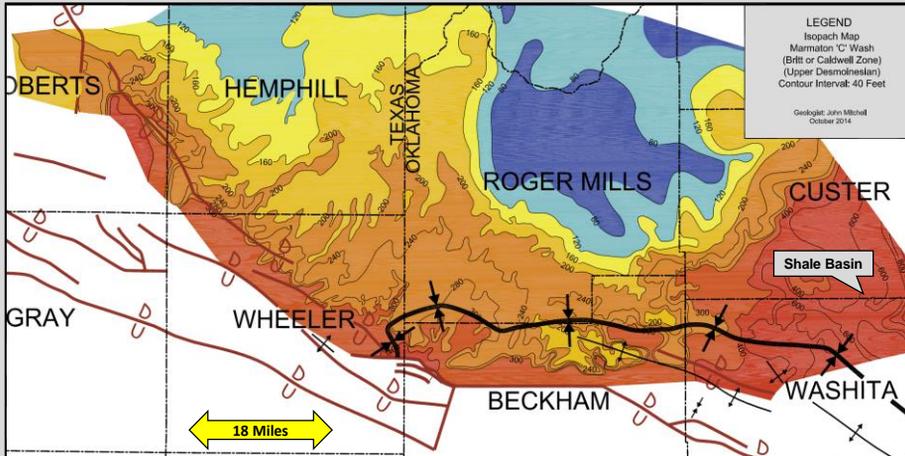
HORIZONTAL GRANITE WASH PLAY MARMATON 'B' WASH ISOPACH MAP



Marmaton 'B' Wash = Carr Zone in Texas Usage

*Interval Isopach Map
Contour Interval: 40/100 Ft*

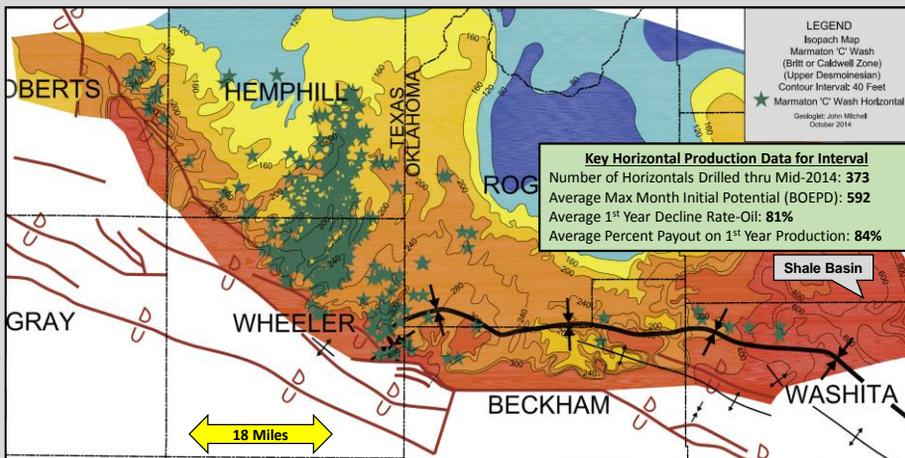
HORIZONTAL GRANITE WASH PLAY MARMATON 'C' WASH ISOPACH MAP



Marmaton 'C' Wash = Caldwell or Britt Zones in Texas Usage

*Interval Isopach Map
Contour Interval: 40/100 Ft*

HORIZONTAL GRANITE WASH PLAY MARMATON 'C' WASH ISOPACH MAP

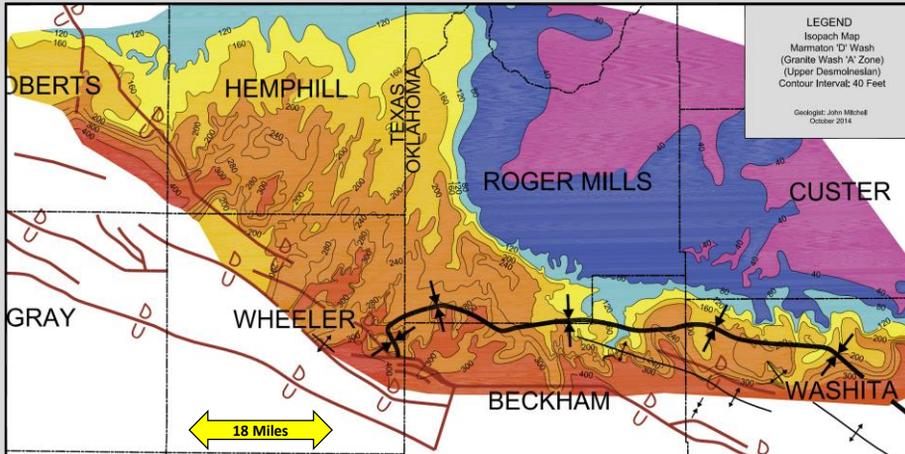


Key Horizontal Production Data for Interval
 Number of Horizontals Drilled thru Mid-2014: **373**
 Average Max Month Initial Potential (BOEPD): **592**
 Average 1st Year Decline Rate-Oil: **81%**
 Average Percent Payout on 1st Year Production: **84%**

Marmaton 'C' Wash = Caldwell or Britt Zones in Texas Usage

*Interval Isopach Map
Contour Interval: 40/100 Ft*

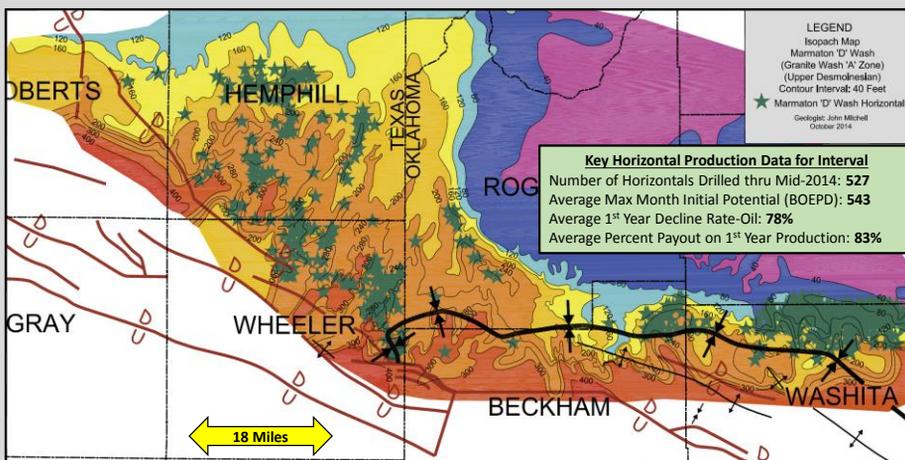
HORIZONTAL GRANITE WASH PLAY MARMATON 'D' WASH ISOPACH MAP



Marmaton 'D' Wash = Granite Wash 'A' in Texas Usage

Interval Isopach Map
Contour Interval: 40/100 Ft

HORIZONTAL GRANITE WASH PLAY MARMATON 'D' WASH ISOPACH MAP



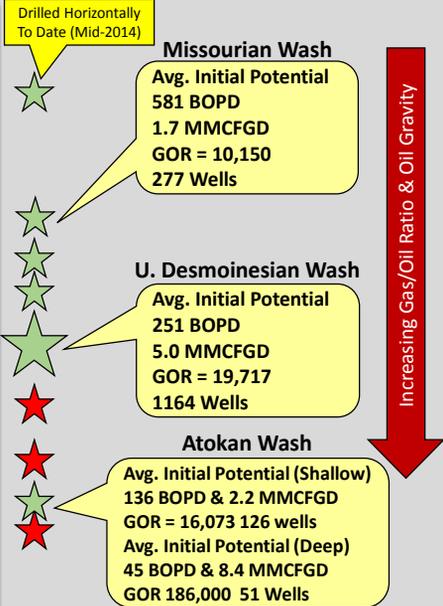
Marmaton 'D' Wash = Granite Wash 'A' in Texas Usage

Interval Isopach Map
Contour Interval: 40/100 Ft

HORIZONTAL WELL INITIAL POTENTIAL & GAS/OIL RATIOS BY PENNSYLVANIAN STAGE

STRATIGRAPHIC CHART			
SYS.	SERIES / STAGE	GROUP	UNIT
PENNSYLVANIAN	VIRGILIAN	Shawnee/Cisco	<ul style="list-style-type: none"> ★ Shawnee Wash Heebner Sh
		Douglas/Cisco	<ul style="list-style-type: none"> ★ Haskell Sh ★ Tonkawa Ss
	MISSOURIAN	Lansing/Hoxbar	★ Cottage Grove Wash
		Kansas City/Hoxbar	★ Hoxbar Wash/Shale
			★ Hogshooter Wash
			★ Checkerboard Wash
	DESMOINESIAN	Marmaton	★ Marmaton Wash
		Cherokee	★ Upper Skinner Shale
			★ Upper Skinner Wash
			★ Lower Skinner Shale (Pink Ls Marker)
			★ Lower Skinner Wash
	★ Red Fork Sa & Sh		
ATOKAN	Atoka	★ Atoka Wash	
MORROWAN	Morrow	★ 13 Finger Ls	
		★ Upper Morrow	
		★ Squawbilly Ls	
		★ L. Morrow (Pineflow)	

ANADARKO BASIN - MOUNTAIN FRONT - OKLAHOMA



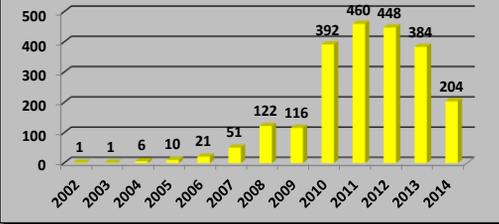
Missourian Wash
 Avg. Initial Potential
 581 BOPD
 1.7 MMCFGD
 GOR = 10,150
 277 Wells

U. Desmoinesian Wash
 Avg. Initial Potential
 251 BOPD
 5.0 MMCFGD
 GOR = 19,717
 1164 Wells

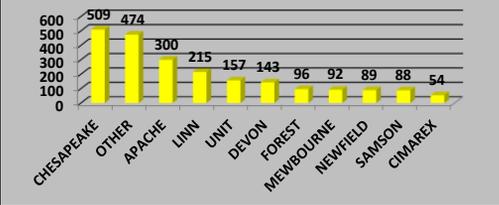
Atokan Wash
 Avg. Initial Potential (Shallow)
 136 BOPD & 2.2 MMCFGD
 GOR = 16,073 126 wells
 Avg. Initial Potential (Deep)
 45 BOPD & 8.4 MMCFGD
 GOR 186,000 51 Wells



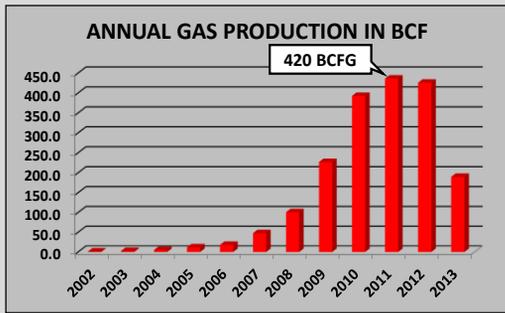
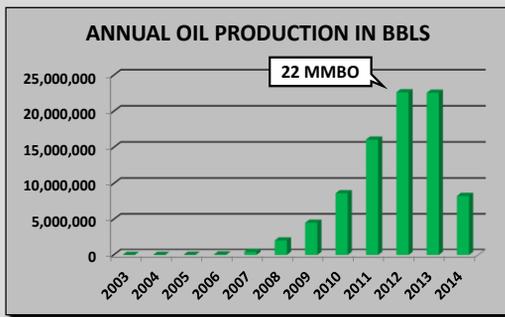
HRZ PERMITS BY YEAR THROUGH AUG. 2014



PERMITTED HORIZONTAL GRANITE WASH WELLS BY OPERATOR THROUGH AUGUST 2014



PERMITTING DATA PENNSYLVANIAN GRANITE WASH HORIZONTALS



ANNUAL PRODUCTION FROM PENNSYLVANIAN GRANITE WASH HORIZONTALS

CONCLUSIONS

- Play extends over 125 miles from Roberts County, TX to Washita County, OK
- Granite Wash reservoirs derived from erosion of Lower Paleozoic igneous and sedimentary rocks on adjacent Amarillo-Wichita uplift
- Sandstone and conglomerate reservoirs are 8,000 to 14,500 feet deep
- Sedimentary column 2,500 to 5,000 feet thick
- Reservoirs in arkosic sandstones & conglomerates 20 to 200 feet thick
- Reservoirs mainly deposited in southwest to northeast trends
- Stratigraphic traps are dominant trap type
- Play limited on southwest by faults & water bearing massive sandstones; limited on north/northeast by thinning of reservoirs into distal silt facies
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- Est. horizontal well daily production in March 2014 of 51,000 BOPD, 1.1 BCFGPD & 110,000+ BWPD

THANKS!

Many thanks to several colleagues who generously gave me their time and insights into the Granite Wash play. Also, eternal thanks to my lovely wife Carol Mitchell for her support and patience with my many long nights at the office over my career.