

# An Overview of Oklahoma Shale Resource Plays

Fnu “Ming” Suriamin\*

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November 10, 2020

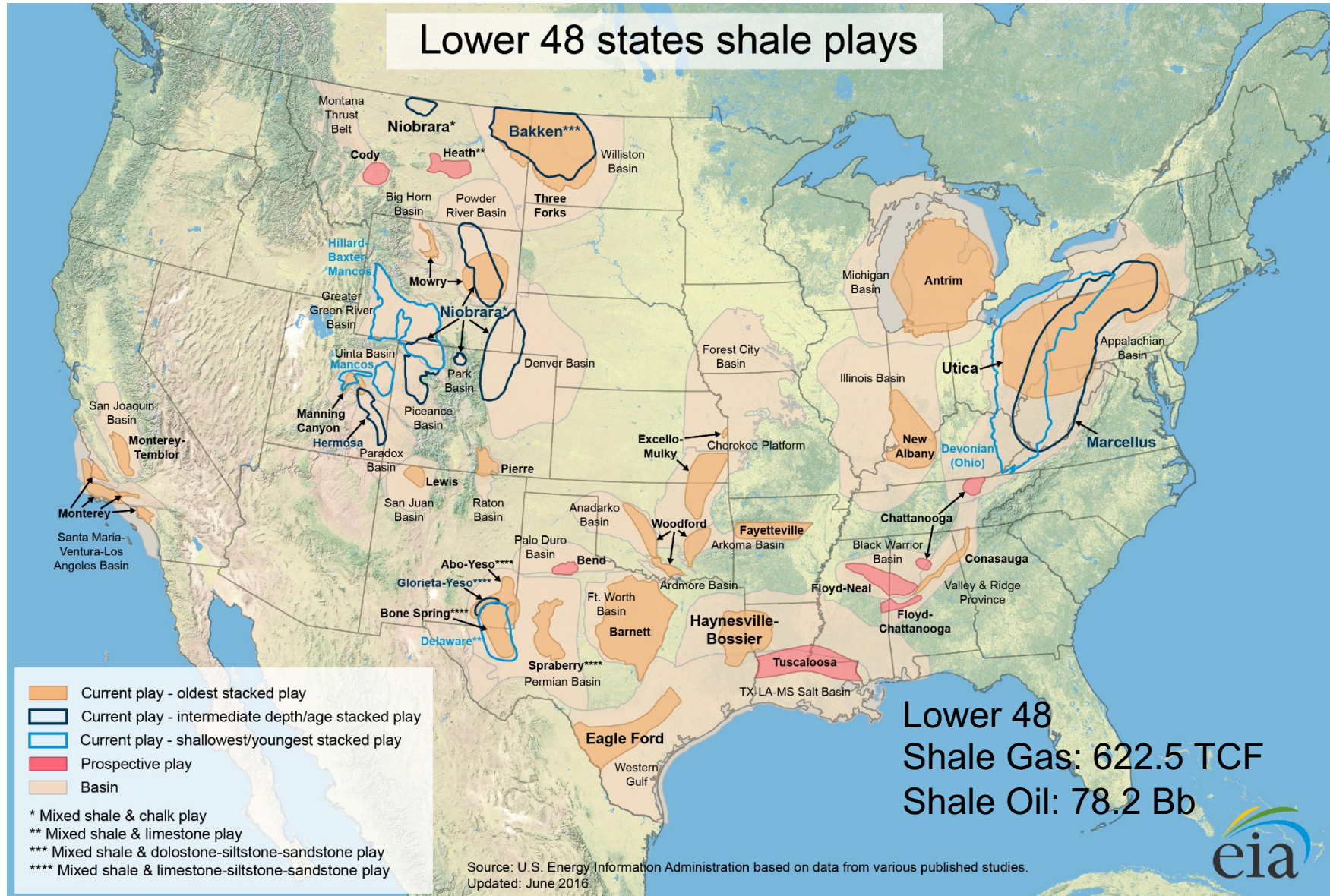
# Agenda

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- **Shale Resource Plays in the United States**
- **Key Elements of Successful Shale Resource Plays**
- **Hydrocarbon Source Rocks of Oklahoma**
- **Evaluation (oldest to youngest):**
  - **Sylvan**
  - **Arkansas Novaculite**
  - **Woodford**
  - **Caney**
  - **Goddard/Springer**
  - **Atoka**
  - **Pennsylvanian shales**

# Shale Resource Plays - What has been found?

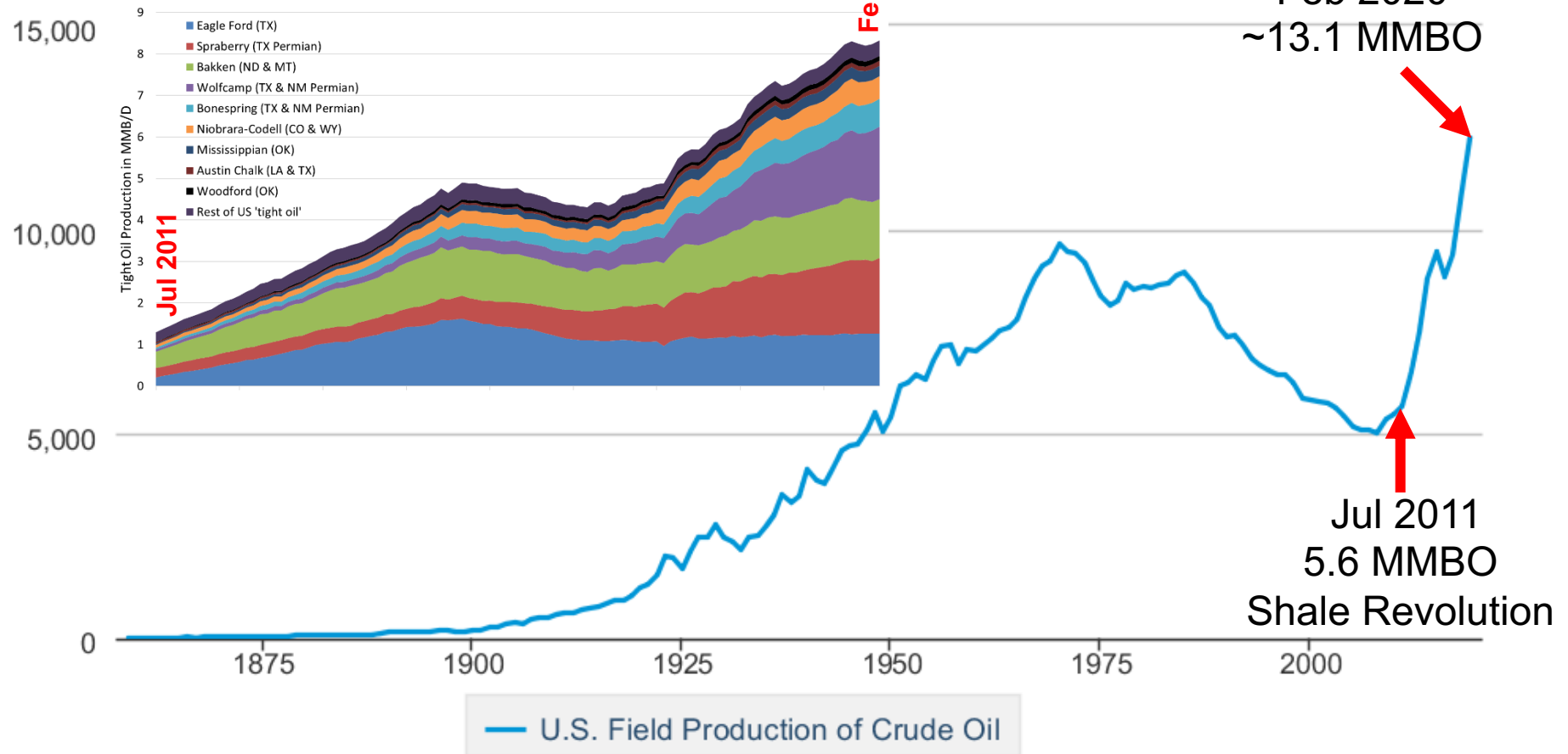


# Why are shale resources important?



## U.S. Field Production of Crude Oil

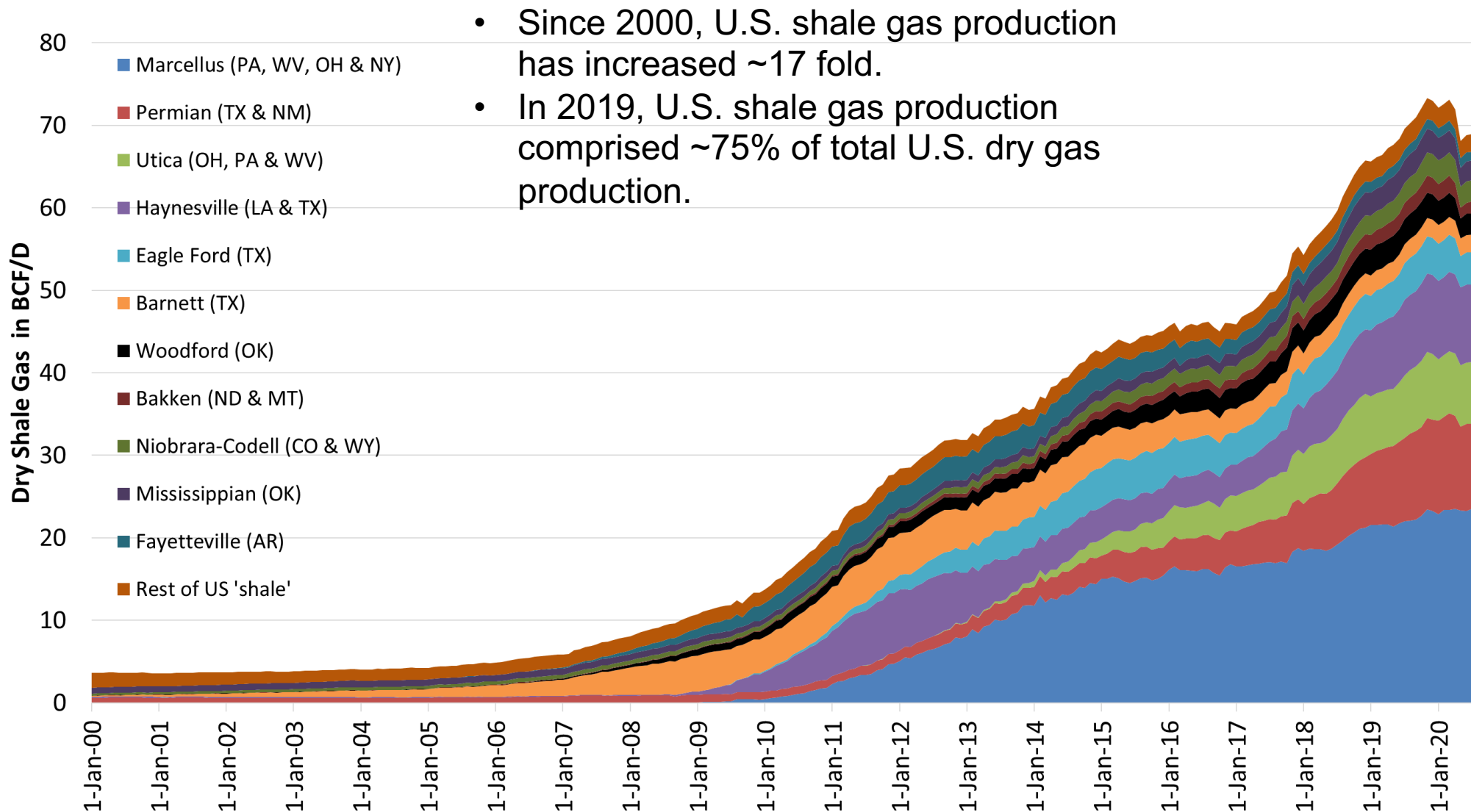
Thousand Barrels per Day



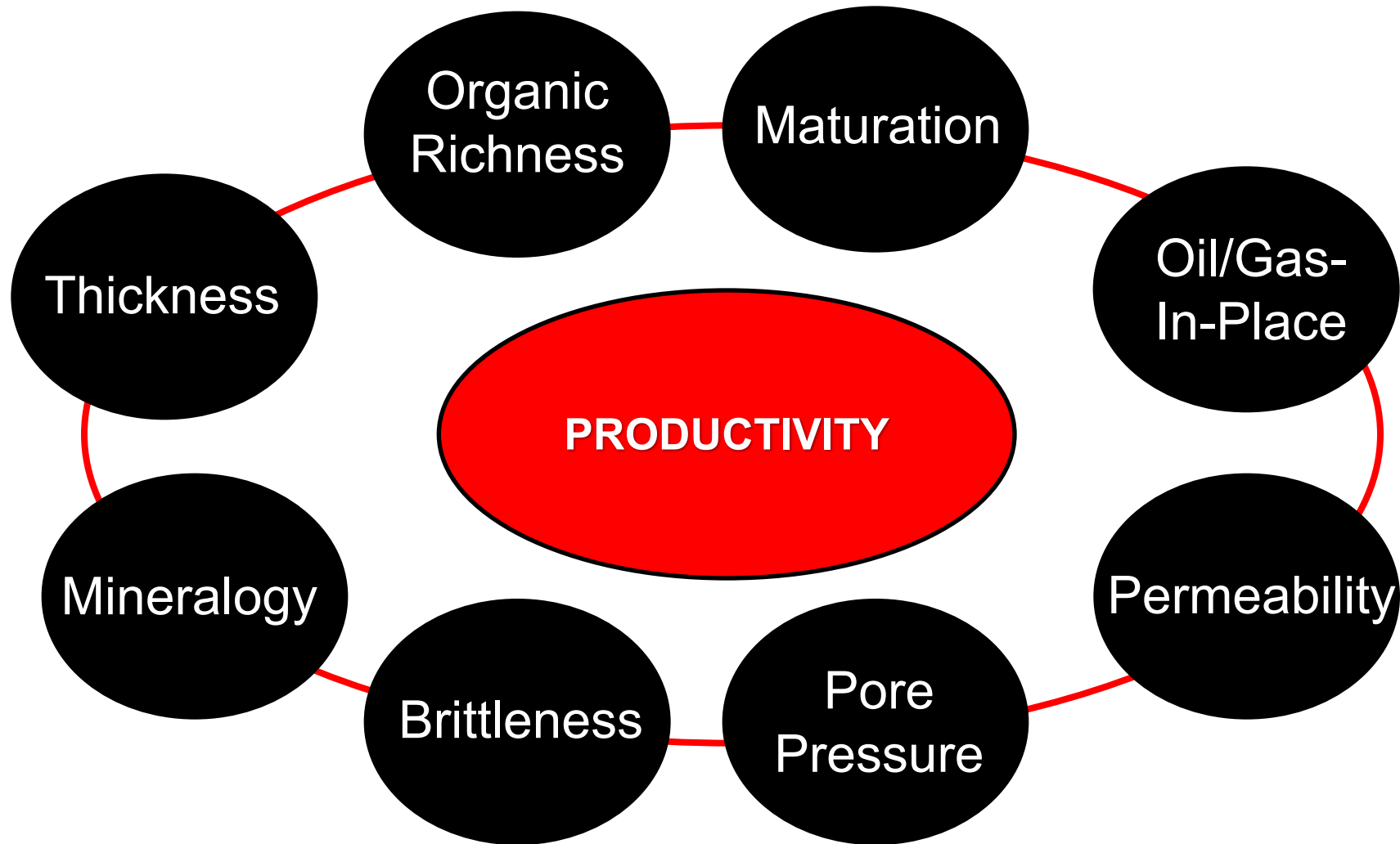
Source: U.S. Energy Information Administration



# Why are shale resources important?



# Key Elements of Successful Shale Resource Plays



# Ardmore and Marietta Basins Oil and Hydrocarbon Source Rock Study



Period	Group	Formation	Oils
Cretaceous	Trinity		3
Permian	Pontotoc		6
	Hoxbar		
Pennsylvanian	Deese		165
	Dornick Hills		
	Springer		
Mississippian	Goddard		25
	Caney		
	Sycamore		
	Woodford		
Devonian	Hunton		21
Silurian	Sylvan		
Ordovician	Viola		51
	Simpson		53
Cambrian	Arbuckle		61

Figure 2. Stratigraphic distribution of 385 oil samples.

Wavrek, 1992

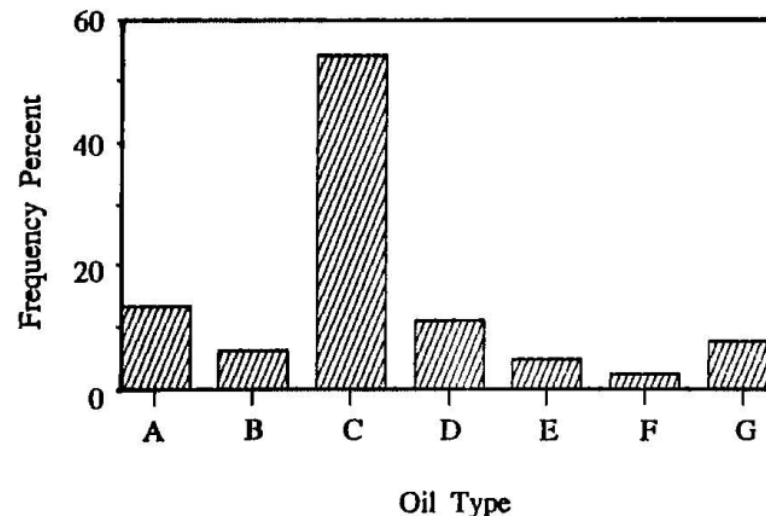


Figure 11. Frequency distribution of oil types reser-voired in the Ardmore and Marietta basins.

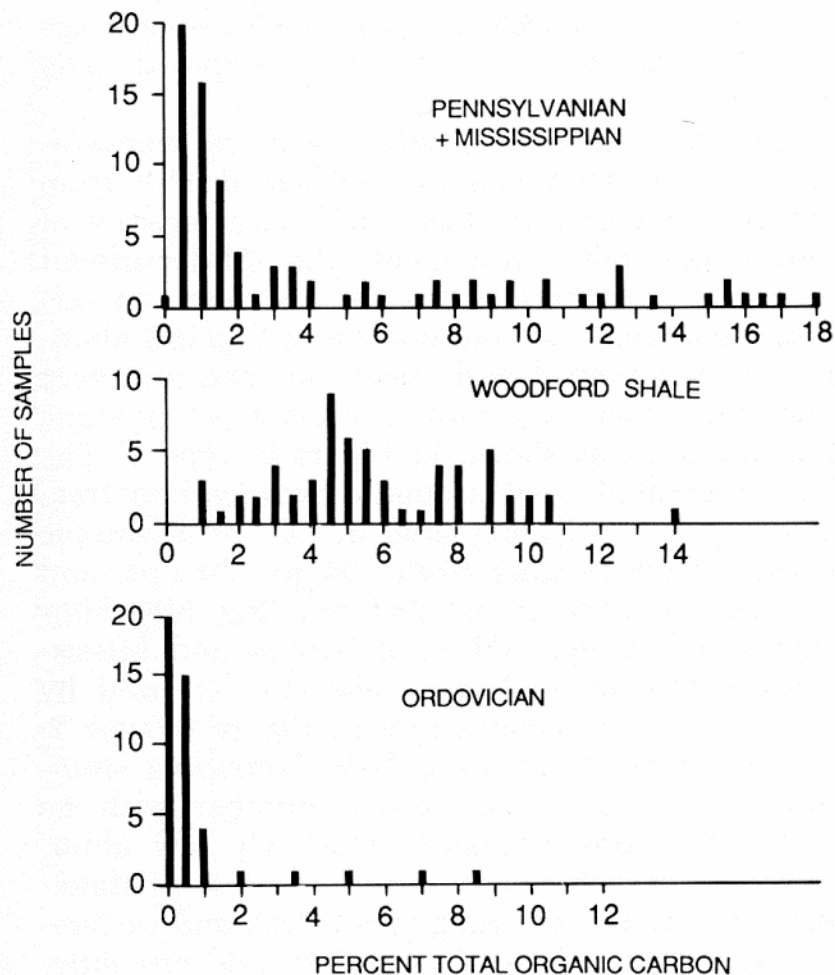
## Source Facies:

- A Pennsylvanian (Atoka?)
- B Mississippian (Goddard, Caney, Sycamore)
- C Devonian-Mississippian (Woodford)
- D Upper Ordovician (Viola Group)
- E Middle Ordovician (Simpson Group)
- F & G Mixed

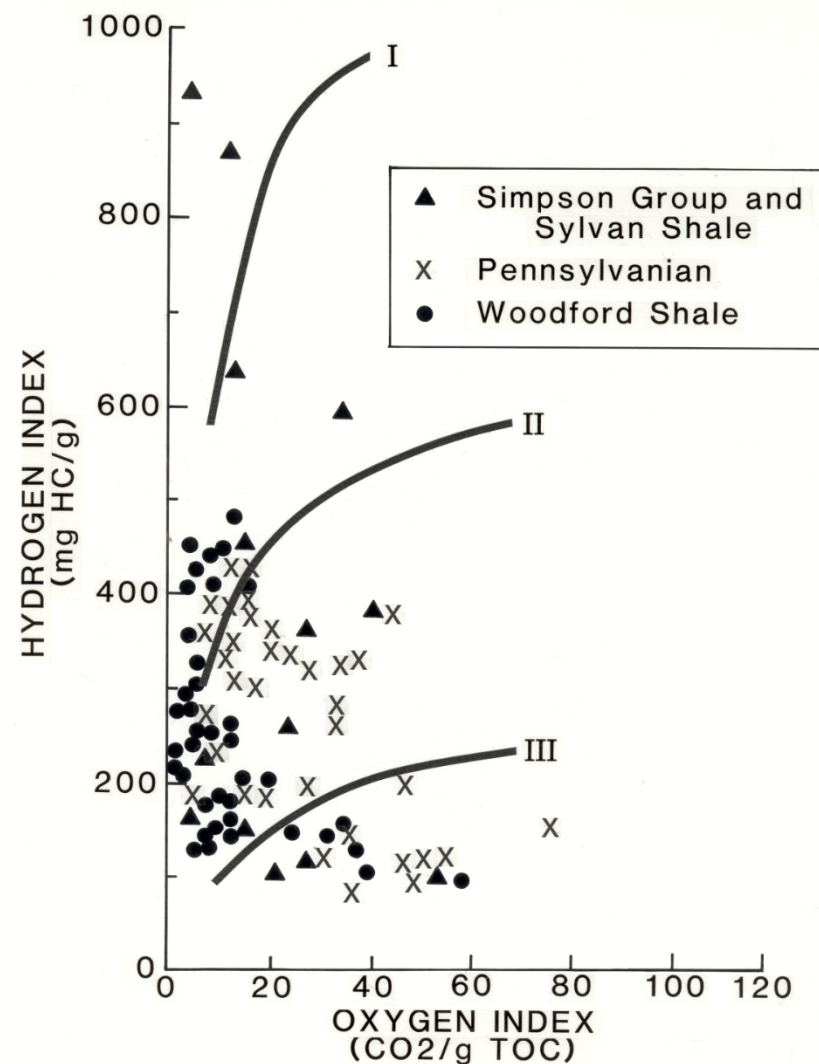
# Anadarko Basin Oil and Hydrocarbon Source Rock Study



## Anadarko Basin Source-Rock TOC

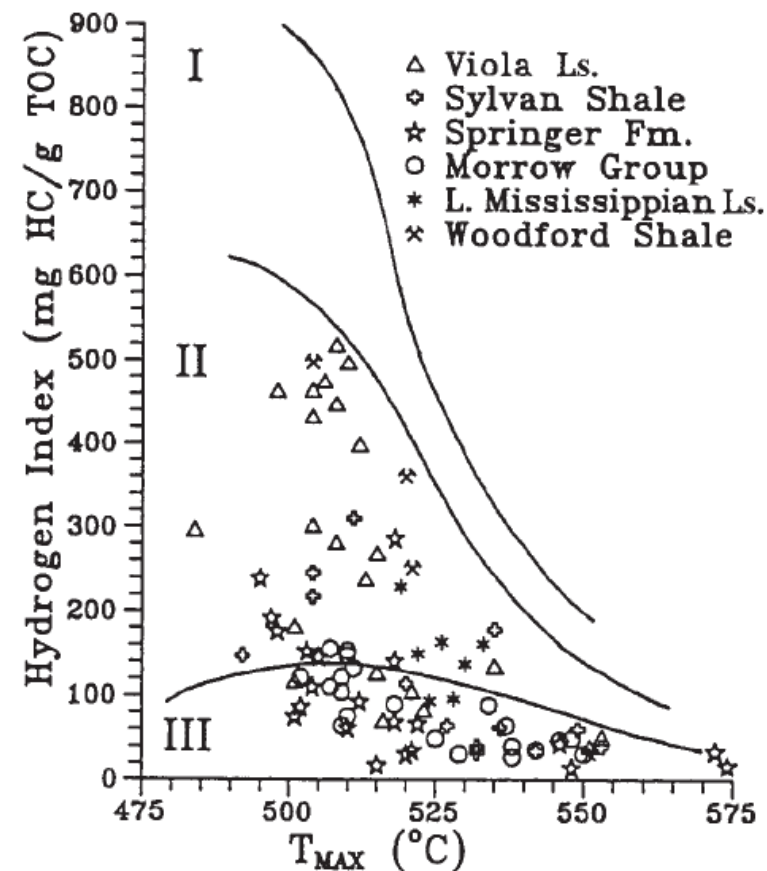
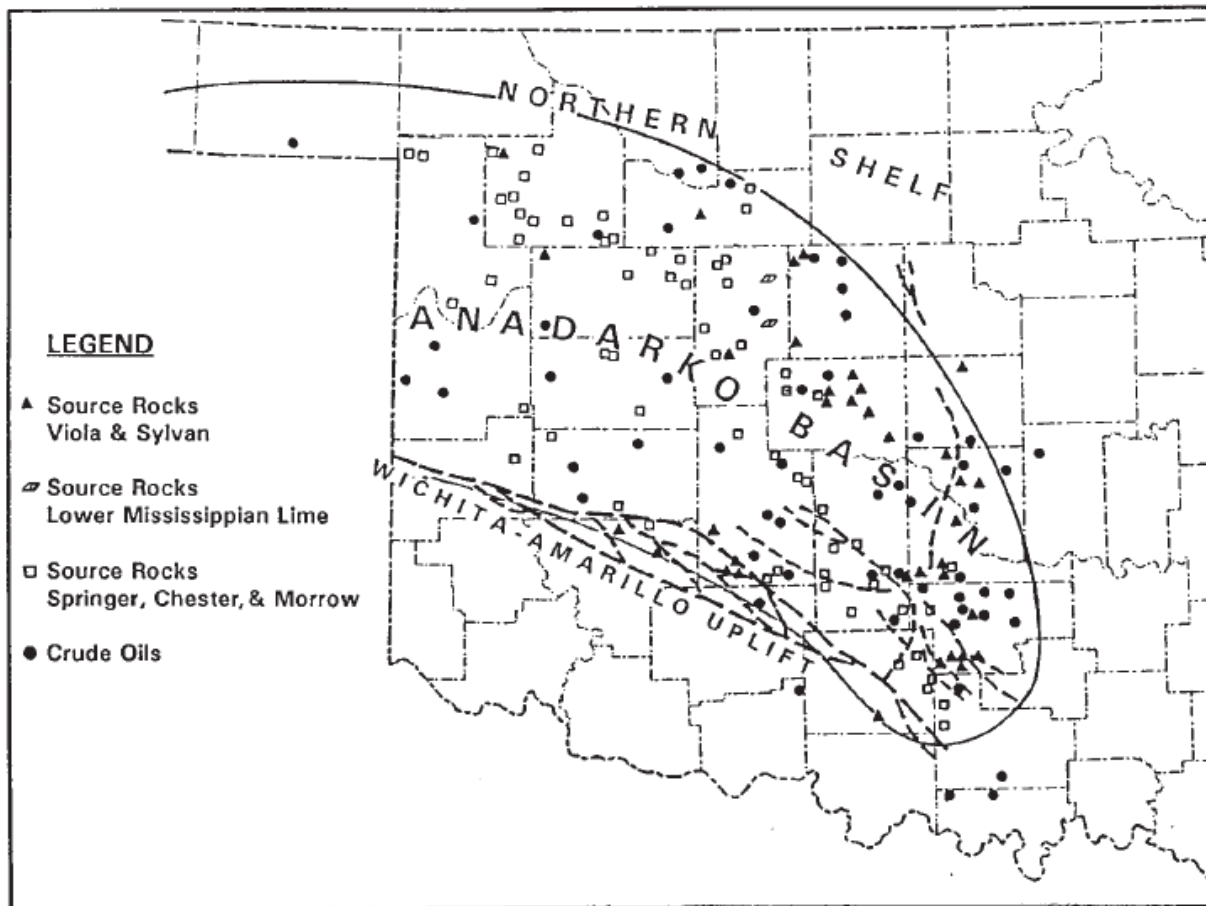


## Van Krevelen Type Diagram



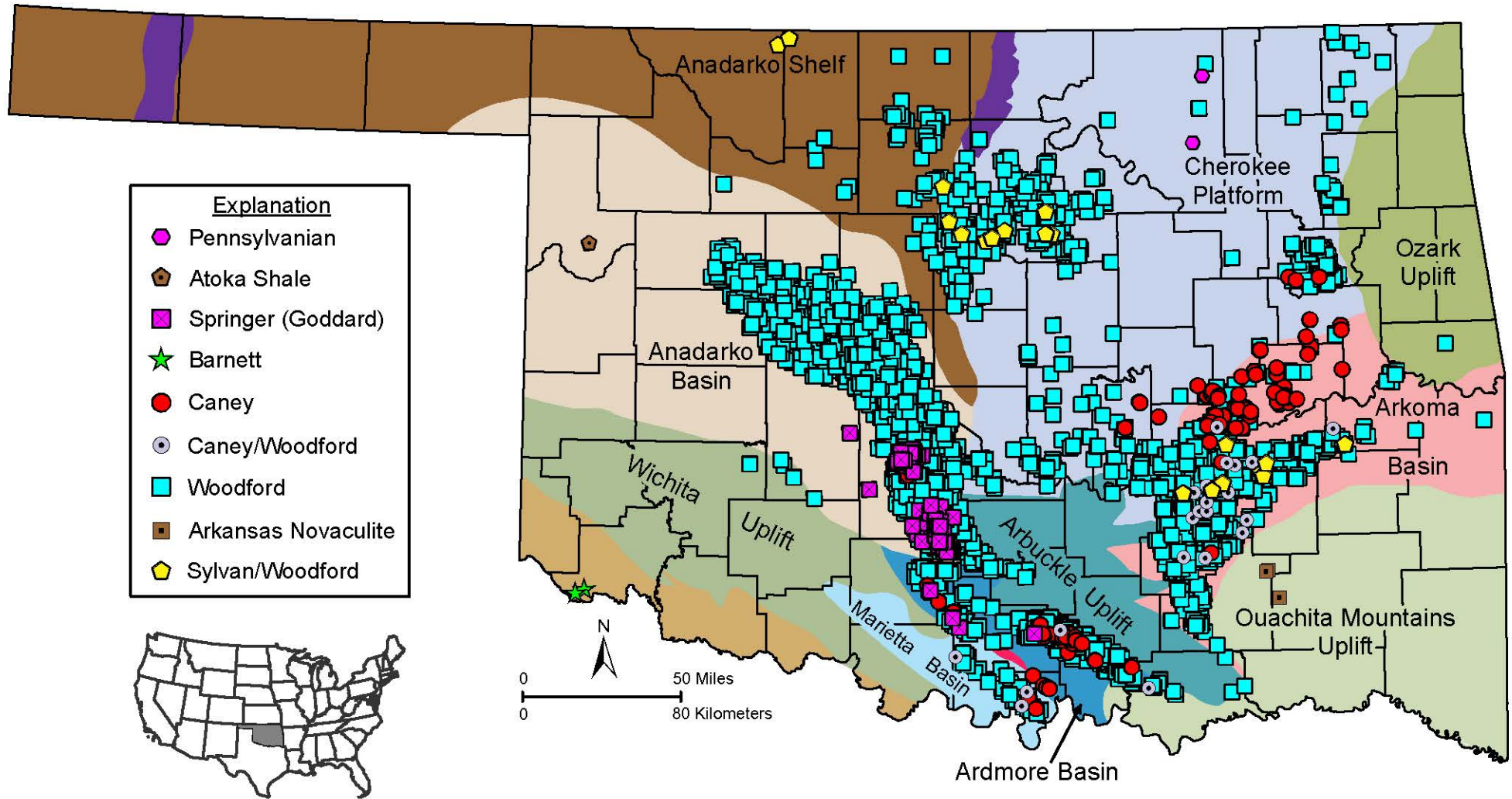


# Anadarko Basin Oil and Hydrocarbon Source Rock Study



Wang and Philp, 1997

# Oklahoma Shale Gas/Oil Completions (1939-2020)



**5,907 completions**

# Sylvan Shale (Ordovician Age)



SYSTEM/SERIES	ANADARKO BASIN, SW OKLAHOMA	ARBuckle MOUNTAINS, ARDMORE BASIN	ARKOMA BASIN, NE OKLAHOMA	OUACHITA MOUNTAINS
QUATERNARY	Alluvium and Terrace Deposits			
TERTIARY	Ogallala Formation			
CRETACEOUS	Dakota Group			
JURASSIC	Morrison Formation			
TRIASSIC	Dockum Group			
PERMIAN	Ochoan	Elk City Sandstone Doxey Shale		
	Guadalupian	Cloud Chief Formation Whalehorse Group El Reno Group		
	Leonardian	Hennessey Shale Garber Sandstone Wellington Formation	Garber Sandstone Wellington Formation	
	Wolfcampian	Chase Group Council Grove Group Admiral Group	Pontotoc Group Pontotoc Group Council Grove Admiral Group	
PENNSYLVANIAN	Virgilian	Wauburnsee Group Shawnee Group Douglas Group	Ada Formation Vamoosa Formation	Wauburnsee Shawnee Douglas
	Missourian	Ochelata Group Skiatook Group	Hilltop Fm. Ochelata Group	Skiatook Group
	Desmoinesian	Marmaton Group Cherokee Group	Deese Group	Marmaton Group Cabaniss Group Krebs Group
	Atokan	Atoka Group	Atoka Formation	Atoka Formation
MISSISSIPPIAN	Morrowan	Morrow Group	Wapanucka Union Valley McCully Sausbee	Johns Valley Shale Jackfork Group
	Chesterian	Springer Formation	Springer Formation	
	Meramecian	"Meramec Lime"	Goddard Formation	Stanley Group
	Osagean	"Osage Lime"	Delaware Creek Shale	
DEVONIAN	Upper	Woodford Shale	Woodford Shale	Arkansas Novaculite
	Middle	Misener Sandstone	Chattanooga Shale Sylamore Sandstone	
	Lower	Haragan Fm. Henryhouse Fm.	Salisaw Fm. Frisco Fm.	Pinetop Chert
	Upper	Chimney Hill Subgroup	Haragan Bois d'Arc Formation Henryhouse Formation	Missouri Mountain Shale
SILURIAN	Lower	Chimney Hill Subgroup	Clarita Formation Cochrane Formation Keel Formation	Blaylock Sandstone
	Upper	Chimney Hill Subgroup	Quarry Mtn. Fm. Tenkiller Fm. Blackgum Fm.	Polk Creek Shale
	Lower	Chimney Hill Subgroup	Petit Colite	Bigfork Chert
	Upper	Sylvan Shale	Sylvan Shale	
ORDOVICIAN	Middle	Viola Group	Viola Group	Wornie Shale
	Lower	Simpson Group	Bromide Formation Tulip Creek Formation McLish Formation Oil Creek Formation Joins Formation	Blakely Sandstone
	Upper	Arbuckle Group	West Spring Creek Formation Kindblade Formation Cool Creek Formation McKenzie Hill Formation Butterfly Dolomite	Mazarrn Shale
	Lower	Arbuckle Group	Signal Mountain Formation Royer Dolomite Fort Sill Limestone	Crystal Mountain Sandstone
CAMBRIAN	Upper	Timbered Hills Group	Honey Creek Limestone Reagan Sandstone	Collier Shale
	Middle	Granite, Rhyolite, and Gabbro	Rhyolite	?
	Lower	Granite, Rhyolite, and Metasediments	Granite and Gneiss	?
PRECAMBRIAN				

**Kerogen Type**

**II (Burruss and Hatch, 1989)**

**III (Wang 1993)**

**Amount of TOC**

**<1% (Wang, 1993)**

**Maturity**

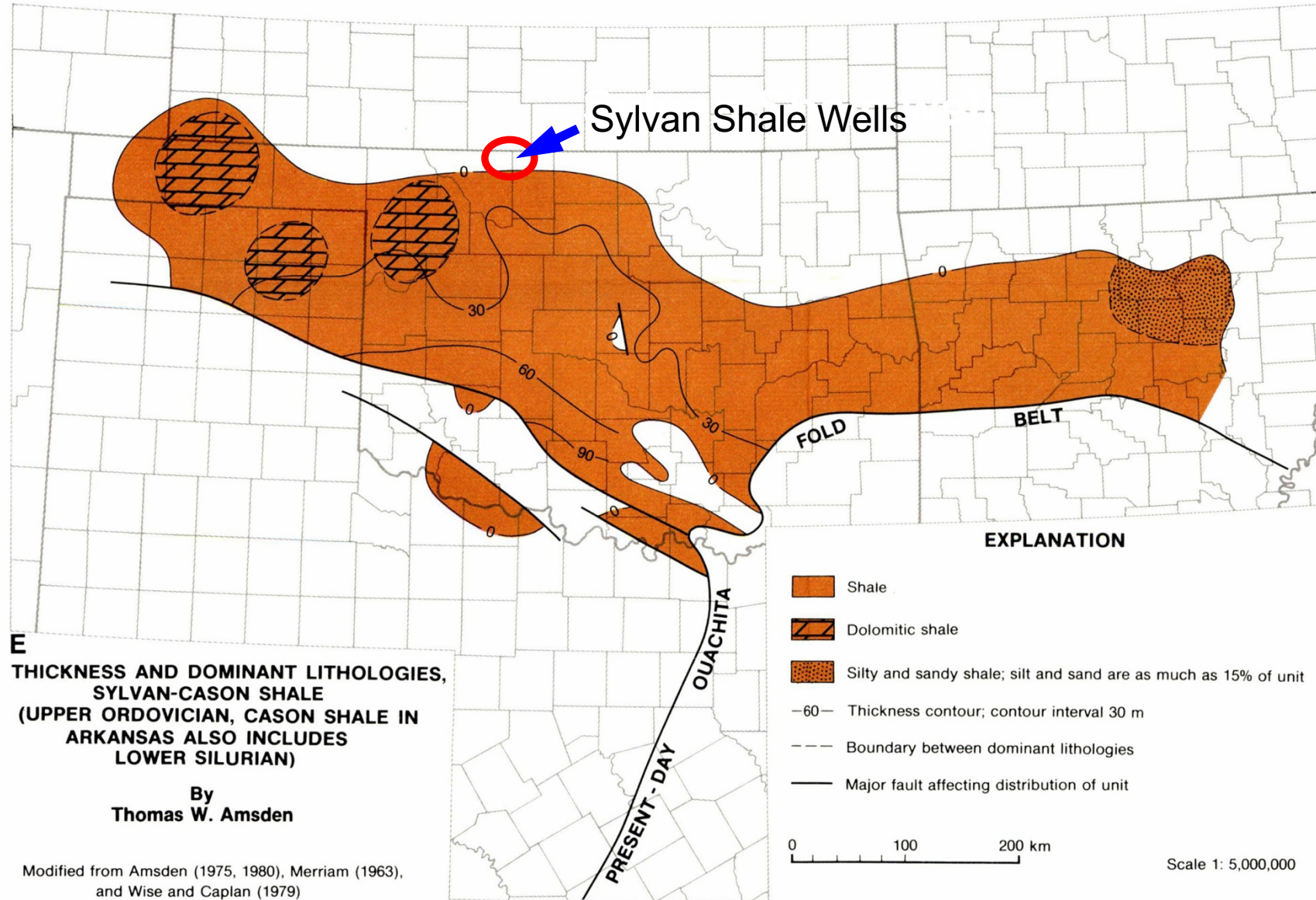
**>0.5% VRo**

**Wang and Philp (1997):**

“The Sylvan Shale is thin and organically lean in the Anadarko Basin, and probably **NOT** a source rock in the basin.”

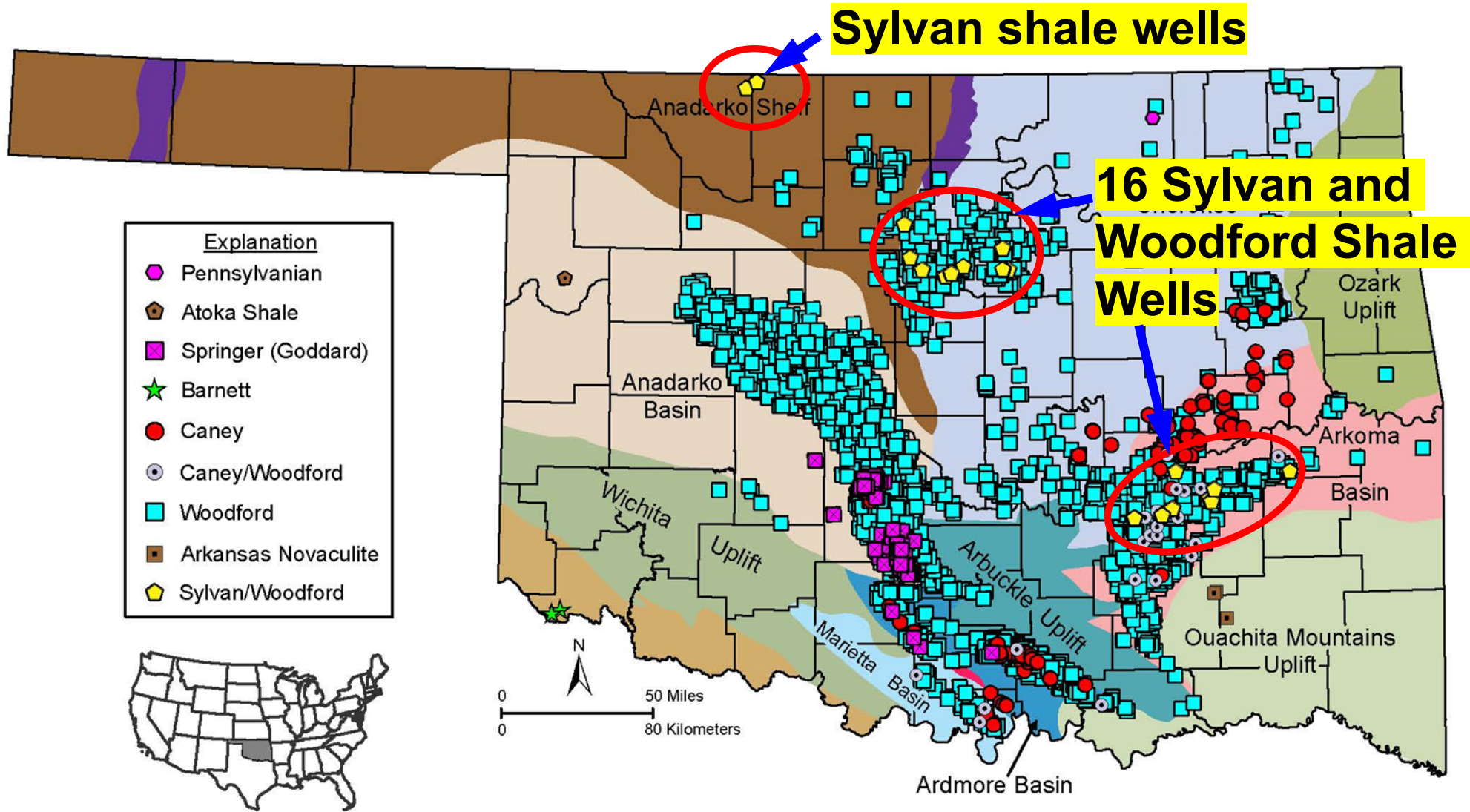


# Sylvan Shale Isopach Map



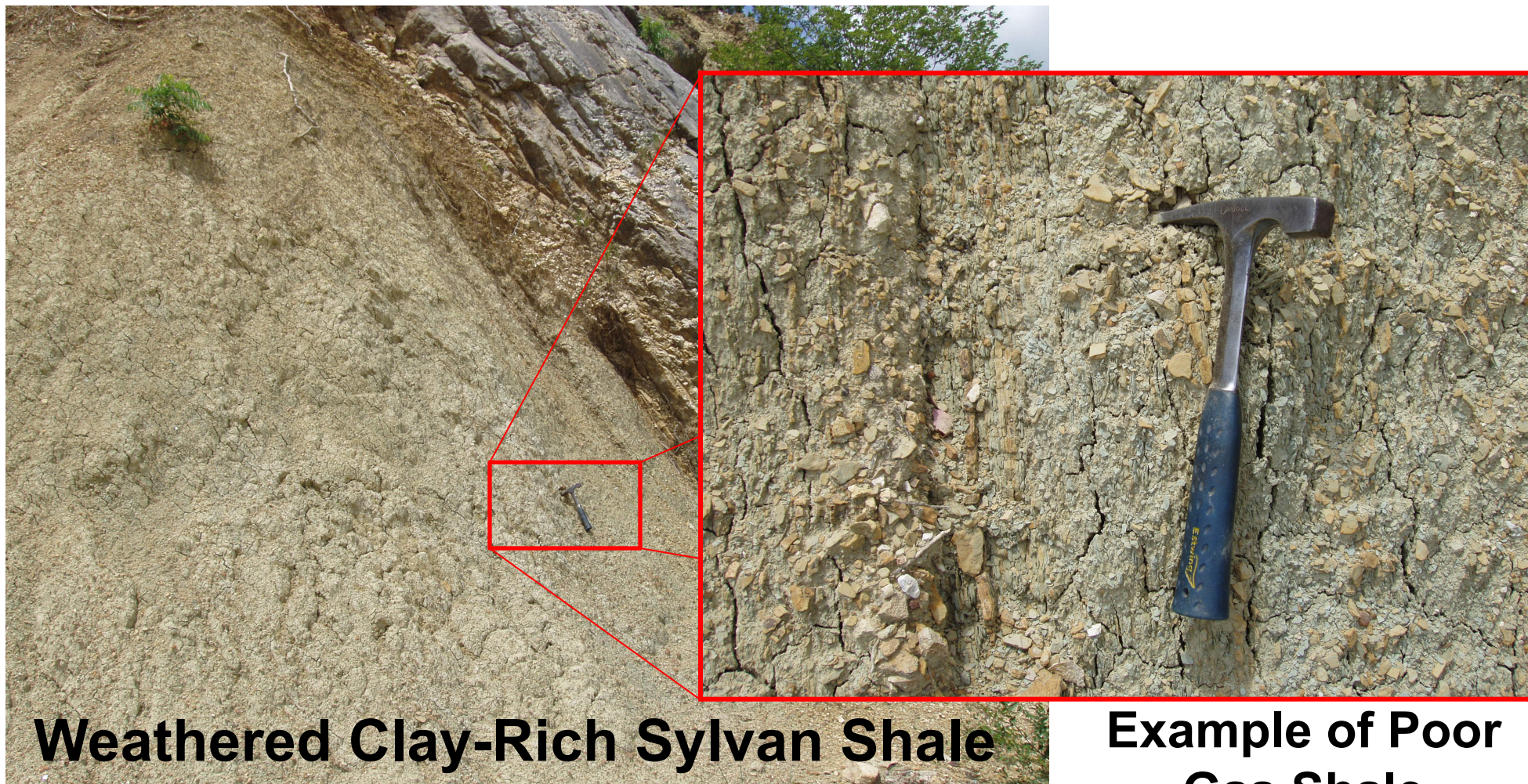


# Sylvan Shale Wells [2008-2020]





# Sylvan Shale in the Arbuckle Mountains



**Weathered Clay-Rich Sylvan Shale**

**Example of Poor Gas Shale  
(But Good Fracture Barrier)**

Photographs are courtesy of Brian J. Cardott

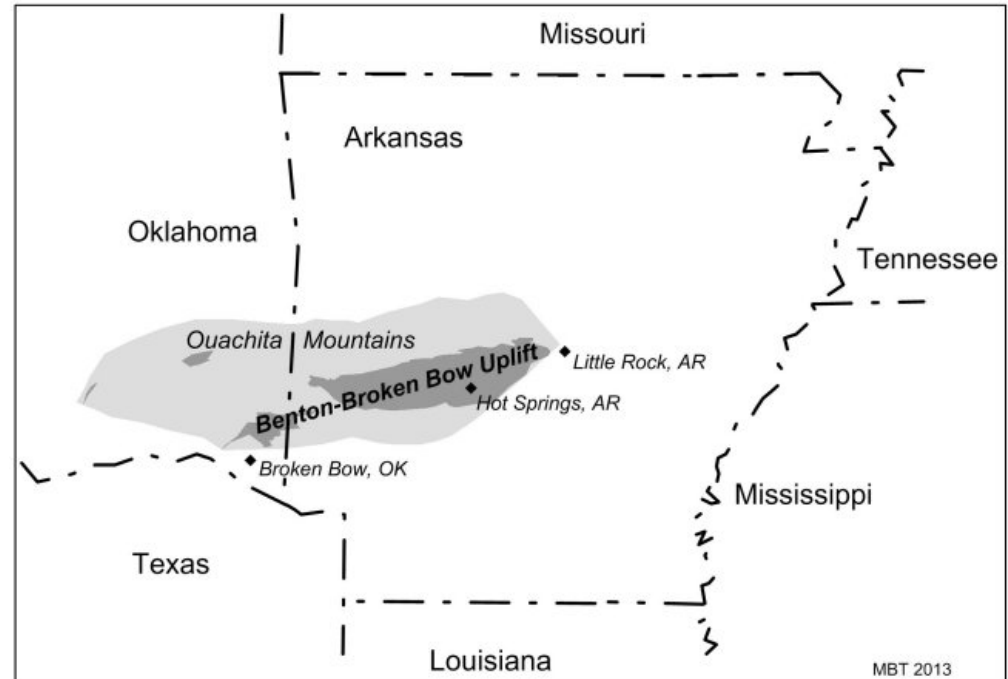


# Arkansas Novaculite (Silurian-Mississippian Age)



SYSTEM/SERIES	ANADARKO BASIN, SW OKLAHOMA	ARBuckle MOUNTAINS, ARDMORE BASIN	ARKOMA BASIN, NE OKLAHOMA	OUACHITA MOUNTAINS
QUATERNARY	Alluvium	and	Terrace	Deposits
TERTIARY	Ogallala Formation			
CRETACEOUS	Dakota Group			
JURASSIC	Morrison Formation			
TRIASSIC	Dockum Group			
PERMIAN	Ochoan	Elk City Sandstone Doxey Shale		
	Guadalupian	Cloud Chief Formation Whitehorse Group El Reno Group		
	Leonardian	Hennessey Shale Garber Sandstone Wellington Formation	Garber Sandstone Wellington Formation	
	Wolfcampian	Chase Group Council Grove Group Admiral Group	Pontotoc Group Pontotoc Group Admiral Group	Chase Group Council Grove Admiral Group
PENNSYLVANIAN	Virgilian	Waubesa Group Shawnee Group Douglas Group	Ada Formation Vamoosa Formation	Waubesa Group Shawnee Group Douglas Group
	Missourian	Ochelata Group Skiatook Group	Hoxbar Group	Hilltop Fm. Ochelata Group Skiatook Group
	Desmoinesian	Marmaton Group Cherokee Group	Deese Group	Marmaton Group Cathlamet Group Krebs Group
	Atokan	Atoka Group	Derrick Hills Group	Atoka Formation
	Morrowan	Morrow Group	Springer Formation	Wapanucka Union Valley McCully Sausbee
	Chesterian	Springer Formation	Goddard Formation	Pittsboro Limestone Fayetteville Shale Hindsville Formation
MISSISSIPPIAN	Meramecian	"Meramec Lime"	Delaware Creek Shale	Moorefield Formation
	Osagean	"Osage Lime"	Limestone	Boone Group St. Joe Group
	Kinderhookian	Woodford Shale Misenar Sandstone	Woodford Shale	Chattanooga Shale Sylamore Sandstone
DEVONIAN	Upper			Arkansas Novaculite
	Middle			
	Lower			
SILURIAN	Upper	Haragan Fm. Henryhouse Fm.	Haragan Bois d'Arc Formation Henryhouse Formation	Pinetop Chert
	Lower	Chimney Hill Subgroup	Chimney Hill Subgroup Cochrane Formation Keel Formation	Quarry Mtn. Fm.
				Missouri Mountain Shale
ORDOVICIAN	Upper	Sylvan Shale Viola Group	Sylvan Shale Viola Group	Blaylock Sandstone Polk Creek Shale Bigfork Chert
	Middle	Simpson Group	Bromide Formation Tulip Creek Formation McLish Formation Oil Creek Formation Joins Formation	Wormle Shale Blakely Sandstone
	Lower	Arbuckle Group	West Spring Creek Formation Kindblade Formation Cool Creek Formation McKenzie Hill Formation Butterfly Dolomite	Mazarrn Shale Crystal Mountain Sandstone
			Signal Mountain Formation Royer Dolomite Fort Sil Limestone	Collier Shale
CAMBRIAN	Upper	Timbered Hills Group	Honey Creek Limestone Reagan Sandstone	Timbered Hills Group
	Middle	Granite, Rhyolite, and Gabbro	Rhyolite	
	Lower			
PRECAMBRIAN	Granite, Rhyolite, and Metasediments	Granite and Gneiss	Granite and Rhyolite	

Source: <http://archeology.uark.edu/novaculite/index.html>



**Kerogen Type**

**II and III (Johnson and Cardott, 1992)**

**Amount of TOC**

**< 1% - 12.5% (Cardott 1994, Weber 1992, 1994, Godo et al. 2011)**

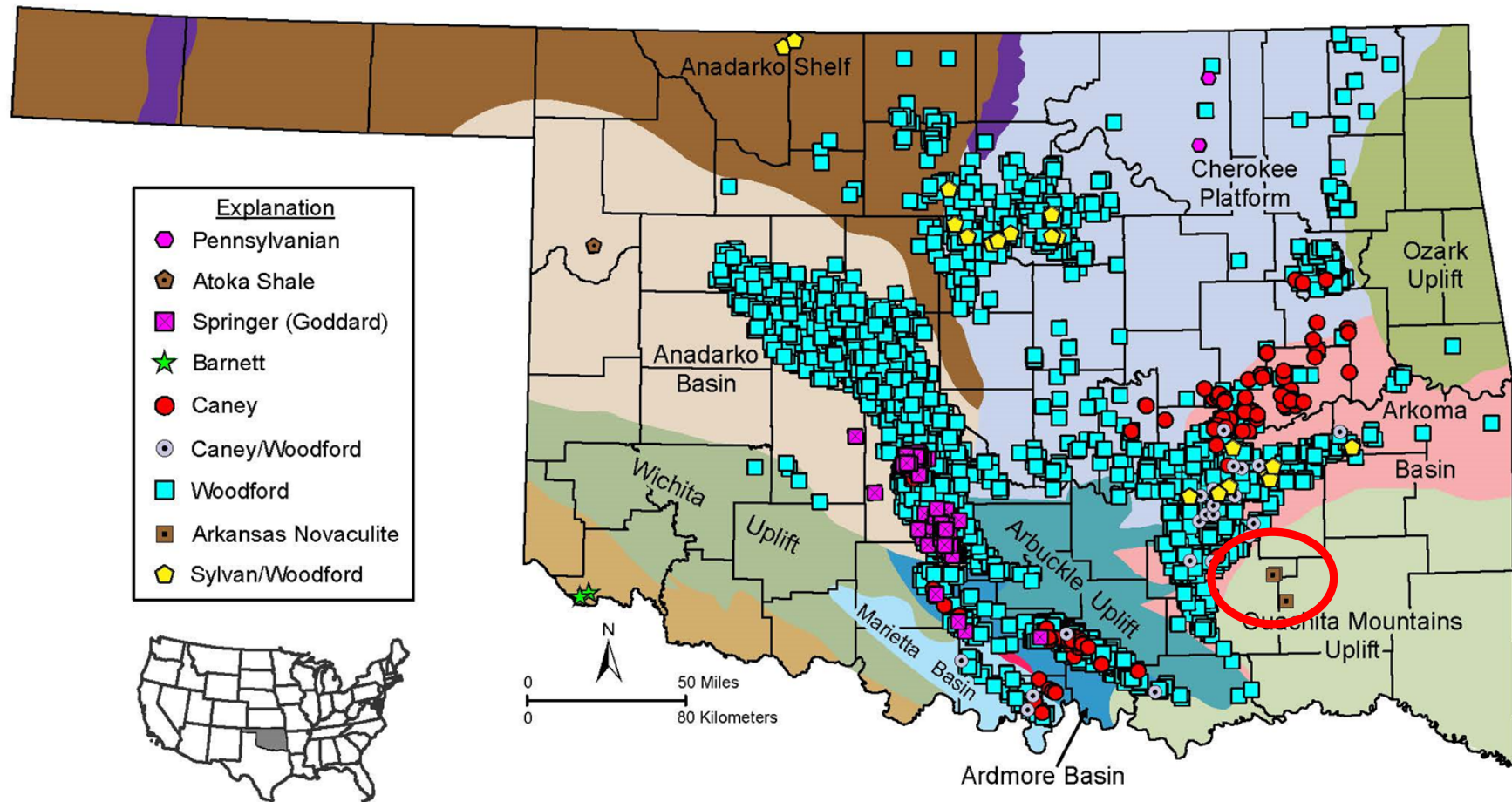
**Maturity**

**< 0.62% VRo (Cullen and Miller, 2020)**

**< 3.32% VRo (Godo et al., 2011)**

Modified from Cardott, 2017

# Arkansas Novaculite/Bigfork Chert Wells (2009-2020)



- RKI E&P 2-9 Denton-Perrin (1/2009; 9-2S-15E; 6,250 ft; IP 243 Mcf).
- Longfellow Energy LP 26-3 Wyrick (2/2010; 26-1N-14E; 8,104 ft; IP 2,926 Mcf; as of 2013 cum >1,109 MMcf).
- Longfellow Energy LP 35-3 Ertman Unit (4/2010; 35-1N-14E; 8,890 ft; IP 2,762 Mcf; as of 2013 cum >282 MMcf).



# Arkansas Novaculite (Scratch Hill Section, Atoka, OK)



Photographs are courtesy of Brian J Cardott



# Woodford Shale (Devonian-Mississippian Age)



SYSTEM/SERIES	ANADARKO BASIN, SW OKLAHOMA	ARBUCKLE MOUNTAINS, ARDMORE BASIN	ARKOMA BASIN, NE OKLAHOMA	QUACHITA MOUNTAINS
QUATERNARY	Alluvium and Terrace Deposits			
TERTIARY	Ogallala Formation			
CRETACEOUS	Dakota Group			
JURASSIC	Morrison Formation			
TRIASSIC	Dockum Group			
PERMIAN	Ochoan			
	Elk City Sandstone Doxey Shale			
	Cloud Chief Formation Whitehorse Group El Reno Group			
	Leonardian			
PENNSYLVANIAN	Hennessey Shale Garber Sandstone Wellington Formation	Garber Sandstone Wellington Formation		
	Wolfcampian			
	Chase Group Council Grove Group Admire Group	Pontotoc Group	Pontotoc Group Chase Group Council Grove Admire Group	
	Virgilian	Wabunsee Group Shawnee Group Douglas Group	Ada Formation Vamoosa Formation	Wabunsee Shawnee Douglas
	Missourian	Ochelata Group Skiatook Group	Hilltop Fm. Ochelata Group	Skiatook Group
	Desmoinesian	Marmaton Group Cherokee Group	Deese Group	Marmaton Group Cabaniss Group Krebs Group
	Atokan	Atoka Group	Atoka Formation	Atoka Formation
	Morrowan	Morrow Group	Wapanucka Union Valley	Johns Valley Shale Jackfork Group
	Springer Formation	Springer Formation	McCully Saubee	
	Chesterian	Goddard Formation	Pikun Limestone Fayetteville Shale Hindsville Formation	Stanley Group
MISSISSIPPIAN	Meramecian	Delaware Creek Shale	Moorefield Formation	
	Osagean	Sycamore Limestone	Boone Group St. Joe Group	
	Kinderhookian			
	Woodford Shale Miserer Sandstone	Woodford Shale	Chattanooga Shale Sylamore Sandstone	
DEVONIAN	Upper			
	Middle			
	Lower			
SILURIAN	Haragan Fm. Henryhouse Fm.	Haragan Fm. Henryhouse Fm.	Salisaw Fm. Frisco Fm.	Pinetop Chert
	Upper			
	Lower			
	Chimney Hill Subgroup	Chimney Hill Subgroup	Quarry Mtn. Fm. Tenkiller Fm. Blackgum Fm.	Missouri Mountain Shale
ORDOVICIAN	Sylvan Shale	Sylvan Shale	Petit Colite Sylvan Shale	Blaylock Sandstone
	Upper			
	Viola Group	Viola Group	Viola Group	Polk Creek Shale
				Bigfork Chert
CAMBRIAN	Simpson Group	Simpson Group	Bromide Formation Tulip Creek Formation McLish Formation Oil Creek Formation Joins Formation	Wornble Shale
	Middle			
	Lower			
	Arbuckle Group	Arbuckle Group	Burgen Sandstone	Blakely Sandstone
PRECAMBRIAN	West Spring Creek Formation Kindblade Formation Cool Creek Formation McKenzie Hill Formation Butterfly Dolomite	West Spring Creek Formation Kindblade Formation Cool Creek Formation McKenzie Hill Formation Butterfly Dolomite	Arbuckle Group	Mazarrn Shale

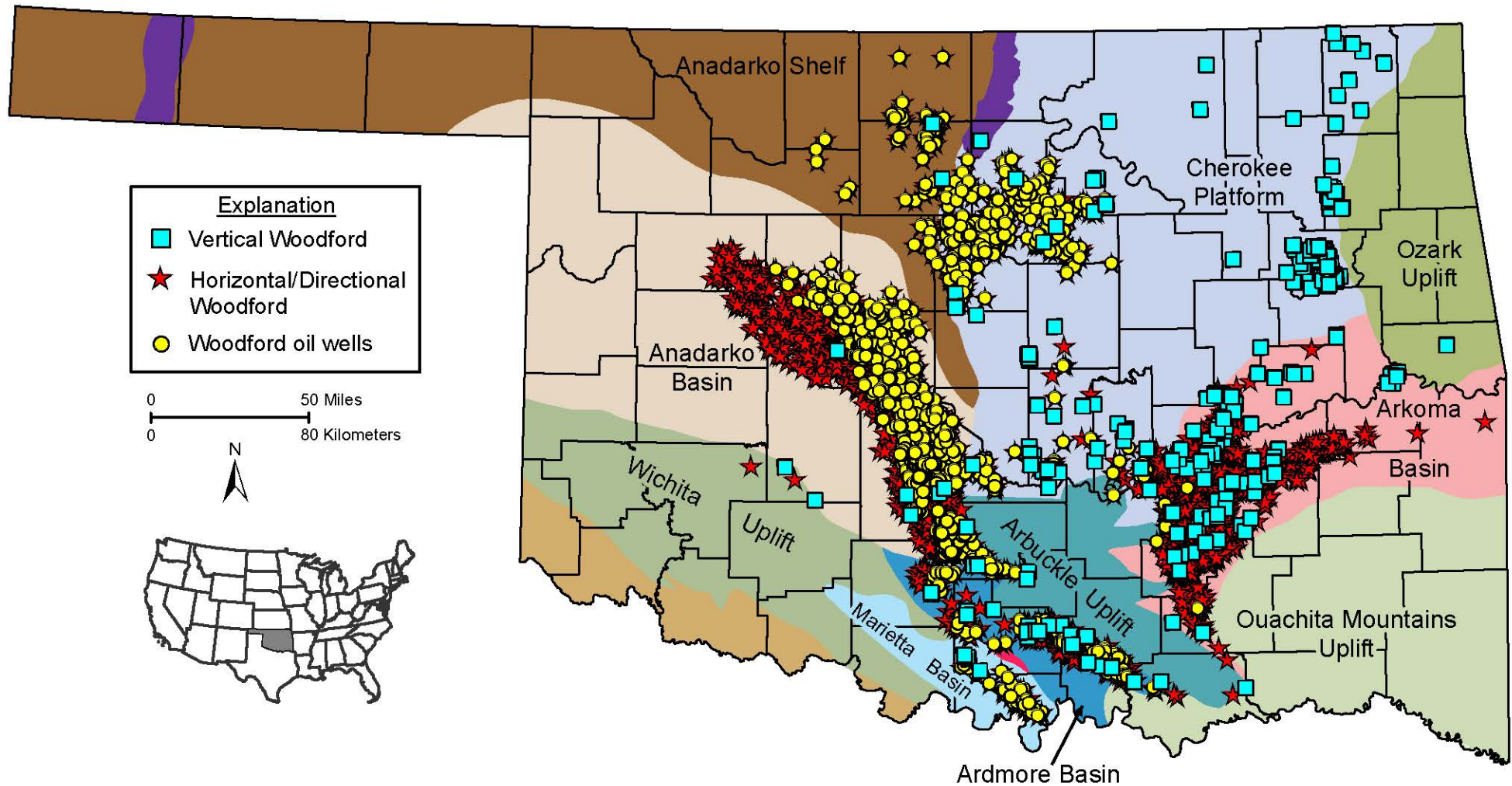
<b>Kerogen Type</b>	<b>II and III</b>
<b>Amount of TOC</b>	<b>&lt;1% – 28%</b>
<b>Maturity</b>	<b>&lt;1% to 6.5% VRo</b>

**ISOPACH MAP OF WOODFORD SHALE  
IN OKLAHOMA AND TEXAS PANHANDLE**

By  
Kurt Rottmann  
(Modified from Thomas W. Amsden, 1975, 1986; Sherrill D. Howery, 1993;  
and Thomas W. Amsden and James E. Barrick, 1993)  
2000

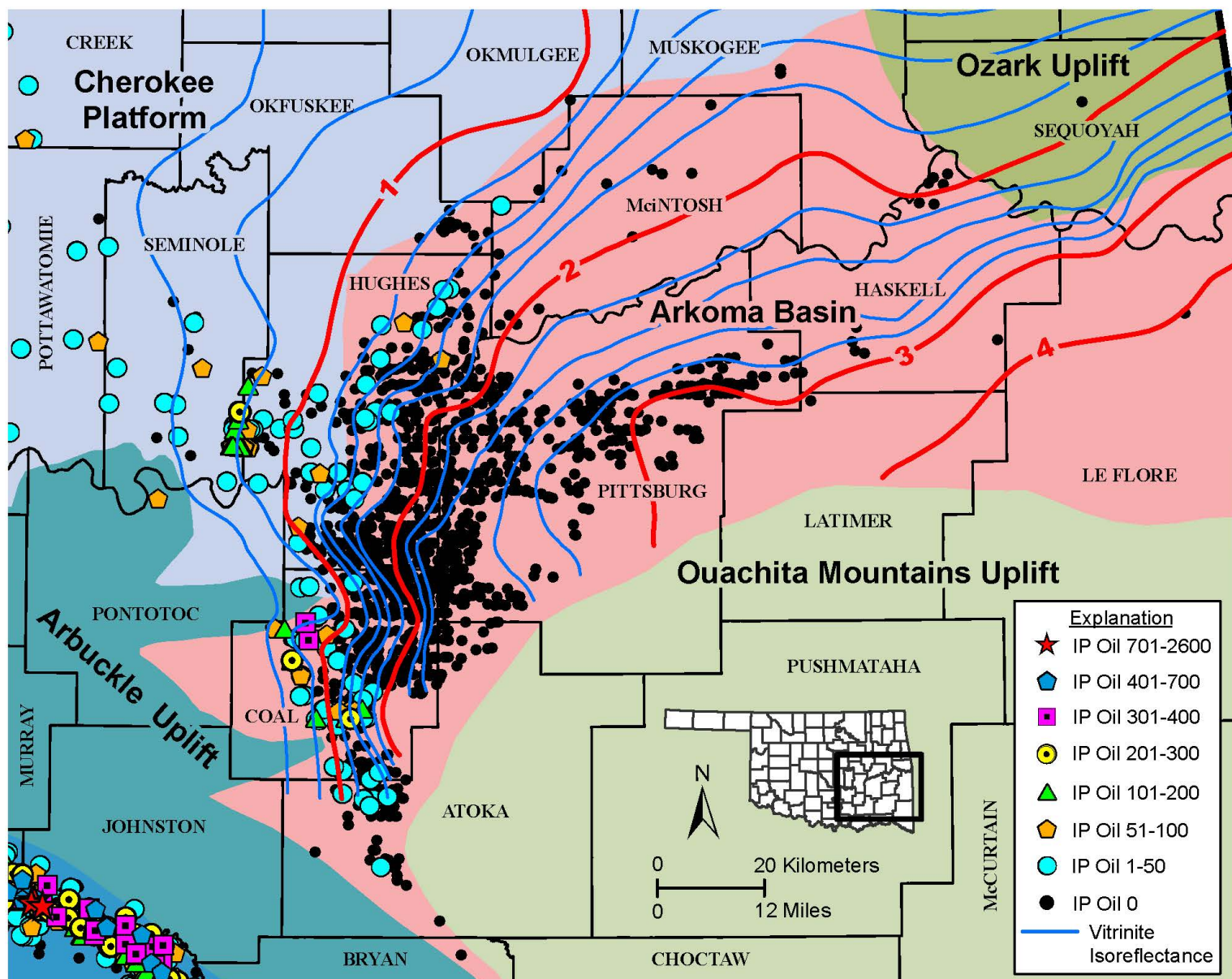


# Woodford Shale (2004-2020)

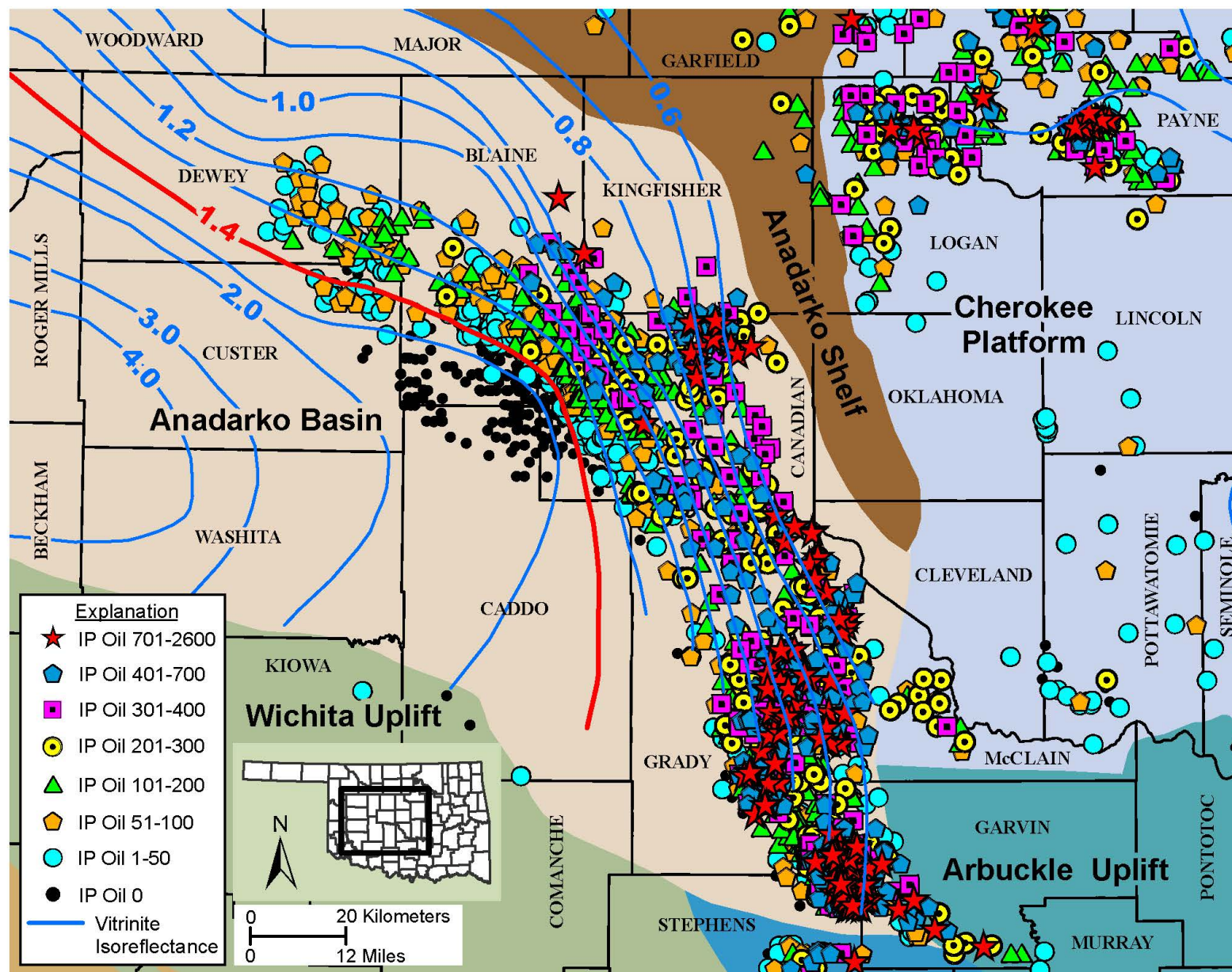




# Woodford Shale Arkoma Basin Oil IP

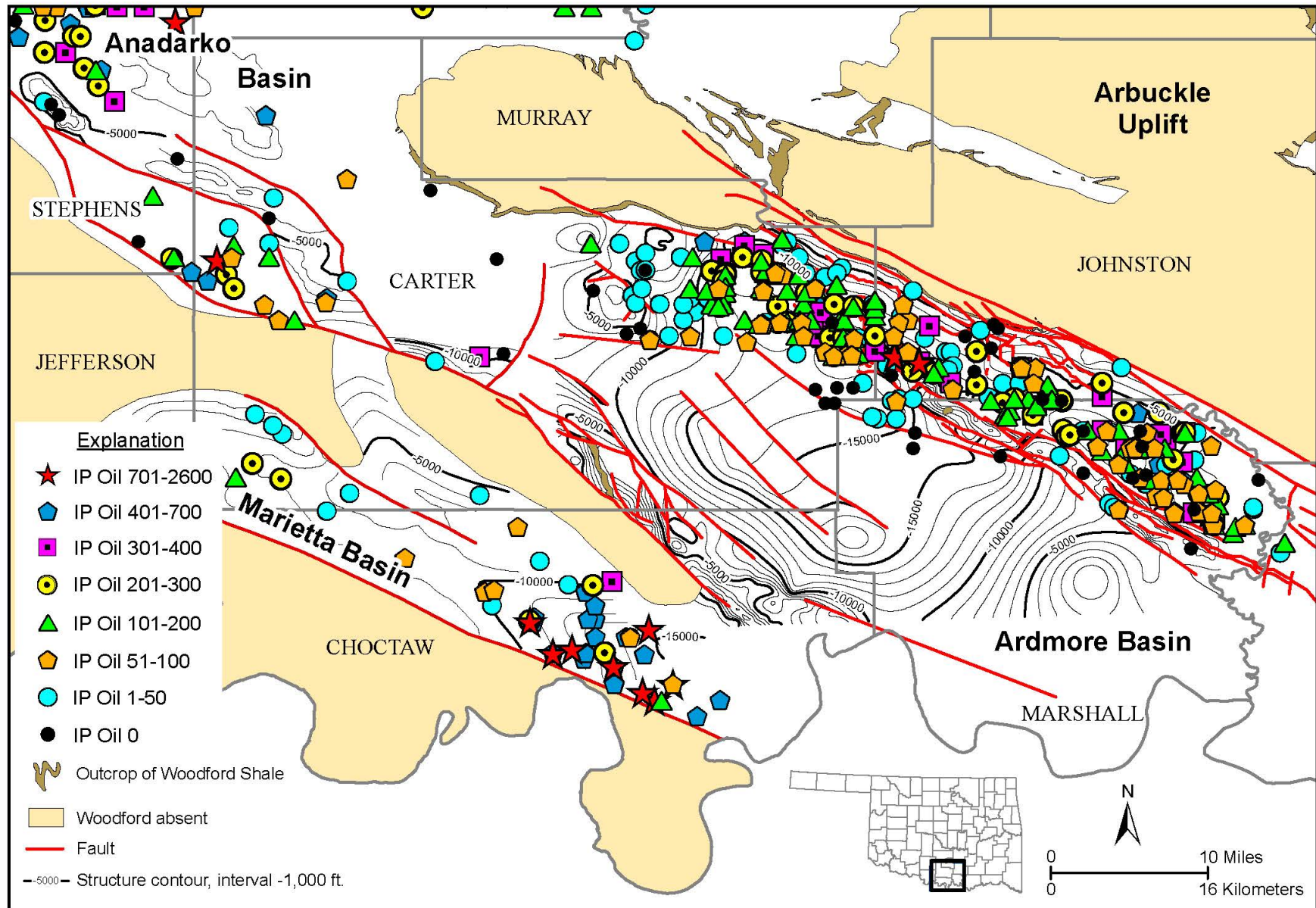


# Woodford Shale Anadarko Basin Oil IP





# Woodford Shale Ardmore Basin Oil IP



# Caney Shale (Mississippian Age)



SYSTEM/SERIES	ANADARKO BASIN, SW OKLAHOMA	ARBuckle MOUNTAINS, ARDMORE BASIN	ARKOMA BASIN, NE OKLAHOMA	OUACHITA MOUNTAINS
QUATERNARY	Alluvium and Terraces		Deposits	
TERTIARY	Ogallala Formation			
CRETACEOUS	Dakota Group			
JURASSIC	Morrison Formation			
TRIASSIC	Dockum Group			
PERMIAN	Ochoan	Elk City Sandstone Doxey Shale		
	Guadalupian	Cloud Chief Formation Whitehorse Group El Reno Group		
	Leonardian	Hennessey Shale Garber Sandstone Wellington Formation	Garber Sandstone Wellington Formation	
PENNSYLVANIAN	Wolfcampian	Chase Group Council Grove Group Admiral Group	Pontotoc Group Pontotoc Group Council Grove Admiral Group	
	Virgilian	Wauburnsee Group Shawnee Group Douglas Group	Ada Formation Vamoosa Formation Hilltop Fm.	Wauburnsee Shawnee Douglas
	Missourian	Ochelata Group Skiatook Group	Ochelata Group Skiatook Group	
	Desmoinesian	Marmaton Group Cherokee Group	Deese Group Marmaton Group Cathlamet Group Krebs Group	
	Atokan	Atoka Group	Atoka Formation	Atoka Formation
	Morrowan	Morrow Group	Derrick Hills Group Springer Formation	Johns Valley Shale Jackfork Group
	Springer Formation			
MISSISSIPPIAN	Chesterian	Chester Group	Goddard Formation Delaware Creek Shale	Stanley Group
	Meramecian	"Meramec Lime"		
	Osagean	"Osage Lime"	Sycamore Limestone	
	Kinderhookian			
DEVONIAN	Upper	Woodford Shale Misenor Sandstone	Woodford Shale	Arkansas Novaculite
	Middle			
	Lower			
SILURIAN	Upper	Haragan Fm. Henryhouse Fm.	Haragan Fm. Henryhouse Fm.	Pinetop Chert
	Lower	Chimney Hill Subgroup	Chimney Hill Subgroup	Missouri Mountain Shale
				Blaylock Sandstone
ORDOVICIAN	Upper	Sylvan Shale Viola Group	Sylvan Shale Viola Group	Polk Creek Shale Bigfork Chert
	Middle	Simpson Group	Bromide Formation Tulip Creek Formation McLish Formation Oil Creek Formation Joins Formation	Wormle Shale Blakely Sandstone
	Lower	Arbuckle Group	West Spring Creek Formation Kindblade Formation Cool Creek Formation McKenzie Hill Formation Butterfly Dolomite	Mazarrn Shale Crystal Mountain Sandstone
CAMBRIAN	Upper	Timbered Hills Group	Signal Mountain Formation Royer Dolomite Fort Sil Limestone	Collier Shale
	Middle	Granite, Rhyolite, and Gabbro		
	Lower			
PRECAMBRIAN	Granite, Rhyolite, and Metasediments	Granite and Gneiss	Granite and Rhyolite	

[Age equivalent to the Barnett Shale and Fayetteville Shale]

<b>Kerogen Type</b>	<b>II - III</b>
<b>Amount of TOC</b>	<b>~1% – 11.46%</b>
<b>Maturity</b>	<b>0.55 – 1.14% VRo (2 samples)</b>

Caney cores:

1. Sohio 1 Whitehead
2. Texaco 1 Elliott

- Caney
- Woodford

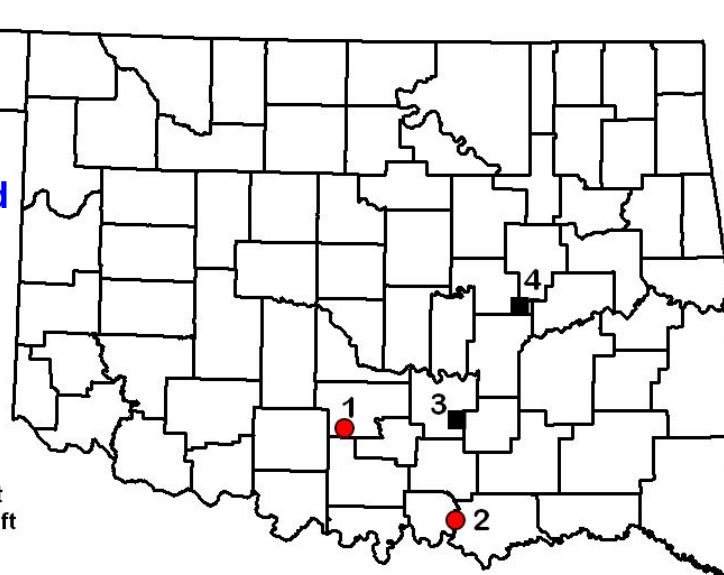
Caney

(1) 0.55% VRo, 8.23% TOC, 6,285 ft  
(2) 1.14% VRo, 4.83% TOC, 11,465 ft

Woodford

(3) 0.50% VRo, 7.18% TOC, 3,266 ft  
(4) 1.23% VRo, 3.76% TOC, 3,709 ft

Rock-Eval data compliments of  
Humble Geochemical Services

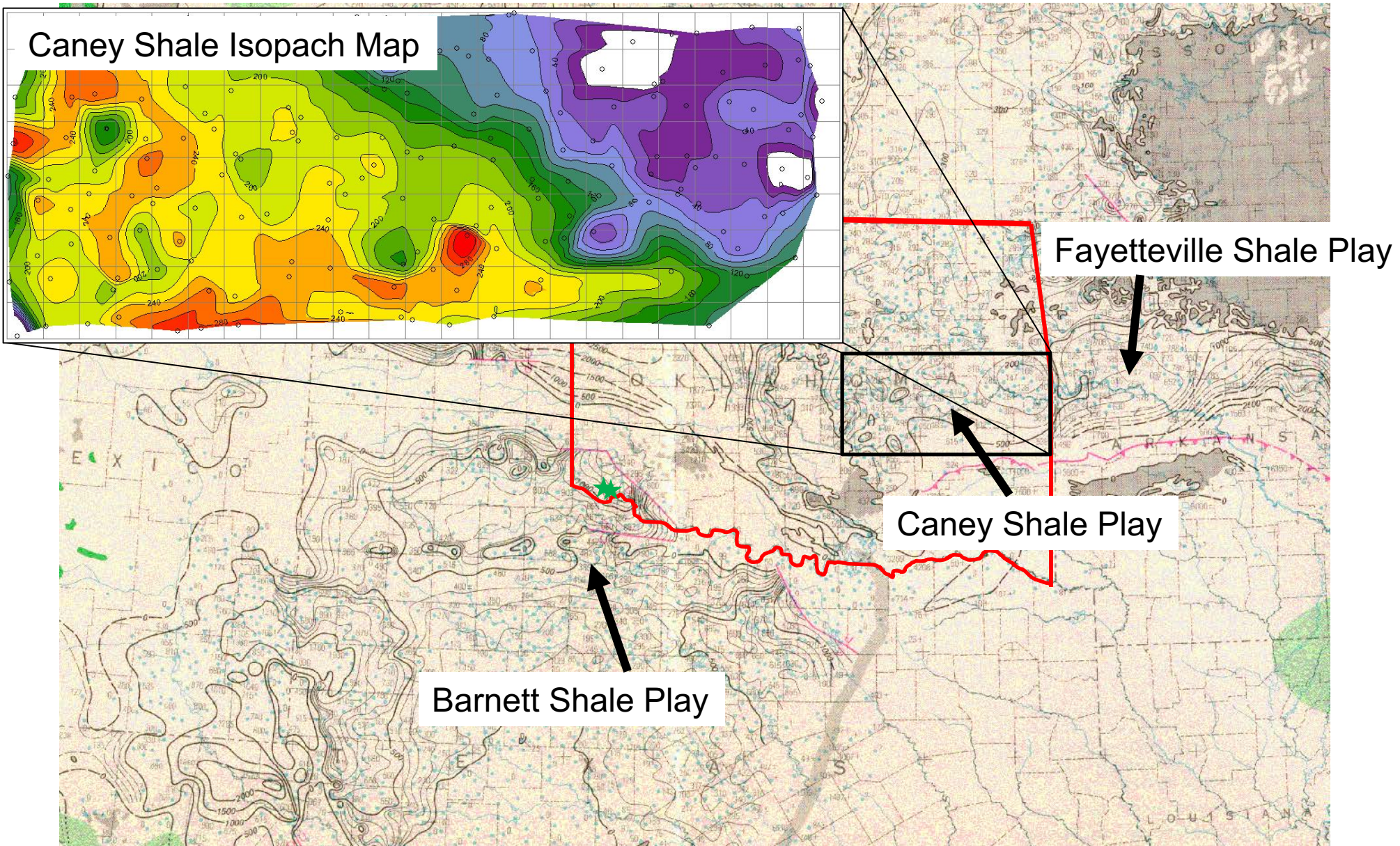




# Total Mississippian Isopach Map

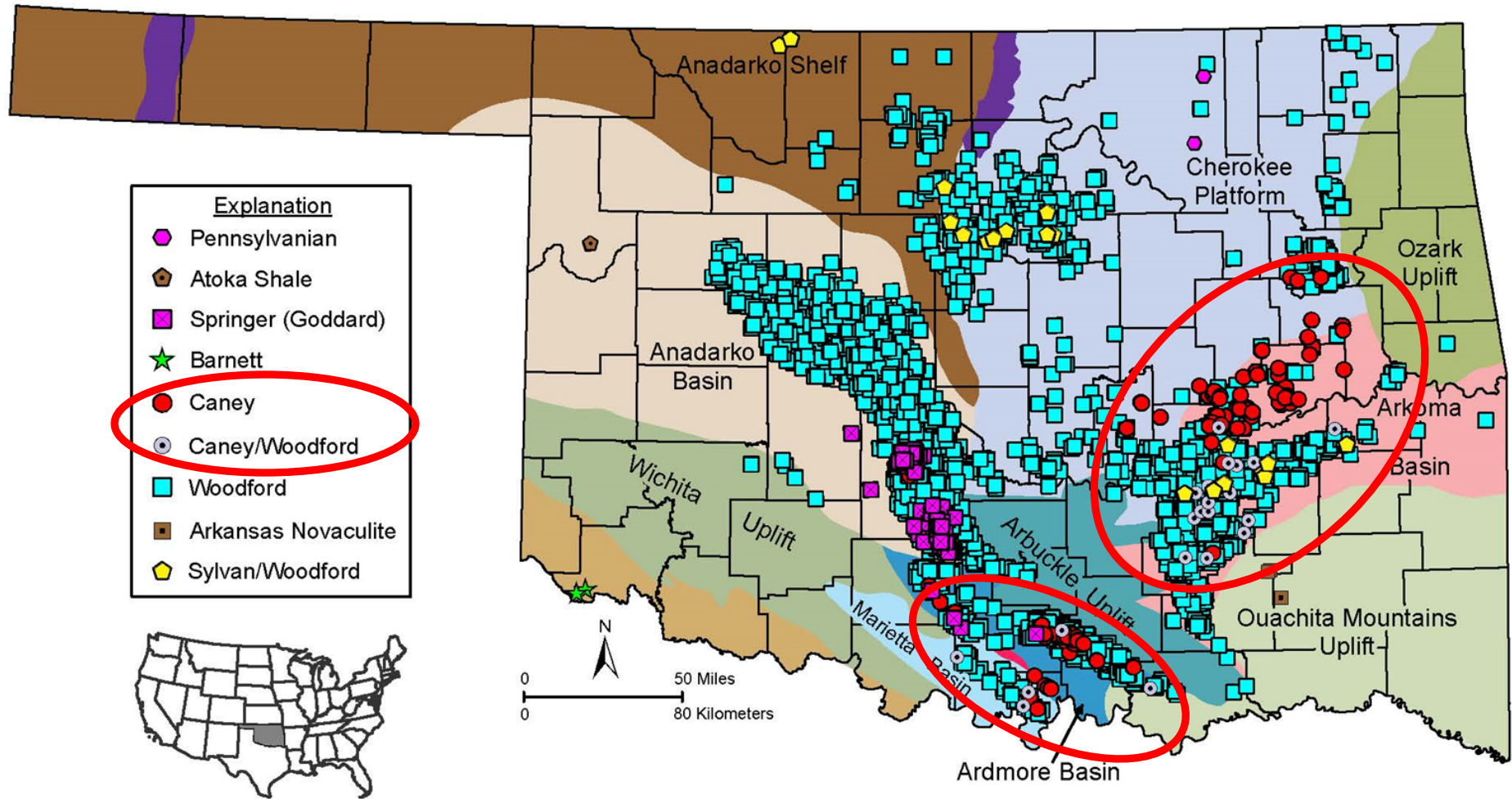


Caney Shale Isopach Map





# Caney Shale (1982 -2020)



# Goddard Formation (Mississippian Age)



SYSTEM/SERIES	ANADARKO BASIN, SW OKLAHOMA	ARBUCKLE MOUNTAINS, ARDMORE BASIN	ARKOMA BASIN, NE OKLAHOMA	QUACHITA MOUNTAINS
QUATERNARY	Alluvium and Terrace Deposits			
TERTIARY	Ogallala Formation			
CRETACEOUS	Dakota Group			
JURASSIC	Morrison Formation			
TRIASSIC	Dockum Group			
PERMIAN	Ochoan	Elk City Sandstone Doxey Shale		
	Guadalupian	Cloud Chief Formation Whitehorse Group El Reno Group		
	Leonardian	Hennessey Shale Garber Sandstone Wellington Formation	Garber Sandstone Wellington Formation	
	Wolfcampian	Chase Group Council Grove Group Admiral Group	Pontotoc Group Pontotoc Group Council Grove Admiral Group	
PENNSYLVANIAN	Virgilian	Wabunsee Group Shawnee Group Douglas Group	Ada Formation Vamoosa Formation	Wabunsee Shawnee Douglas
	Missourian	Ochelata Group Skiatook Group	Hilltop Fm. Ochelata Group Skiatook Group	
	Desmoinesian	Marmaton Group Cherokee Group	Deese Group	Marmaton Group Cabaniss Group Krebs Group
	Atokan	Atoka Group	Atoka Formation	Atoka Formation
MISSISSIPPIAN	Morrowan	Morrow Group	Wapanucka Union Valley McCully Sausbee	Johns Valley Shale Jackfork Group
	Cheslerian	Chesler Group	Goddard Formation	Stanley Group
	Meramecian	"Meramec Lime"	Delaware Creek Shale	
	Osagean	"Osage Lime"	Sycamore Limestone	
DEVONIAN	Kindershookian	Woodford Shale Misenor Sandstone	Woodford Shale	Arkansas Novaculite
	Upper		Chattanooga Shale Sylamore Sandstone	
	Middle		Salisaw Fm. Frisco Fm.	
	Lower	Haragan Fm. Henryhouse Fm.	Haragan Fm. Henryhouse Formation	Pinetop Chert
SILURIAN	Upper	Chimney Hill Subgroup	Clairton Formation Cochrane Formation	Missouri Mountain Shale
	Lower		Keel Formation	Blaylock Sandstone
			Petit Colite Sylvan Shale	Polk Creek Shale
			Viola Group	Bigfork Chert
ORDOVICIAN	Upper	Simpson Group	Bromide Formation Tulip Creek Formation McLish Formation Oil Creek Formation Joins Formation	Wornble Shale
	Middle		Burgen Sandstone	Blakely Sandstone
	Lower	Arbuckle Group	West Spring Creek Formation Kindblade Formation Cool Creek Formation McKenzie Hill Formation Butterfly Dolomite	Mazarr Shale Crystal Mountain Sandstone
			Signal Mountain Formation Royer Dolomite Fort Sil Limestone	Collier Shale
CAMBRIAN	Upper	Timbered Hills Group	Honey Creek Limestone Reagan Sandstone	Timbered Hills Group
	Middle	Granite, Rhyolite, and Gabbro	Rhyolite	
	Lower			
PRECAMBRIAN		Granite, Rhyolite, and Metasediments	Granite and Gneiss	Granite and Rhyolite

Pearson, 2016

Kerogen Type

Mainly Type II and III

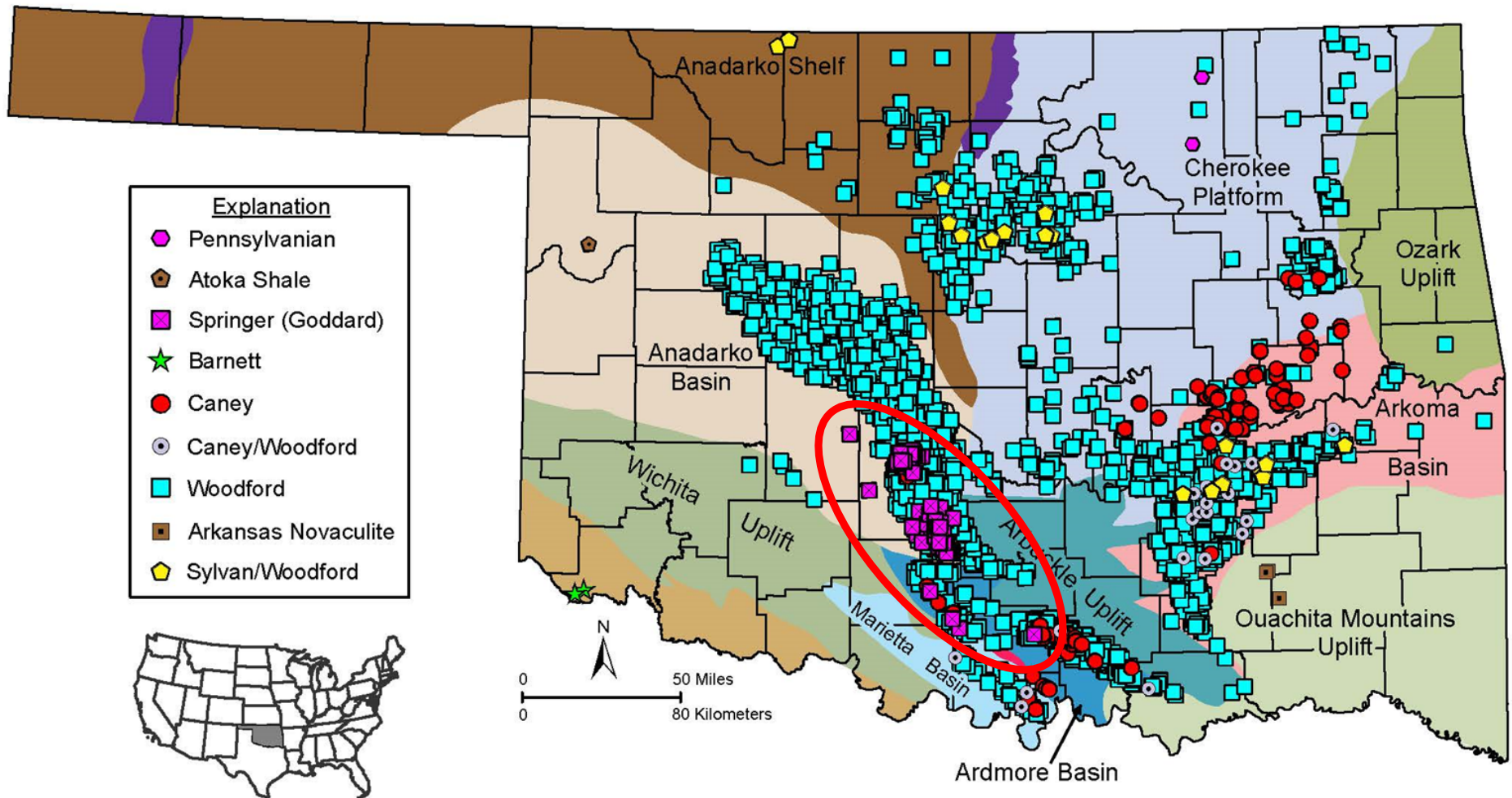
Amount of TOC

<1% - 7.77%

Maturity

0.6% - 1.26% VRo

# Goddard Formation





# Atoka Shale (Pennsylvanian Age)



SYSTEM/SERIES	ANADARKO BASIN, SW OKLAHOMA	ARBUCKLE MOUNTAINS, ARDMORE BASIN and	ARKOMA BASIN, NE OKLAHOMA	OUACHITA MOUNTAINS
QUATERNARY	Alluvium		Terrace Deposits	
TERTIARY	Ogallala Formation			
CRETACEOUS	Dakota Group			
JURASSIC	Morrison Formation			
TRIASSIC	Dockum Group			
PERMIAN	Ochoan	Elk City Sandstone Doxey Shale		
	Guadalupean	Cloud Chief Formation Whitehorse Group El Reno Group		
	Leonardian	Hennessey Shale Garber Sandstone Wellington Formation	Garber Sandstone Wellington Formation	
	Wolfcampian	Chase Group Council Grove Group Admiral Group	Pontotoc Group Pontotoc Group	Chase Group Council Grove Admiral Group
PENNSYLVANIAN	Virgilian	Wabunsee Group Shawnee Group Douglas Group	Ada Formation Vamoosa Formation	Wabunsee Shawnee Douglas
	Missourian	Ochelata Group Skiatook Group	Hoxbar Group	Hilltop Fm. Ochelata Group Skiatook Group
	Desmoinesian	Marmaton Group Cherokee Group	Deese Group	Marmaton Group Cathlamet Group Krebs Group
	Atokan	Atoka Group	Dornick Hills Group	Atoka Formation
MISSISSIPPIAN	Morrowan	Morrow Group	Springer Formation	Wagonmound McCully Union Valley Saubee
	Chesterian	Springer Formation	Goddard Formation	Pilot Limestone Fayetteville Shale Hindsville Formation
	Meramecian	"Meramec Lime"	Delaware Creek Shale	Moorefield Formation
	Osagean	"Osage Lime"	Sycamore Limestone	Boone Group St. Joe Group
DEVONIAN	Kindershookian	Woodford Shale	Woodford Shale	Chattanooga Shale Sylamore Sandstone
	Upper	Misener Sandstone		Arkansas Novaculite
	Middle			
SILURIAN	Lower	Haragan Fm. Henryhouse Fm.	Friscow Fm. Haragan Bois d'Arc Formation Henryhouse Formation	Pinetop Chert
	Upper			
	Lower	Chimney Hill Subgroup	Chimney Hill Subgroup Clairton Formation Cochrane Formation Keel Formation	Missouri Mountain Shale Blaylock Sandstone
ORDOVICIAN	Upper	Sylvan Shale	Sylvan Shale	Polk Creek Shale
	Middle	Viola Group	Viola Group	Bigfork Chert
	Lower			
CAMBRIAN	Upper	Simpson Group	Bromide Formation Tulip Creek Formation McLish Formation Oil Creek Formation Joins Formation	Wormle Shale
	Middle		West Spring Creek Formation Kindblade Formation Cool Creek Formation McKenzie Hill Formation Butterfly Dolomite	Blakely Sandstone
	Lower	Arbuckle Group	Signal Mountain Formation Royer Dolomite Fort Sil Limestone	Mazarrn Shale
PRECAMBRIAN	Upper	Timbered Hills Group	Honey Creek Limestone Reagan Sandstone	Crystal Mountain Sandstone
	Middle	Granite, Rhyolite, and Gabbro	Rhyolite	Collier Shale
	Lower			
		Granite, Rhyolite, and Metasediments	Granite and Gneiss	Granite and Rhyolite

**Kerogen Type**

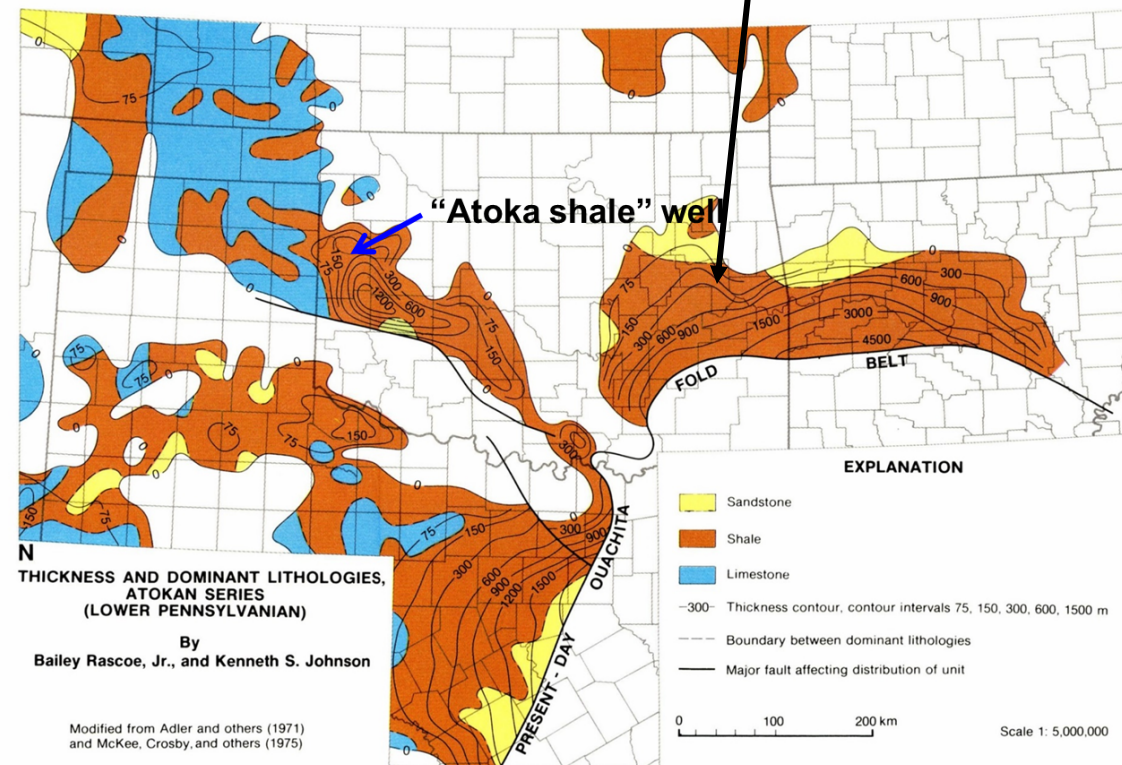
**Mainly II and III (Samson, 2005)**

**Amount of TOC**

**0.22 – 2.92% (Weber, 1992 & Hendrick, 1992)**

**Maturity**

**<2 - >3.6% VRo (Houseknecht, 1987)**



Modified from Cardott, 2017

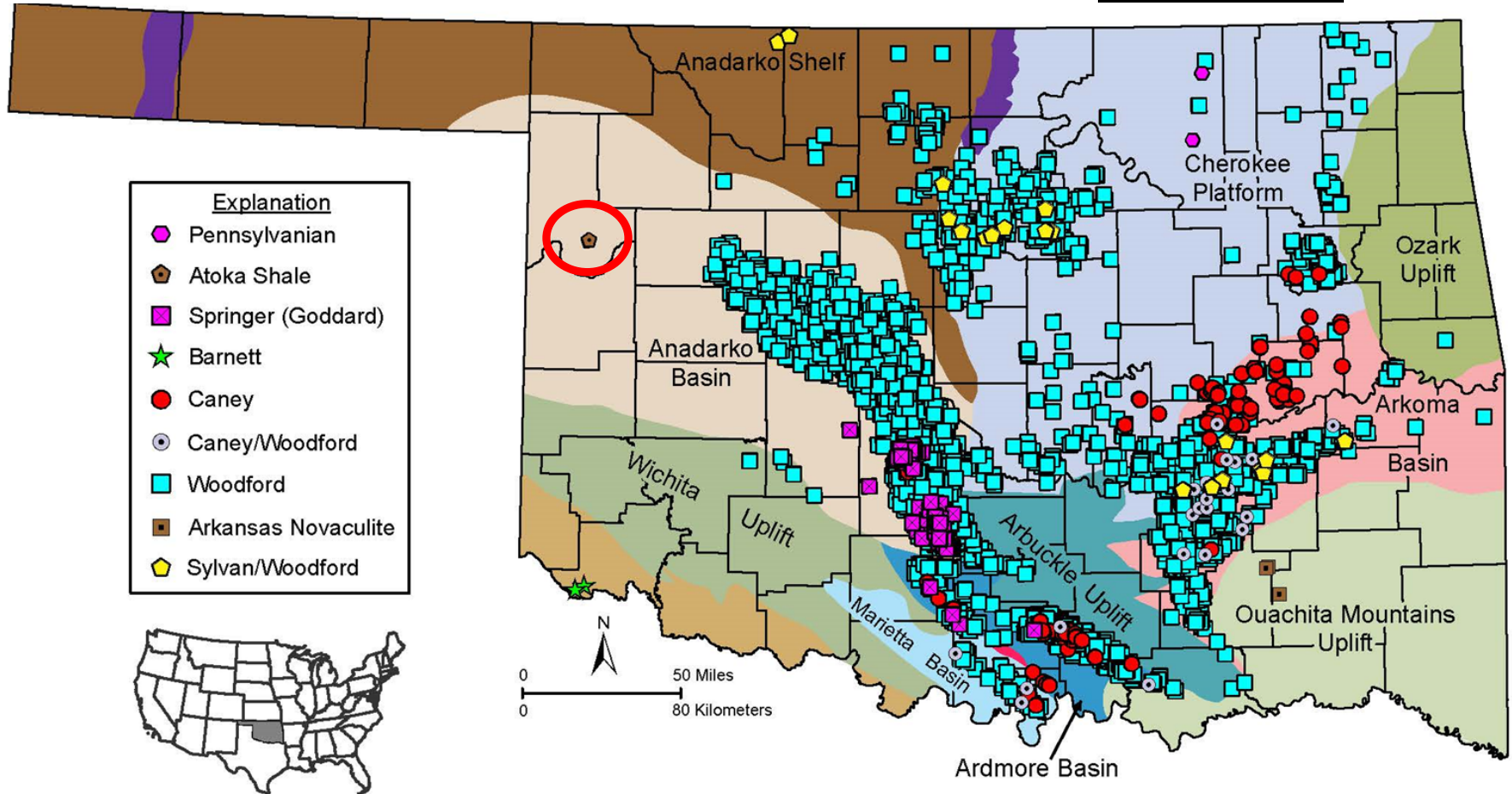
From Johnson and others, 1989  
page 29



# Atoka Shale (Pennsylvanian Age)



Continental Resources 1-22H Shrewder well; 22-18N-23W; Ellis Co.; **Atoka Shale**; 10,926 TVD



An unconventional gas resource play in **Pennsylvanian Atoka shale** is emerging in the **Anadarko** basin in the Texas Panhandle and far western **Oklahoma**. **Continental Resources Inc.**, Enid, Okla., says it has 34,000 net acres in the play as of mid-December 2008. The play stretches about 85 miles from Peek Field in Ellis County, Okla., west to Lipscomb, Ochiltree, eastern Hansford, northeastern Roberts, and northernmost Hemphill counties in the Texas Panhandle. Continental says **EOG Resources Inc.**, Houston, has completed 26 horizontal wells at as much as 7 MMcf/d per well and attributed 400 Bcf of Atoka recovery potential to its 60,000 net acres. **January 7, 2009**

## The Relationship between Specific Reservoir Characteristics and the Gas Productive Coals and Carbonaceous Mudstones in the Cherokee Basin\*

Steven Tedesco<sup>1</sup>

Search and Discovery Article #10789 (2015)\*\*

Posted November 30, 2015

\*Adapted from oral presentation given at AAPG Mid-Continent Section meeting in Tulsa, Oklahoma, October 4-6, 2015

\*\*Datapages © 2015 Serial rights given by author. For all other rights contact author directly.

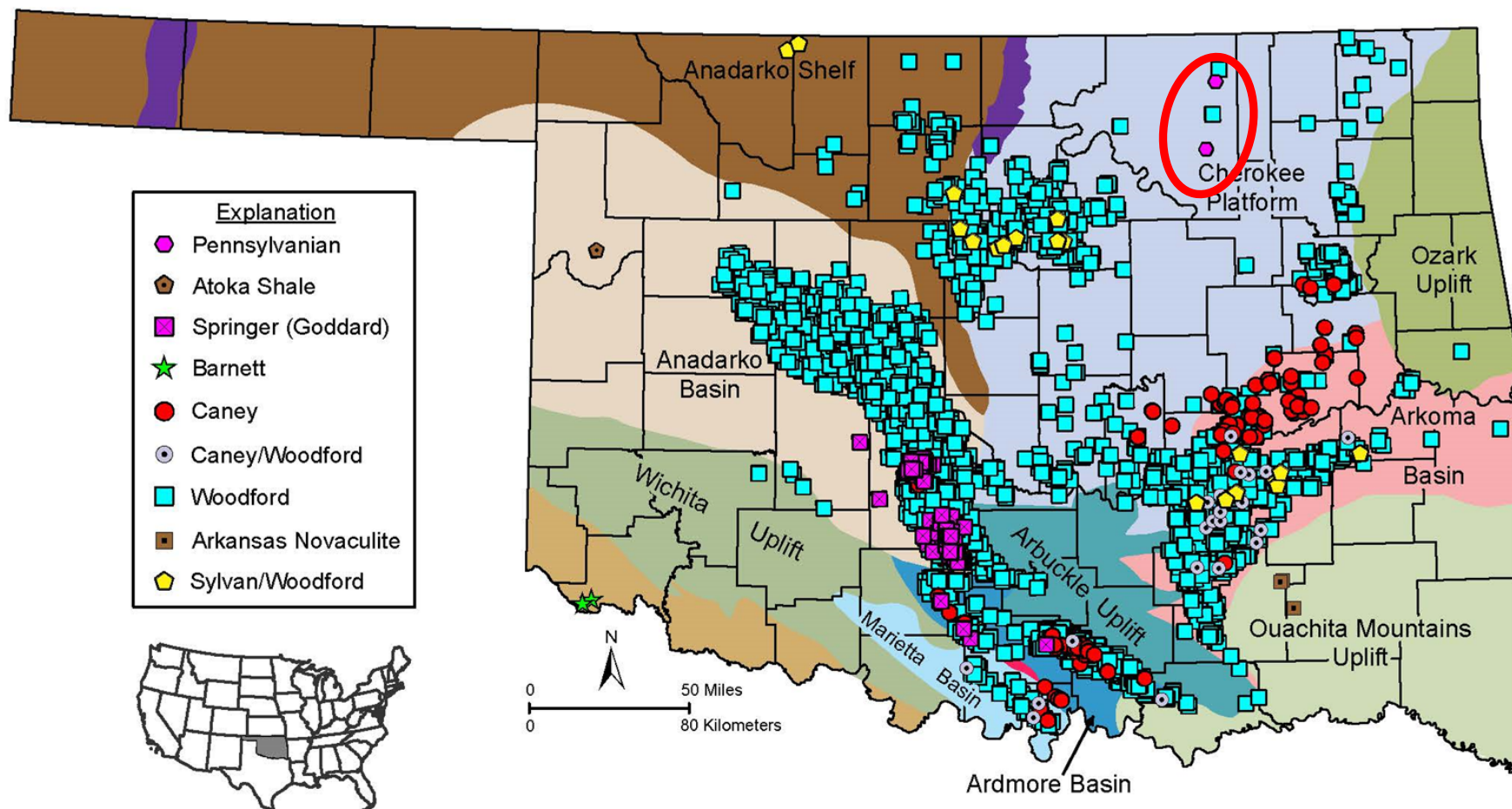
<sup>1</sup>Running Foxes Petroleum Inc., Centennial, CO, USA ([s.a.tedesco14@runningfoxes.com](mailto:s.a.tedesco14@runningfoxes.com))

### Abstract

The Cherokee Basin is a shallow intracratonic basin that has significant gas production from the Desmoinesian and Atokan age Cherokee Formation coals and carbonaceous mudstones at less than 2,000 feet. The Cherokee Group's coals in the Cherokee Basin were deposited on an abandoned deltaic surface in a coastal setting. Only specific coals, the Mulky, Weir-Pittsburgh, Rowe and Riverton and the Excello Shale within the Cherokee Formation are generally productive whereas the remaining seams and carbonaceous shale are not productive. The basin was subject to thermal maturation in late Pennsylvanian and Permian time caused by expulsion of low temperature hydrothermal fluids from the Anadarko, Ardmore and Arkoma basins that migrated north through the Cherokee Basin into the Forest City Basin. Proximate analysis of the coals indicates that select seams are gas productive due to higher sulfur contents, which allowed hydrocarbon generation at lower temperatures. The Excello Shale is productive because it has over 50% quartz-carbonate minerals making it more brittle allowing hydraulic fracturing stimulation to be effective. The main productive area is in the central part of the basin and is related to the apex of the Silurian-Devonian age Chautauqua Arch. By mapping sulfur trends in coals and quartz-carbonate percentage content trends in carbonaceous mudstones allows a more definitive method to identify areas that will be gas productive.



# Pennsylvanian Shales (NE OK)



**Tedesco, 2015**

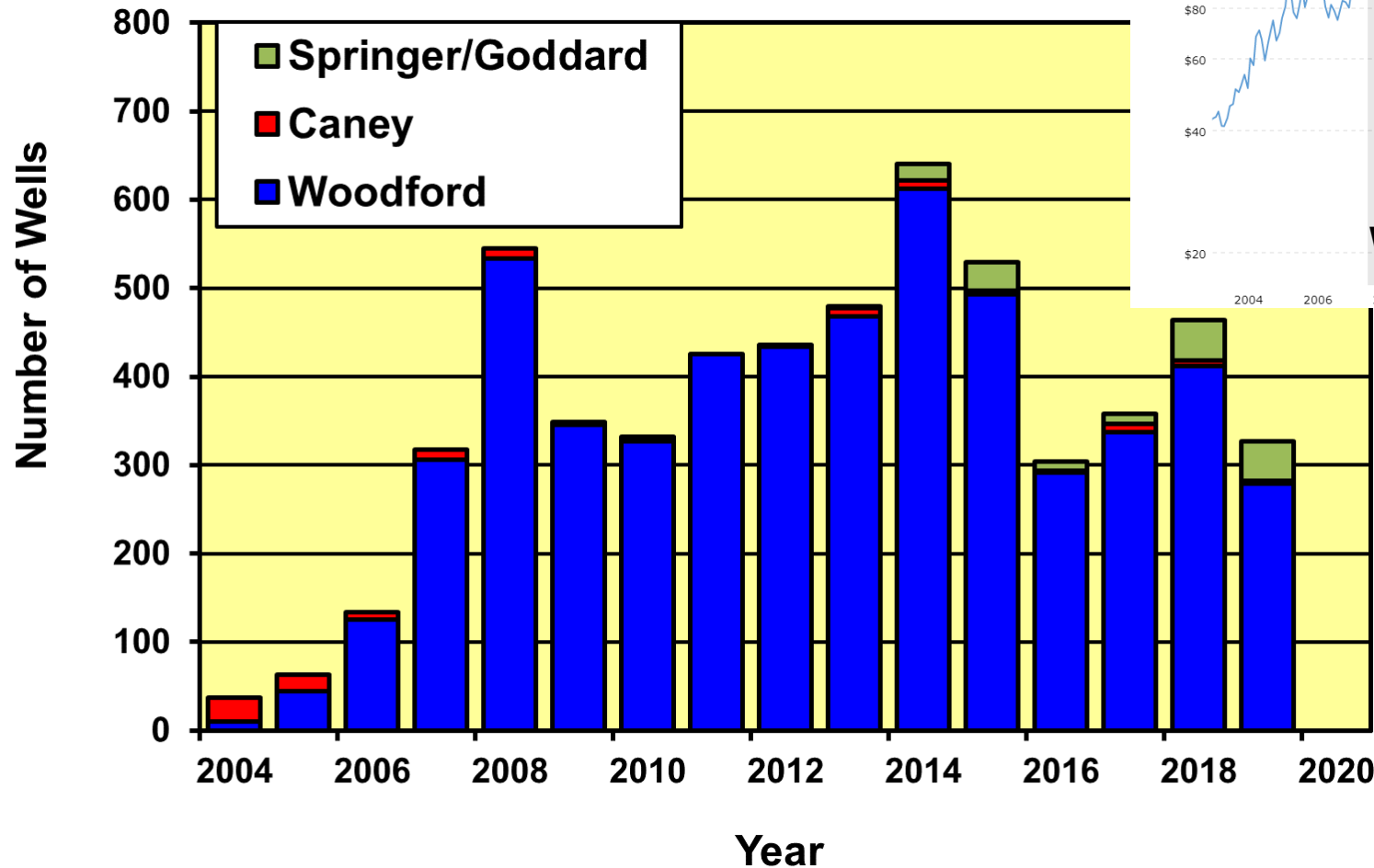
<b>Kerogen Type</b>	<b>II, III, and IV</b>
<b>Amount of TOC</b>	<b>&lt;1% - ~12%</b>
<b>Maturity</b>	<b>0.45 – 0.76% VRo</b>

# Oklahoma Shale Oil and Gas Well Completions History



**5445 Woodford + 131 Caney + 166 Springer/Goddard Wells**

**2004–2019**





**All shales are different and complex**