KANSAS GEOLOGICAL SOCIETY

BULLETIN

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"Woodford Shale as a Source/Reservoir Rock"

By

Brian J. Cardott

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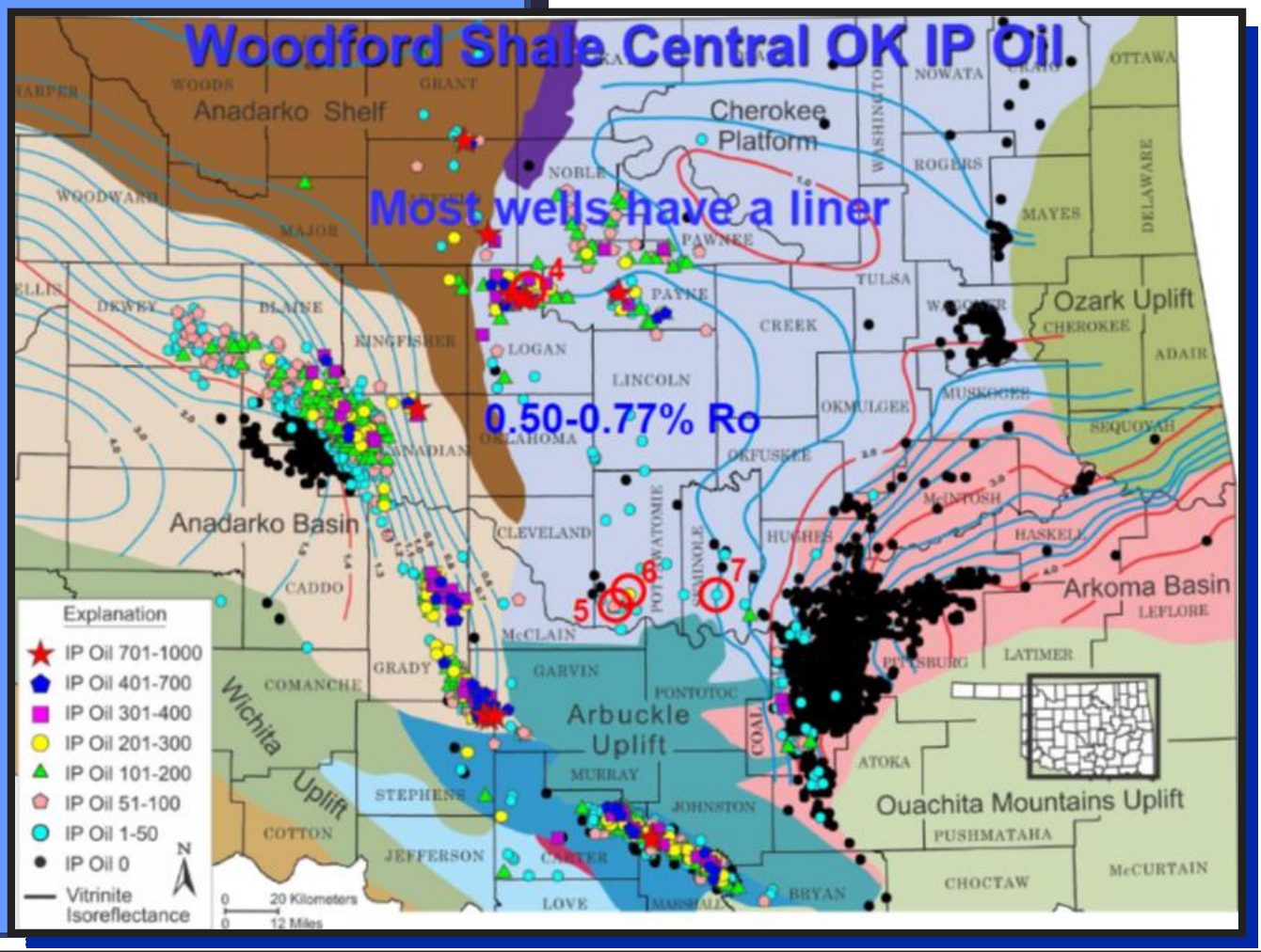

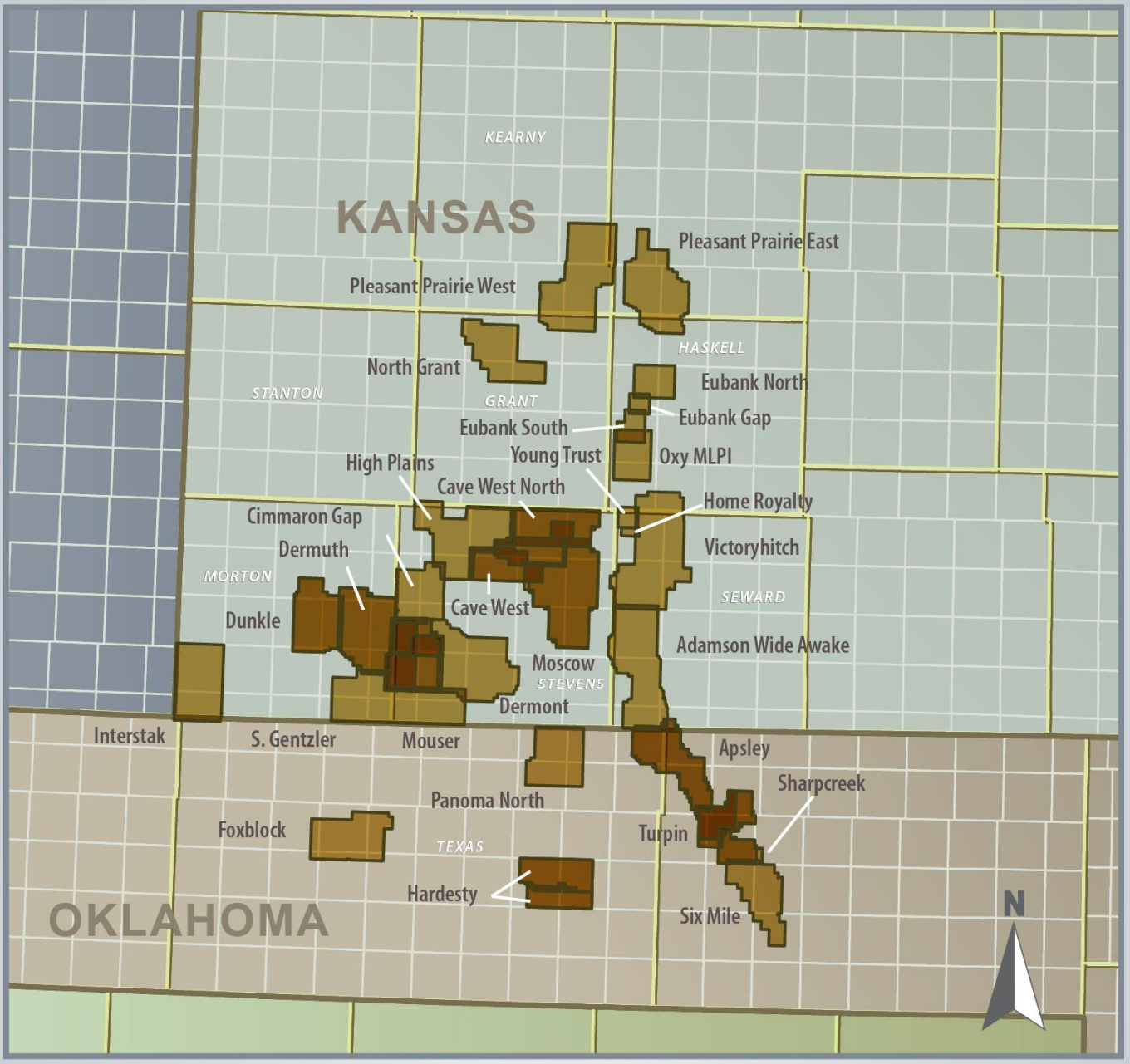

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Date: 3/25/15

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A slide from Brian Cardottôs power point presentation given to the Society on March 3rd. His paper is included in this issue, starting on page 10. His slide presentation can be viewed on-line at: http://www.ogs.ou.edu/oilgaspres.php

CALL FOR PAPERS

The Kansas Geological Society Bulletin, which is published bimonthly both in hard-copy and electronic format, seeks short papers dealing with any aspect of Kansas geology, including petroleum geology, studies of producing oil or gas fields, and outcrop or conceptual studies. Maximum printed length of papers is 5 pages as they appear in the Bulletin, including text, references, figures and/or tables, and figure/table captions. Inquiries regarding manuscripts should be sent to Rebecca Radford, manager@kgslibrary.com or mailed to 212 N. Market, Ste. 100, Wichita, KS 67202. Specific guidelines for manuscript submission appear in each issue of the Bulletin, which can also be accessed on-line at the Kansas Geological Society web site at http://www.kgslibrary.com

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2015 Technical Talks

May 18ð (A Monday) ***"From Chaos to Confucius: Making sense out of the Mississippian Reservoirs of Northern Oklahoma"*** - Shane Matson

May 26ð ***WSU Student Field Studies***ð Larry Richardsonôs class

The Technical Talks will break for summer and resume in September

For More Information or suggestions of speakers please contact Dave Clothier: dave@mccoypetroleum.com

Note: For those geologists who need 30 points to renew their licenses, there will be a sign-in sheet at each presentation and also a certificate of attendance.

Tech Talks are held at Landmark Square
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Please remember to check the website for the most up to date information on Technical Talks
http://www.kgslibrary.com/techtalks.cfm

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Bulletin committee members and PhD's in Paleontology are prohibited from entering.

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President's Letter

Greetings fellow KGS members,

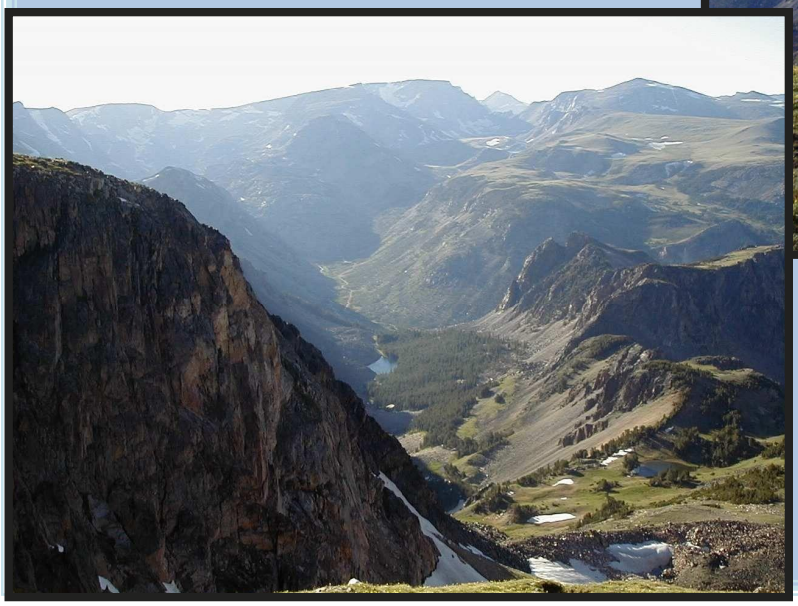
Hope everyone is weathering our recent decline in oil prices. It is unfortunate that our nation does not understand what a pivotal role our industry plays in our economy until we have a drastic change in our circumstances. With tax revenues dropping rapidly, and job loss increasing dramatically, perhaps folks will begin to understand. As I write this letter, I see the announcement that our economy grew 0.2% (stagnant) in the first quarter of this year, much lower than was projected. I remember some advice I received from an old (actually, he wasn't so old.....he was younger at the time than I am now) Humble Oil geologist, Winford Howard, while on my first job. He exclaimed to me that you have to develop the attitude, "When it is too tough for everyone else, it is just right for me". This advice I have valued for just short of 40 years. Those of us that work Kansas see that play out every time the price of oil drops.

So how does this affect us at the Library? We have had to lay off some of our part time help. Fortunately, the Foundation has stepped up with some help for some of our summer employees, for which we thank them most kindly. We continue to focus on scanning in Eastern Kansas logs and Geologic Reports. Our future depends on the growth of the Digital Library, and we desperately need to back up our paper records, as a great many are irreplaceable.

I want to encourage our membership to use our facilities for their printing and scanning needs. Maps, geologic reports, hard copies of electric logs.....we can handle them all!

For this month's picture I'm stepping away from tradition with a picture of a friend of mine and fellow KGS member from Indiana, Larry Whitmer. The picture was taken in the Bear Tooth Mountain area in Montana, while Barbara and I were visiting him at his cabin east of Yellowstone in Wyoming.

Frank S. Mize
President 2015



Bear Tooth Mountain area in Montana

View these photos on line to experience them in color

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From The Manager

Dear Members,

One of the more enjoyable aspects of my job as manager of the Society is when the geology students come to present their field studies and projects at our Technical Meetings. The KU students always weather the storm and come in the winter but spring brings us the Fort Hays State students and the Wichita State students.

Pictured below is Dr. Hendratta Ali and her students from Fort Hays State, with Frank Mize and Dave Clothier. These students gave us outstanding presentations and in turn, we fattened them up a bit with lunch and dessert at the Petroleum Club.

We will be looking forward to the Wichita State Petroleum Class, taught by our own Larry Richardson. His students will be presenting on Tuesday, May 26th.

Wednesday, May 13th will be the Foundation's Annual Spring Mixer at the Petroleum Club. All are welcome! See flyer in this issue or on-line.

The KGS Golf Tournament will be on Monday, **July 13th**. Watch the web site for more information as we get closer to that date. Registration forms will be available on-line or at the library or can be emailed upon request.

Respectfully submitted,
Rebecca Radford
Manager

"Woodford Shale as a Source/Reservoir Rock"

By

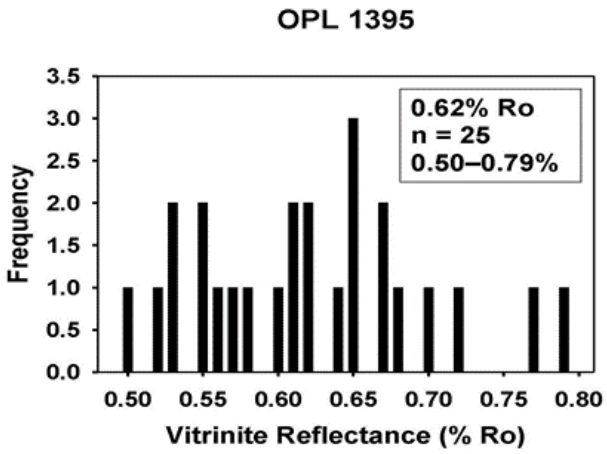
Brian J. Cardott

Cardott received a Bachelorôs degree in geology from the University of Illinois-Urbana in 1977, and a Masterôs degree in geology from Southern Illinois University-Carbondale in 1981. In addition to the AAPG, he is a member of and active in several geological societies: The Society for Organic Petrology (President, 1995-1996; Vice President, 1991-1992), International Committee for Coal and Organic Petrology, Geological Society of America (Coal Geology Division Member-at-Large, 1989-1991), Oklahoma City Geological Society, and Tulsa Geological Society.

In March 2015 Brian gave a great talk about the Woodford Shale as a Source/Reservoir Rock and some of the intricacies of this shale as it recognized as both a reservoir and as a source. The following information has been taken from internet site: http://www.ogs.ou.edu/oilgaspres.php For further and more detailed information please go to that site.

Outline of the presentation

*Define the Oil Window, with an Emphasis on the Start of the Window
*Basic Parameters Needed for Oil Production from Shale Resource Plays
*Evaluation of Woodford Shale as a Liquid Hydrocarbon Reservoir



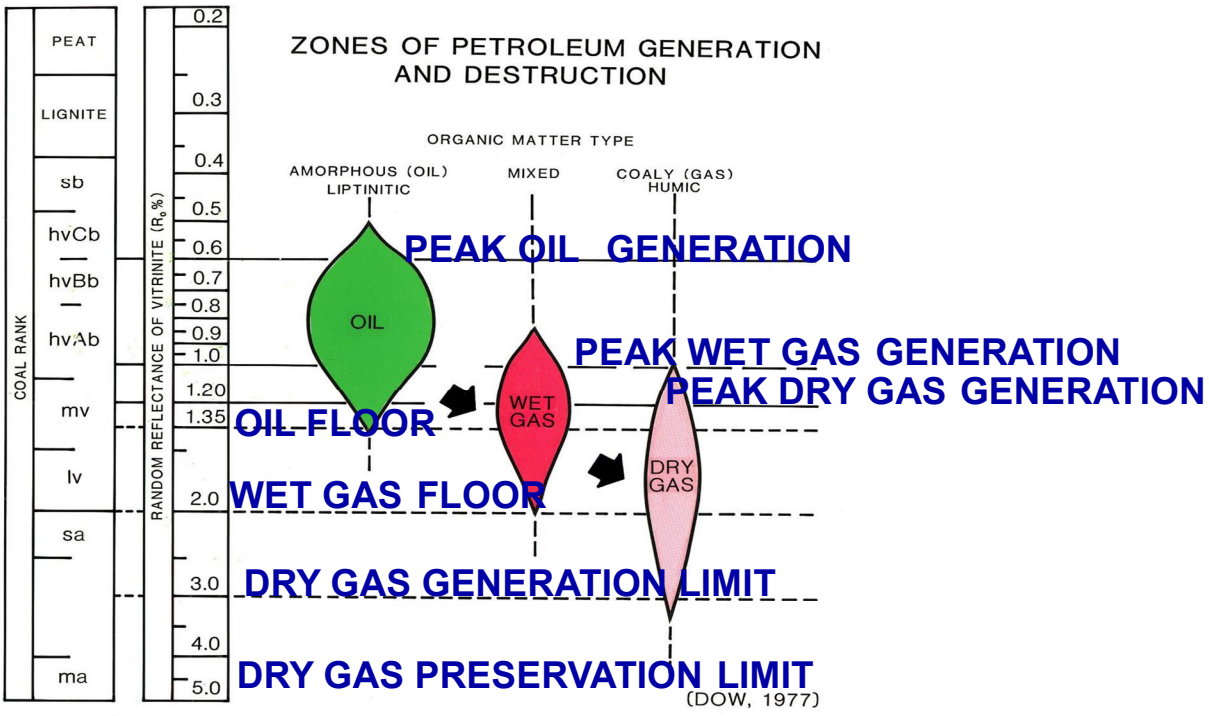
VITTINITE REFLECTANCE SUMARY

The Vitrinite reflectance value is an average of >20 measurements typically following a a normalized distribution over a range of ~0.3% Ro.

Part of the Problem of Determining the Vitrinite Reflectance of a Shale at the Start of the oil Window (~0.5% Ro) is the presence of Vitrinite-Like Pre-Oil Solid Bitumen (genetic bitumen classification of Curiale, 1986)

Pre-Oil Solid Bitumen: early generation of products of rich source rocks, probably extruded from their sources as a very viscous fluid, and migrated the minimum distance necessary to reach fractures and voids in the rock.

Vitrinite-like bitumen is the greatest source of error for low thermal maturity shaleôs and possibly the source of reflectance suppression: Hackley and others(2013) concluded that Vitrinite reflectance measurements of early mature Devonian shaleôs in the Appalachian Basin may erroneously include pre-oil solid bitumen reflectance measurements.



Even if some of Woodford Shale vitrinitereflectance values <0.5% Ro included lower bitumen-reflectance values, the influence would most likely lower the mean Vitrinite-reflectance value by ~0.10-0.20% R0 (e.g., 0.48% Ro may actually be ~0.58-0.68% Ro at the start of the oil window), confirmed by other qualitative petrographic thermal maturity indicators.

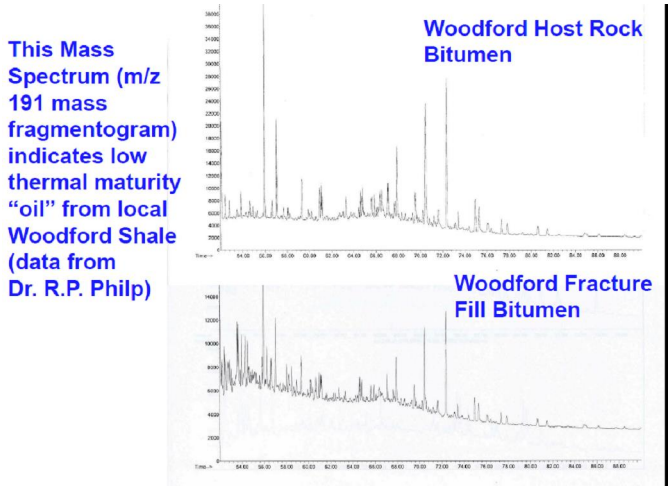
Jarvie (2012, p. 91):
ñé .thermal maturity values from about 0.60 to 1.40 Ro are the most likely values significant for petroleum liquid generation. Regardless of thermal maturity, there must be sufficient oil saturation to allow for the possibility of commercial production of oilò. Most petroleum geochemists use 0.6% Ro as the onset of oil generation (e.g., Peters and Cassa, 1994 Applied source rock geochemistry: AAPG Memoir 60, p. 93-117)

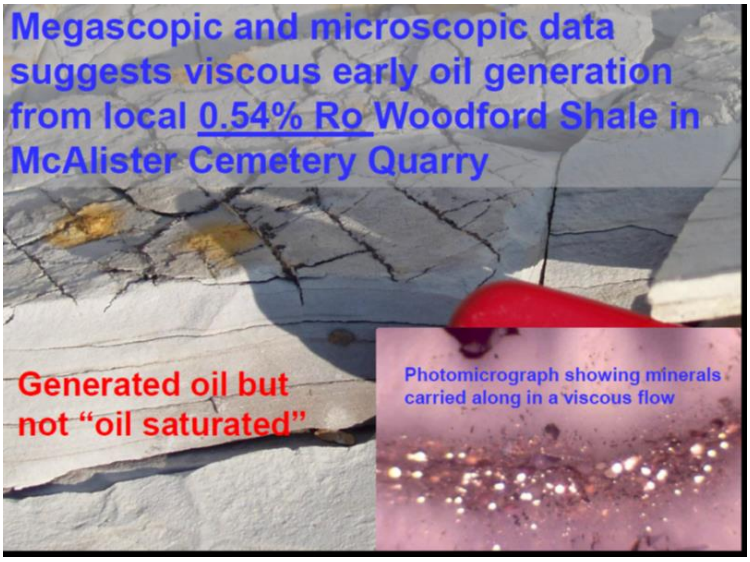
Table 5.3. Geochemical Parameters Describing Level of Thermal Maturation

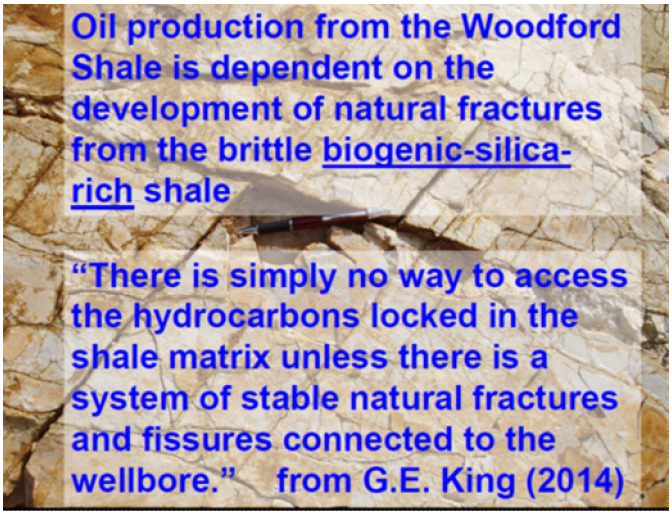
Stage of Thermal Maturity for Oil	Maturation R_o (%)	Maturation T_{max} (°C)	Maturation TAI[a]	Generation Bitumen/TOC[b]	Generation Bitumen (mg/g rock)	Generation PI[c] $[S_1/(S_1 + S_2)]$
Immature	0.2–0.6	<435	1.5–2.6	<0.05	<50	<0.10
Mature						
Early	0.6–0.65	435–445	2.6–2.7	0.05–0.10	50–100	0.10–0.15
Peak	0.65–0.9	445–450	2.7–2.9	0.15–0.25	150–250	0.25–0.40
Late	0.9–1.35	450–470	2.9–3.3	—	—	>0.40
Postmature	>1.35	>470	>3.3	—	—	—

[a]TAI, thermal alteration index.
[b]Mature oil–prone source rocks with type I or II kerogen commonly show bitumen/TOC ratios in the range 0.05–0.25. Caution should be applied when interpreting extract yields from coals. For example, many gas–prone coals show high extract yields suggesting oil–prone character, but extract yield normalized to TOC is low (<30 mg HC/g TOC). Bitumen/TOC ratios over 0.25 can indicate contamination or migrated oil or can be artifacts caused by ratios of small, inaccurate numbers.
[c]PI, production index.

Hunt (1996, p. 368):
ñthe lowest value associated with the known generation of conventional oil is about 0.5% [Ro], and 0.6% [Ro] is generally recognized as the beginning of commercial oil accumulations. What is the lowest thermal maturity to produce economic quantities of oil in the Woodford Shale? Please note the start of the oil window is a zone rather than an exact number







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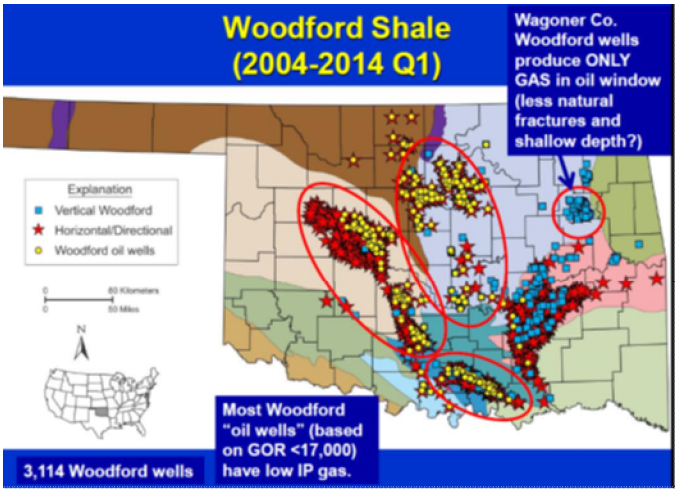
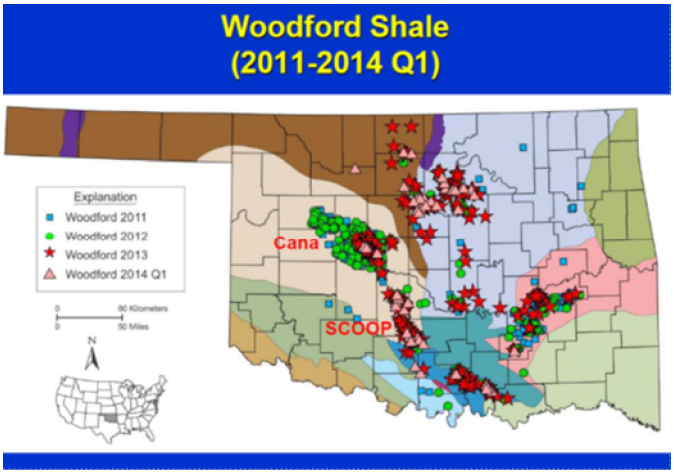
Jarvie (2012, p.91): ñAlthough an organic-rick source rock in the oil window with good oil saturation is the most likely place to have oil, it is also the most difficult to produce, unless it has open fractures or an organic-lean facies closely associate with it. This is due to molecular size, viscosity, and sorption of oil.ò

Oklahoma Oil/Condensate/Gas
Production Caveat

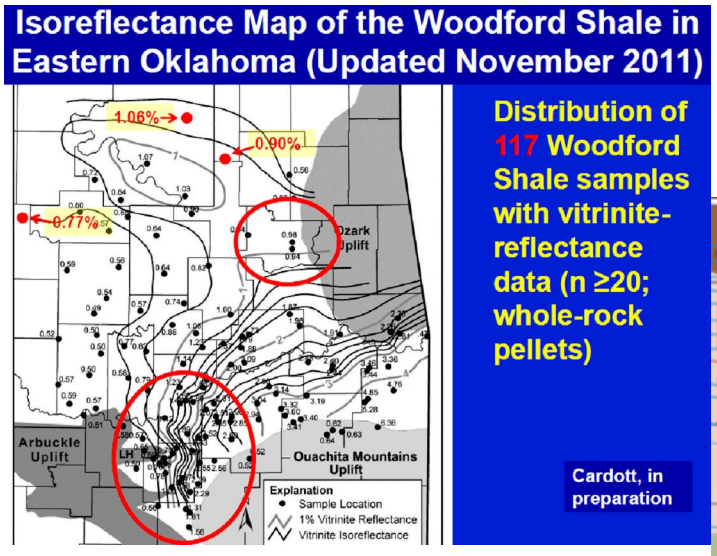
Gas Production is reported by the Oklahoma Corporation Commission by Well and Oil/condensate production reported by the Oklahoma Tax Commission by Lease [production by well is only on single-well lease] The production data is supplied by PI/Dwights LLC, 2014 HIS Energy Group.

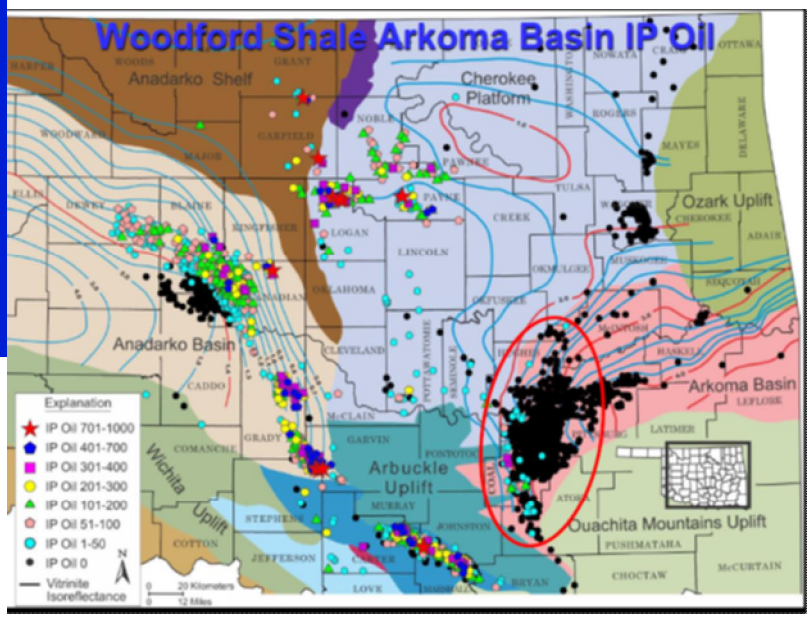


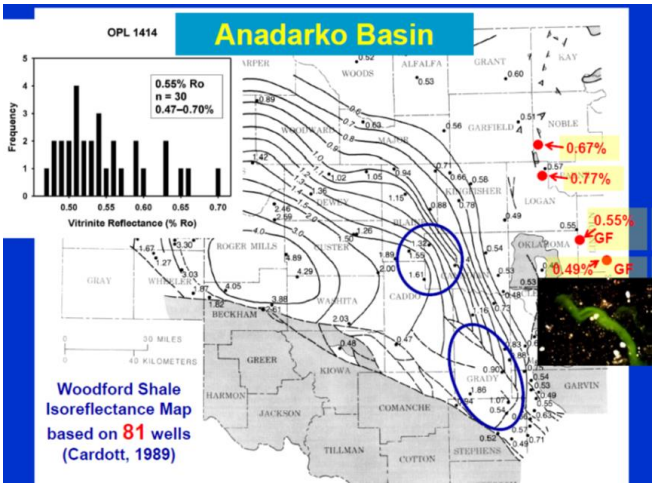


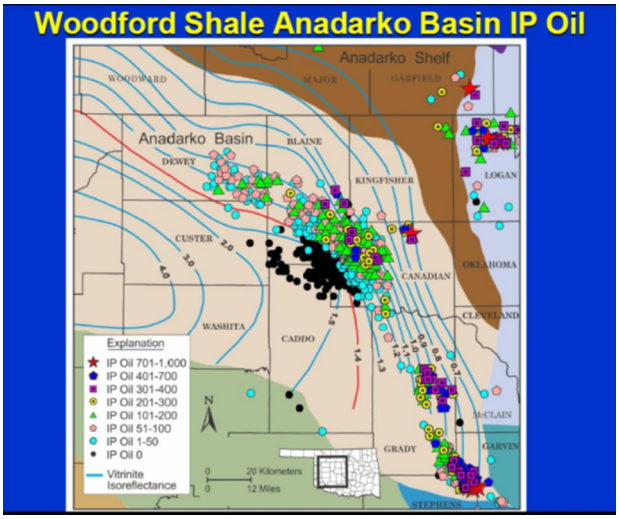
Due to a number of variables, Woodford Shale Vitrinite isoreflectance maps should be used as a qualitative thermal maturity indicator (e.g., start, middle, end of oil window; condensate window; gas window) and not as a ñdrill hereò indicator because of the following factors:

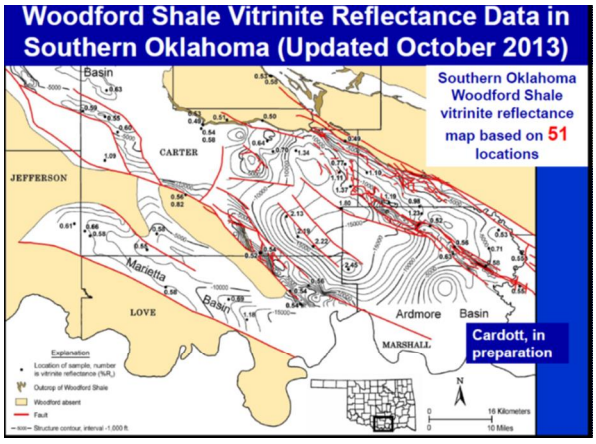
*Vitrinite reflectance is an average of many values and has some internal variation.
*Woodford Shale Vitrinite reflectance was originally determined to estimate the general hydrocarbon source rock potential
*The Woodford Shale is divided into three informal members: the lower member was deposited more near- shore marine and is where the most and largest Vitrinite and petrified wood is found.
*The Vitrinite reflectance value is extrapolated to the entire thickness even though the Woodford shale may be up to 700ô thick.

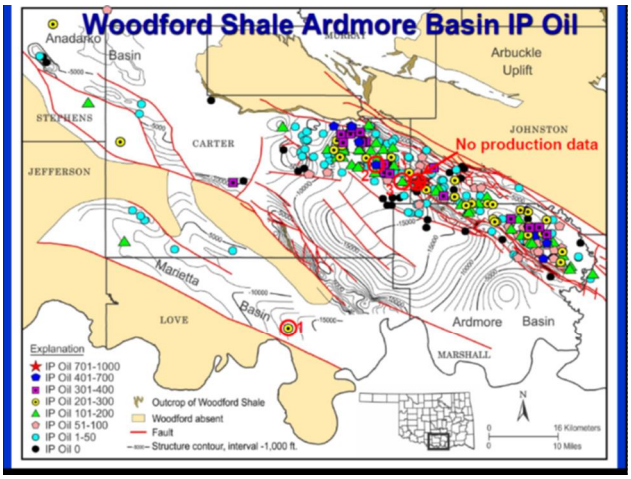


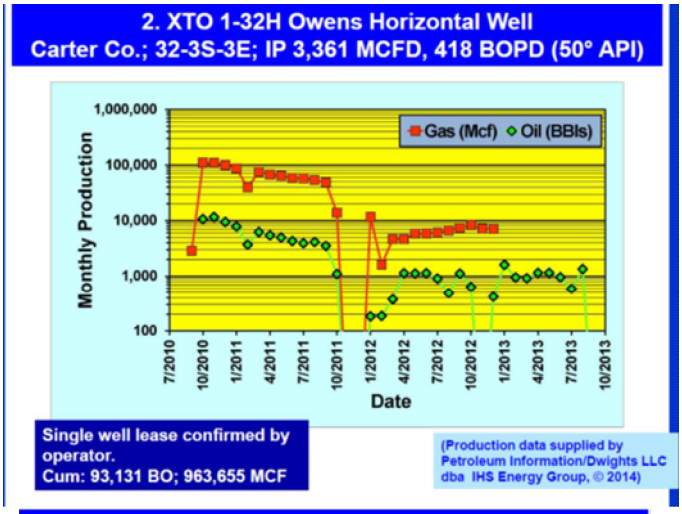


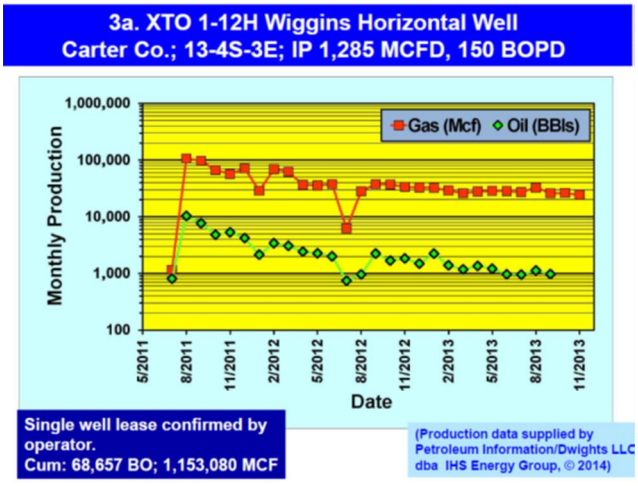












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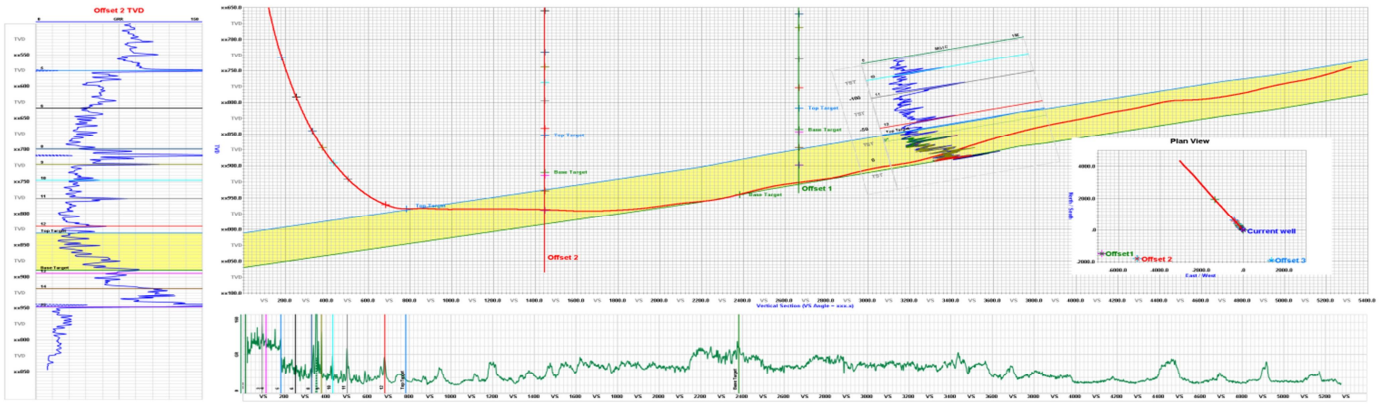

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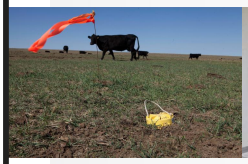




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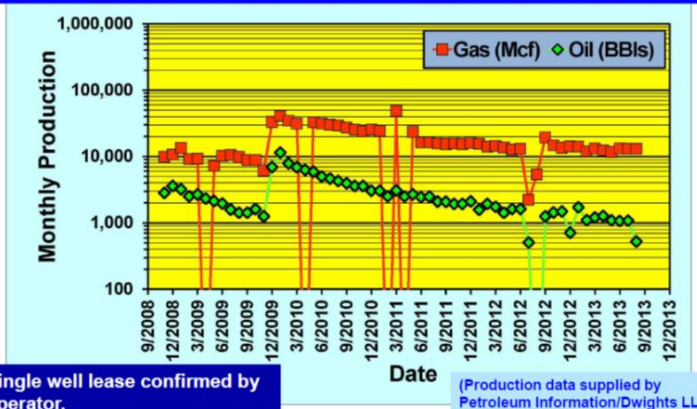
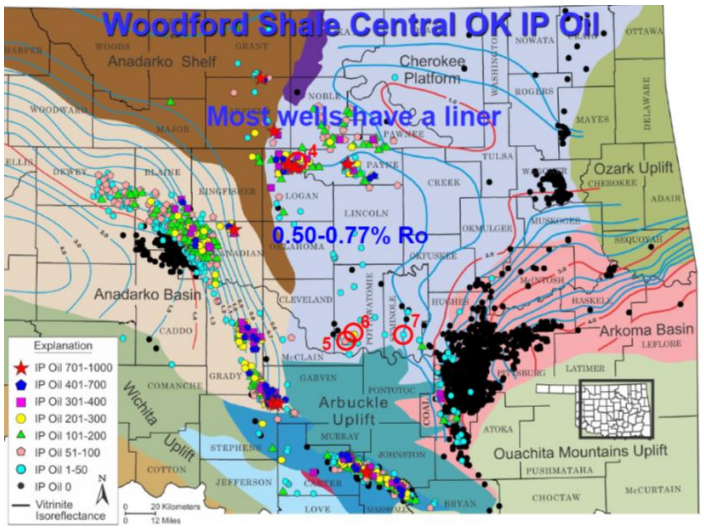
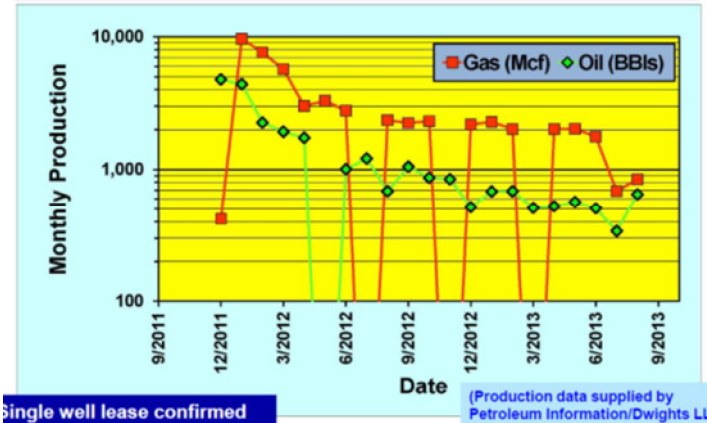


Single well lease confirmed by operator.
Cum: 154,994 BO; 943,423 MCF

(Production data supplied by Petroleum Information/Dwights LLC dba IHS Energy Group, © 2014)



4. Devon Energy 1-33H Johnson Horizontal Well; Logan Co.; 33-19N-2W; IP 242 MCFD, 285 BOPD



Single well lease confirmed by operator.
Cum: 25,761 BO; 53,415 MCF

(Production data supplied by Petroleum Information/Dwights LLC dba IHS Energy Group, © 2014)

In an area recently measured 0.77% VRo

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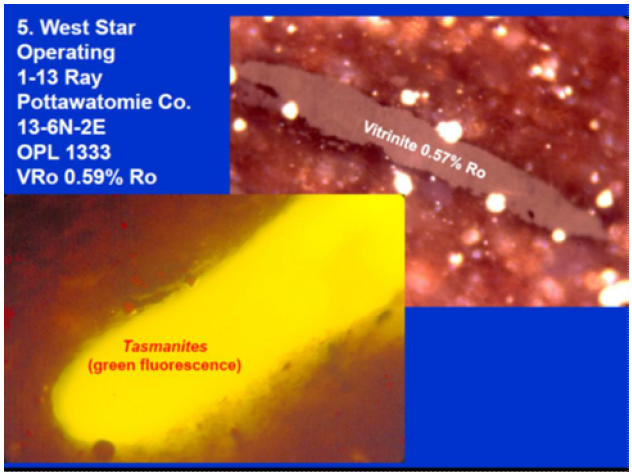

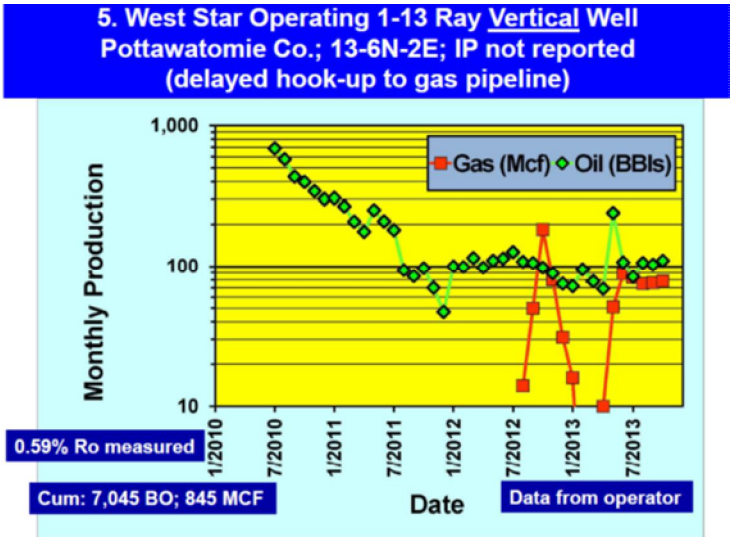

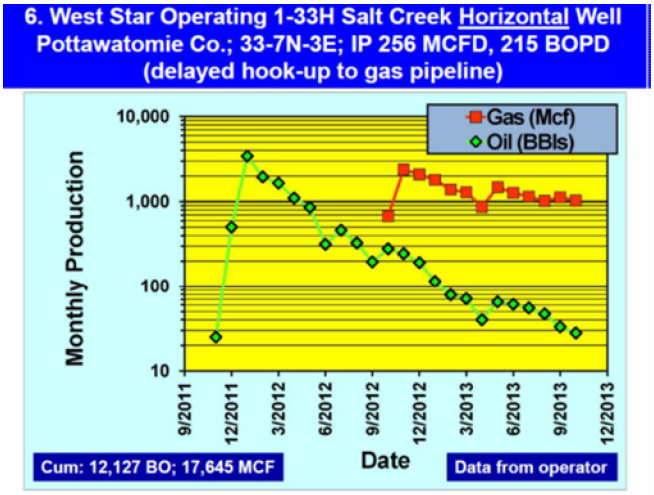

Vitrinite reflectance values <0.5% Ro may have errors because (1) pre-oil solid bitumen may be mistaken for vitrinite and (2) this is the level that vitrinite forms from huminite. Oil production ranges from thermal maturities of `0.59-1.18% Ro in the Anadarko, Ardmore, and Arkoma Basins and shelf area (dependent on oil saturation). Condensate production ranges from thermal maturities of `1.15-1.67% Ro in the Anadarko, Ardmore, and Arkoma Basins.

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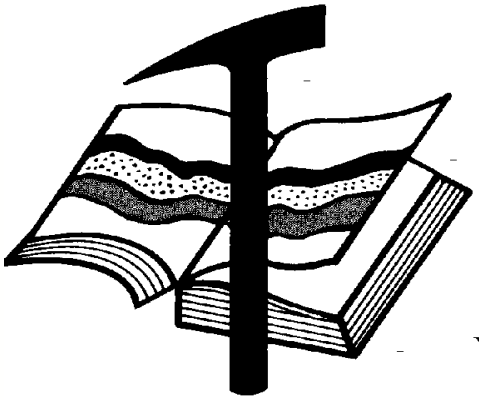

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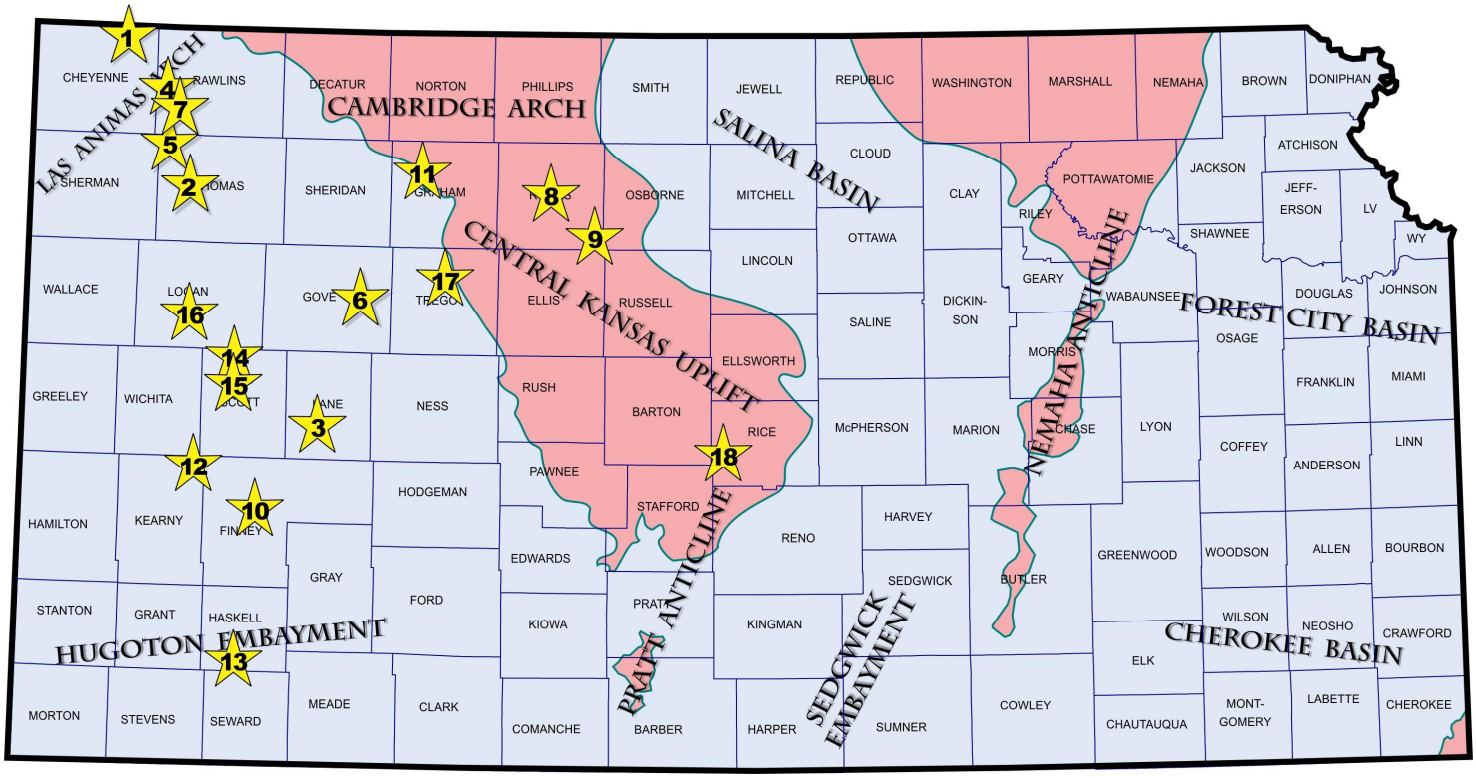
Exploration Highlights

By John H. Morrison, III
Independent Oil & Gas



1-Murfin Drilling Company, Wichita (KS), has discovered new Lansing-Kansas City oil reserves at the #1-29 Bash wildcat well in Cheyenne County, northwest Kansas. The new Devilôs Canyon North pool opener is producing oil in the NE/4 of section 29- T1s- R38W, about thirteen miles north and three miles west of Bird City. The well was drilled to a depth of 5,002 ft in Granite rock. The new reserves lie over one mile north of the Devilôs Canyon field (estbl. 1988, LKC oil).

2-VAL Energy, Wichita (KS), has a new Cherokee (Johnson Zone) oil discovery in western Thomas County. The #1-21 Otto is on pump making an undisclosed amount of oil at site located in the NW/4 of section 21- T8s- R35W, about seven miles east of the town of Brewster. The wildcat well opens the Schroeder Southeast oil field nearly one and one-quarter miles east of Valôs John lease in section 20, which also produced Cherokee oil last year and established the Schroeder East field.

3-Larson Operating Company, Olmitz (KS), is producing oil from the Lansing-Kansas City formation at their #1 -32 Lora, spotted in the SE/4 of section 32- T19s- R29W in Lane County. The wildcat well establishes new production over one and one-half miles east of the Clark Southeast oil field (est. 2009, LKC and Marmaton), or about nine miles southwest of Dighton, Kansas. Rotary total depth was stopped at 4,675 ft. No completion details are available. The new field has been given the name Frontier East.

4-Samuel Gary Jr & Associates, Inc., Denver (CO), has discovered oil deposits in the Celia Sand member of the Marmaton Group at the #1-3 Fisher Cattle Company, spotted in the NW/4 of section 3- T4s- R36W, in Rawlins County. The new Wind Crest West pool opener found new reserves nearly one mile southeast of established production in the Celia South oil field (estbl. 1983, Marmaton, Cherokee oil) and about three miles southeast of the town of McDonald, Kansas. Total depth of the well is 4,949 ft.

5-Raymond Oil Company, Inc., Wichita (KS), has successfully completed the 1 Baird Revocable Trust as a commercial oil well to open the Sun Dog oil field in Thomas County. Discovery was made in the SE/4 of section 25- T6s- R36W, nearly two miles south of the WWM oil field (estbl. 1979, Marmaton oil). The 4,876 ft deep well is producing crude from the Marmaton (Pawnee) formation, about ten miles northeast of Brewster, Kansas.

6-Questa Energy Corporation, Amarillo (TX), is producing crude oil from the Lansingï Kansas City formation at the #1-36 Bird, located in the NW/4 of section 36- T13s- R27W, in Gove County. The wildcat well was drilled to a total depth of 4,460 ft at site situated about twelve miles southeast of Gove, Kansas. Operator stepped-out almost one and one-half miles north of the established Sutcliffe field (estbl. 1971, LKC, Miss oil) to find the new reserves. The new field has been named. Sutcliffe North.

7-Samuel Gary Jr. & Associates, Inc., of Denver (CO), has discovered new Marmaton (Pawnee) oil reserves at the #1-12 Fisher Cattle Company ï a remote exploratory well drilled in Rawlins County. Crude oil is being produced at location in the SW/4 of section 12- T4s- R36W, two miles southeast of the Windy Ridge field (Arbuckle oil), or a little over five miles southeast of the town of McDonald. Total depth was logged at 4,912 ft. The new field been named FCC.

8-Staab Oil Company, Hays (KS), is pumping 15 bbl of oil per day, no water, at the #1 Hayes wildcat discovery well in Rooks County, about five miles southwest of Stockton, Kansas. The new Webster View Southeast pool opener is drilled to a total depth in the Arbuckle of 3,480 ft in the SE/4 of section 6- T 8s- R 18W. The well is producing 30-degree gravity crude from the Arbuckle formation. Closest known established production lies over one mile away in the Sweet North field (estbl. 1988, Conglomerate, Arbuckle oil).

9-Sandlin Oil Corporation, Denver (CO), has completed their #1 Brown Etal for 20 bbls of oil and an equal amount of water per day. The 3,650 ft deep wildcat well was drilled in the NE/4 of section 17- T10s- R16W, in Rooks County. It establishes production from the Lansingï Kansas City formation at site located over three-quarters mile west of the Natoma Northwest field (estbl. 1965, Shawnee, LKC oil), or a little over two miles east of Codell, Kansas. The new field has been named Codell East.

10-American Warrior, Inc., Garden City (KS), is producing oil from the Mississippian (Saint Louis) formation at the #1-5 OôBrateï Finney, located in the SW/4 of section 5- T23s- R32W, in Finney County. The wildcat well establishes new production over one and one-half miles southeast of the Damme East field (estbl. 1992, Marmaton oil). Total depth was stopped at 5,000 ft. The new Seven Mile pool lies just over six miles north of Garden City, Kansas.

11-Red Oak Energy, Inc., Wichita (KS), is producing crude oil from the Lansingï Kansas City formation at their #9-1 Brown in Graham County. The wildcat well found new reserves over three-quarters mile northwest of the Bessie May field (estbl. 2010, LKC oil), or about seven miles northwest of Penokee, Kansas. Drill site is located in the SW/4 of section 9- T 7s- R 24W. Rotary total depth was obtained at 4,200 ft. The new field is named Bessie May North.

12-Merit Energy Company LLC, Dallas (TX), has discovered new Morrow oil reserves at the #26-1 Cobra in Kearny County. The Cobra pool opener is producing crude at location in the SW/4 of section 26- T 21s- R 35W, about fifteen miles north of Deerfield, Kansas. The new reserves were found several one and one-half miles east of Marmaton oil production in the Beymer (estbl. 1965) and is over two miles south of closest known Morrow production in the Christabelle field (estbl. 1971). Operator bottomed the well at 5,170 ft.

13-Elsewhere in Haskell County, **Merit Energy Company LLC** is producing oil from the Morrow formation at the #12-1 Jacob Moss, spotted in the NW/4 of section 12- T 30s- R 33W. The 5,690 ft deep well establishes the new Tice Northeast field two and one-half miles southwest of the town of Sublette. Discovery site lies over one mile east of the Tice field (estbl. 2009, Morrow oil).

14-Grand Mesa Operating Company, Wichita (KS), has discovered oil deposits in the Marmaton (Altamont) formation at the #1-32 Stoll, located in the SE/4 of section 32- T 16s- R 33W, in Scott County. The Frick Northeast pool opener is producing crude one mile northeast of the established Frick field (estbl: 2012, Marmaton, Cherokee oil) and is about nine miles northwest of the town of Fort Scott, Kansas. The well was bottomed at 4,865 ft.

15-Stelbar Oil Corporation, Wichita (KS), has successfully completed the #1-12 Ellis as a commercial oil well in the NE/4 of section 12- T17s- R33W in Scott County. Operator drilled the wildcat well to a total depth of 4,780 ft. Oil reserves are being recovered from the Lansingï Kansas City limestones. Discovery site lies over one and one-half miles southwest of oil production in the Christy Canyon field (estbl: 2007, Cherokee oil). Closest LKC production in the area is located over four miles away from Stelbarôs latest find. The new field has been given the name Christy Canyon Southwest.

16-Black Tea Oil LLC, Hays (KS), has established athe Antelope Springs oil field in Logan County with the discovery of Lansing ï Kansas City and Cherokee (Johnson Zone) oil deposits at the #1 Wood óAô, spotted in the NW/4 of section 16- T14s- R35W. The wildcat well was drilled to a total depth of 4,500 ft at site located nearly five miles south of Russell Springs, Kansas. Closest known production in the vicinity lies over five miles away in the Lone Butte Southwest field (estbl: 2012, Marmaton oil).

17-H & C Oil Operating, Plainville (KS), has completed the 3-1 North Fork Farms in Trego County to open a new Wakeeney Townsite oil field over one and one-quarter miles southeast of the now abandoned LaRue field (estbl: 1974, abdn: 1981, LKC oil). Discovery was made in the NW/4 of section 3- T12s- R23W, less than one-half mile northeast of the town of Wakeeney, Kansas. Oil is being produced from the Lansingï Kansas City limestones, Rotary total depth was stopped at 4,282 ft.

18-Carrie Exploration & Development LLC, Hays (KS), is producing 18 bbl oil and 60 bbl water per day at the #1C-1 Brian (API 15-159-22799) in Rice County. The well establishes new Lansing-Kansas City oil production over three-quarters mile west of abandoned Simpson oil production in the Raymond East field (estbl: 1954, abdn: 1955) and over one and one quarter miles northeast of production in the Groves field (estbl: 1966, LKC oil). Well site is located in the SW/4 of section 26- T20s- R10W, less than one-half mile east of the town of Raymond. Rotary total depth was ceased at 3,415 ft in the Arbuckle formation. The field is named Raymond.

NOTE: wells 1-10 were also published in the last issue. Pardon our repetition.

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Annette Hedke	02/15	2015

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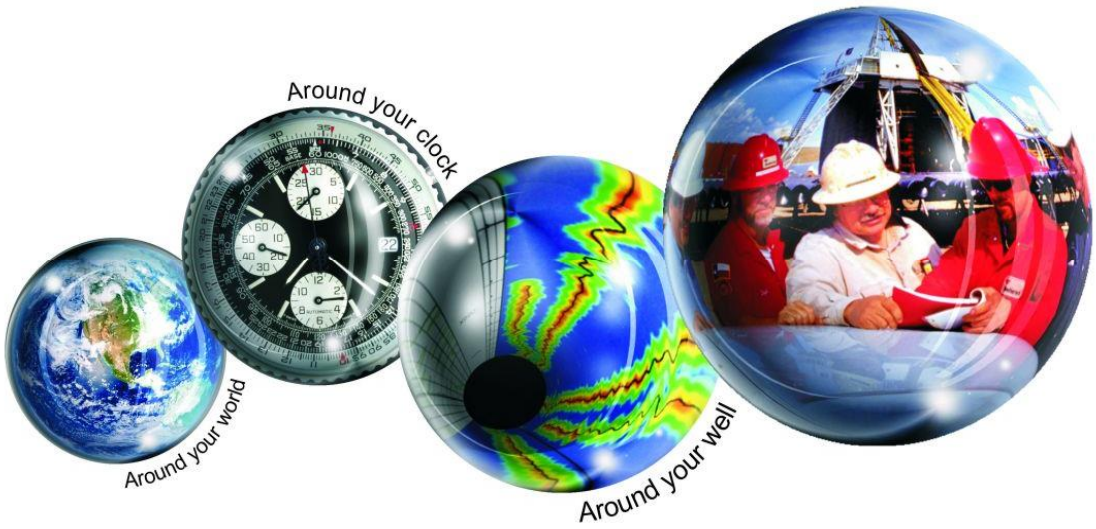

All Around You

Weatherford has always been driven by your needs.

Now, with the addition of Precision Energy Services we're continuing to build a world of skills, services and technologies that revolve – and evolve – around you.

The result?

An expanded global network of 25,000 people, 730 service bases and 87 manufacturing facilities in 100 countries.

This increased local knowledge and service is there to support you anywhere, anytime. From midday in the Middle East to midnight in the middle of nowhere.

And with greatly strengthened capabilities in the critical evaluation skills of directional drilling and wireline logging, we can do even more to improve the profitability and productivity of your wells.

To see how our sphere of services can work for you, visit **www.weatherford.com** or contact either your Weatherford or former Precision Energy Services representative.

Drilling | Evaluation | Completion | Production | Intervention

Kansas Geological Society & Library
212 North Market, Suite 100
Wichita, Kansas 67202

CHANGE SERVICE REQUESTED

KGS BULLETIN
May - June 2015

May 2015

SUN	MON	TUE	WED	THU	FRI	SAT
					1	2
3	4	5	6	7	8	9
10	11	12	13 KGF Spring Mixer	14	15	16
17	18 Tech Talk	19	20	21	22	23
24	25	26 Tech Talk	27	28	29	30
31						

June 2015

SUN	MON	TUE	WED	THU	FRI	SAT
	1	2	3	4	5	6
	AAPG Convention Denver					
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				