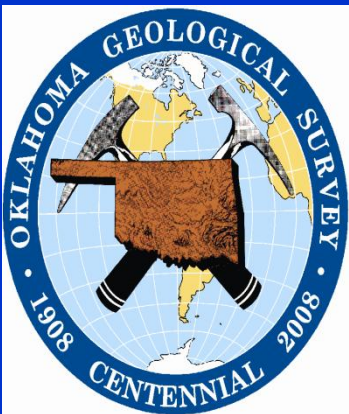
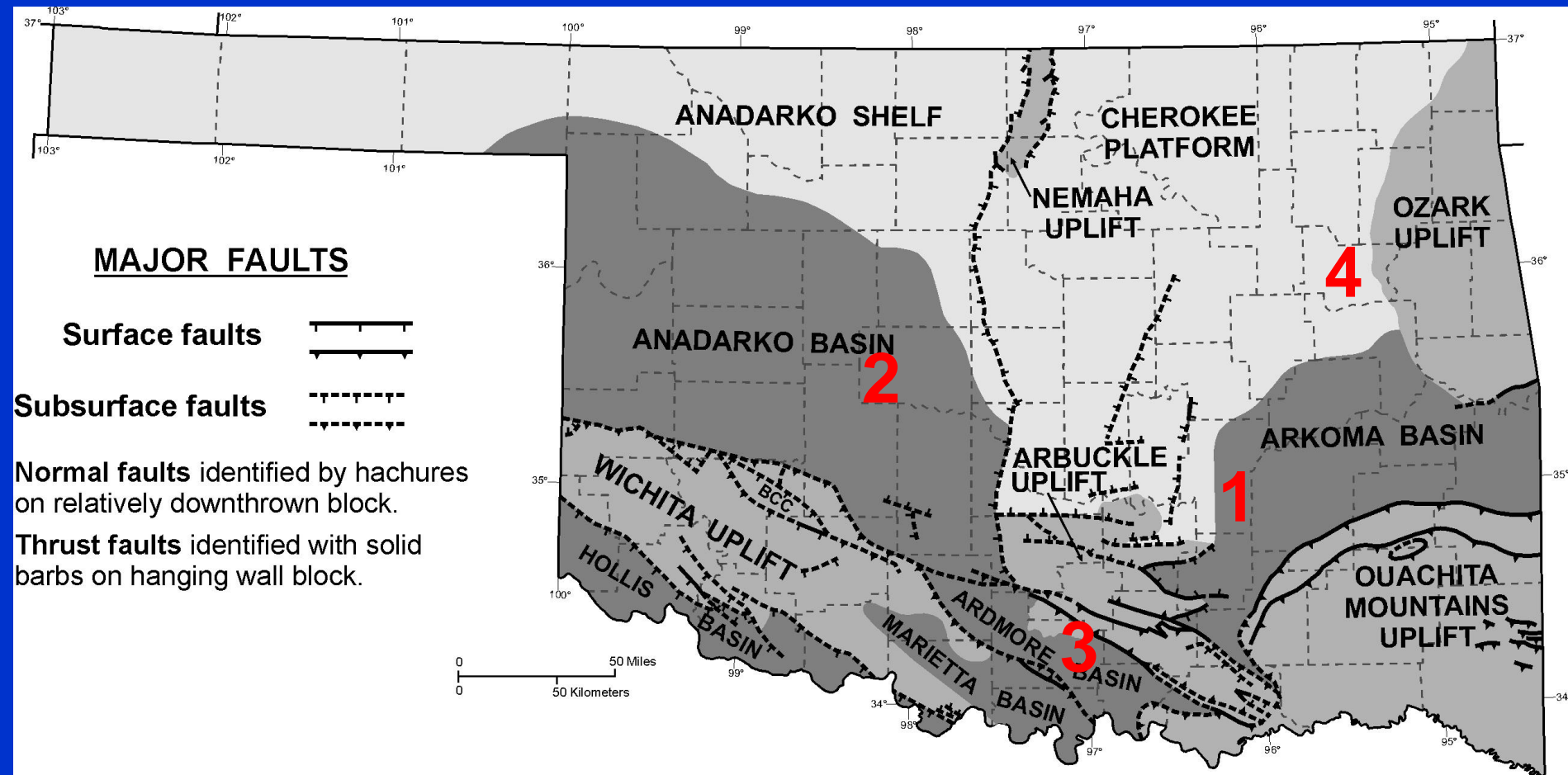


# **Application of Vitrinite Reflectance to Four Woodford Gas-Shale Plays in Oklahoma**

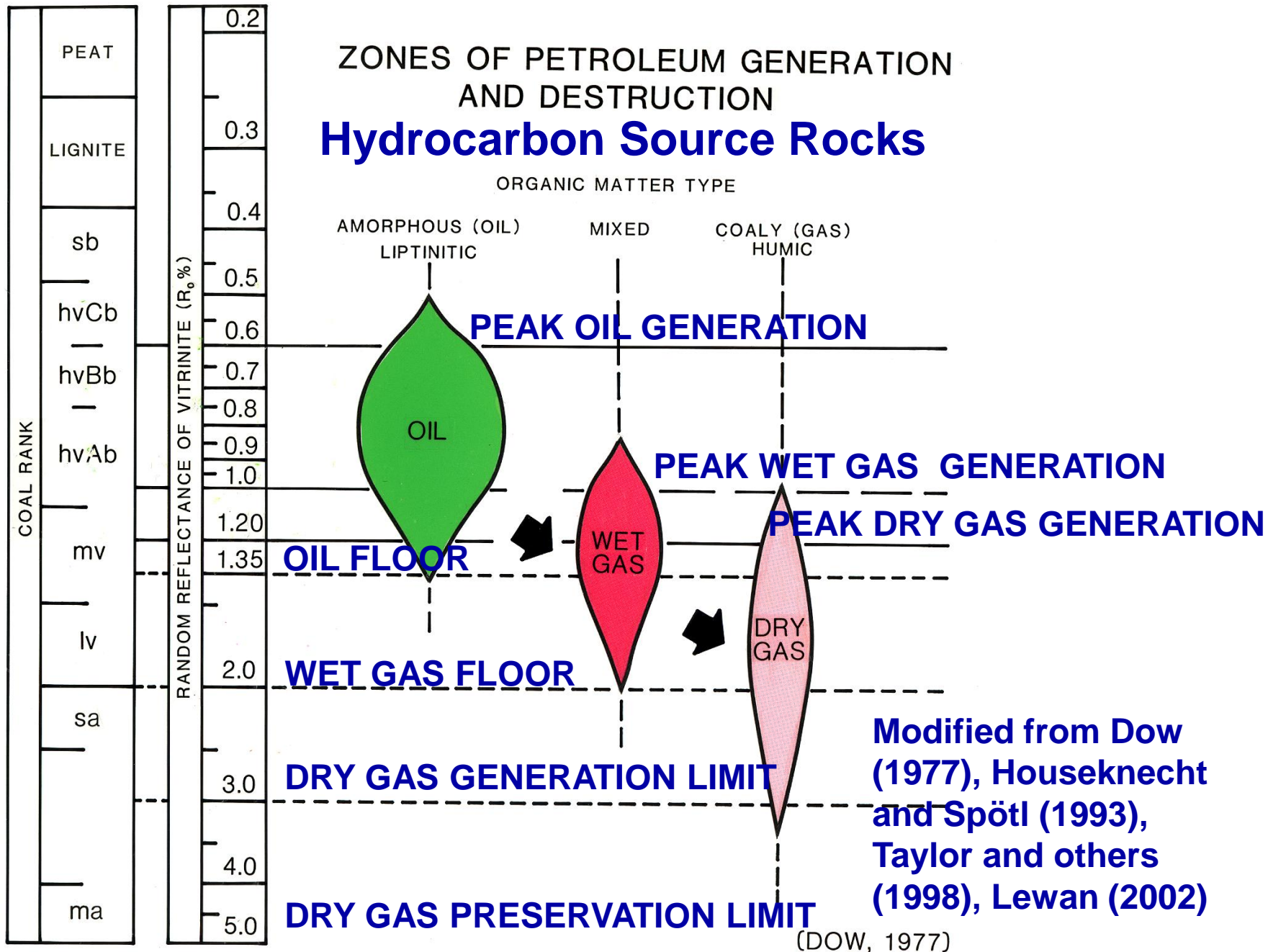
**Brian J. Cardott**  
**Oklahoma Geological  
Survey**



# Woodford Gas-Shale Plays



Geologic provinces from  
Northcutt and Campbell, 1995



# Guidelines for the Barnett Shale (Based on Rock-Eval Pyrolysis)

## VRo Values

## Maturity

<0.55%

Immature

0.55-1.15%

Oil Window (peak  
oil at 0.90%VRo)

1.15-1.40%

Condensate–Wet-  
Gas Window

>1.40%

Dry-Gas Window

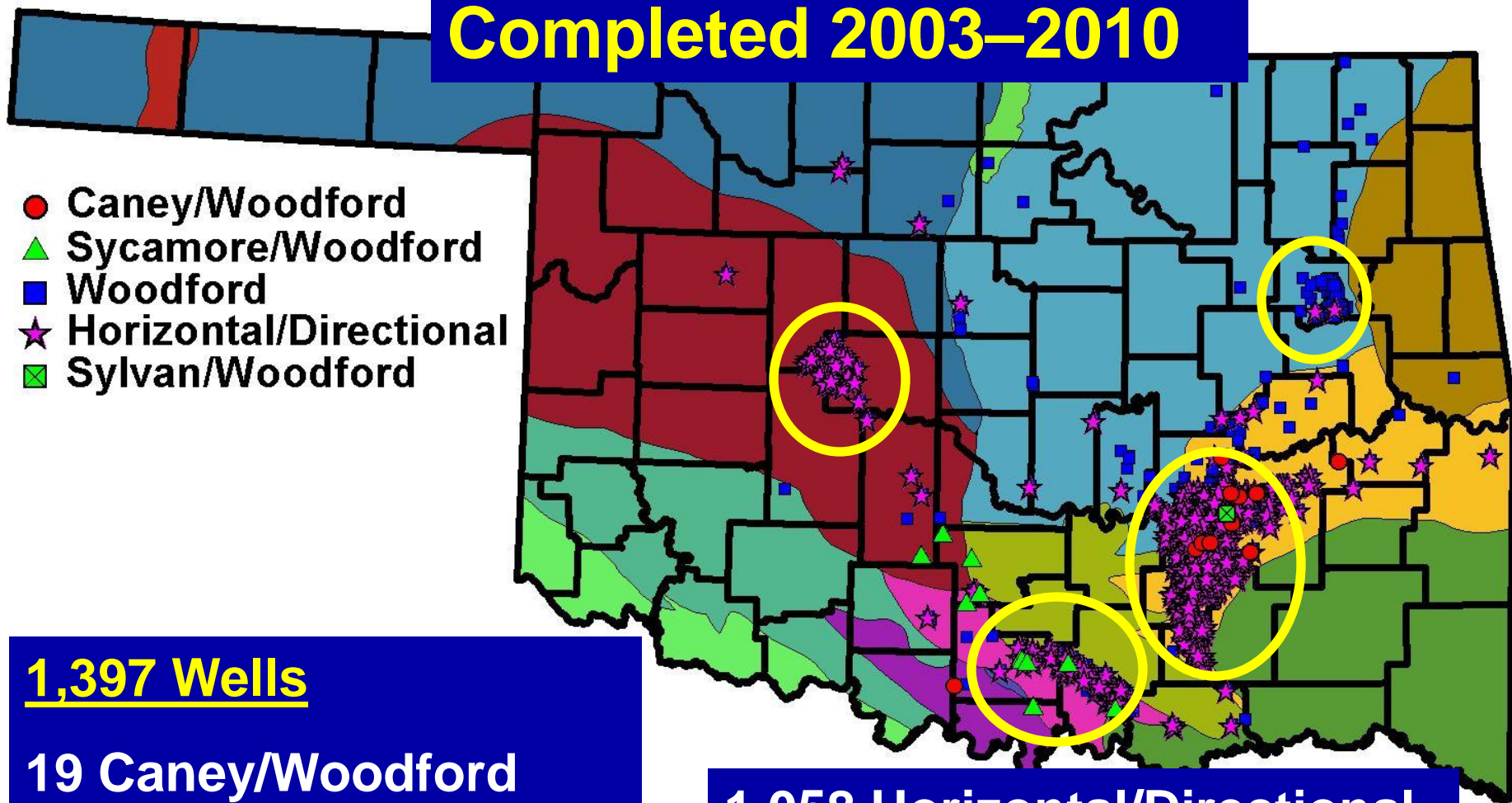
From Jarvie and others, 2005



# Woodford Gas-Shale Wells

Completed 2003–2010

- Caney/Woodford
- ▲ Sycamore/Woodford
- Woodford
- ★ Horizontal/Directional
- ▣ Sylvan/Woodford



1,397 Wells

19 Caney/Woodford

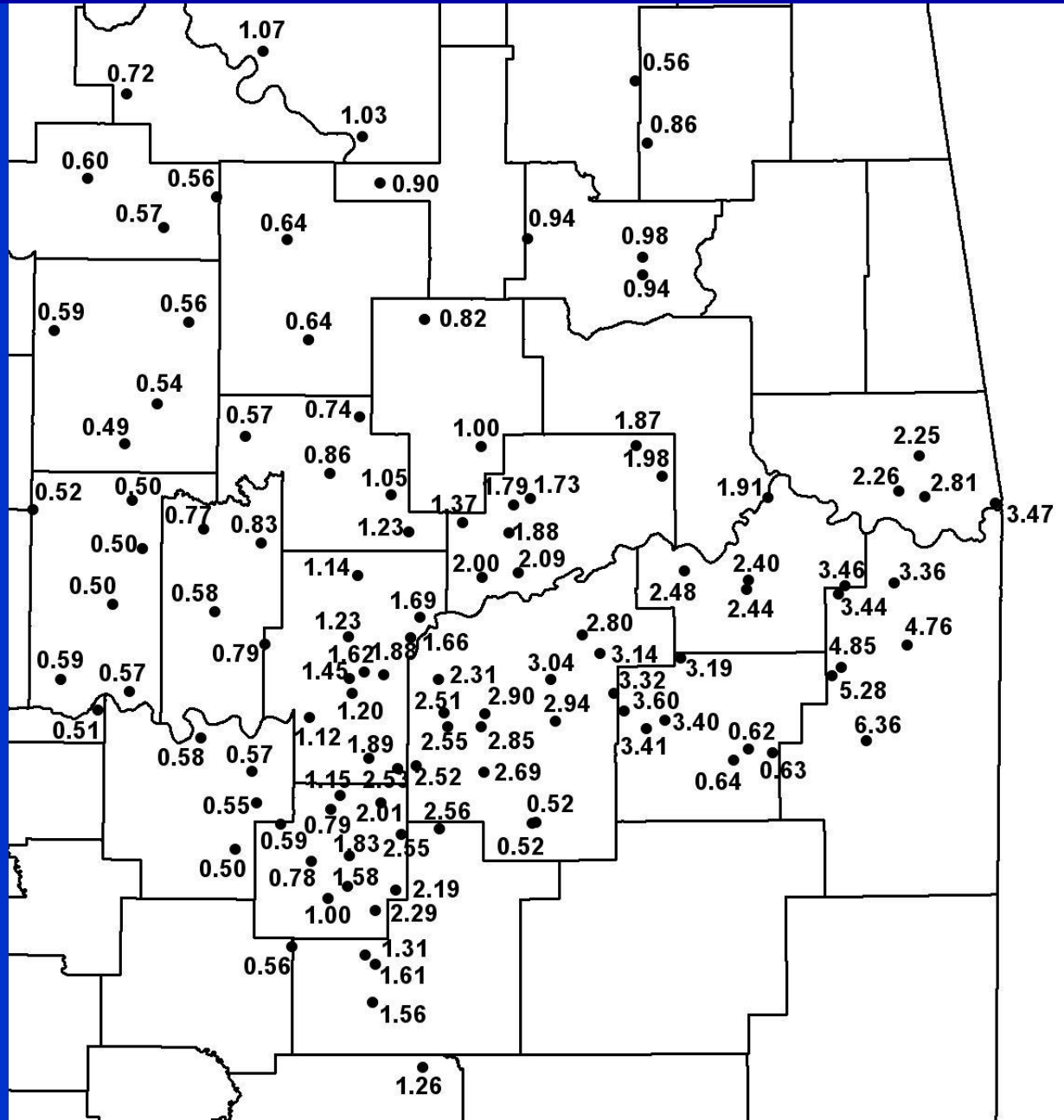
11 Sycamore/Woodford

308 Vertical Woodford

1,058 Horizontal/Directional  
Woodford (76%)

1 Sylvan/Woodford

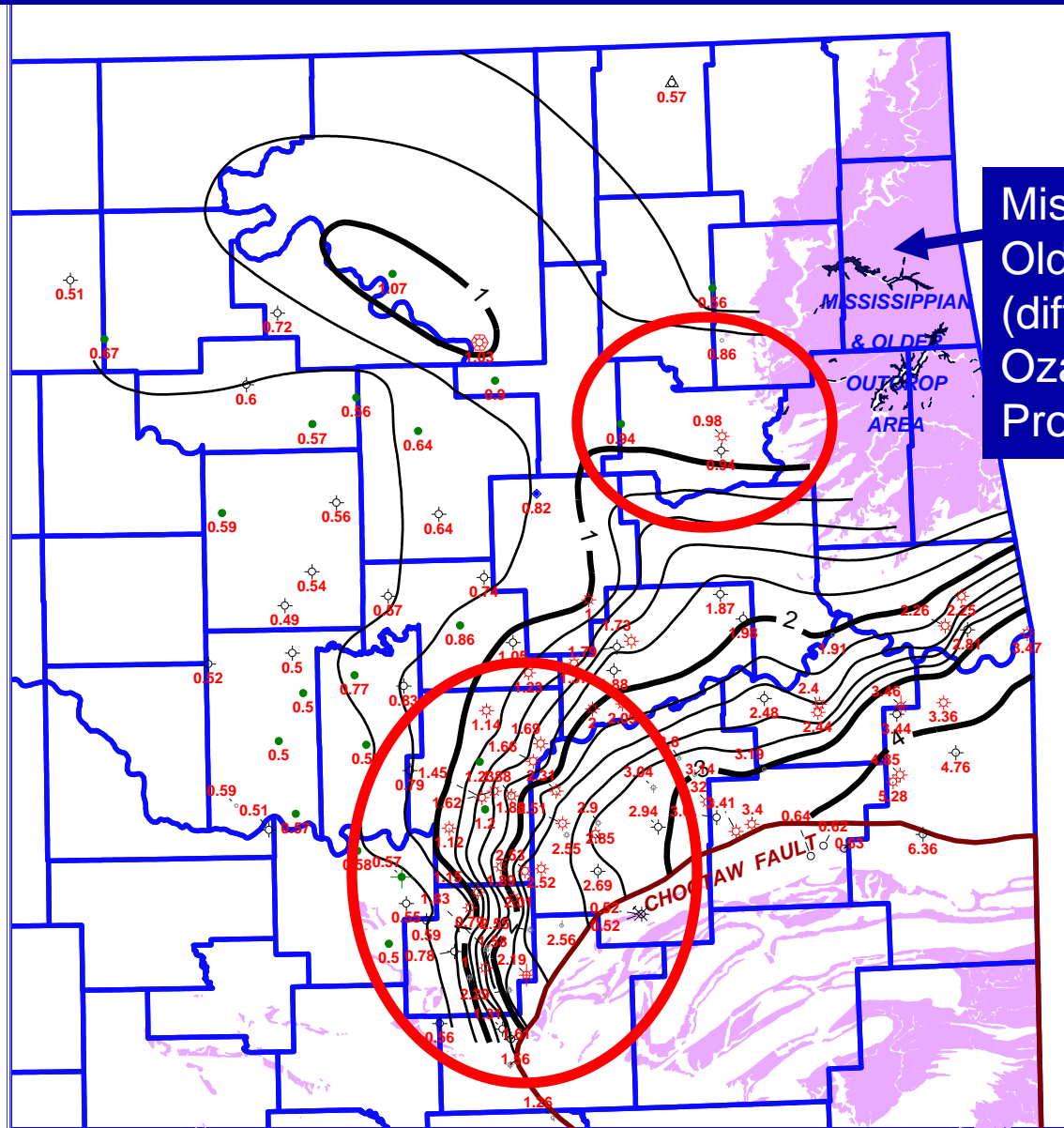
# Eastern Oklahoma



**Distribution  
of 112  
Woodford  
Shale  
samples with  
vitrinite-  
reflectance  
data**

Cardott, in  
preparation

# Isoreflectance Map of the Woodford Shale in Eastern Oklahoma (Updated October 2009)



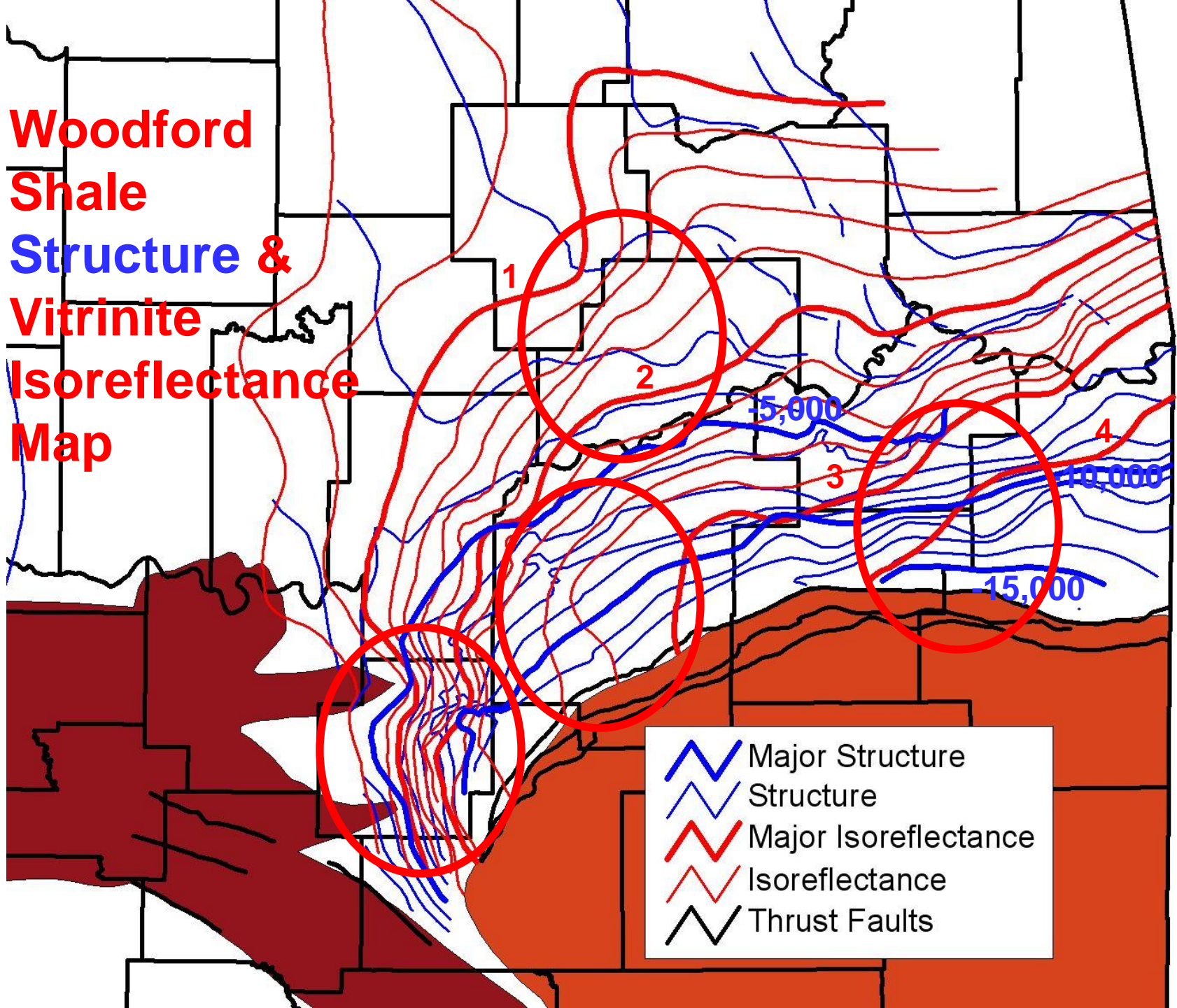
Mississippian and  
Older Outcrop Area  
(different than  
Ozark Uplift  
Province boundary)

Map prepared by  
R. Vance Hall  
using Petra

Cardott, in  
preparation



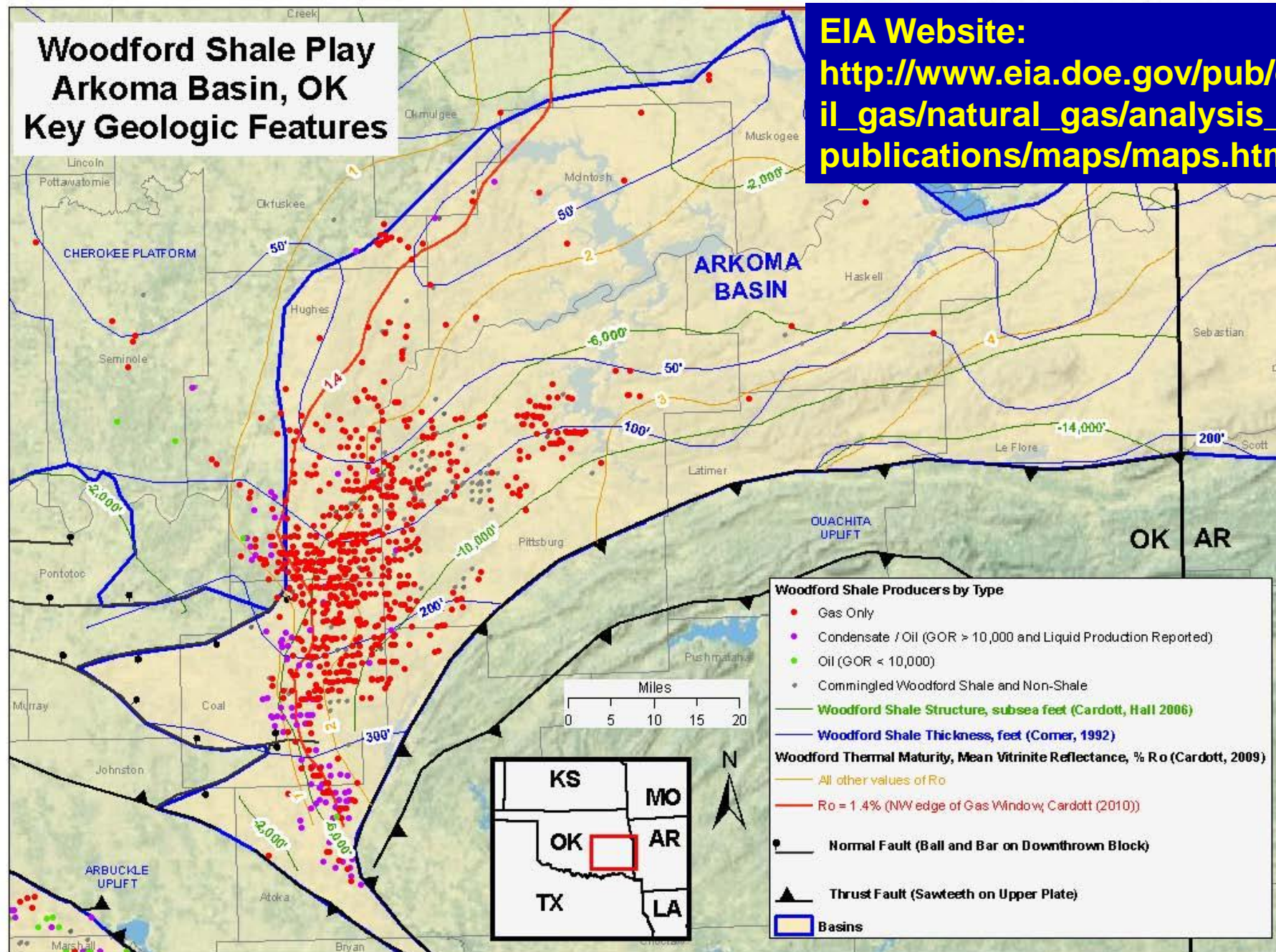
# Woodford Shale Structure & Vitrinite Isoreflectance Map





# Woodford Shale Play Arkoma Basin, OK Key Geologic Features

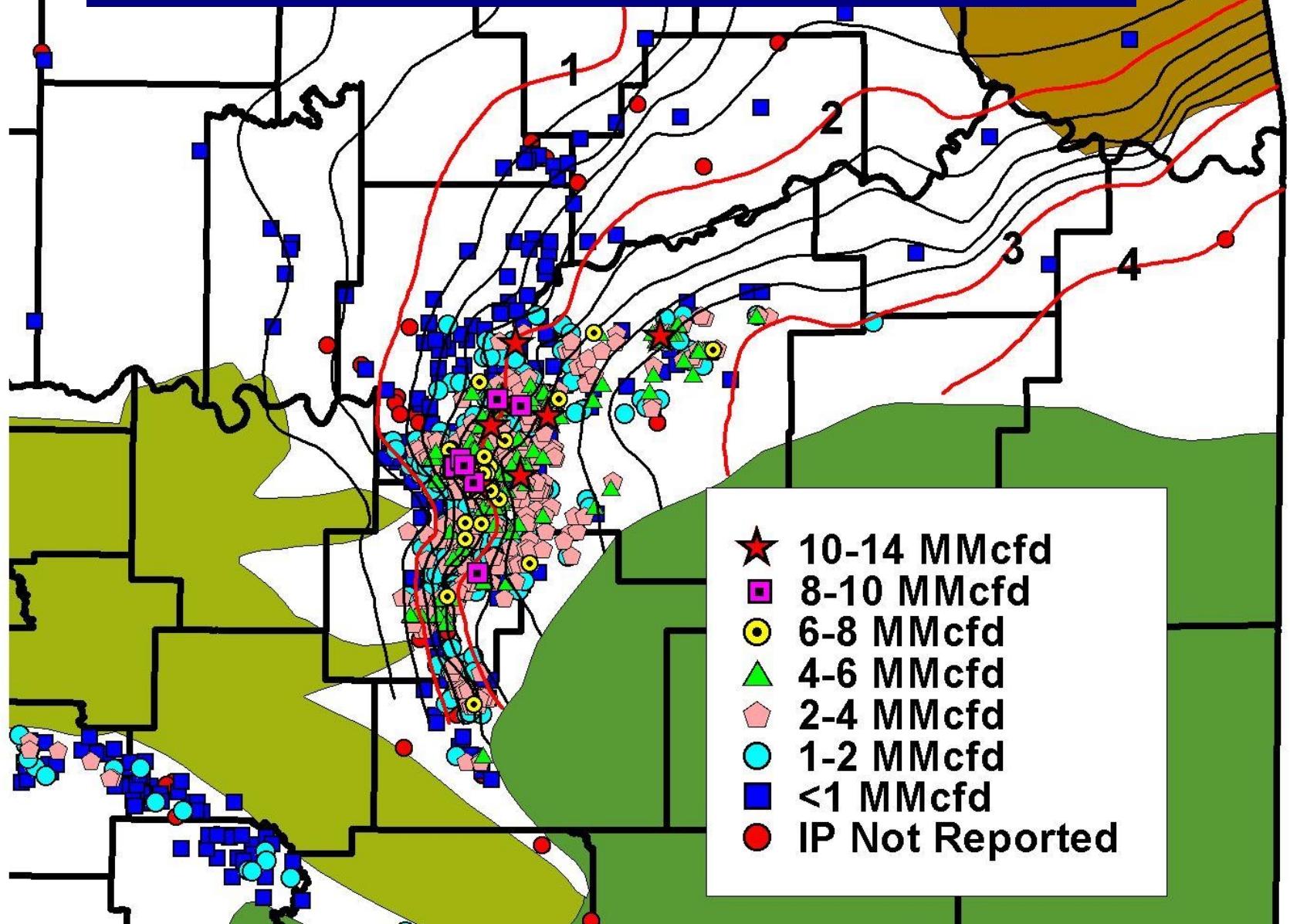
**EIA Website:**  
[http://www.eia.doe.gov/pub/oil\\_gas/natural\\_gas/analysis\\_publications/maps/maps.htm](http://www.eia.doe.gov/pub/oil_gas/natural_gas/analysis_publications/maps/maps.htm)



Source: Energy Information Administration based on well data from HPDI and B. Cardott (OK Geological Survey). Only wells producing from the Woodford Shale with first production after 1-1-2001 are shown. Basins and faults from Northcutt & Campbell (1995) and Cardott (2008). Updated: March 30, 2010

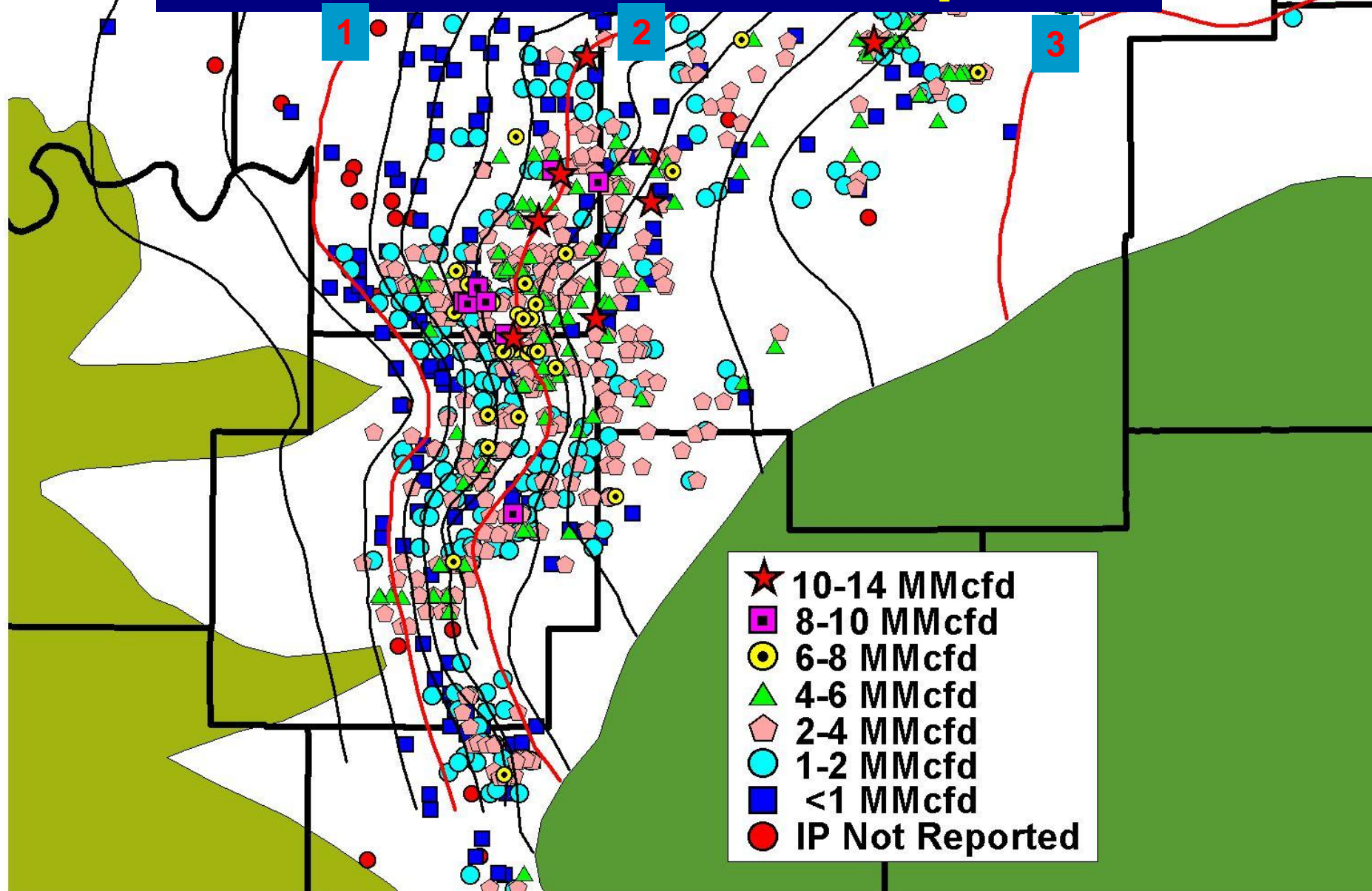


# Woodford Shale-Only IP on Isoreflectance Map

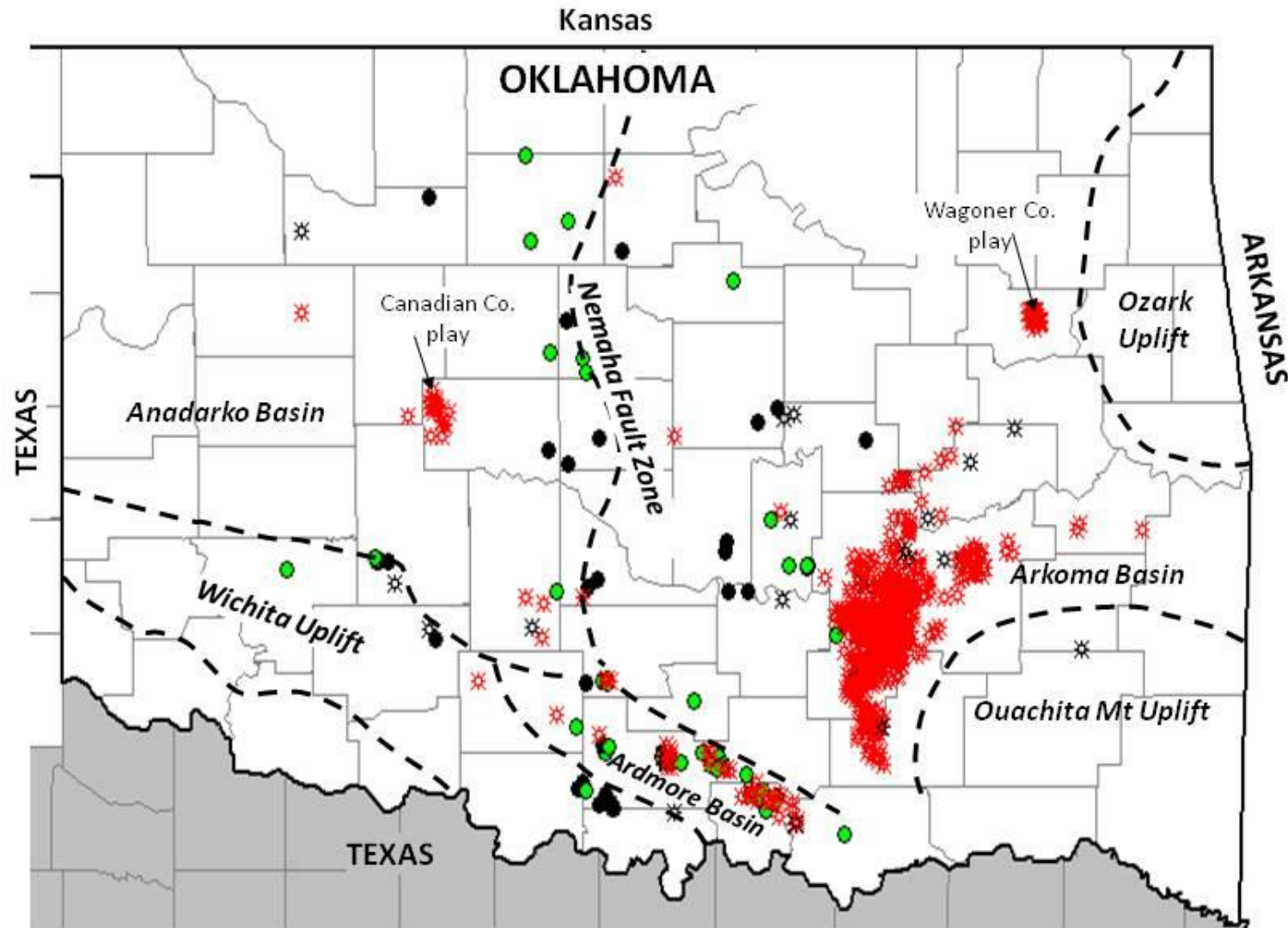




# Woodford Shale-Only IP on Isoreflectance Map



# Woodford Shale Oil & Gas Wells (1934-2009)



Woodford Shale well completions in Oklahoma (1934–2009). From IHS Energy, 2009.

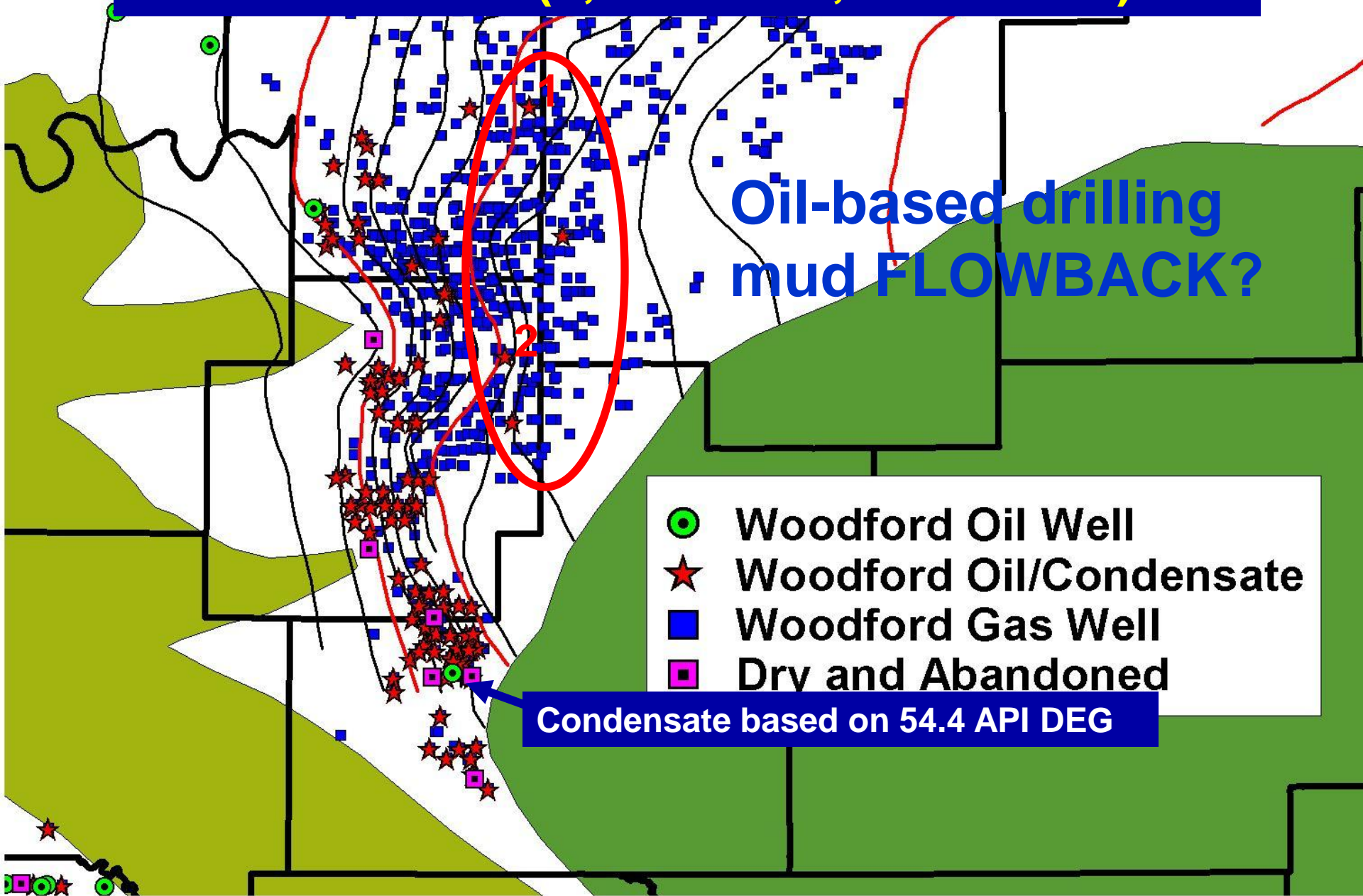
(From Andrews, 2009)

# Woodford Oil/Condensate/Gas Production Caveat

- **Gas** production is reported by the Oklahoma Corporation Commission by **WELL**.
- **Oil/condensate** production is reported by the Oklahoma Tax Commission by **LEASE** [production by well is only on single-well leases]

(Production data supplied by  
PI/Dwights LLC, © 2010, IHS  
Energy Group)

# Woodford Shale-Only Oil/Condensate/Gas Production (1,366 wells; 2005-2009)

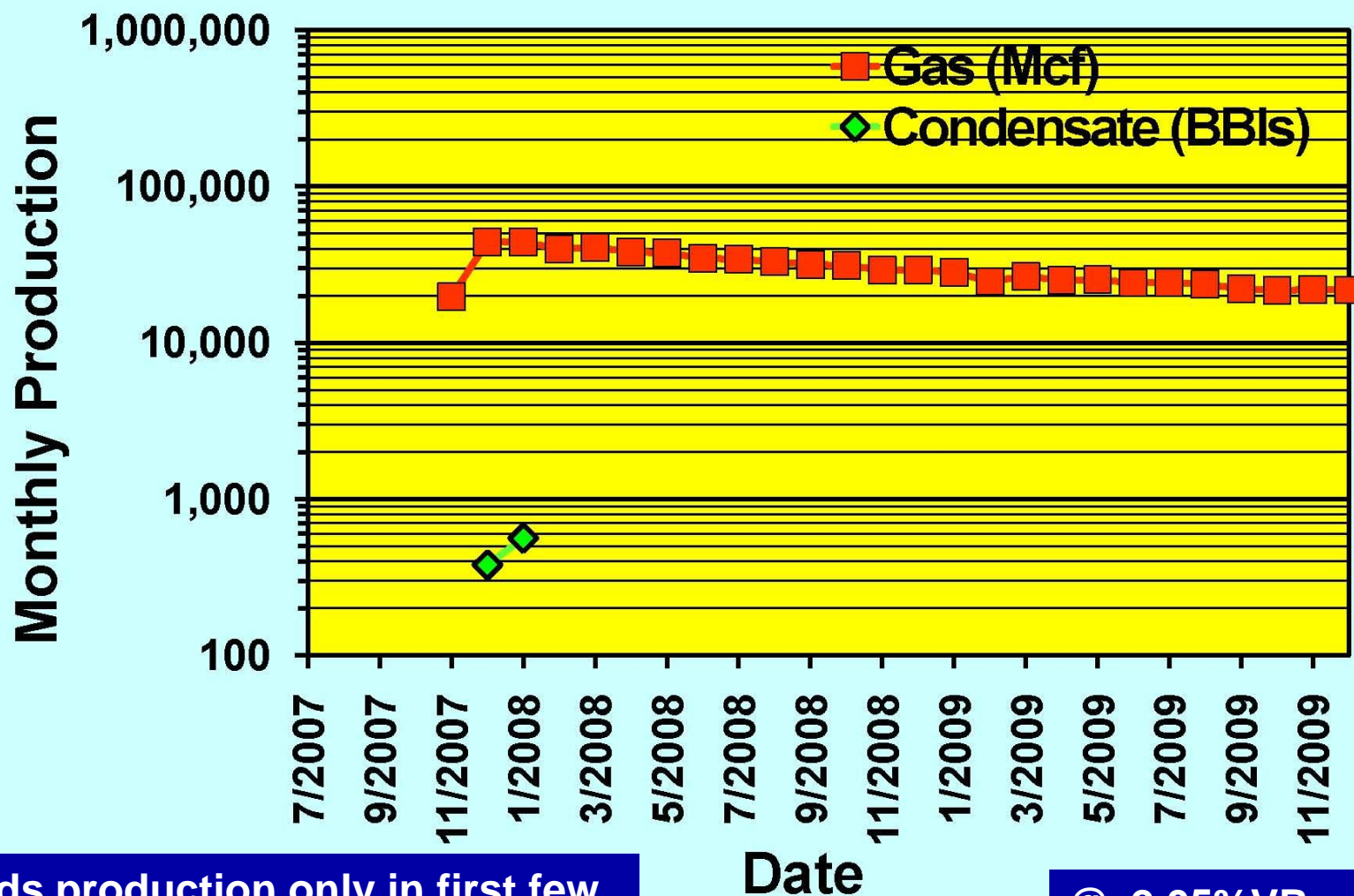




## **Condensate from High Thermal Maturity Arkoma Basin Wells**

- **Production in first few months is interpreted as flowback from oil-based drilling mud;**
- **Spikes in production may be from intermittent trucking**

# (1) Newfield 3H-36 Genevieve (36-6N-11E; Hughes Co.; IP 2,118 Mcfd)

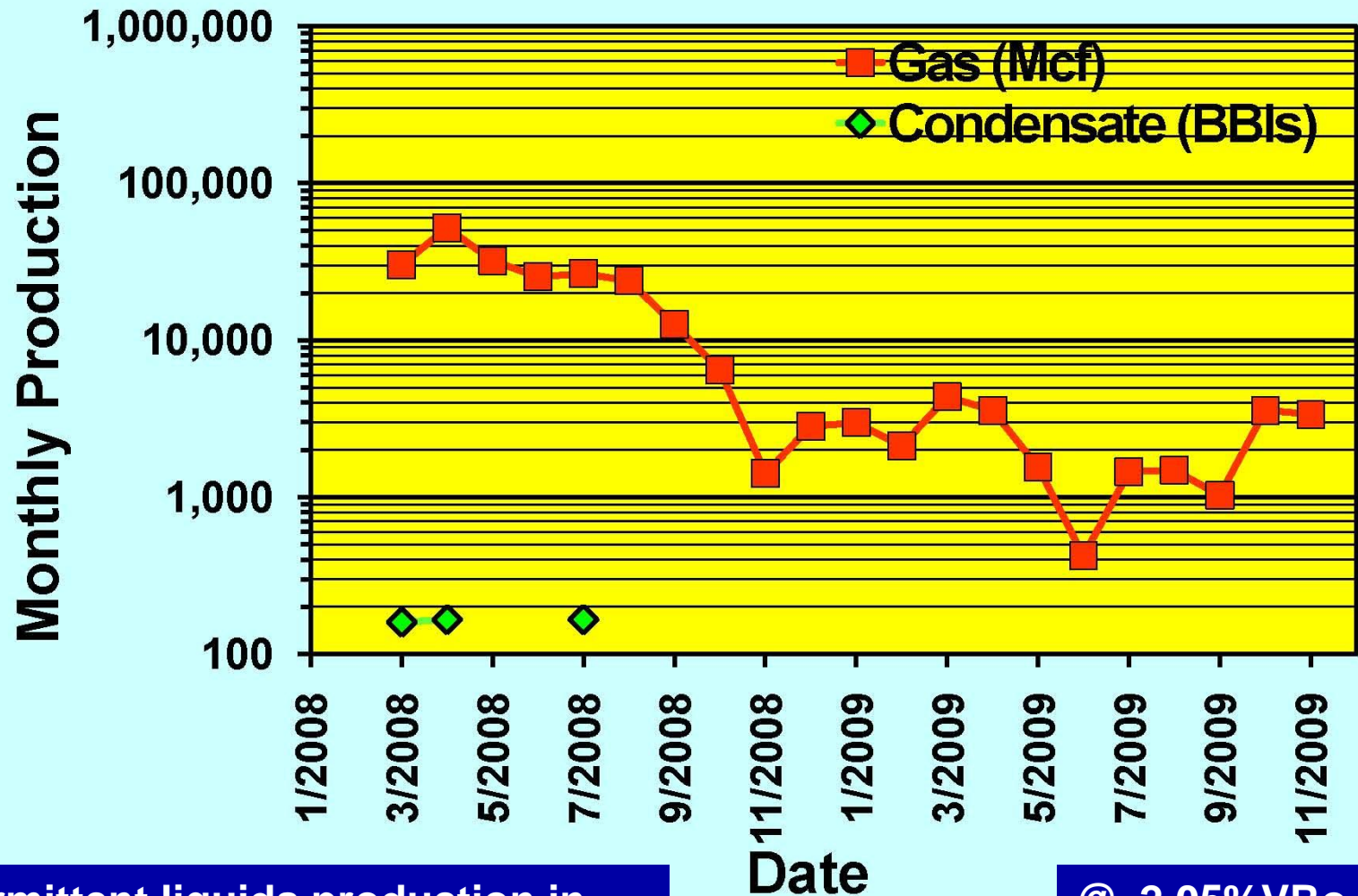


Liquids production only in first few months interpreted as flowback

@ 2.05%VRo



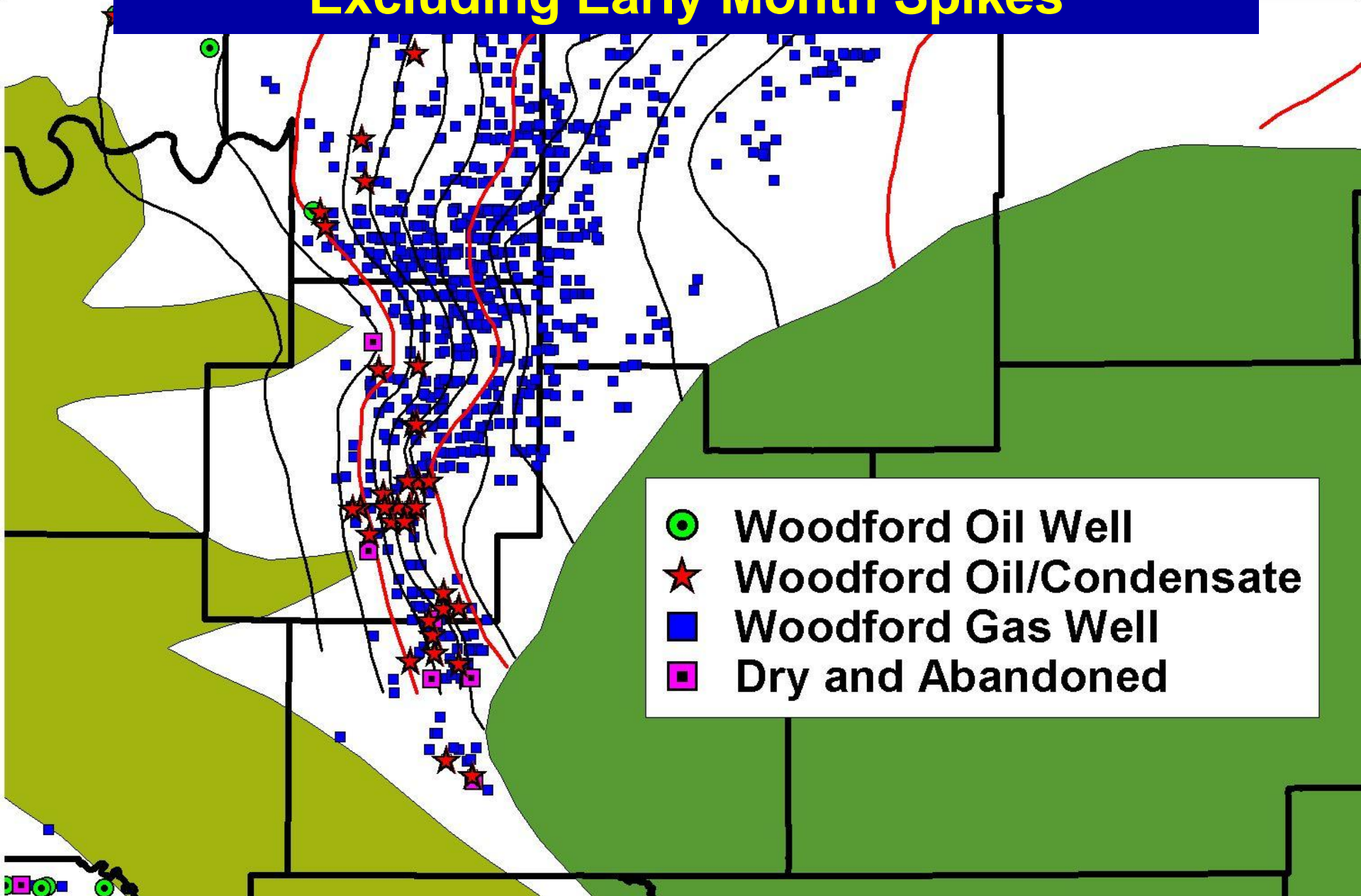
## (2) Cimarex 3-34H Hall (34-3N-11E; Coal Co.; IP 1,740 Mcfd)

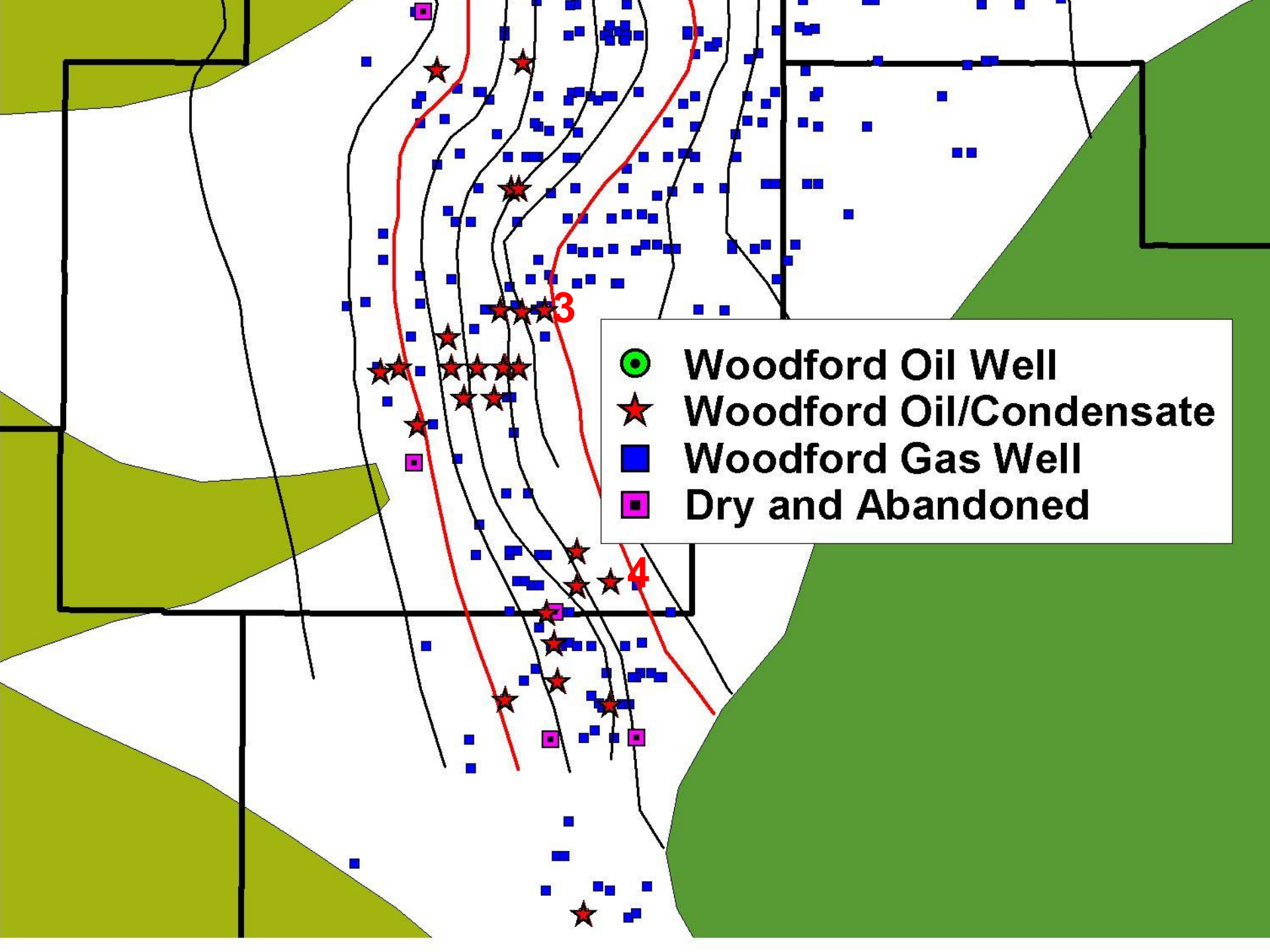


Intermittent liquids production in first few months interpreted as trucking flowback

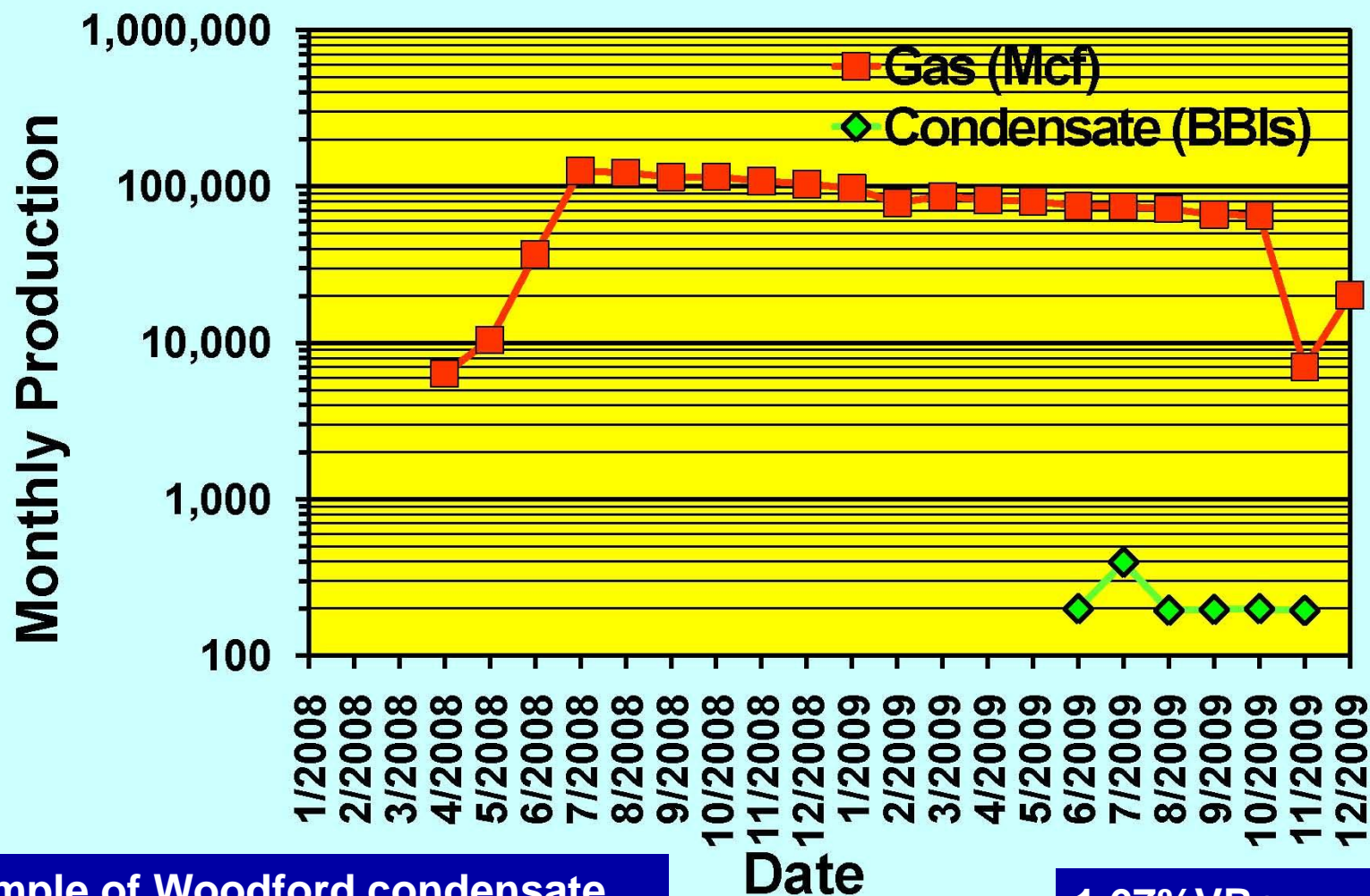
@ 2.05%VRo

# Woodford Shale-Only Condensate Wells Excluding Early Month Spikes





### (3) St. Mary Land & Exploration 3-14 Marvin (14-1N-10E; Coal Co.; IP 3,125 Mcfd)

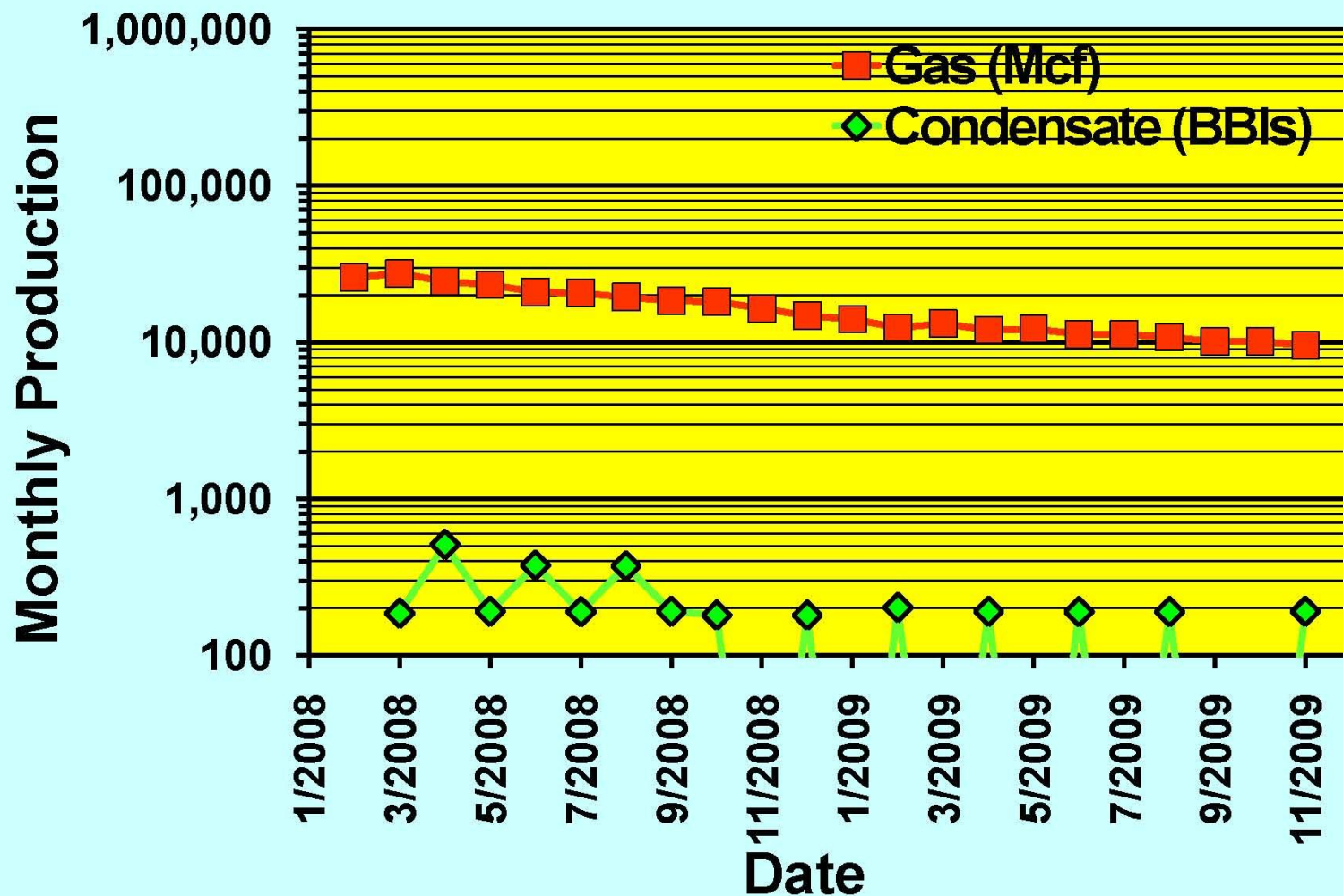


Example of Woodford condensate  
produced later in well's life

1.67%VRo

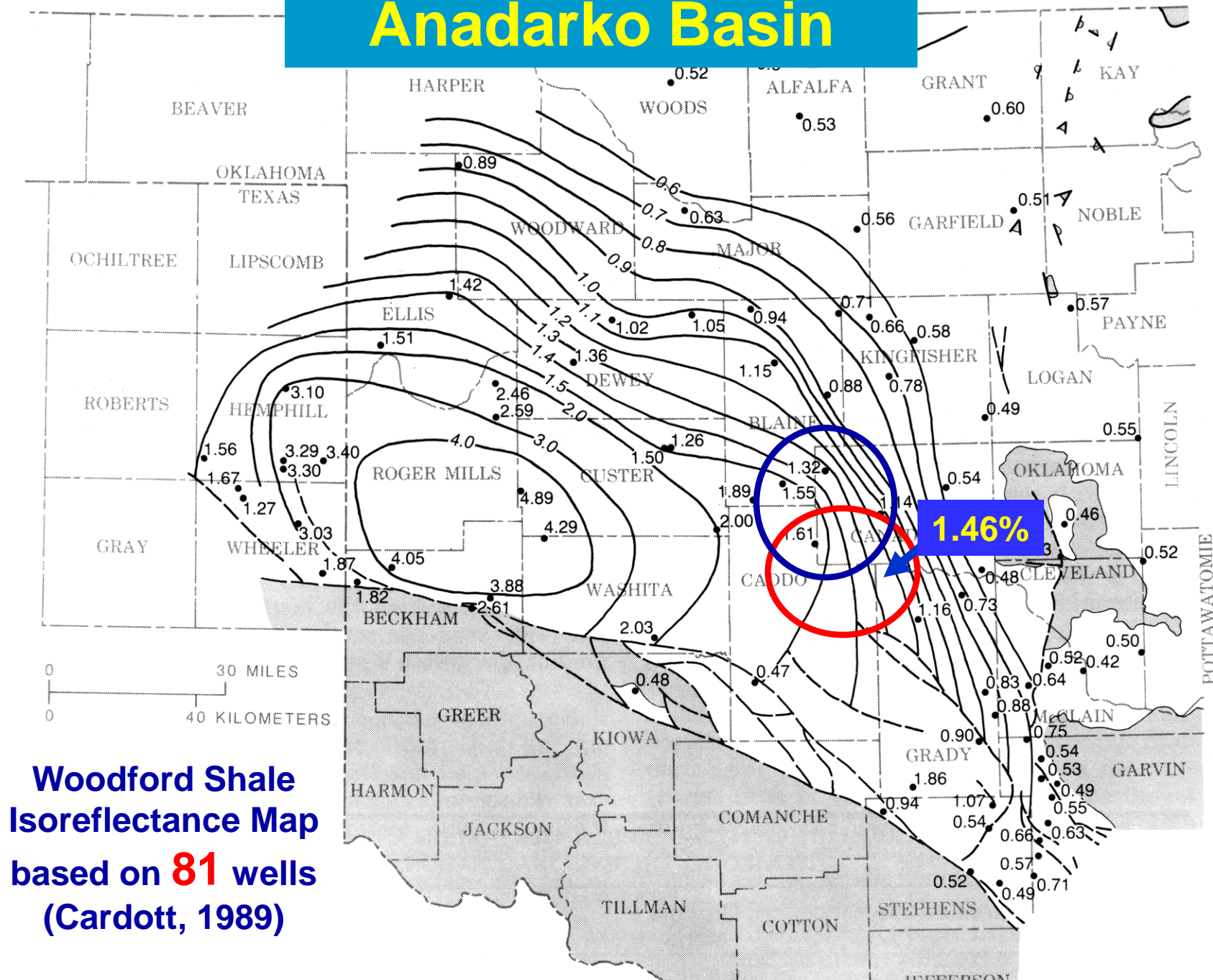


## (4) Antero 30-1H Harris (30-1S-11E; Coal Co.; IP 1,334 Mcfd)



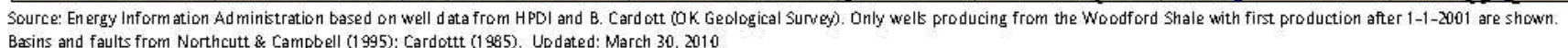
@ 1.6%VRo

# Anadarko Basin





## Woodford Shale Play, Anadarko Basin, OK and TX: Key Geologic Features



# Anadarko Basin (2007-2010)

1.2 1.1  
1.3  
**Blaine**  
1.4  
1.5

**Canadian**

**Woodford-Only  
“Cana” Play**

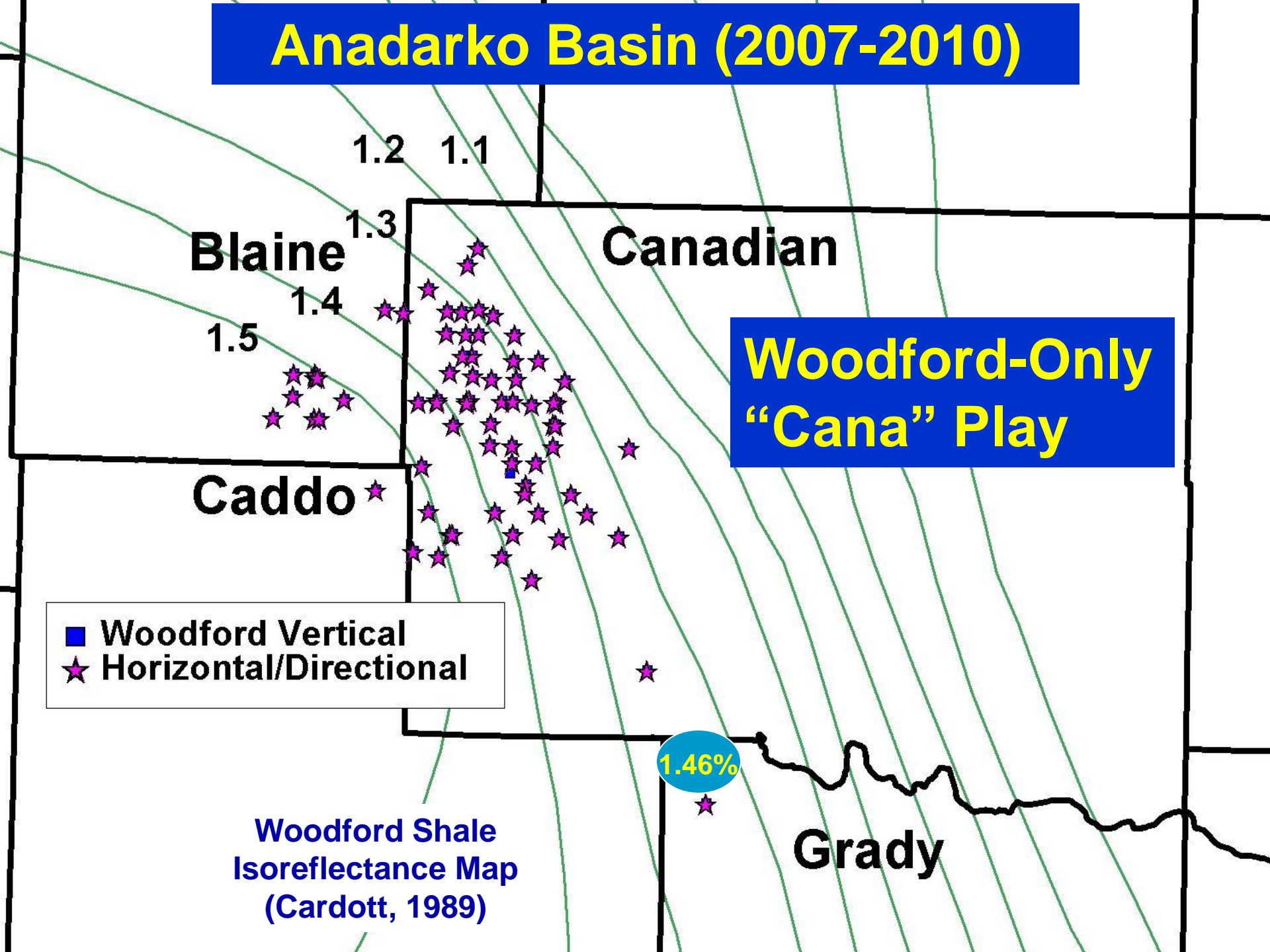
**Caddo**

■ Woodford Vertical  
★ Horizontal/Directional

Woodford Shale  
Isoreflectance Map  
(Cardott, 1989)

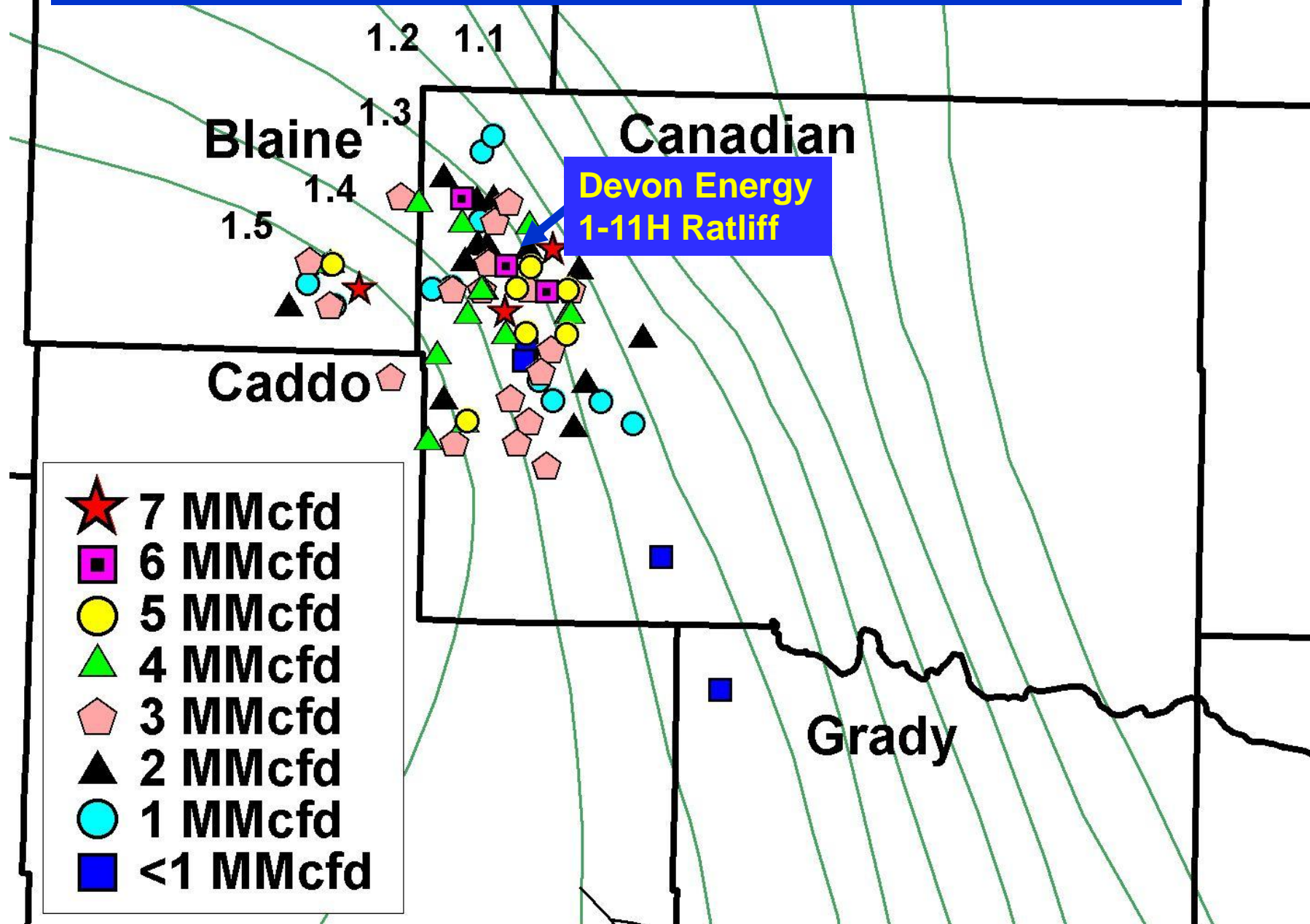
1.46%

**Grady**

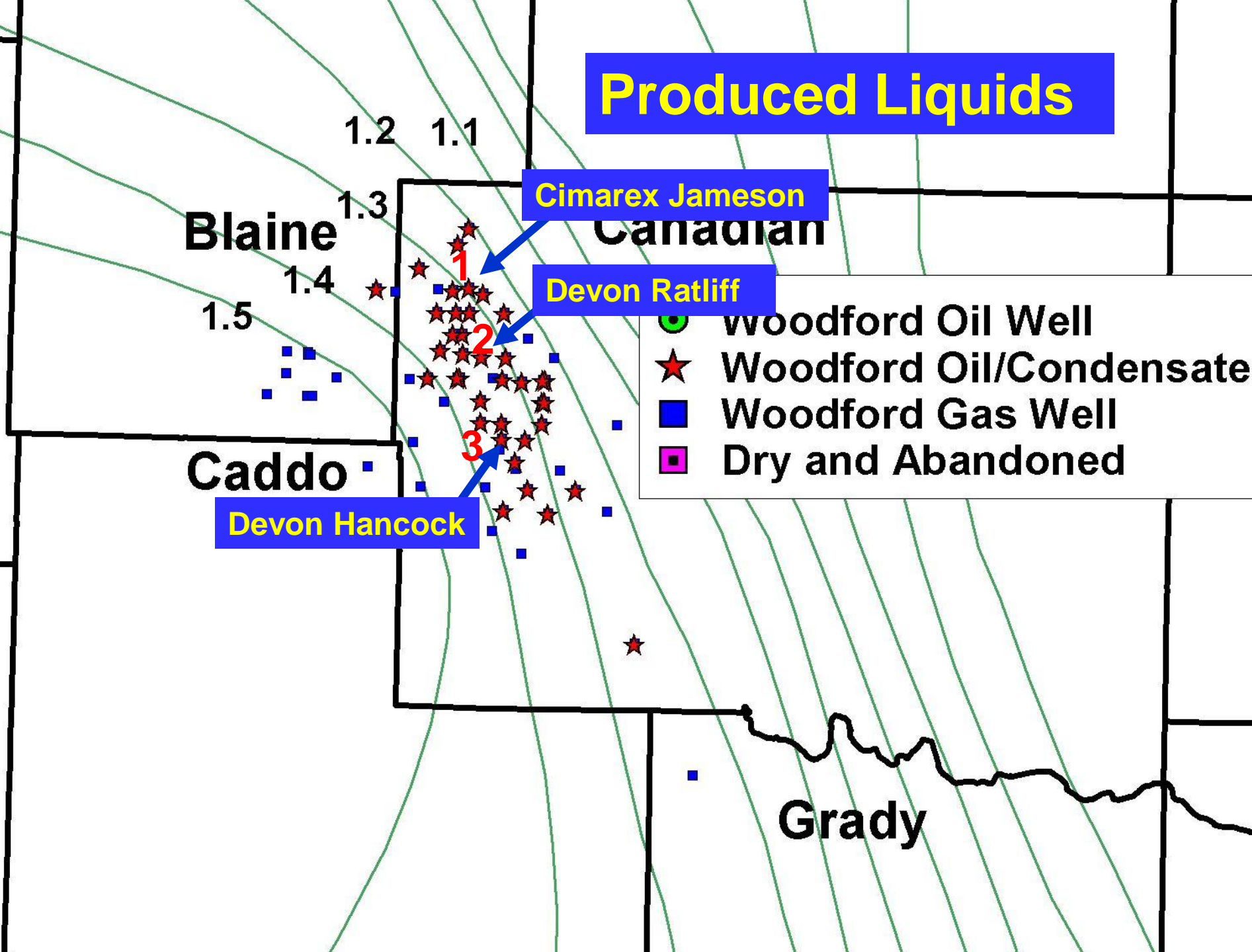




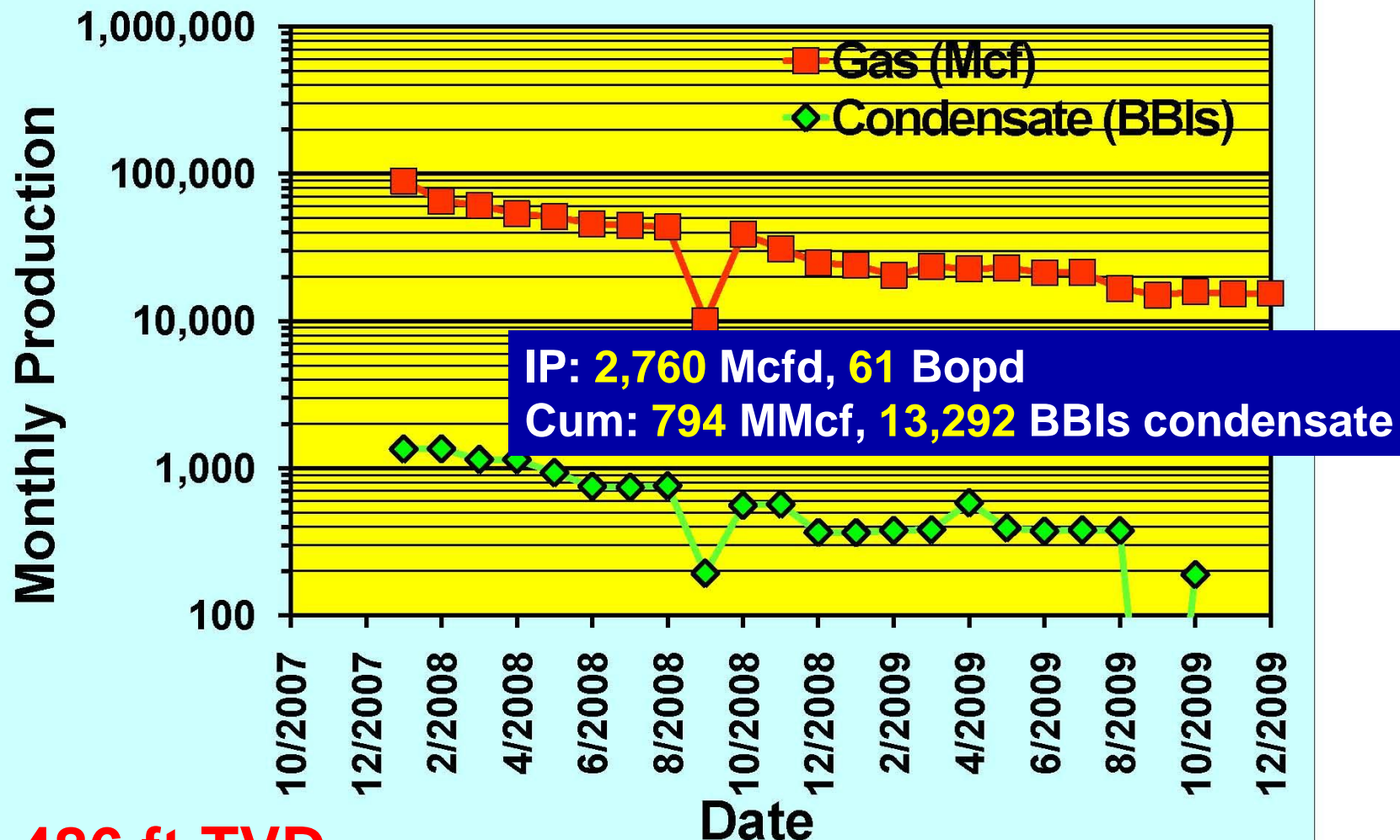
# Anadarko Basin Initial Potential



# Produced Liquids



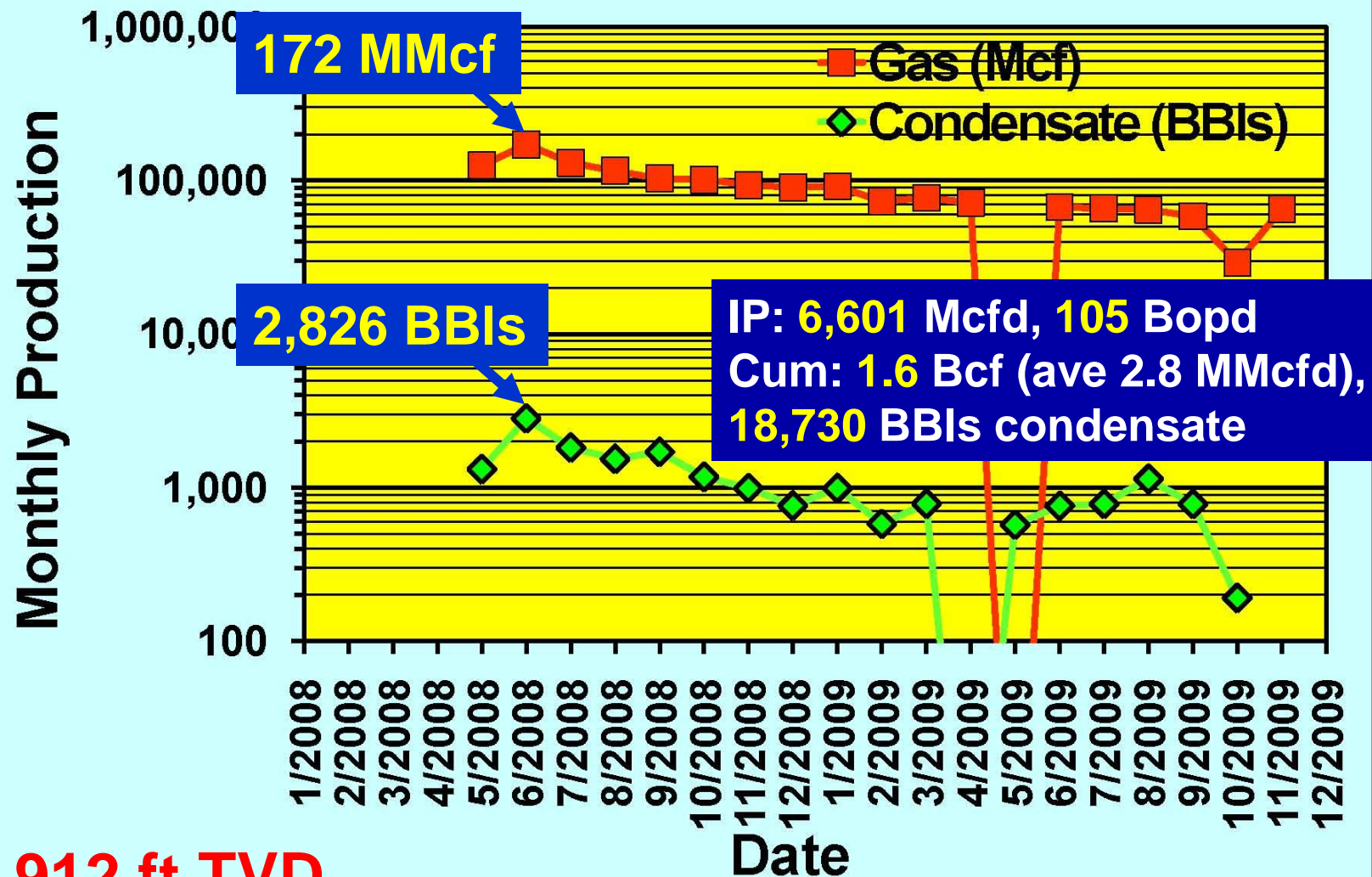
# (1) Cimarex Energy 1H-27 Jameson (27-14N-10W; Canadian Co.)



**12,486 ft TVD**

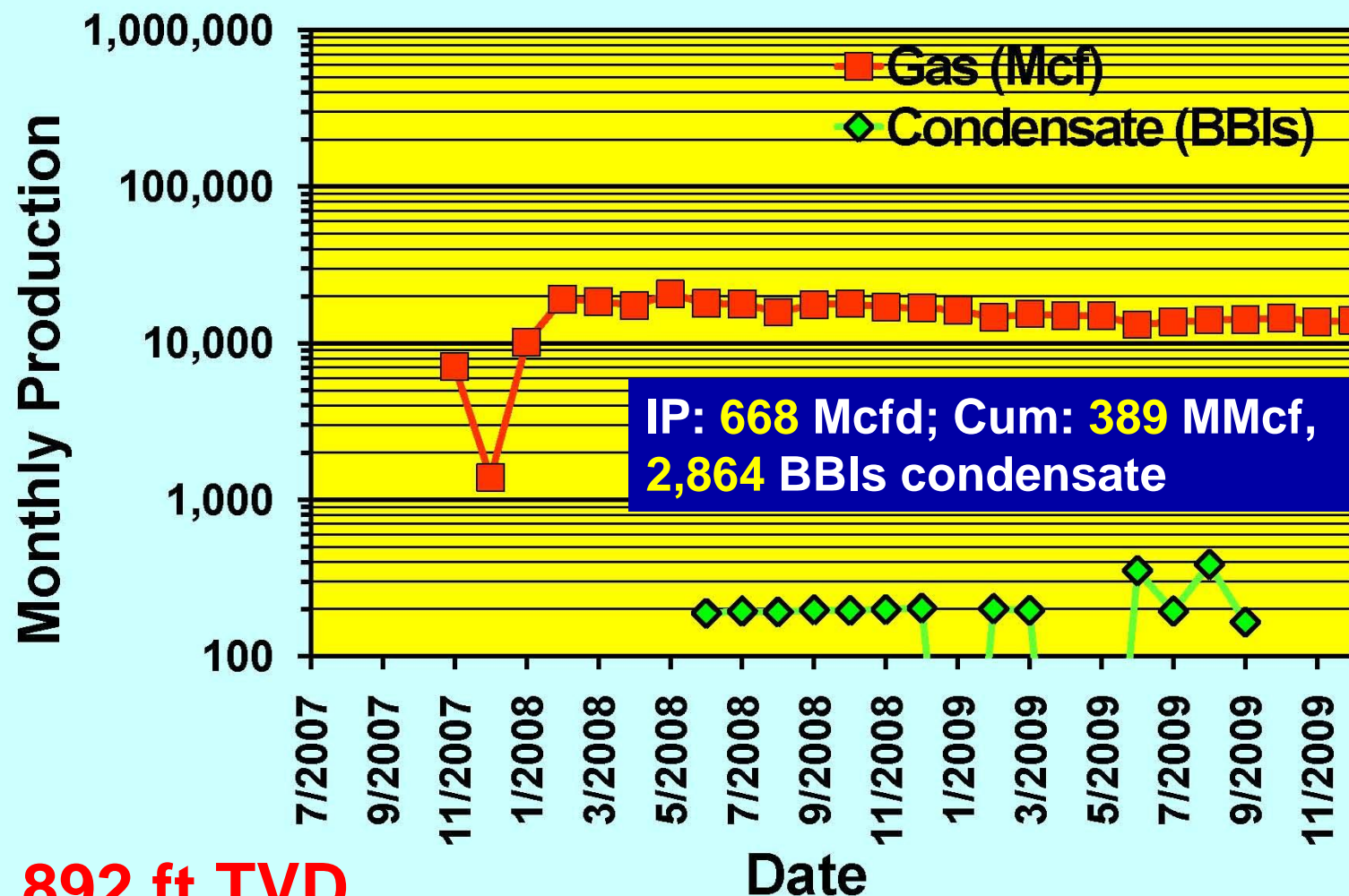
**1st Anadarko Basin Woodford  
Horizontal Well**

## (2) Devon Energy 1-11 Ratliff (11-13N-10W; Canadian Co.)



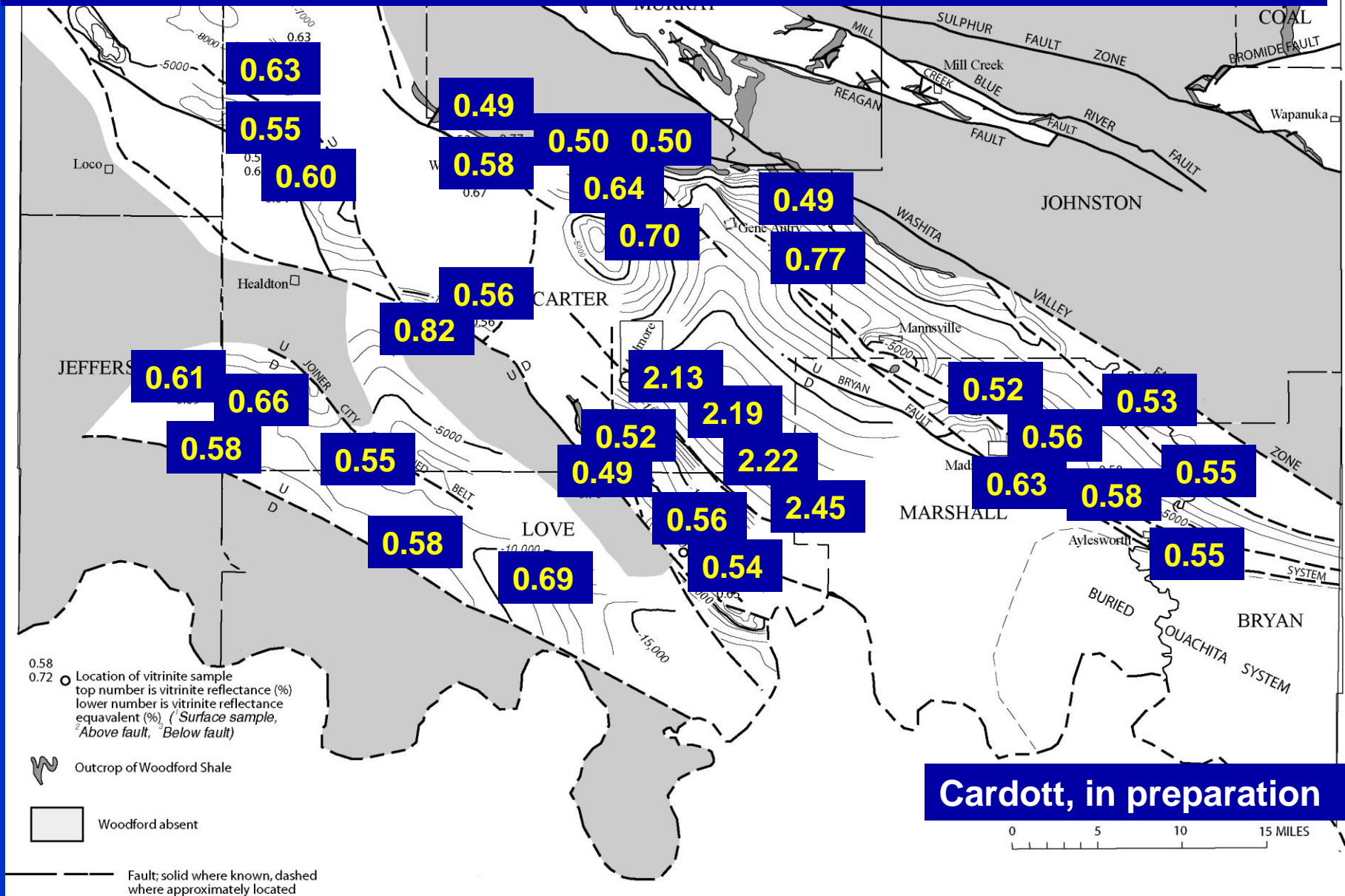


### (3) Devon Energy 1-36H Hancock (36-13N-10W; Canadian Co.)



12,892 ft TVD

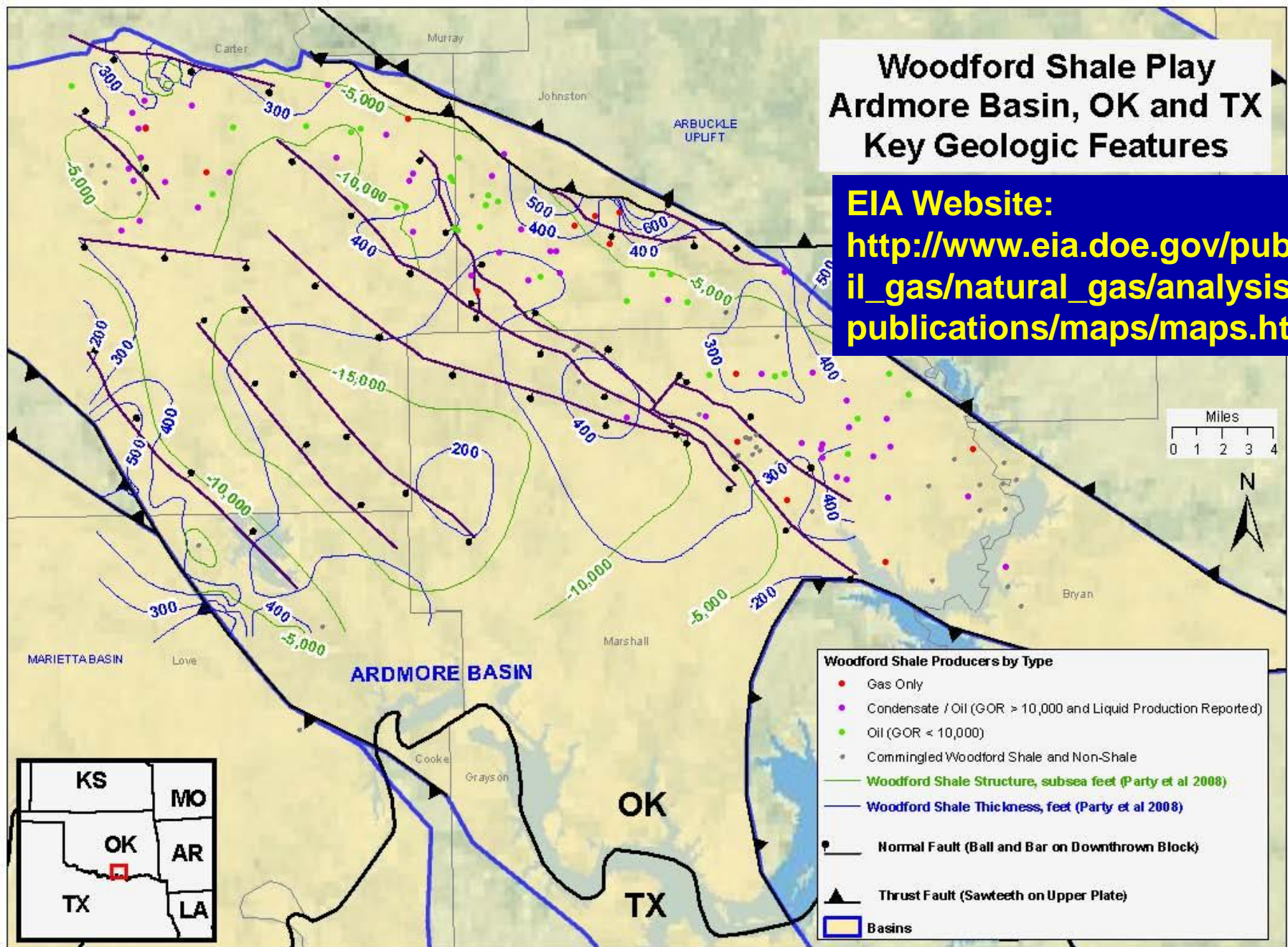
# Structure and Vitrinite Reflectance of Woodford Shale, Southern Oklahoma





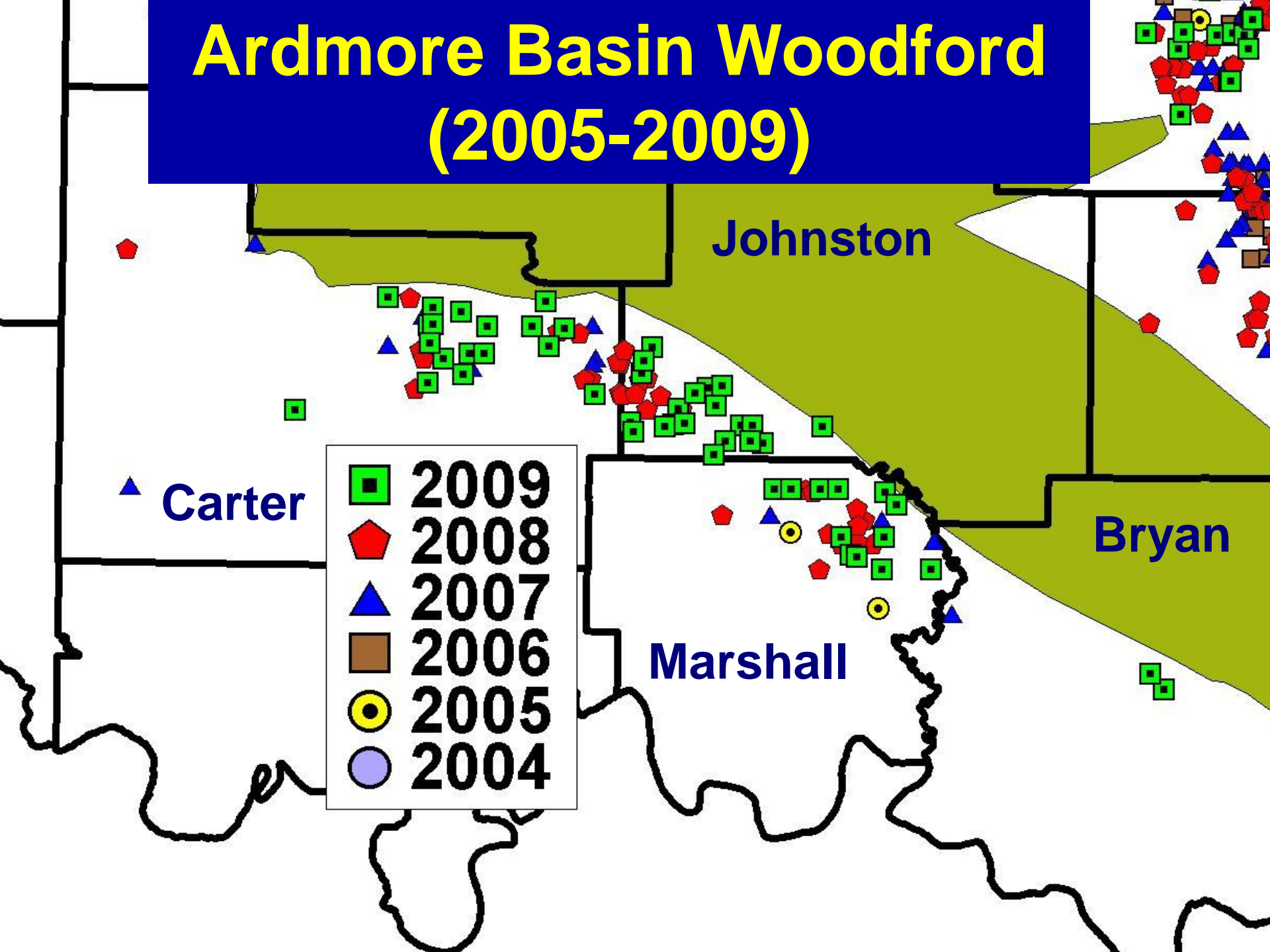
# Woodford Shale Play Ardmore Basin, OK and TX Key Geologic Features

EIA Website:  
[http://www.eia.doe.gov/pub/oil\\_gas/natural\\_gas/analysis\\_publications/maps/maps.htm](http://www.eia.doe.gov/pub/oil_gas/natural_gas/analysis_publications/maps/maps.htm)



Source: Energy Information Administration based on well data from HPDI and B. Cardott (OK Geological Survey). Only wells producing from the Woodford Shale with first production after 1-1-2001 are shown. Basins and faults from Northcutt & Campbell (1995), Party et al (2008). Updated: March 30, 2010

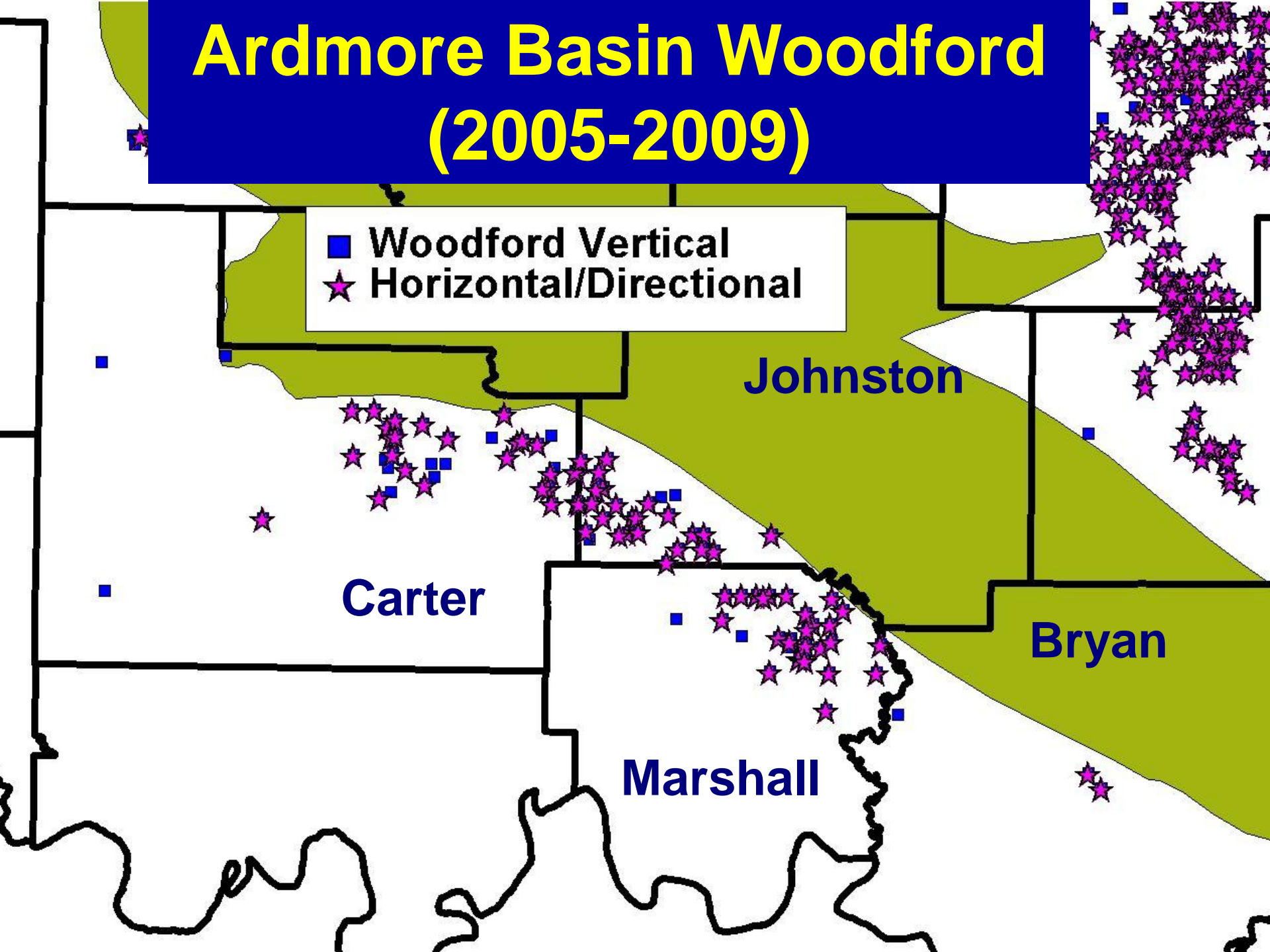
# Ardmore Basin Woodford (2005-2009)



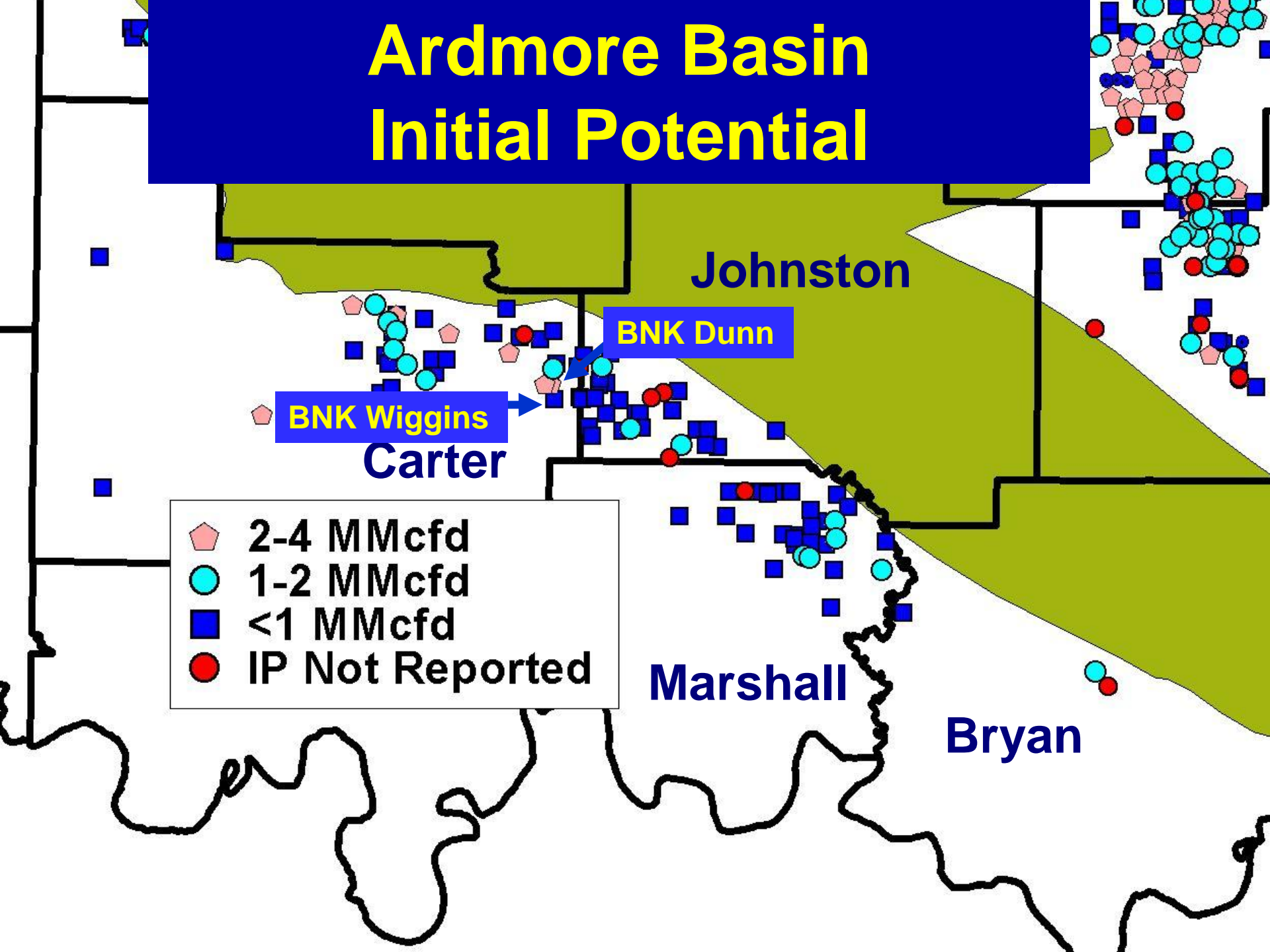


# Ardmore Basin Woodford (2005-2009)

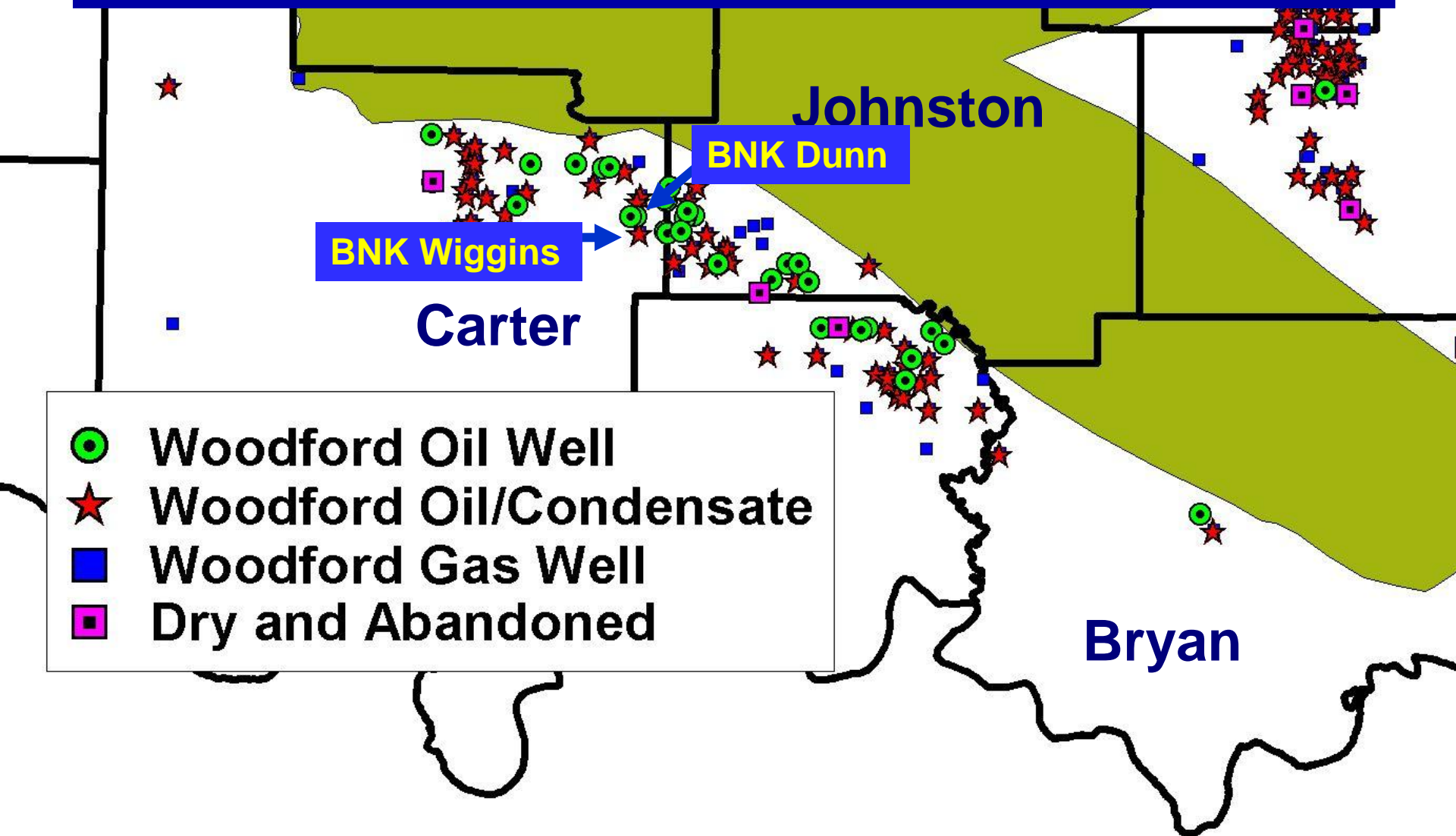
■ Woodford Vertical  
★ Horizontal/Directional



# Ardmore Basin Initial Potential

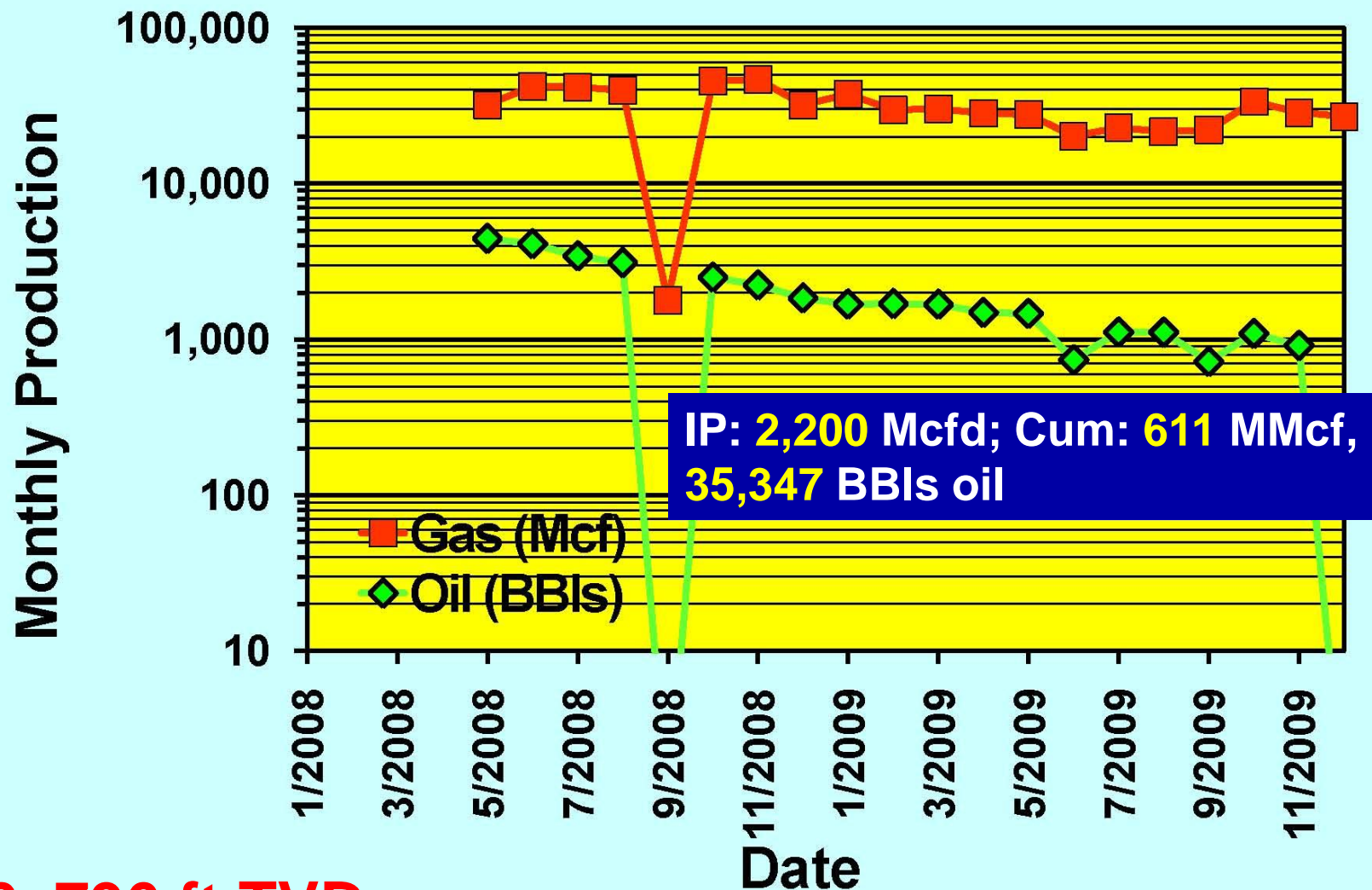


# Ardmore Basin (Woodford-Only Production)



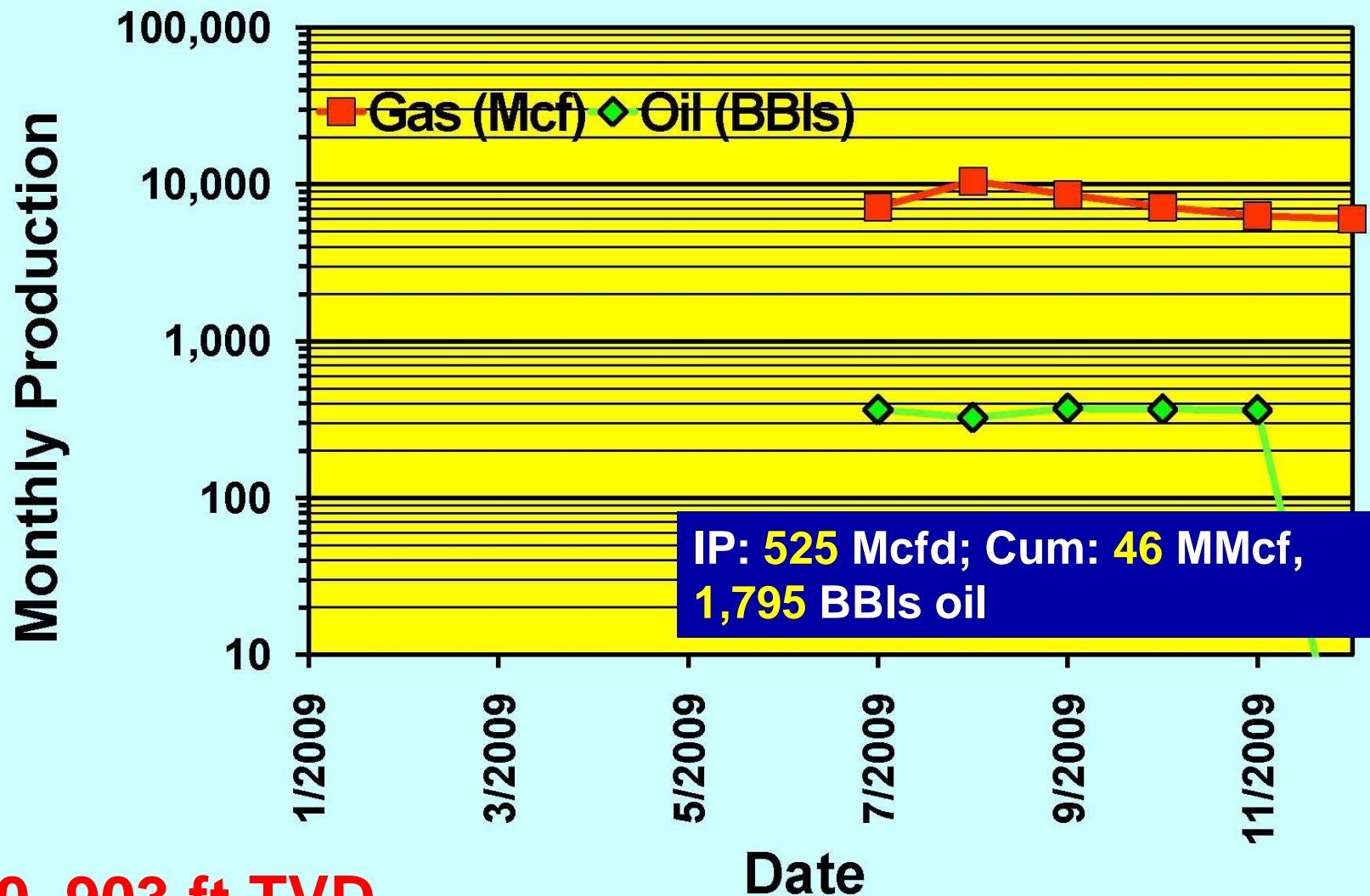


# BNK Petroleum 2-1H Dunn (2-4S-3E; Carter Co.; Oil Well)



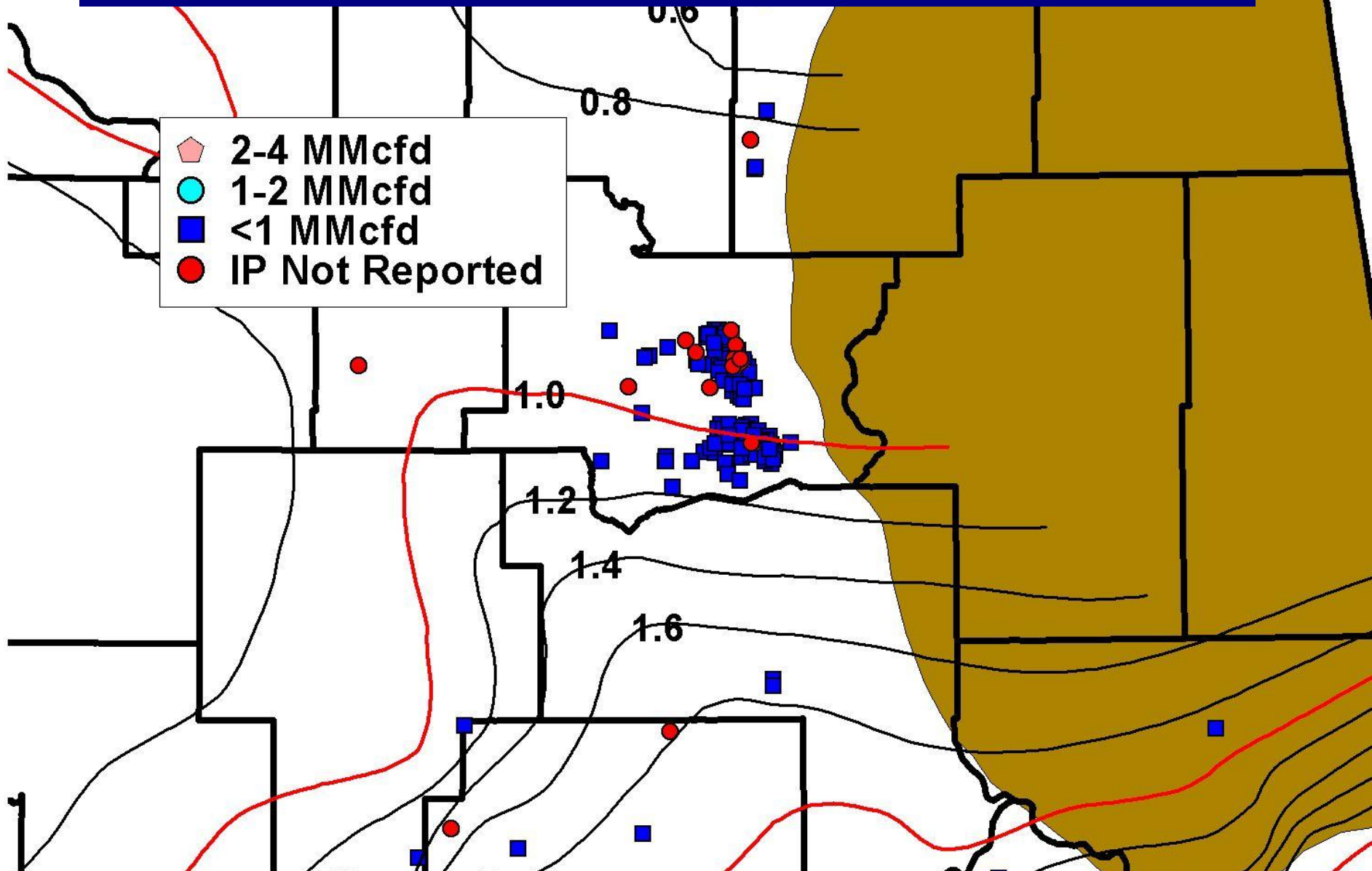
10, 796 ft TVD

# BNK Petroleum 11-1H Wiggins (11-4S-3E; Carter Co.)



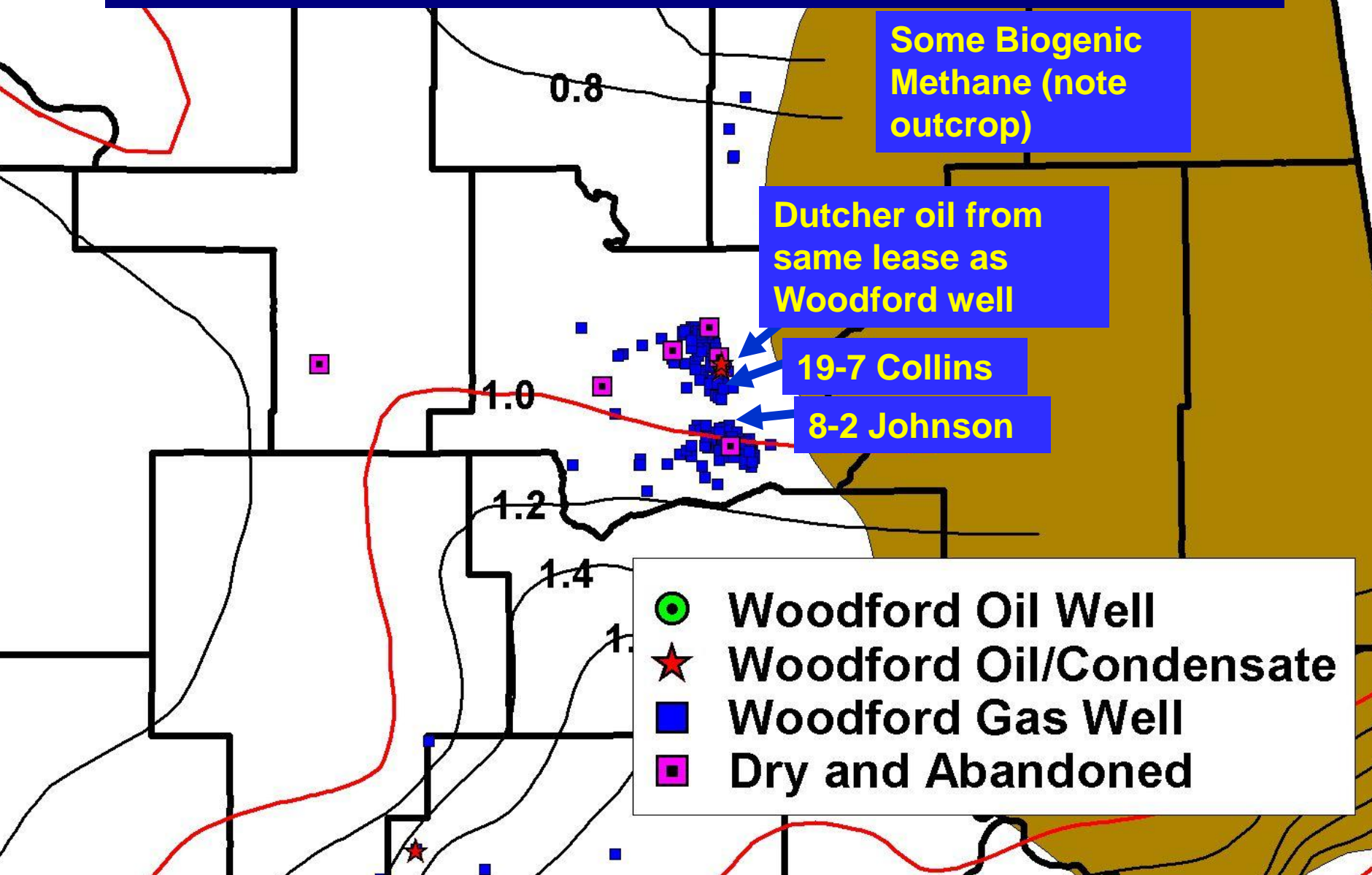
10, 903 ft TVD

# Cherokee Platform Initial Potential on Isoreflectance Map

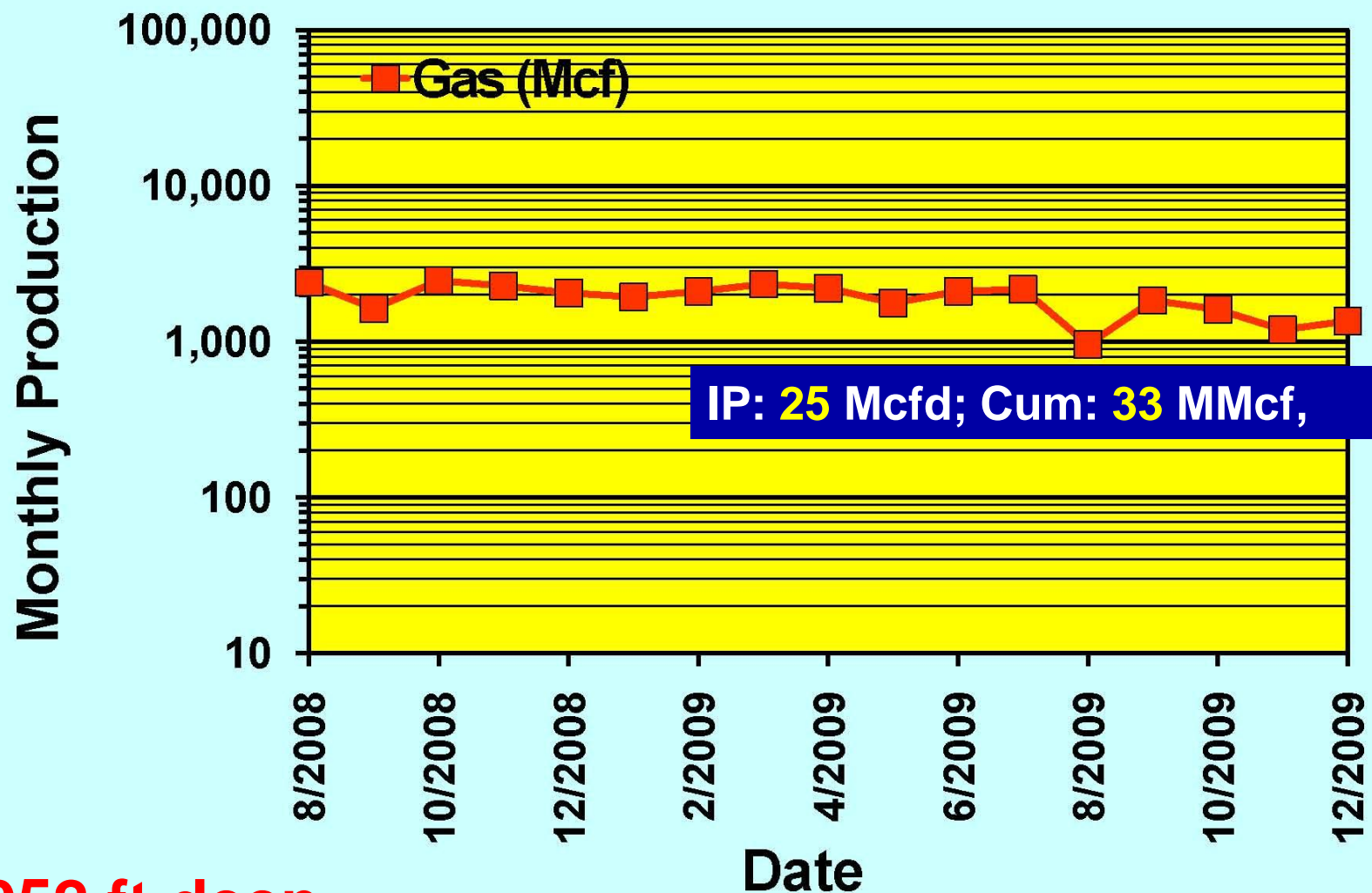




# Cherokee Platform Production on Isoreflectance Map



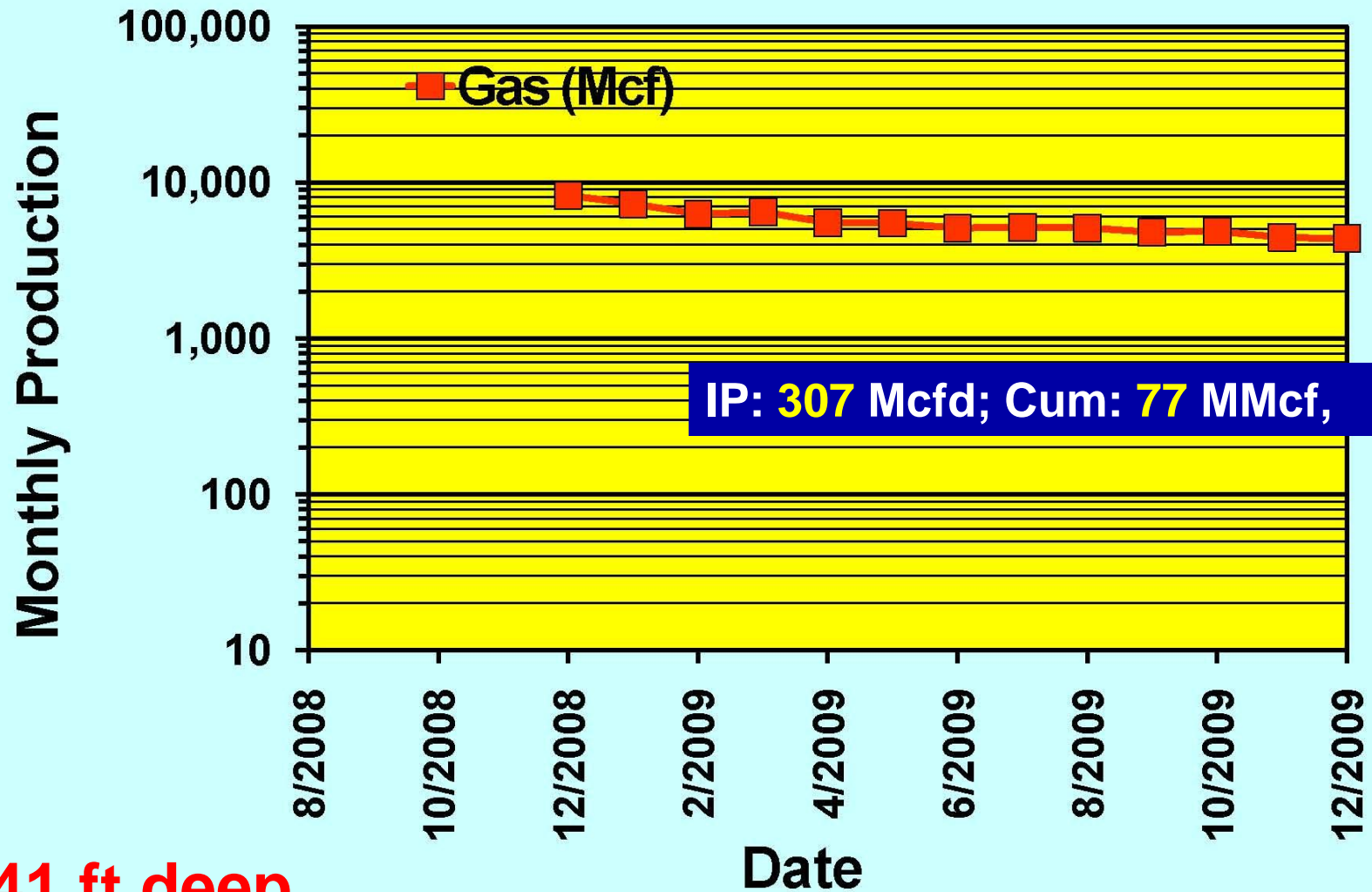
# WCT Operating 19-7 Collins (19-17N-18E; Wagoner Co.)



1,052 ft deep

# Coronado Great Plains

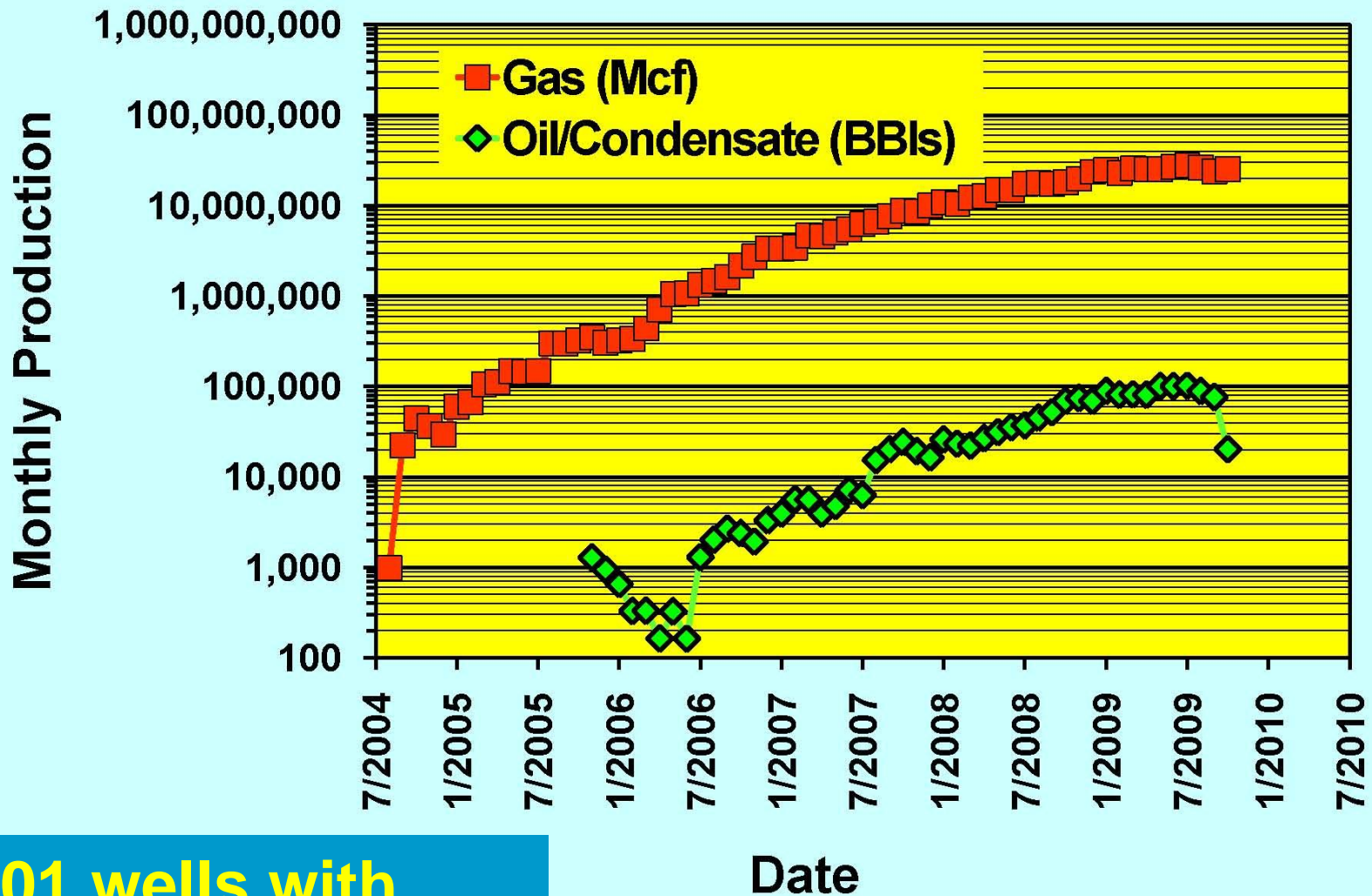
## 8-2 Johnson (8-16N-18E; Wagoner Co.)



**841 ft deep**



# Woodford-Only Production



1,201 wells with  
production data;  
excludes 19 OWWO

Cumulative: 562 Bcf,  
1,485,841 Bo

# SUMMARY OF WOODFORD GAS SHALE PLAYS

- 1. Main Woodford Shale gas play is in the **Arkoma Basin** at <1.15% to >3.0% Ro
- 2. Woodford Shale gas and condensate play in **Anadarko Basin** shelf @1.1% to >1.5% Ro
- 3. Woodford Shale gas and oil play is in the **Ardmore Basin** at <1.2% Ro
- 4. Woodford Shale biogenic methane play is in the **Cherokee Platform** at <1.2% Ro

▶ HOME

▶ PUBLICATIONS SALES

▶ STAFF

▶ CALENDAR

▶ ABOUT OGS

▶ CONTACT US

▶ LINKS

▶ MEWBOURNE COLLEGE  
OF EARTH AND ENERGY

▶ UNIVERSITY OF  
OKLAHOMA

ENERGY

OPIC  
PETROLEUM INFO

GEOLOGY

EARTHQUAKES

EDUCATION,  
OUTREACH

MAPPING

MEETINGS

## OIL AND GAS

OKLAHOMA GEOLOGICAL SURVEY

### Oil and Gas Data and References

[Field Discovery Wells](#) (Excel format)

[Links to other Web sites with Oklahoma](#)

[Stratigraphic Chart](#) [Stratigraphic Guide](#)

[Stratigraphic chart, front of chart \(pdf\)](#)

[Table of Oklahoma Oil and Gas Reserves](#)

[Currently Available OGS Oil and Gas Fields](#)

[All OGS Oil and Gas Related Publications](#)

### Oklahoma Oil and Gas Maps, Cross Sections

Map GM36. Oklahoma oil and gas field (methane), by Dan T. Boyd. ([pdf](#)) ([data](#))

Map GM37. Oklahoma oil and gas field, Dan T. Boyd. ([pdf](#)) ([data](#))

Map GM38. Oklahoma oil and gas field

Map GM28 Map of Oklahoma Oil and Gas supplement, 1997. ([Data files only](#))

[Type Logs](#)

### Oklahoma Hydrocarbon Source Rocks and Gas Shales

[Bibliographies](#)

[Presentations & Reports](#)

Including October 2008 Gas Shales Workshop Presentations!

[Oklahoma Gas-Shale Completions Map, 1939-2009](#)

[Woodford Shale Gas Well Completions Map, 1939-2009](#)

[Woodford Shale Gas Well Completions Map, 2003-2009](#)

[Gas Shales Database](#)

### Oklahoma Oil and Gas History and Activity

[Shale Shaker Articles](#)

[Oklahoma: The Ultimate Oil Opportunity](#)

[Milestones in the Oklahoma Oil and Gas Industry](#)

[\\*NEW 2008 Drilling Highlights](#)

[2007 Drilling Highlights](#)

[2006 Drilling Highlights](#)

## LINKS

[Commonly asked questions, royalty owner information](#)

For more information,  
please visit the  
Oklahoma Geological  
Survey Web Site