Overview of Woodford Gas-Shale Play in Oklahoma, 2008 Update

Brian J. Cardott

Oklahoma Geological Survey
Oklahoma Shale-Gas Well History
650 Wells, 1939–2008

- **Caney**
- **Woodford**

*Application of Advanced Completion Technology in 2004*

Caney/Woodford included with Caney

Updated 8/4/2008
Oklahoma Gas-Shale Wells
Completed 1939-2008

650 Wells
73 Caney Shale
577 Woodford Shale

Updated 8/4/2008
Oklahoma Gas-Shale Wells by Year (1939-2008)

Layered with 2008 Prevalent

Updated 8/4/2008
Based on conodonts, Hass and Huddle (1965) determined a Late Devonian (Frasnian) age for most of the formation; uppermost part is Early Mississippian (Kinderhookian)
Pre-Woodford Geologic Map

From Amsden, 1980
Woodford Shale Members

Three informal members based on palynomorphs (Urban, 1960; Von Almen, 1970), geochemistry (Sullivan, 1985), log signatures (Hester and others, 1990; Lambert, 1993)

From Hester and others (1990) [Anadarko Basin]
Paleogeography and Facies Distribution in the Late Devonian

From Kirkland and others, 1992
Geologic Provinces of Oklahoma

MAJOR FAULTS

Surface faults

Subsurface faults

Normal faults identified by hachures on relatively downthrown block.

Thrust faults identified with solid barbs on hanging wall block

Northcutt and Campbell, 1995
Isopach Map of Woodford Shale

EXPLANATION

- Ouachita Province Boundary (thrust fault)
- Upper Devonian shale missing
- Cretaceous overlap
- Erosional limit of Sylamore Ss. (basal ss. of Chattanooga)
- Covered boundary
- Isopach contours

From Comer, 1992
Woodford Shale

From Comer, 1992
# Woodford Mineralogy

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<th>[grab samples]</th>
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Woodford Gas-Shale Wells

Completed 1939-2008

553 ft (1985)
(IP 122 Mcf)

15,310 ft (2005)
(IP 234 Mcf;
7BO 42° API;
GOR 33,429)

582 Woodford Wells
Woodford Gas-Shale Wells

Completed 2003–2008

561 Wells

- 6 Caney/Woodford
- 4 Sycamore/Woodford
- 123 Vertical Woodford
- 428 Horizontal/Directional Woodford (76%)
Woodford Shale-Only Wells
Completed 2004-2008

546 wells;
“Horizontal” includes 5 directional wells
Woodford Shale Gas Wells, 2003-2007

528 Woodford-only wells:
112 vertical: depth 570-15,310 ft; IP: 1-2,681 Mcfd; 416 horizontal wells: depth 1,700-13,105 TVD; IP 3-11,200 Mcfd
Woodford IP >1 MMcfd
Completed 2004–2008

- Caney/Woodford
- Sycamore/Woodford
- Woodford
- Woodford IP >1 MMcfd
Woodford IP >1 MMcfd
Completed 2004–2008

- 10-12 MMcfd
- 8-10 MMcfd
- 6-8 MMcfd
- 4-6 MMcfd
- 2-4 MMcfd
- 1-2 MMcfd
Woodford Shale Discovery Wells
(New Field or Extension)

546 Woodford-only Wells

Year

Updated 8/4/2008
Woodford Shale Discovery Wells

Completed 2004–2008

238 discovery wells
Generalized Structure Map of Woodford Shale, Eastern Oklahoma

Map prepared by R. Vance Hall using Petra
## Guidelines for the Barnett Shale (Based on Rock-Eval Pyrolysis)

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<th>VRo Values</th>
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<td>&lt;0.55%</td>
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<td>0.55-1.15%</td>
<td>Oil Window (peak oil at 0.90%VRo)</td>
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<td>1.15-1.40%</td>
<td>Condensate–Wet-Gas Window</td>
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<td>&gt;1.40%</td>
<td>Dry-Gas Window</td>
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*From Jarvie and others, 2005*
Vitrinite Reflectance of Woodford Shale, Eastern Oklahoma

VRo mean based on minimum of 20 measurements from whole-rock pellets

Cardott, in preparation
Isoreflectance Map of the Woodford Shale in Eastern Oklahoma

Cardott, in preparation

Map prepared by R. Vance Hall using Petra
Woodford IP >1 MMcfd on Isoreflectance Map

- 10-12 MMcfd
- 8-10 MMcfd
- 6-8 MMcfd
- 4-6 MMcfd
- 2-4 MMcfd
- 1-2 MMcfd
Woodford Gas-Shale Play is primarily in eastern Oklahoma (western Arkoma Basin) where the shale is:

(1) in the gas window (pushing the lower limits to the west and upper limits to the east)
(2) greater than 100 ft thick
(3) relatively shallow (<12,000 ft)
Structure and Vitrinite Reflectance of Woodford Shale, Southern Oklahoma

Cardott, in preparation
Southern Oklahoma VRo vs Depth

Vitrinite Reflectance (%Ro)

Depth (feet)
Woodford Gas Shales

1939-1996

21 Wells
1 Sycamore/Woodford

<1MMcf/mo

steep decline

Sycamore; Woodford
Woodford

oil

Madill

Aylesworth
Cimarex Energy 3 Griffin-Olmstead
(Marshall CO, 16-5S-5E; IP 747 Mcfd; 4,052-4,135 ft)

Madill Field

Average Monthly Production (Mcf)

Cumulative Gas Production 1,803,733 Mcf

Completed as OIL well in McLish 6,536-6,544 ft on 11/4/55;
OIL-WO well in McLish and Bromide 5,664-5,696 ft on 5/18/56;
GAS-WO to Woodford on 3/21/92

(Gas production data supplied by Petroleum Information/Dwights LLC dba IHS Energy Group,
© 2007, IHS Energy Group)
Structure contour map of the top of the Viola Group (Ordovician) in the North Madill field (from Huffman and others, 1987)
Verdad Oil & Gas 1 Mary Haynie
(Bryan CO, 22-6S-7E; IP 962 Mcfd; 3,710-4,054 ft)

Completed as GAS well in Misener 4,192-4,227 ft on 6/27/58; GAS-WO (plugback) in Woodford on 11/22/74

Cumulative Production 2,337,532 Mcf

346 MMcf
75 MMcf

(Gas production data supplied by Petroleum Information/Dwights LLC dba IHS Energy Group, © 2007, IHS Energy Group)
Structure contour map of the top of the Viola Group (Ordovician) in the Aylesworth and SE Aylesworth District fields (from Huffman and others, 1987)
Woodford Shale Production (2004-2008 wells)

Cumulative Production
122,729,596 Mcf gas,
158,238 BBLS oil/condensate from 440 Woodford-only wells (excludes OWWO, D&A)

(Gas production data supplied by PI/Dwights LLC, © 2007, IHS Energy Group)
Woodford Shale Only Oil/Condensate Production (67 of 440 wells; 2004-2008)
Woodford Shale Only Oil/Condensate Production (67 of 440 wells; 2004-2008)

- 0.6% Ro
- 40° API oil
- GOR 22,776
- 0.6% Ro
- GOR 41,210
- 1.4% Ro
- Condensate
- Caney/Woodford
- Sycamore/Woodford
- Woodford
- Woodford Oil/Condensate
SUMMARY OF WOODFORD GAS SHALE PLAY

- Woodford Shale contains Type II (oil generative) Kerogen with adequate TOC
- Woodford Shale is silica rich (e.g., fracture-able)
- Main Woodford Shale gas play is in eastern Oklahoma at >1.1% Ro
- Some Woodford Shale gas potential is in southern Oklahoma at <1.1% Ro
http://www.ogs.ou.edu

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

Brian J. Cardott
Oklahoma Geological Survey

Bibliography of Caney Shale
Bibliography of Excello Shale
Bibliography of Woodford Shale
Bibliography of Oklahoma Asphalt
Bibliography of Oklahoma Rock-Eval
Bibliography of Oklahoma Solid Hydrocarbons
Bibliography of Oklahoma Gas Shales
Bibliography of Oklahoma Hydrocarbon Source Rocks
Oil and Gas Presentations and Reports

- Woodford Gas-Shale Play Update (2008 AAPG Poster)
- Conventional Wisdom Applied to Oklahoma Gas Shales
- Overview of Woodford Gas Shale Play (2007 Conference)
- Oklahoma Gas Shales (2006 CBM Symposium)
- Woodford Shale and Caney Shale Reservoir Property Analysis Report
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Typical Calf Creek point of Woodford chert found in Haskell County, Oklahoma (Norman Transcript, March 11, 2007, p. E1)