USGS
science for a changing world

Shale-Gas Resources


Sampling upper portion of Woodford Shale, Arbuckle Mountains, OK


Inspecting Lower Fayetteville Shale near Snowball, AR

Stan Paxton, Marvin Abbott, Bob Milici, and Dave Houseknecht

U.S. Department of the Interior
U.S. Geological Survey

Outline - Shale

- Global / Regional Setting
- Woodford / Chattanooga
  - > Stratigraphic Context
  - > Depositional Environments
- Caney / Fayetteville
  - > Stratigraphic Context
  - > Depositional Environments
- Assessment Units

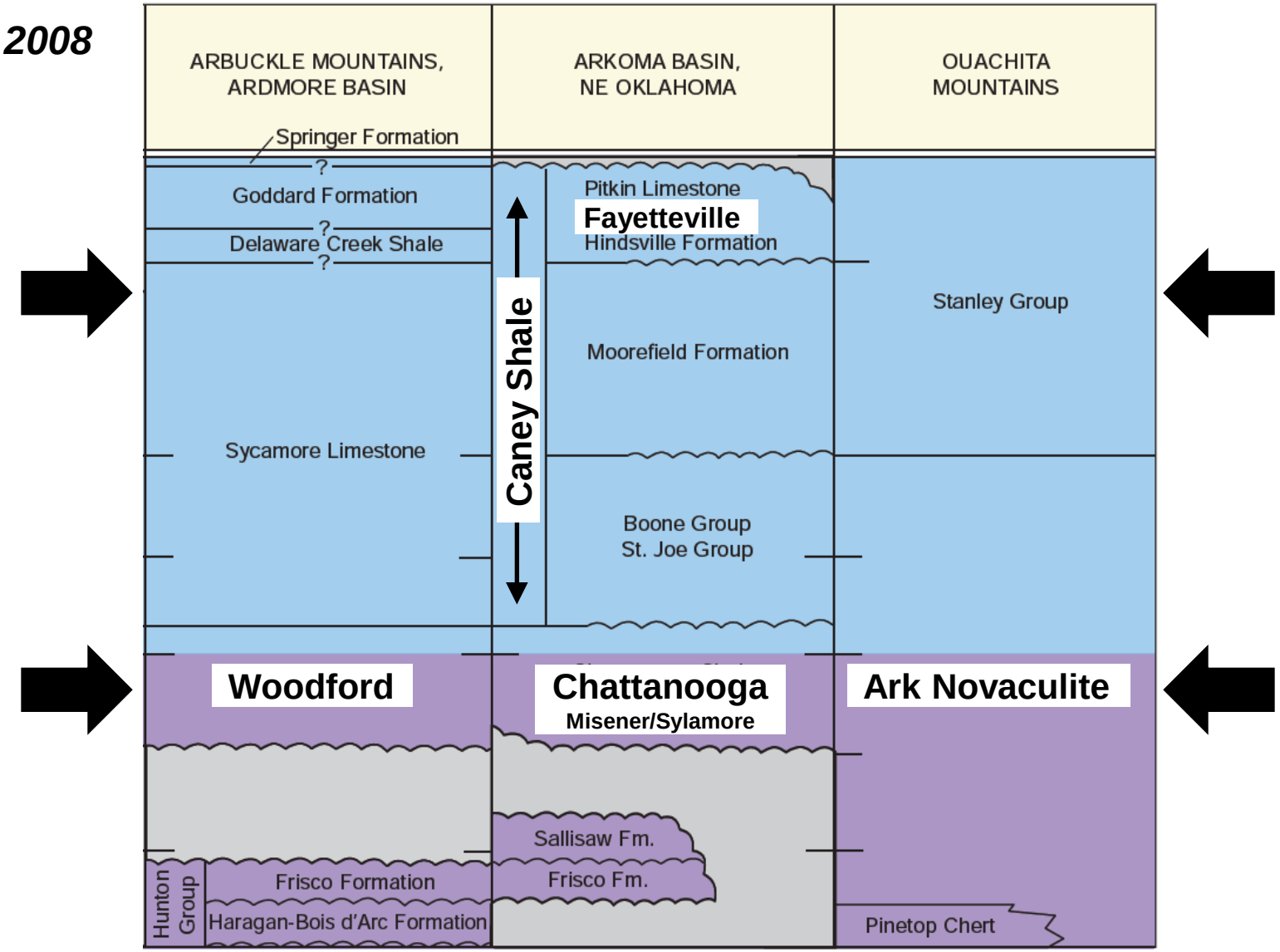
Literature and On-Line Sources

- J. Comer, Indiana Survey
- B. Cardott, Oklahoma Survey
- R. Andrews, Oklahoma Survey
- E. Ratchford, Arkansas Survey
- R. Blakey, N Arizona U
- F. Ettensohn, U Kentucky
- Other Open Literature / USGS Publications

USGS

Regional Stratigraphy

Comer, 2008



USGS

ICS / North American Stages

Atokan (or Derryan)
(Middle Pennsylvanian, base @ 312 mya)

Morrowan (or Bashkirian)
(Lower Pennsylvanian, base @ 318 mya)

Chesterian
(Middle/Upper Mississippian, base @ 333 mya)

Meramecian
(Middle Mississippian, base @ 340 mya)

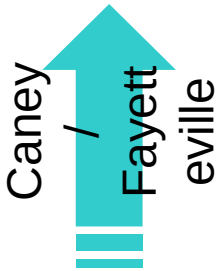
Osagean
(Lower/Middle Mississippian, base @ 348 mya)

Kinderhookian (or Tournaisian)
(Lower Mississippian, base @ 359 mya)

Famennian
(upper Upper Devonian, base @ 375 mya)

Frasnian
(lower Upper Devonian, base @ 385 mya)

Givetian Stage
(upper M. Devonian, base @ 392 mya)



Compiled from Rhode, 2009.

USGS

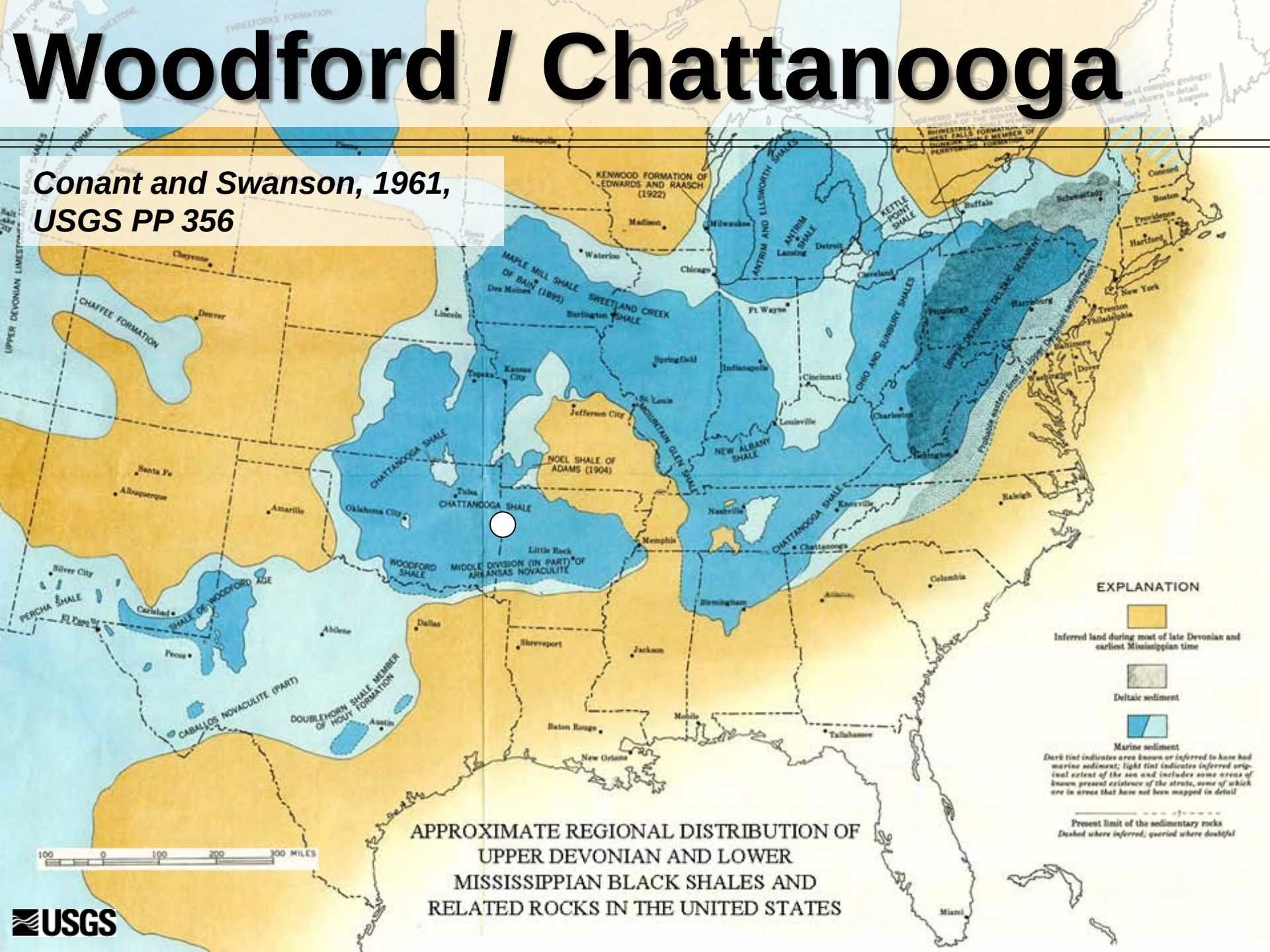
Outline - Shale

- Global / Regional Setting
- Woodford / Chattanooga
  - > Stratigraphic Context
  - > Depositional Environments
- Caney / Fayetteville
  - > Stratigraphic Context
  - > Depositional Environments
- Assessment Units

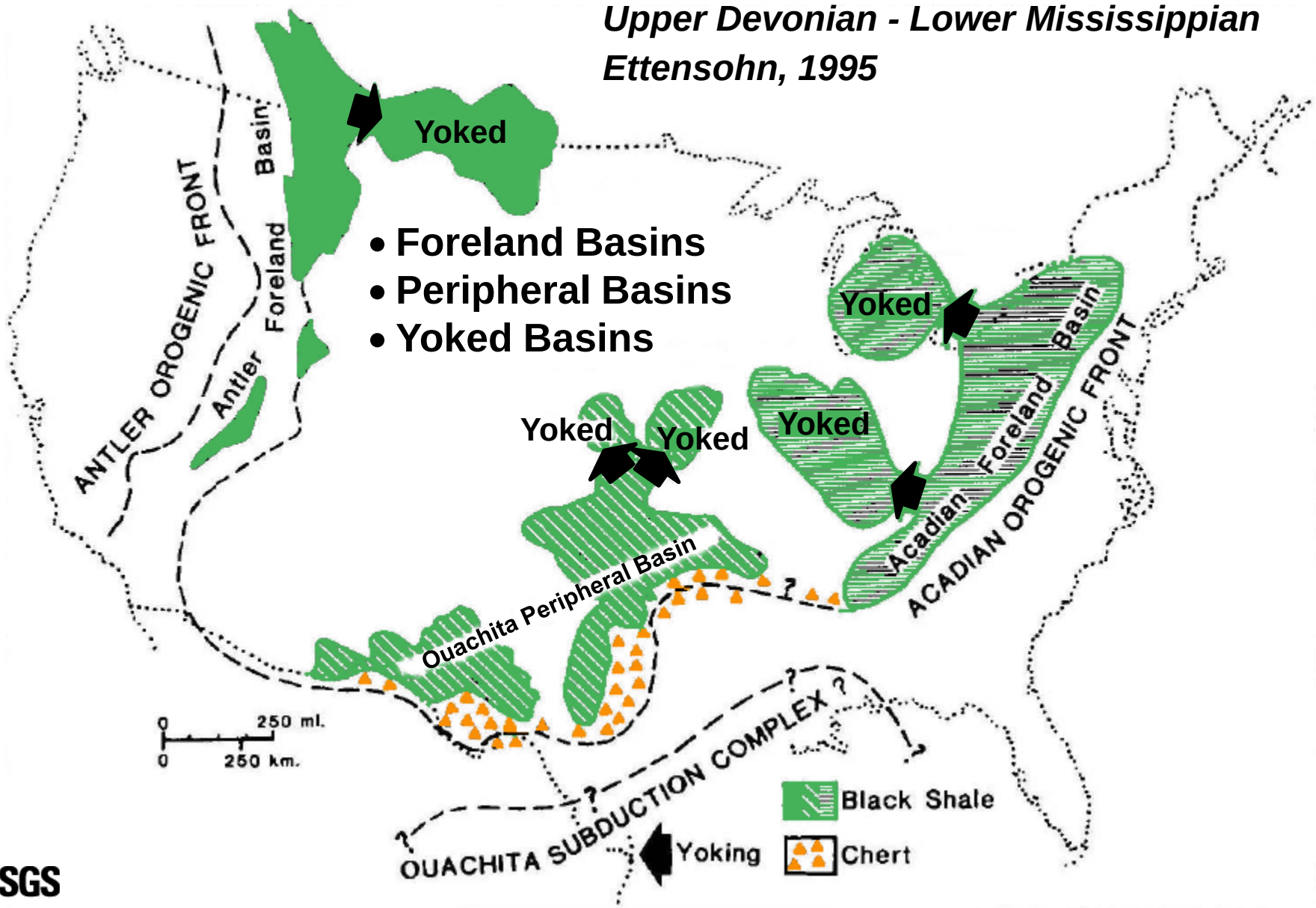
USGS

Woodford / Chattanooga

Conant and Swanson, 1961, USGS PP 356



First Order Tectonic Control

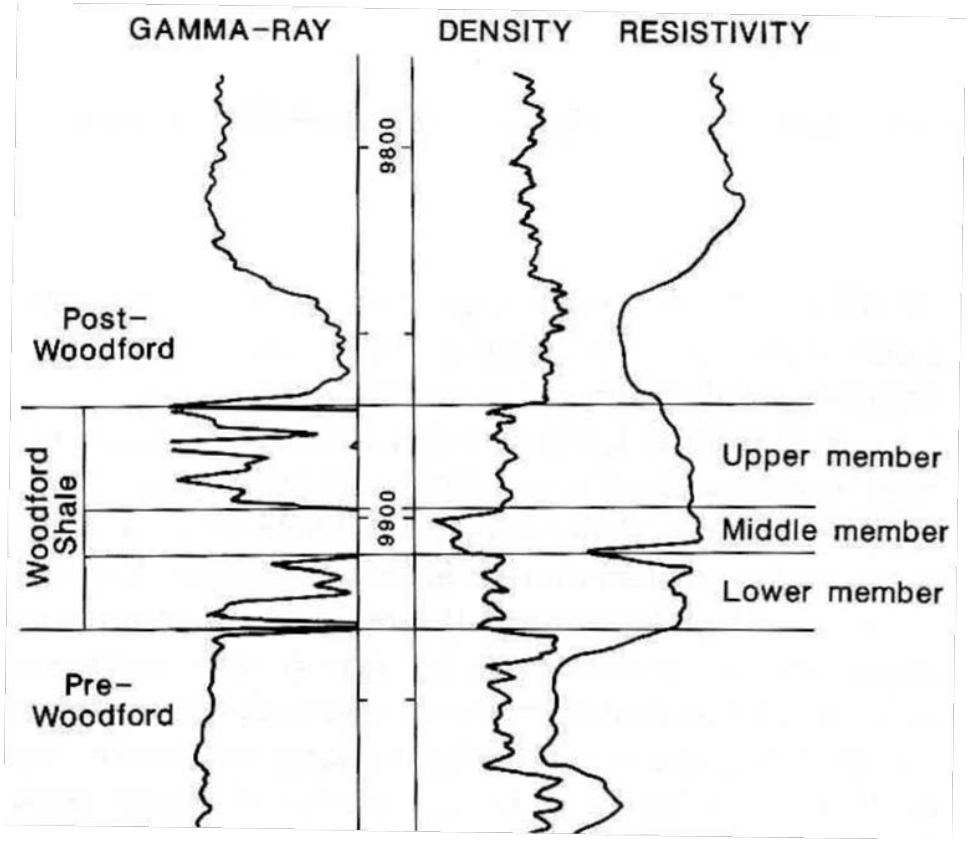


USGS

Woodford Shale Members

Three Informal Members*
(Anadarko Basin)

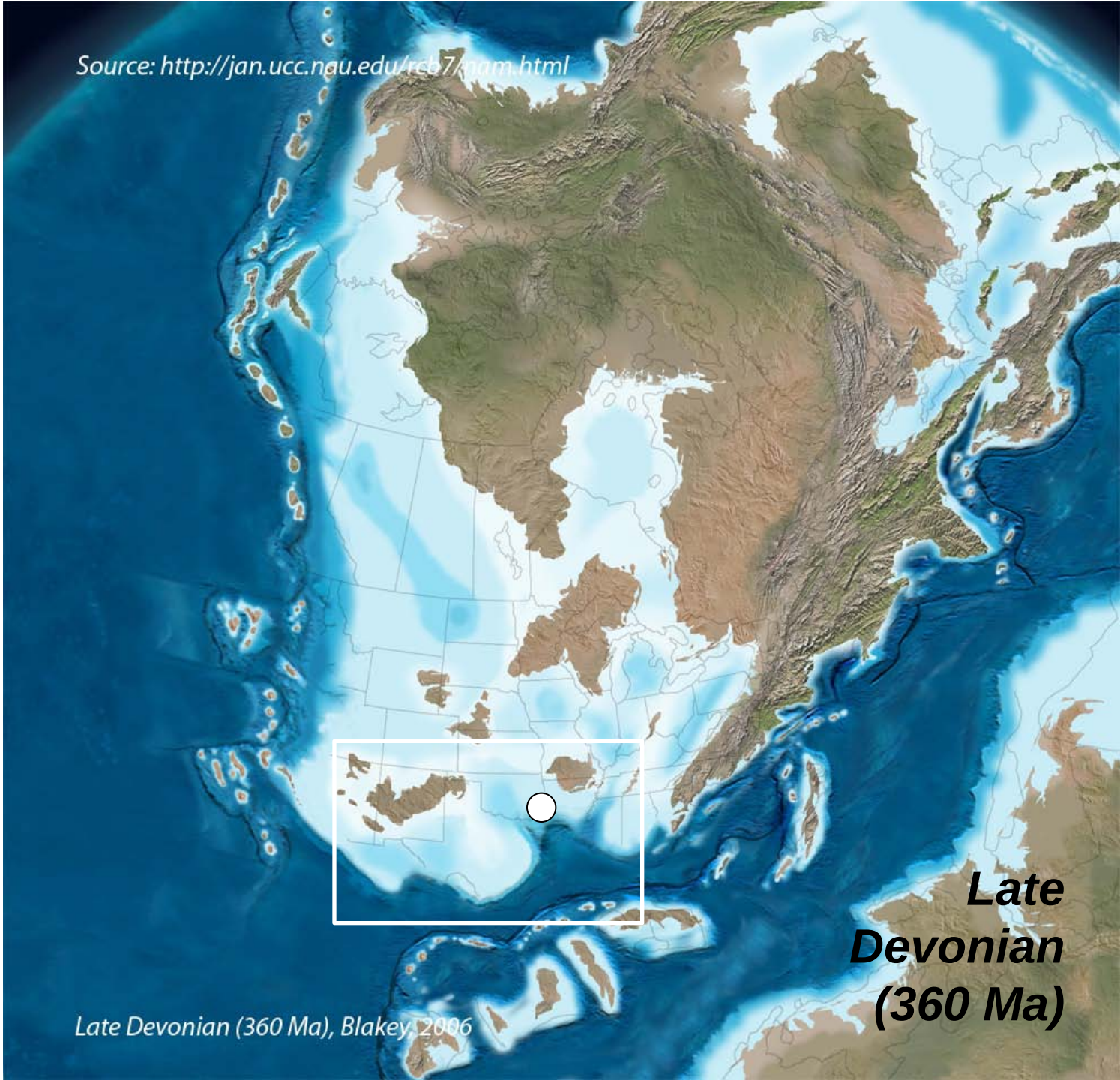
- palynomorphs
- geochemistry
- geophysical log signatures



*Urban, 1960; von Almon, 1970; Sullivan, 1985; Hester and others, 1990; Lambert, 1993
Modified after from a compilation by B. Cardott, Oklahoma Geological Survey

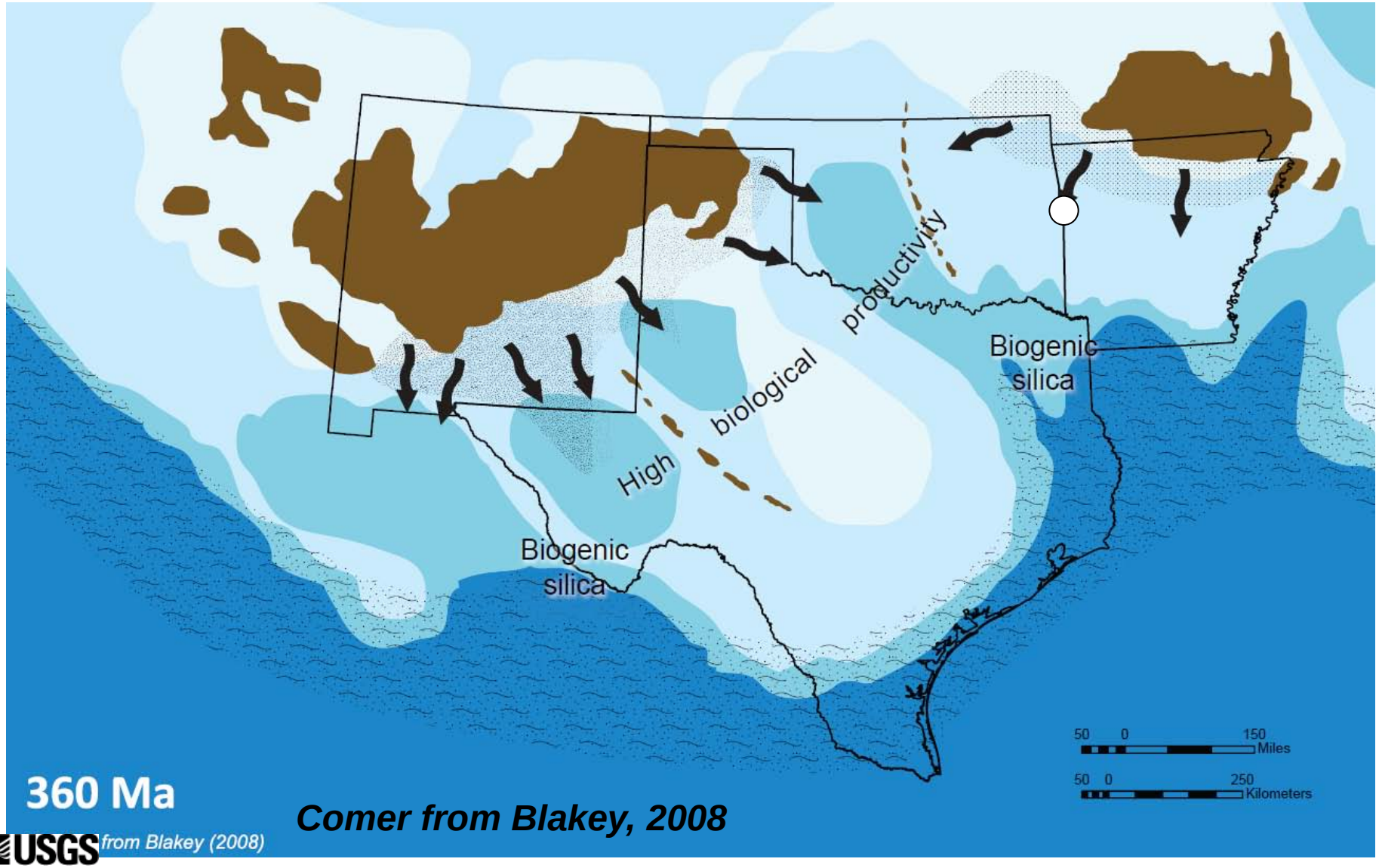
USGS

Late Devonian Sea Level



USGS

Biogenic Silica



Comer from Blakey, 2008

Poster Displays

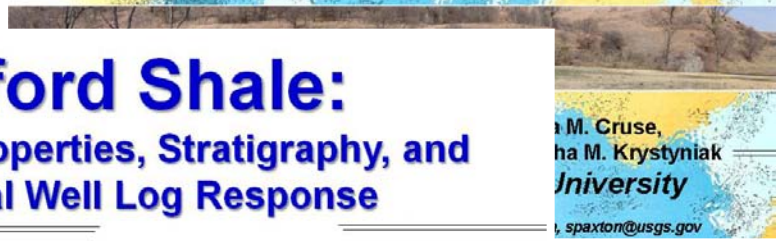
1

Fingerprints of Global Sea-Level Change Revealed in Hydrocarbon Source Rock?

2

Defining Regional Gas-Shale Properties through Outcrop-Based Spectral Gamma-Ray Character

Woodford Shale, Henry House Creek Section, South-Central Oklahoma



M. Cruse,
ha M. Krystyniak
University
spaxton@usgs.gov

Woodford Shale:

Outcrop Properties, Stratigraphy, and Geophysical Well Log Response

Stanley T. Paxton*
Anna M. Cruse
Michael Aufill
Oklahoma State University

3

[4]USGS Oklahoma Water Science Center, 202 NW 66th, Bldg. 7, Oklahoma City, OK 73116

5

Character of Arkoma and Southern Midcontinent Gas-Shales

S.T. Paxton and M.A. Abbott
USGS Oklahoma Water Science Center
Oklahoma City, Oklahoma

N.S. Fishman, G.S. Ellis, and M.D. Lewan
USGS Denver Federal Center
Denver, Colorado

Upper Fayetteville Shale Marshall, Arkansas

Caney Shale south of Ada, Oklahoma

Spectral Gamma-Ray Response of Oklahoma Shales in Outcrop

S.T. Paxton[1], M. Aufill[2], P. Kamann[3], A. Krystyniak[4]

4

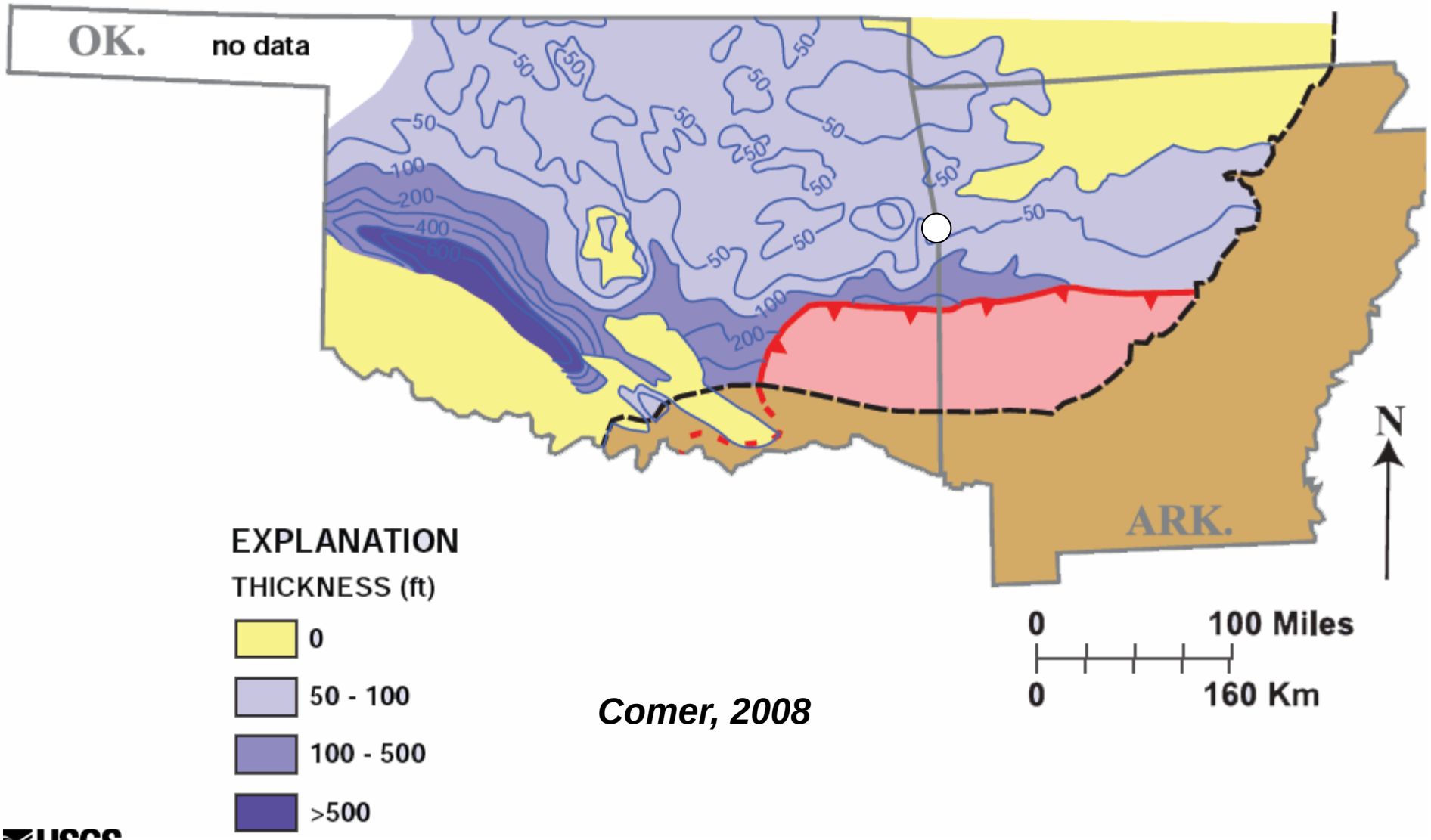
Caney Shale along Tulip Creek, OK

[1]USGS Oklahoma Water Science Center, Oklahoma City
[2]Newfield Exploration, Tulsa
[3]Devon Energy, Oklahoma City
[4]Chesapeake Operating, Oklahoma City

Shale Science
Water
Life
Energy

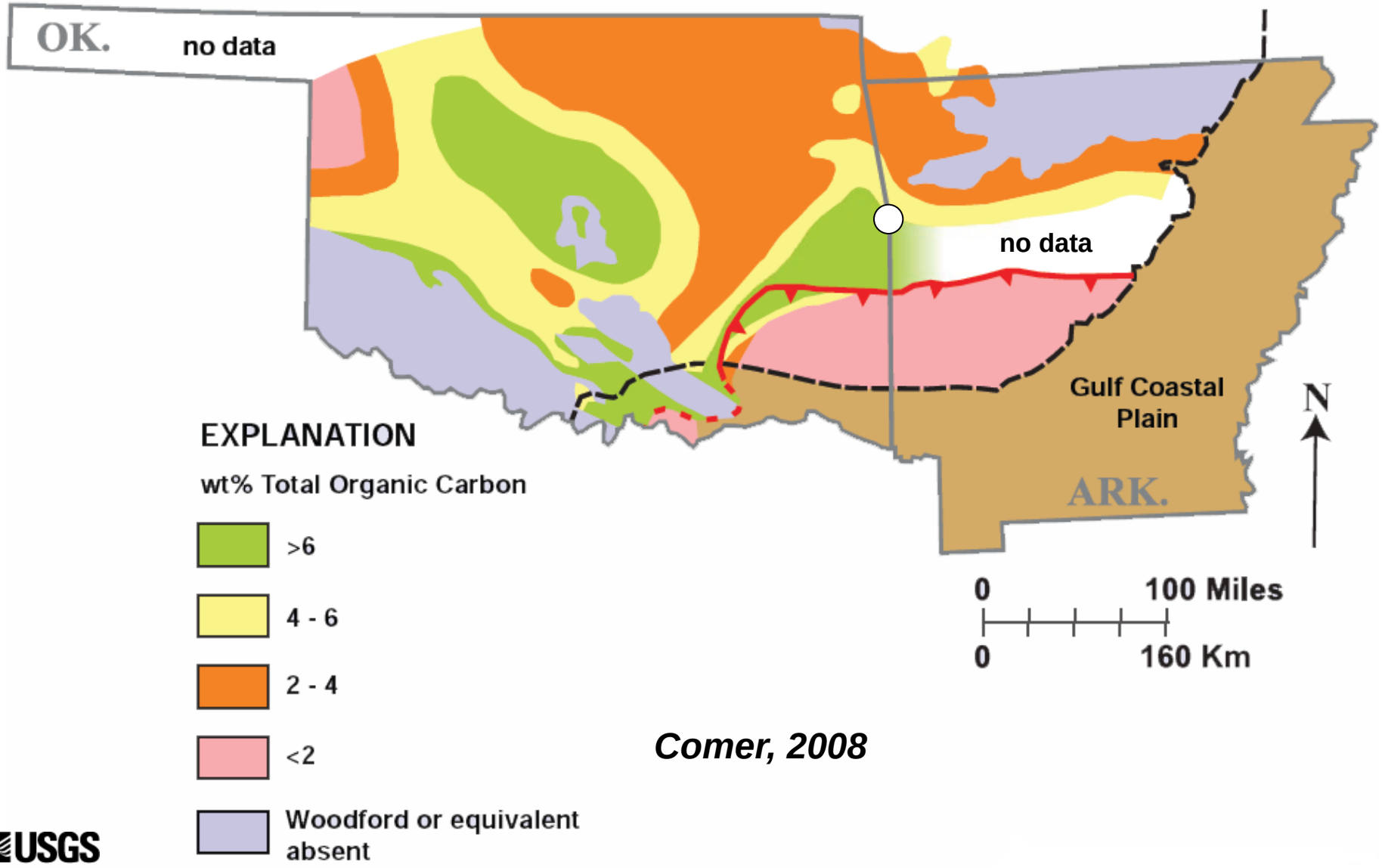
USGS

Woodford Thickness



USGS

Organic Carbon



Comer, 2008

USGS

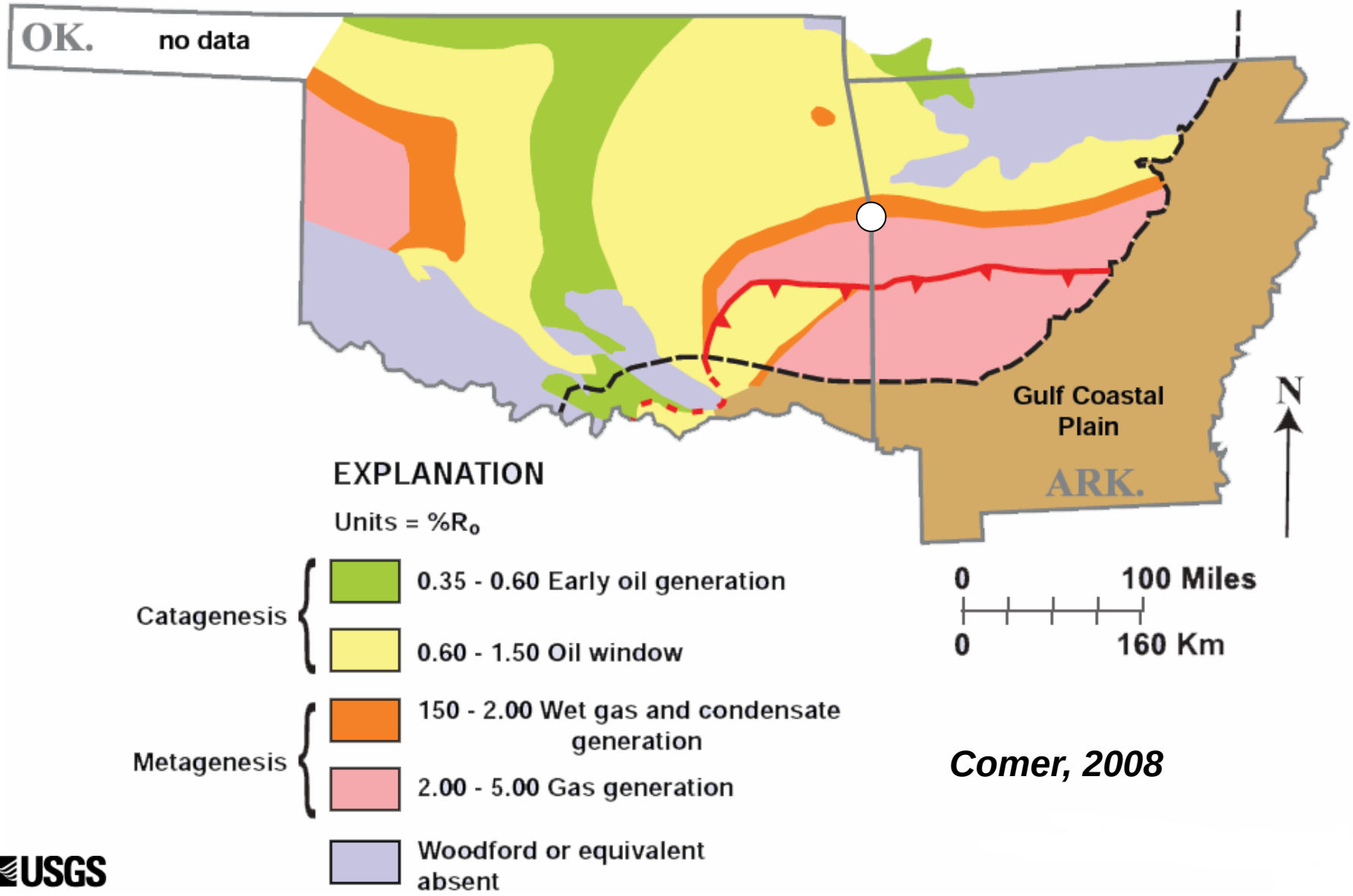
Woodford/Chat TOC

Geologic Province	Minimum TOC %	Maximum TOC %	Average TOC %	Standard Deviation 1 σ	Number of Samples
Northern Oklahoma Platform	0.7	12.1	5.1	2.7	28
Anadarko Basin	0.3	9.7	4.4	3.0	54
Central Oklahoma Platform	0.6	14.8	8.9	3.7	26
Arbuckle Mountain Uplift	0.9	22.0	7.7	5.7	23
Marietta Ardmore Basin	0.9	17.6	7.1	4.3	32
Ouachita Frontal Zone	0.1	24.6	6.8	5.4	36
Ozark Uplift	0.1	7.7	3.6	1.6	65
Oklahoma-Arkansas Total	***0.1***	***24.6***	***5.7***	***4.1***	***264***

Comer, 2008

USGS

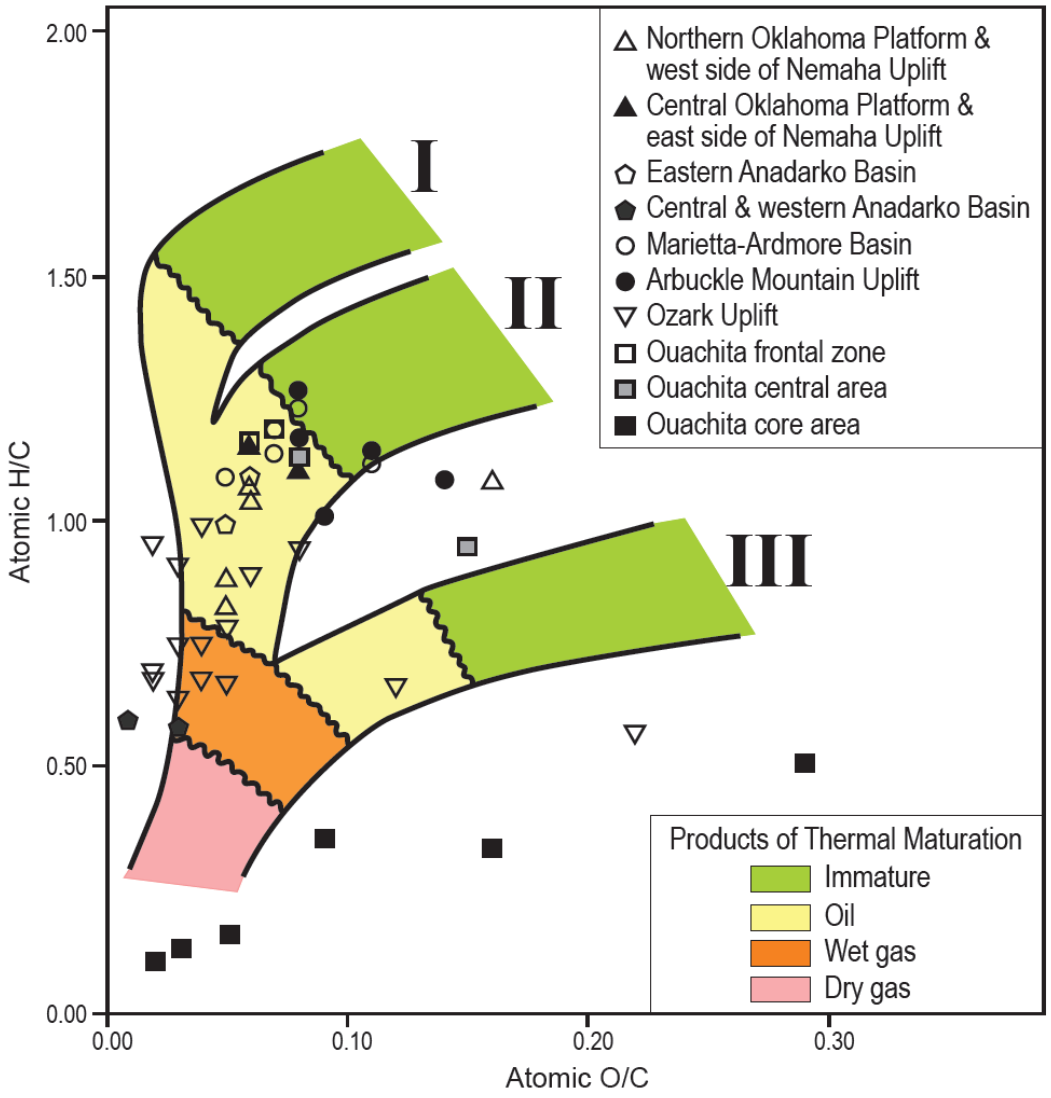
Thermal Maturity



Comer, 2008

USGS

Organic Matter Types



Comer, 2008

USGS

Early Mississippian S.L.

USGS

Outline - Shale

- Global / Regional Setting
- Woodford / Chattanooga
  - > Stratigraphic Context
  - > Depositional Environments
- Caney / Fayetteville
  - > Stratigraphic Context
  - > Depositional Environments
- Assessment Units

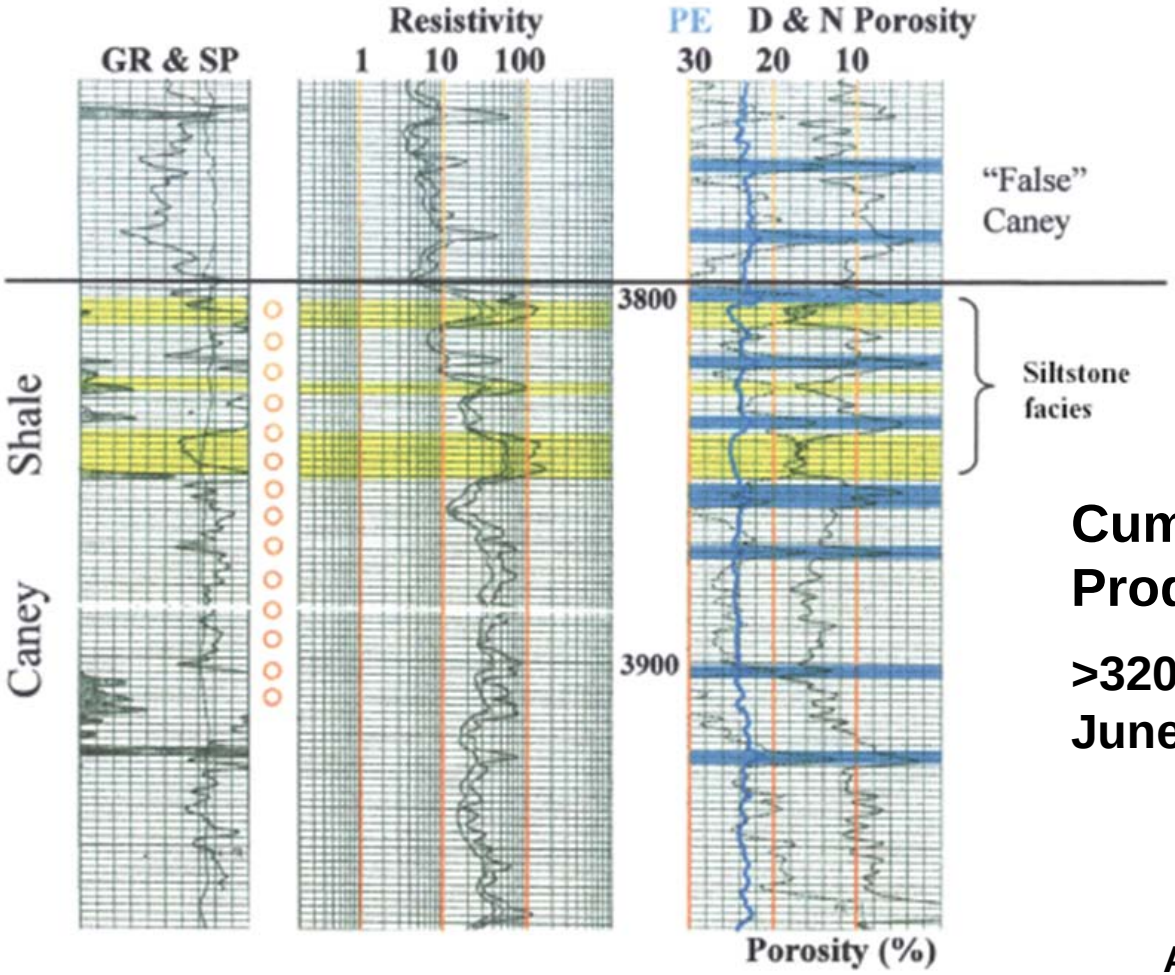
USGS

Late Mississippian S.L.

USGS

Geophysical Well Logs

Citrus Energy Wild Turkey No. 1
NE NE sec. 7, T9N, R13E



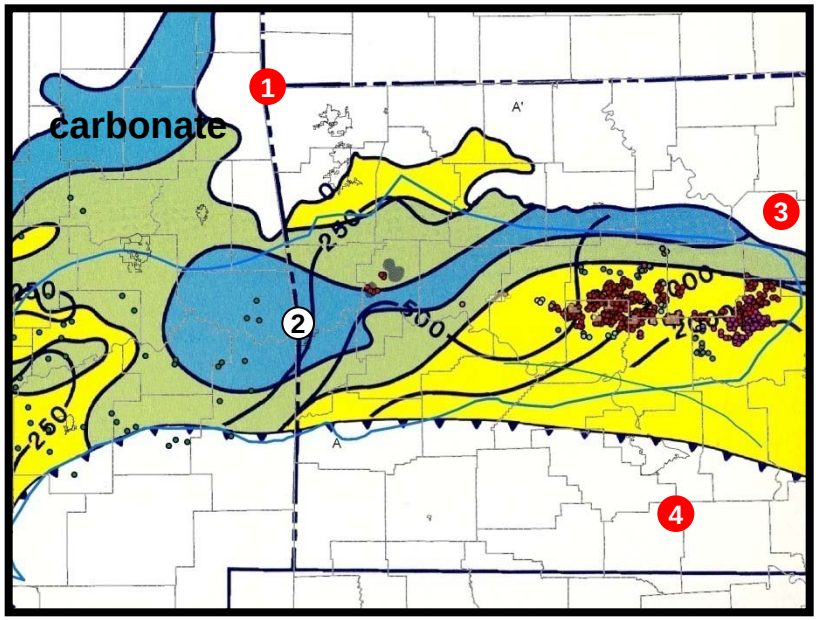
Cumulative Production:

>320 MMCFG through June, 2005

Andrews, 2007

Mississippian Lithofacies / Depositional Setting

Chester Series Isopachs
(Adler and others, 1971)

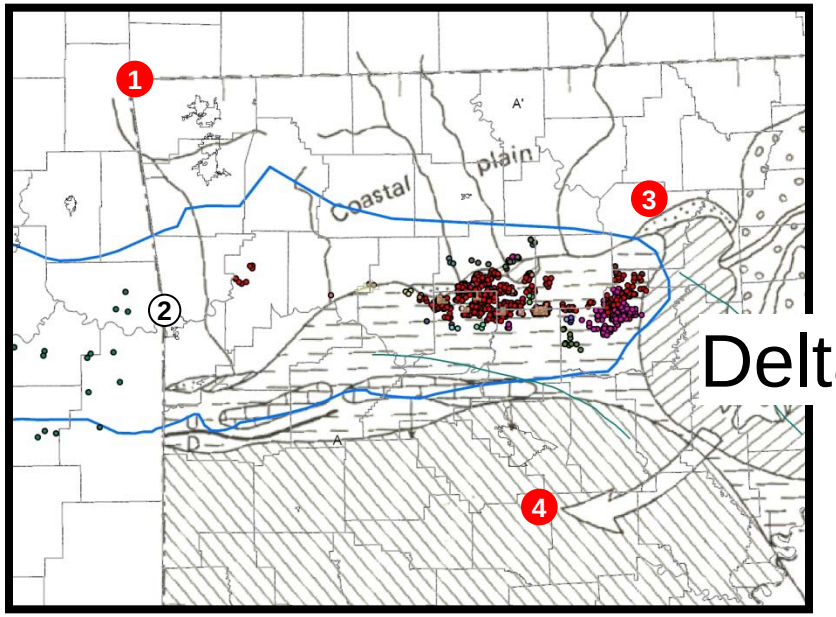


carbonate

clastic

Visual Reference Points

End Chester Sediment Distribution
(Glick, 1979)



0 —— 100 Miles

USGS

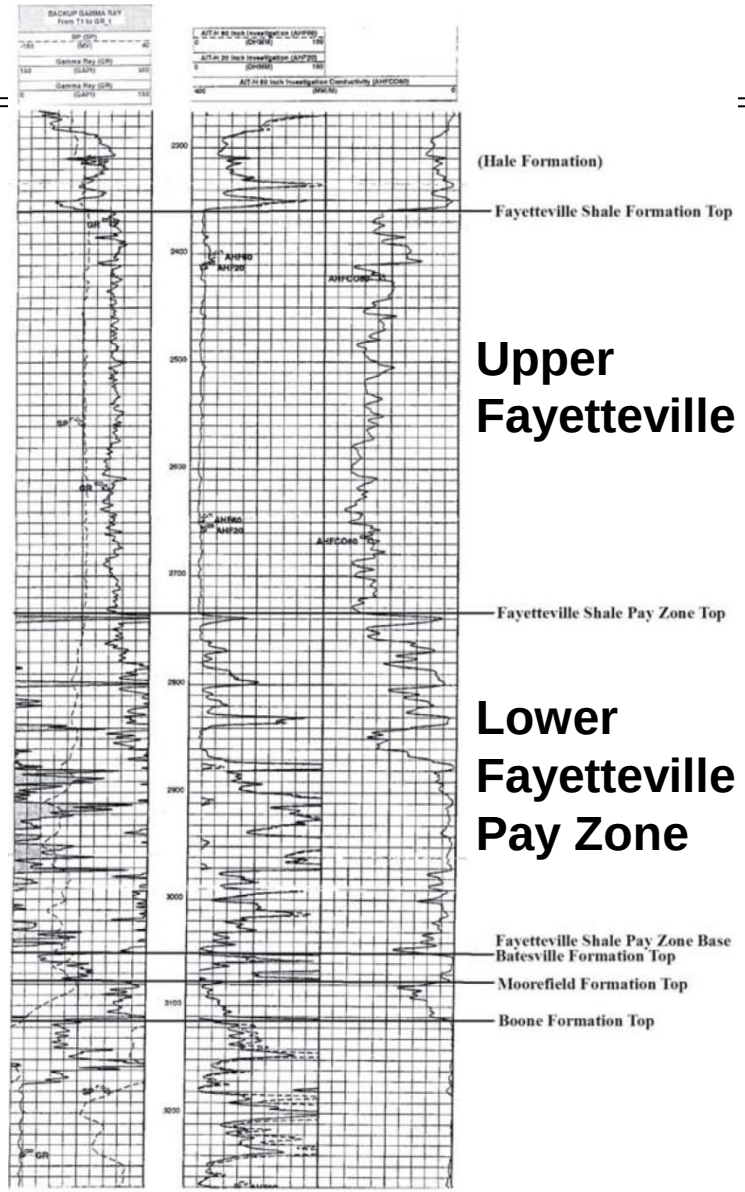
Fayetteville Shale

Discovery Well

Thomas No. 1-9
S7, T9N, R17E

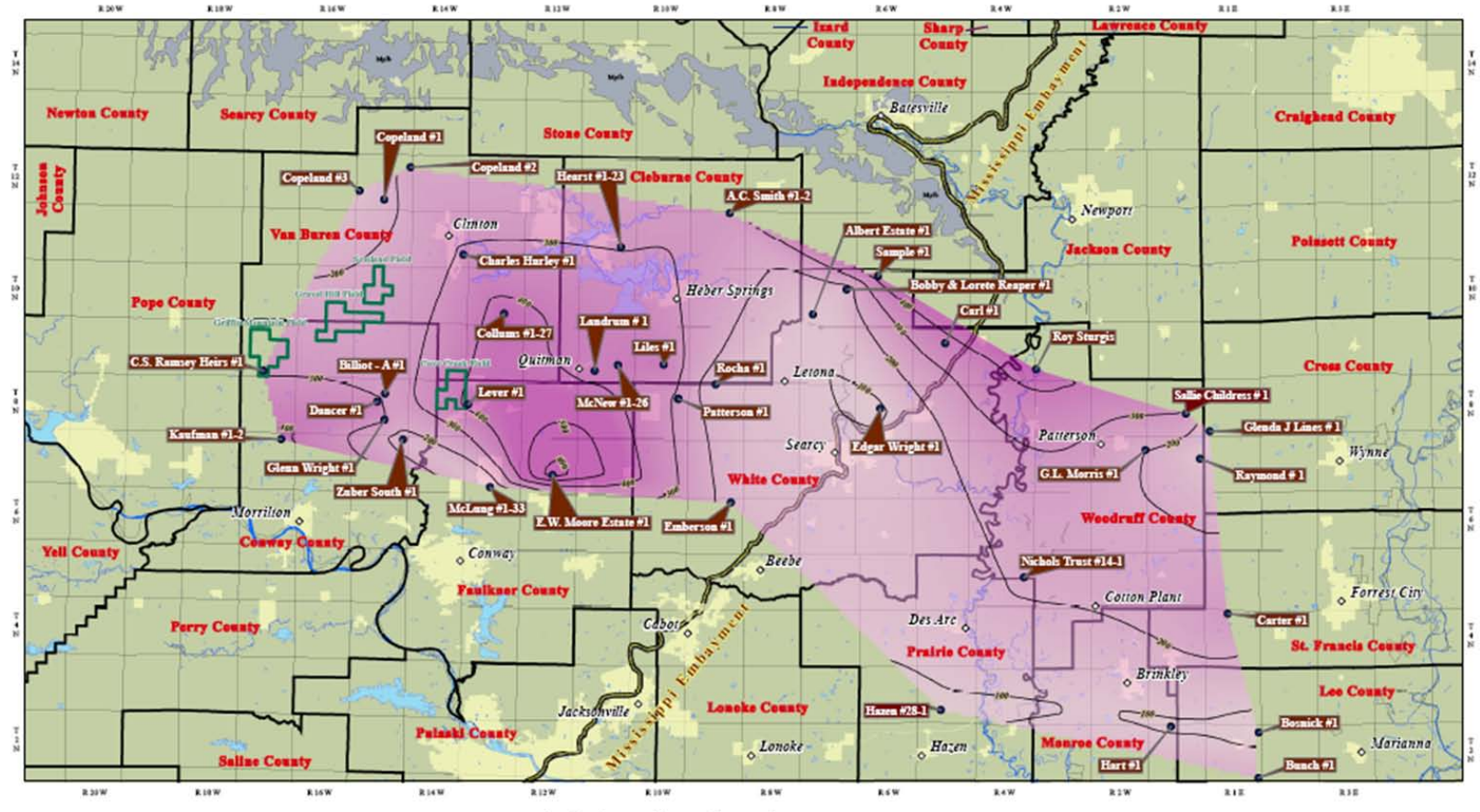
Geophysical Log Suite from Ratchford and others, 2006

Lower Fayetteville Shale behind Ozark Bowling Alley, Fayetteville, AR



USGS

AGS Gross Pay Thickness



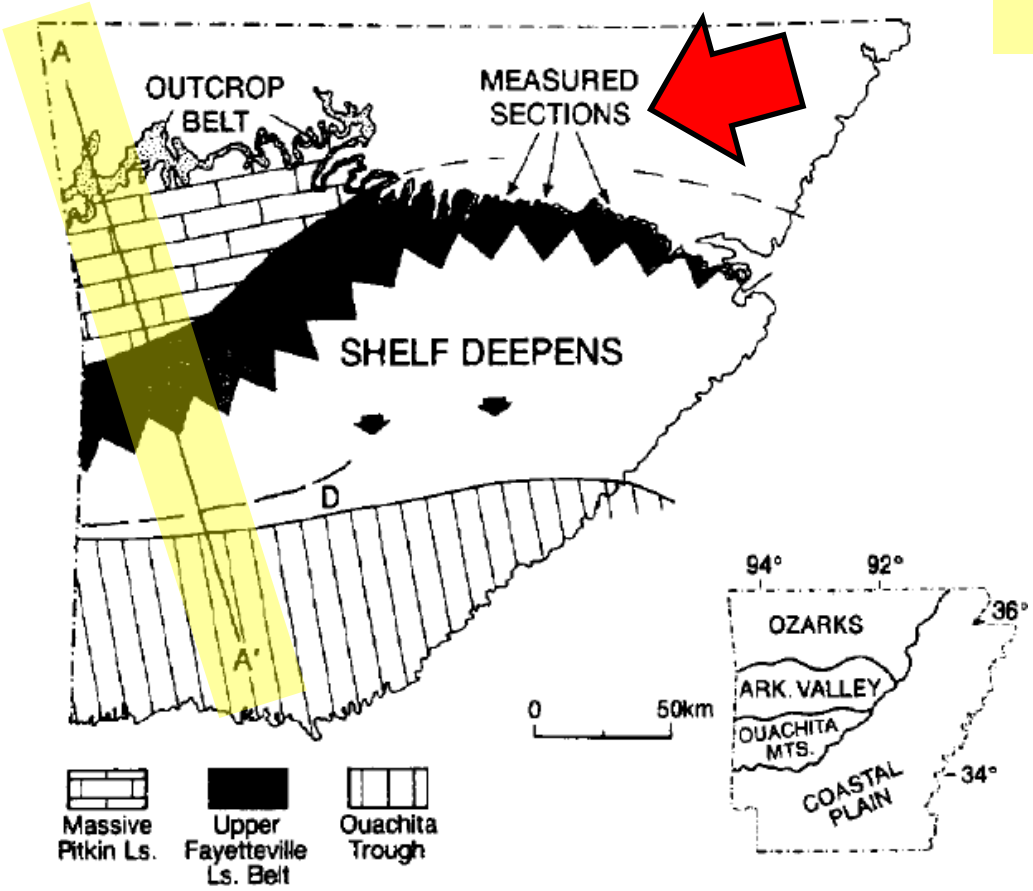
Statistical Interpolation of Gross Pay Zone Thickness for Selected Wells in the Fayetteville Shale

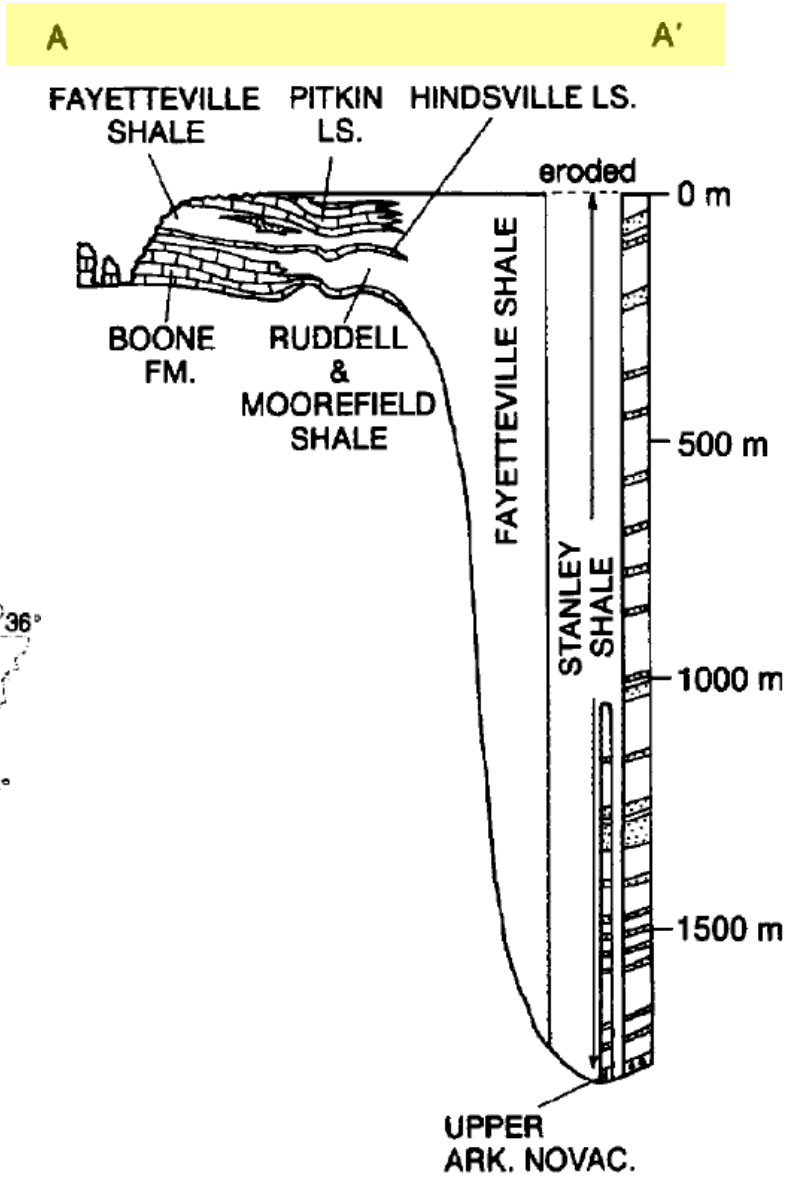
Contour Interval = 100 feet

Ratchford and others, 2006

USGS

Paleogeography / Lithofacies

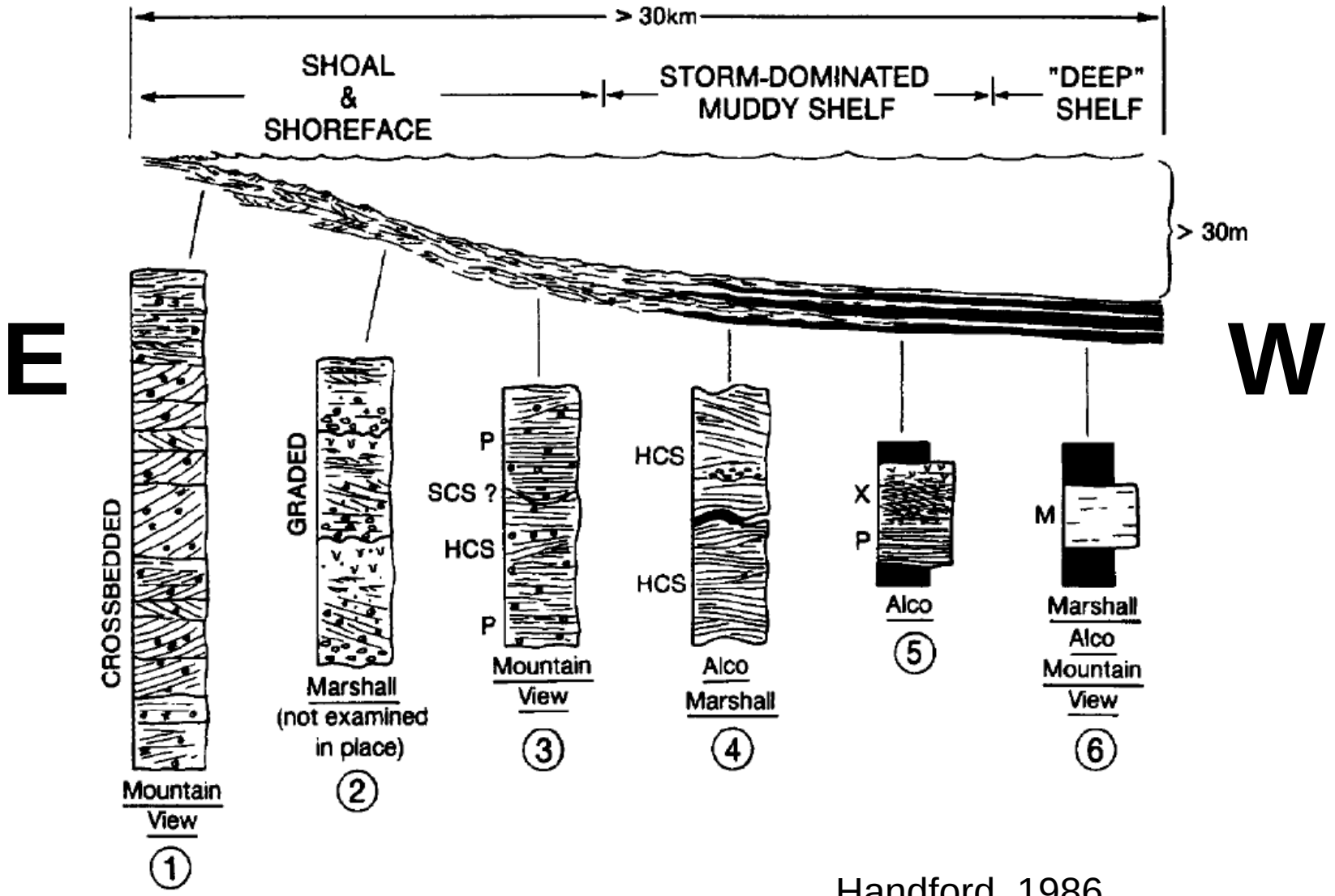




Handford, 1986

USGS

Depositional Profile

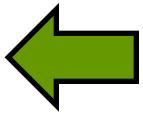


Handford, 1986

USGS

Outline - Shale

- Global / Regional Setting
- Woodford / Chattanooga
  - > Stratigraphic Context
  - > Depositional Environments
- Caney / Fayetteville
  - > Stratigraphic Context
  - > Depositional Environments
- Assessment Units



USGS