

An Introduction to the Berea and Rogersville Shales in Kentucky



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Kentucky Geological Survey

West Virginia Oil and Natural Gas Association, Wheeling, WV

29-Sep-2015

Kentucky Geological Survey

- **Research & Public Service Center**
- **Established 1838**
- **Focus areas**
 - Research in earth resources & processes
 - Disseminate data, knowledge, & experience
- **Stakeholders**
 - Public
 - Industry
 - Government
 - Educators



WWW.UKY.EDU/KGS

The screenshot shows the website for the Kentucky Geological Survey (KGS) at www.uky.edu/KGS. The page features a blue header with the UK logo and the text "Kentucky Geological Survey Earth Resources—Our Common Wealth". Below the header is a navigation bar with links for Home, Mobile, Contact, About, Staff, Calendar, and SiteMap. A search bar is also present. On the left side, there is a vertical navigation menu with icons and labels for various sections: General Geology, Online Maps (highlighted), Data, Research/Programs, Publications, Outreach and Education, Laboratory, and Well Sample & Core Library. A dropdown menu is open under "Online Maps", listing several options: Online Maps Home, Coal Information, Coal Resource, Core & Sample Holdings, Energy Infrastructure, Geologic Map, Groundwater Quality, Karst Potential, Kentucky Arches, KGS Geoportal, Land Use Planning, Landslide Information, Mineral Resources, Oil and Gas Permits, Petroleum Geology, and Water Wells & Springs. The main content area includes a large image of a natural rock archway, a section titled "Of Interest" with news articles, and a footer with contact information and a logo.

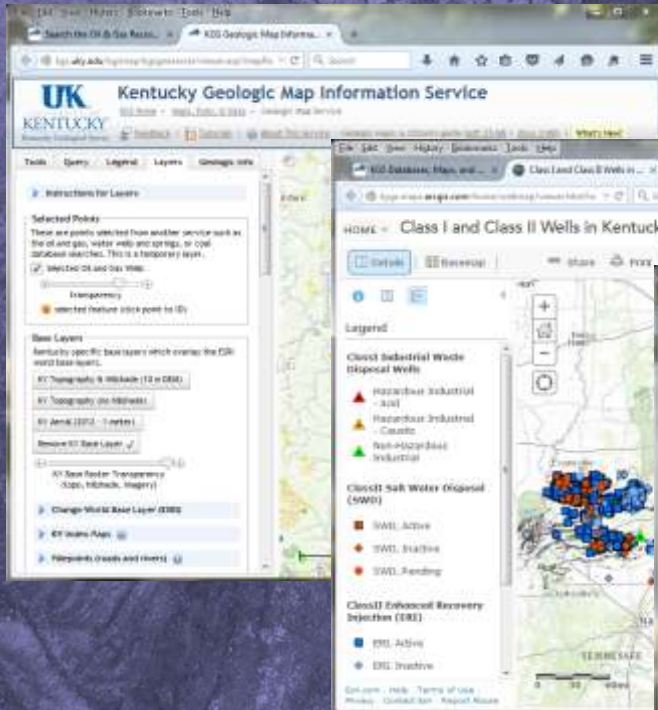
- Water wells & springs
- Earthquakes
- Coal
- Minerals
- Mapping
- Karst

Energy & Minerals

Oil and gas well map service

Specialty map services

Data searching



Scanned images
(converting to PDF)

Acknowledgements

- Dave Harris, Head
- Warren Anderson
- Rick Bowersox
- Cortland Eble
- Steve Greb
- John Hickman
- Marty Parris
- Tom Sparks

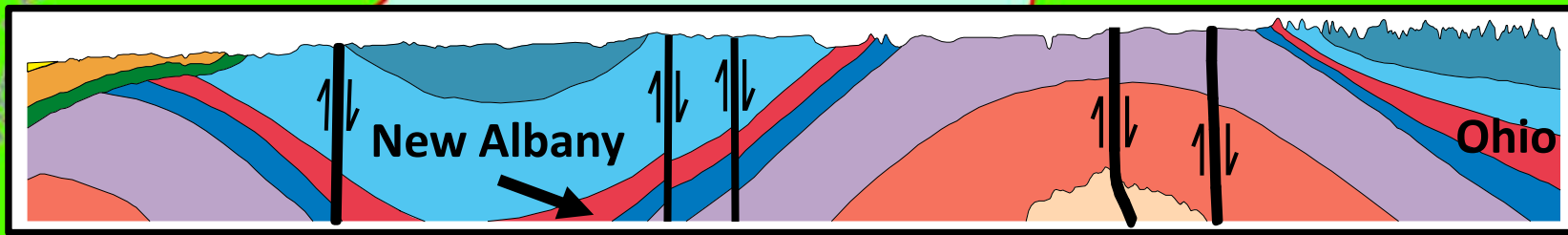
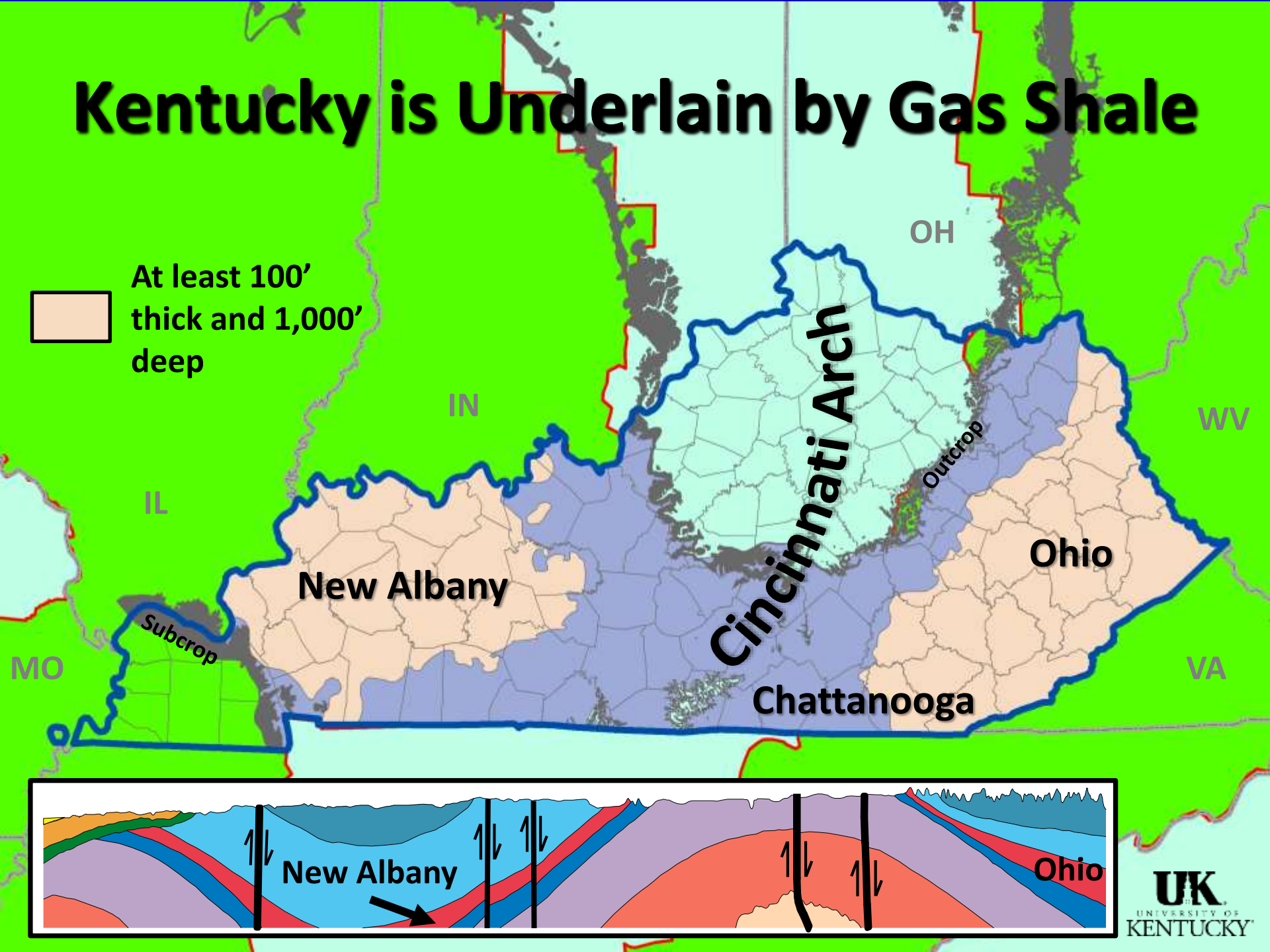
Energy &
Minerals
Section

KRS 353 Update – HVHF

- “High-volume” defined
 - Fluid (water, chemicals, sand)
 - >80,000 gallons for any stage
 - >320,000 gallons in aggregate for all stages
- Baseline water quality testing, post-frac monitoring
- Disclosure at chemical registry, FracFocus.org
- Notification (surface owners within 1,000’)
- Site reclamation, BMP

Kentucky is Underlain by Gas Shale

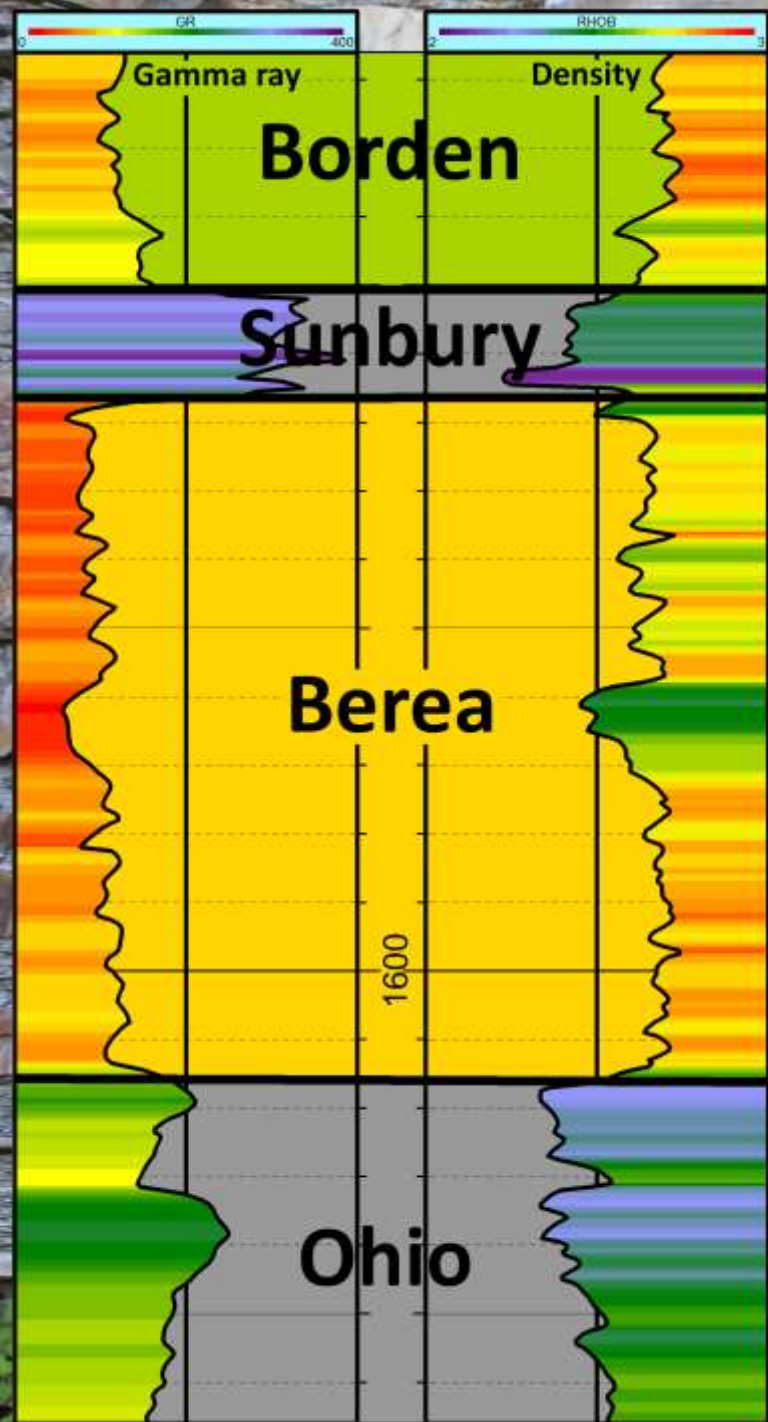
At least 100'
thick and 1,000'
deep



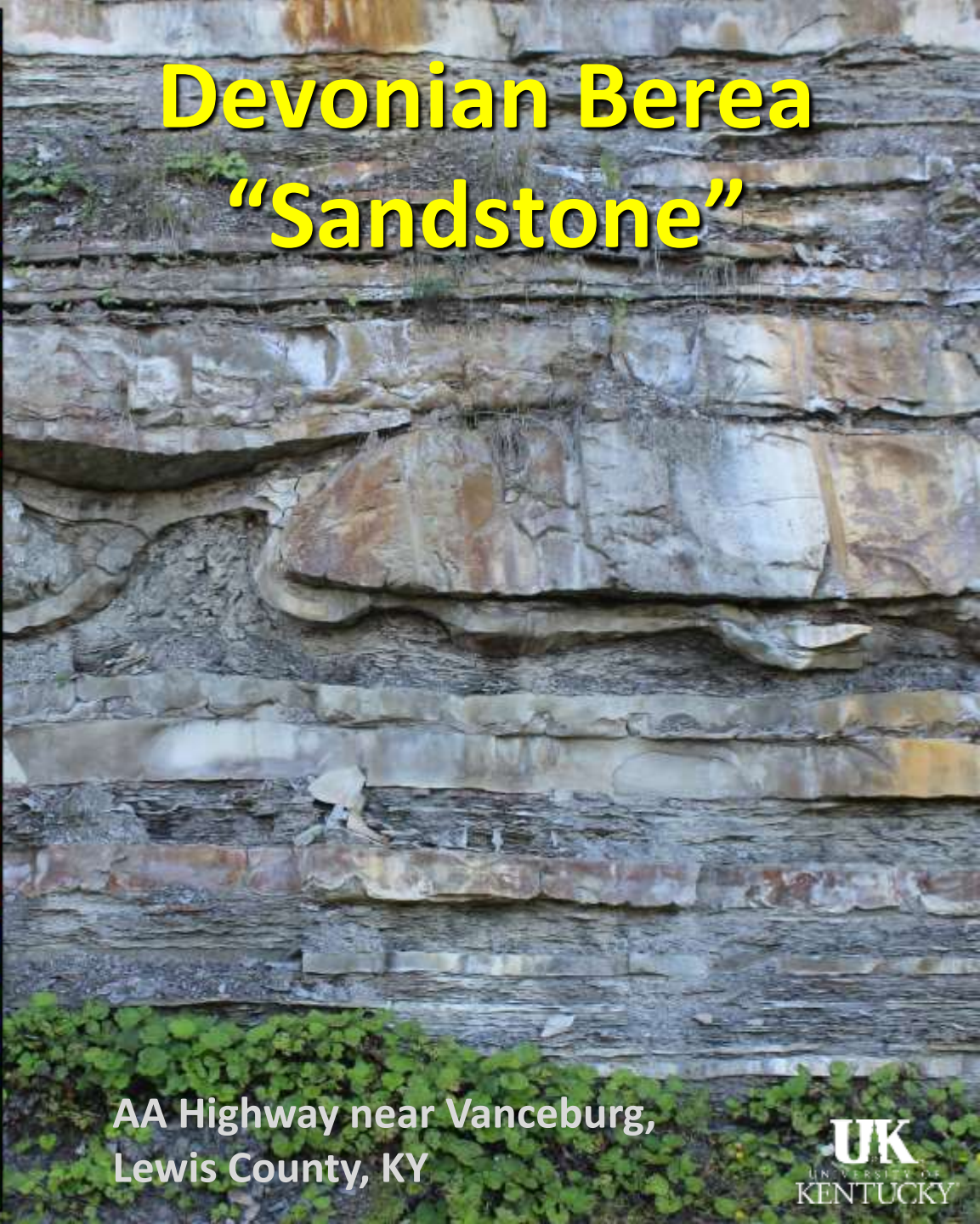
Things are Looking Up in Kentucky



1 Mcf = 0.172 barrels (based on Btu content)

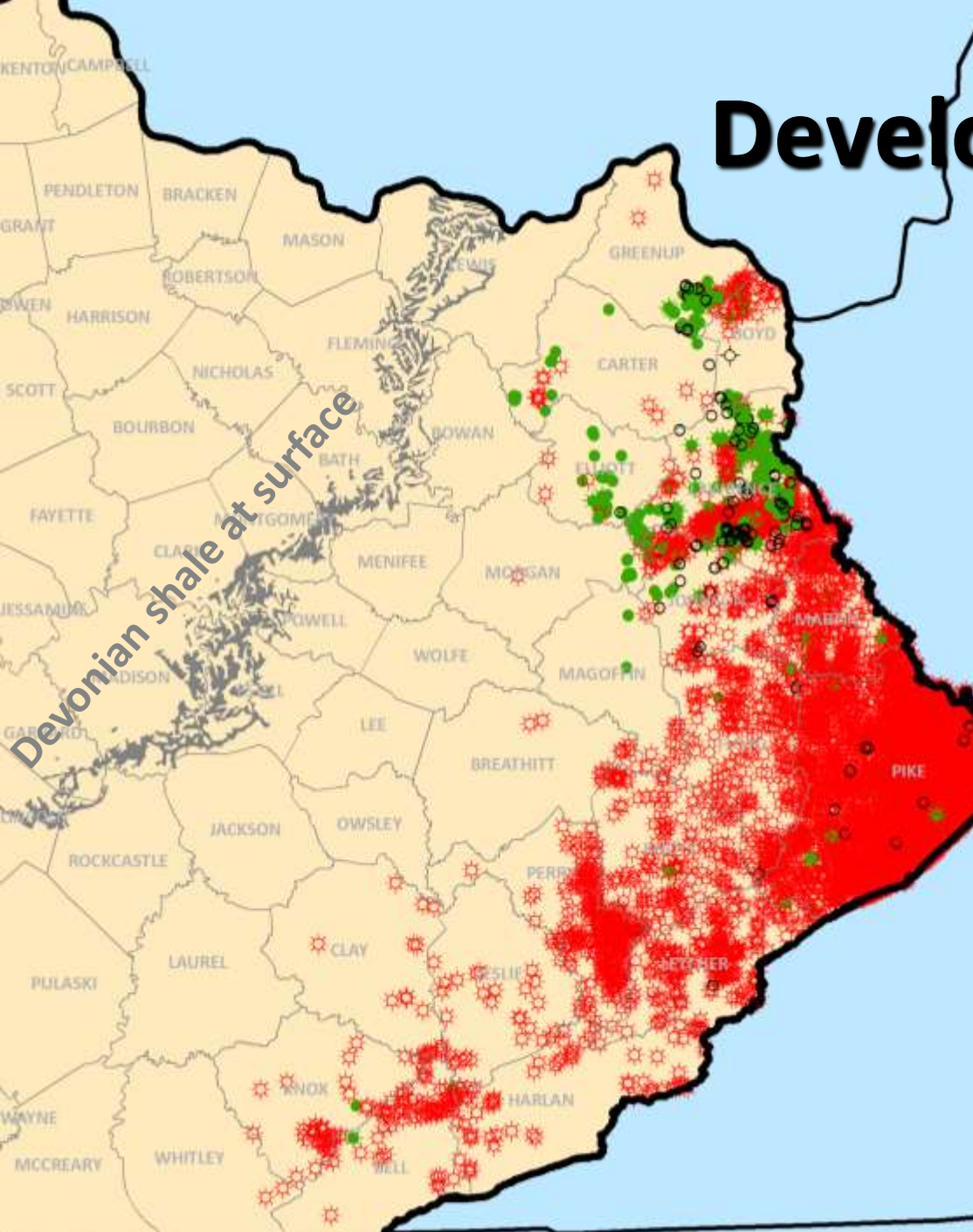


Devonian Berea "Sandstone"



AA Highway near Vanceburg,
Lewis County, KY

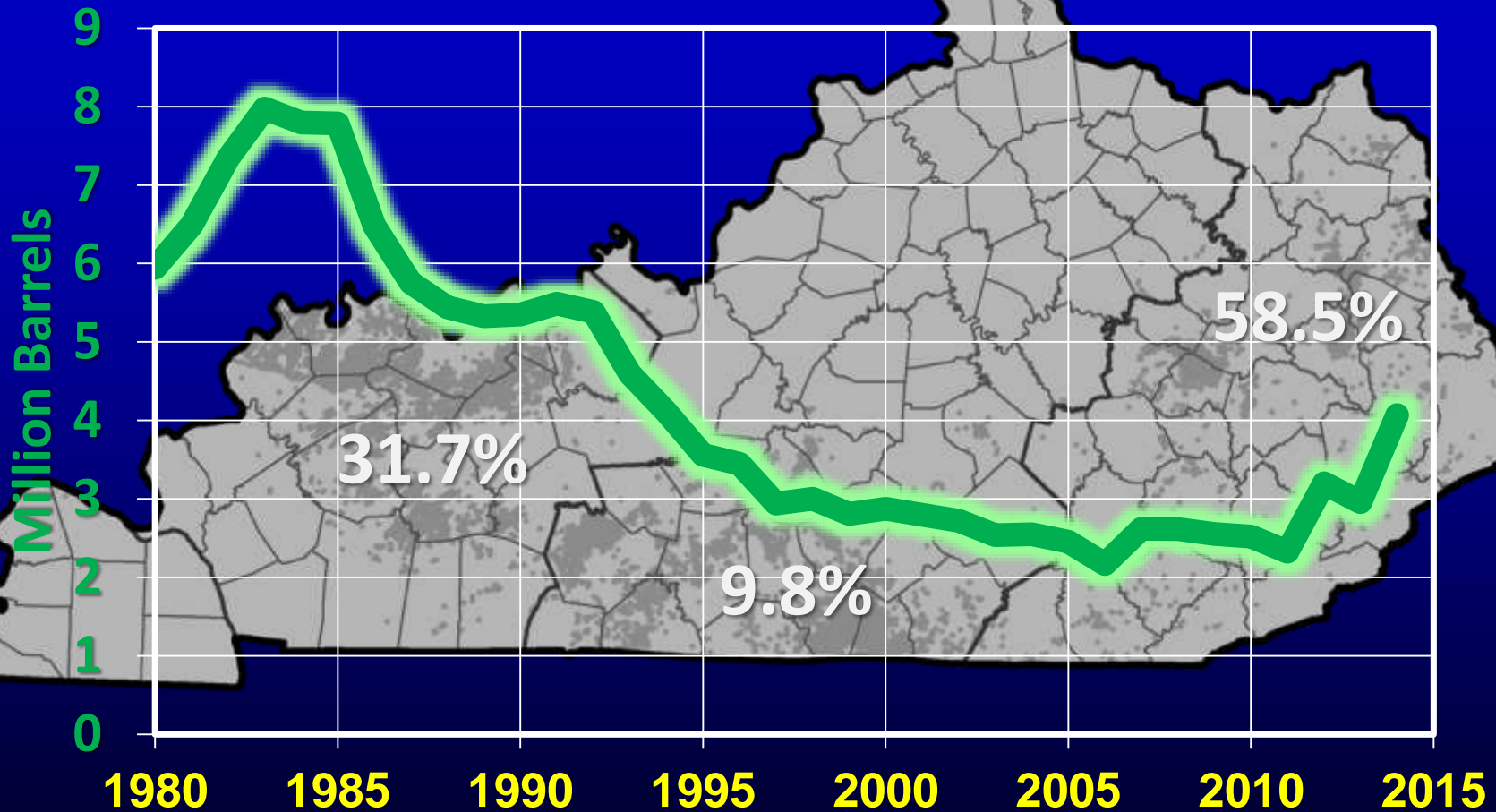
Development History



- **1879 – 1st producer near Paintsville, Johnson Co.**
- **1890s – Blaine Creek, Lawrence Co.**
- **1905 – Minor producer with shows of oil & gas**
- **1920s – Drilling boom**
- **1980s – Section 29 tax credit**
- **2011 – Horizontal wells, slickwater fracks**

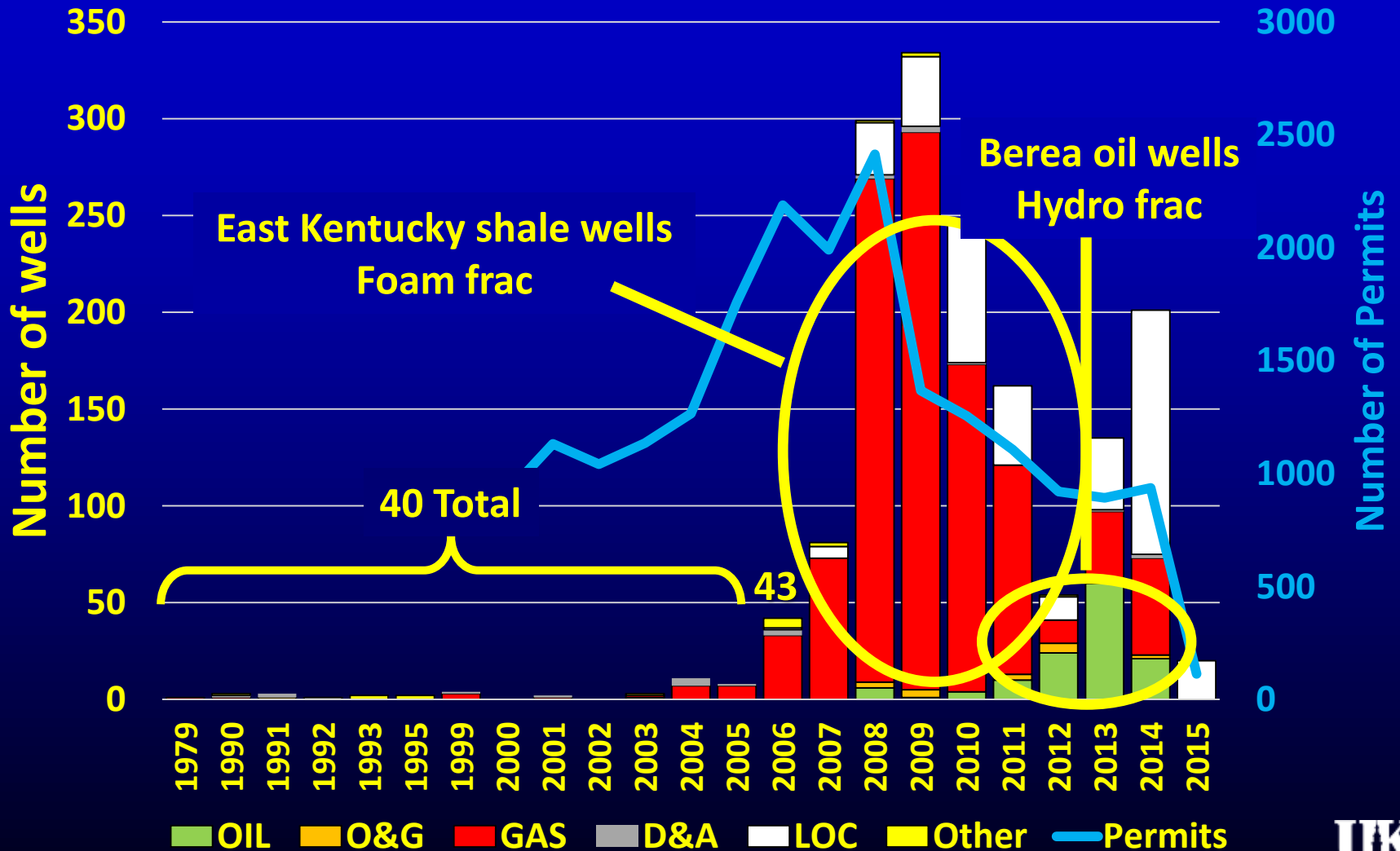
2014 Oil Production: 4.1 MMbo

75% increase over 2011

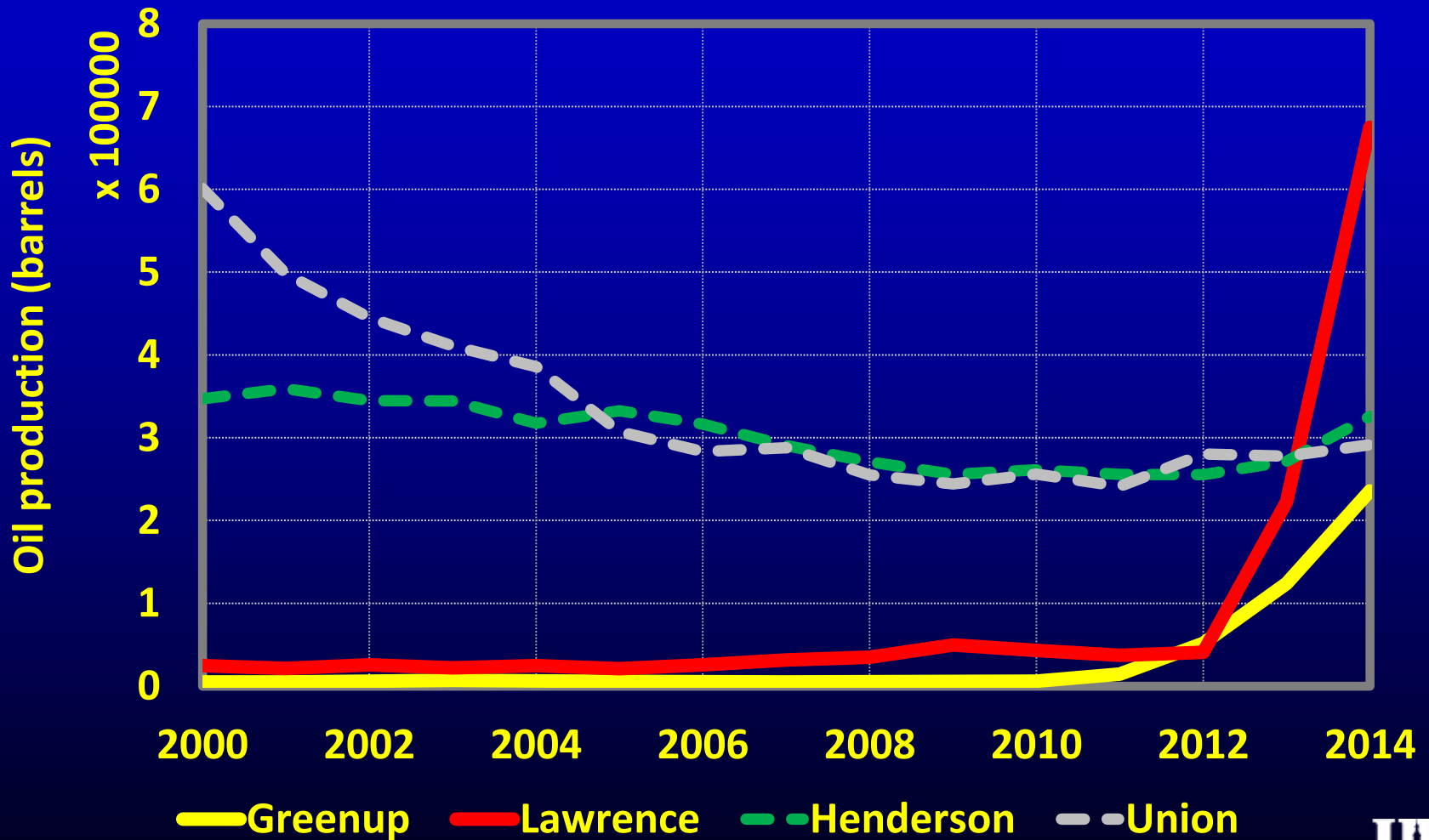


63 Kentucky counties

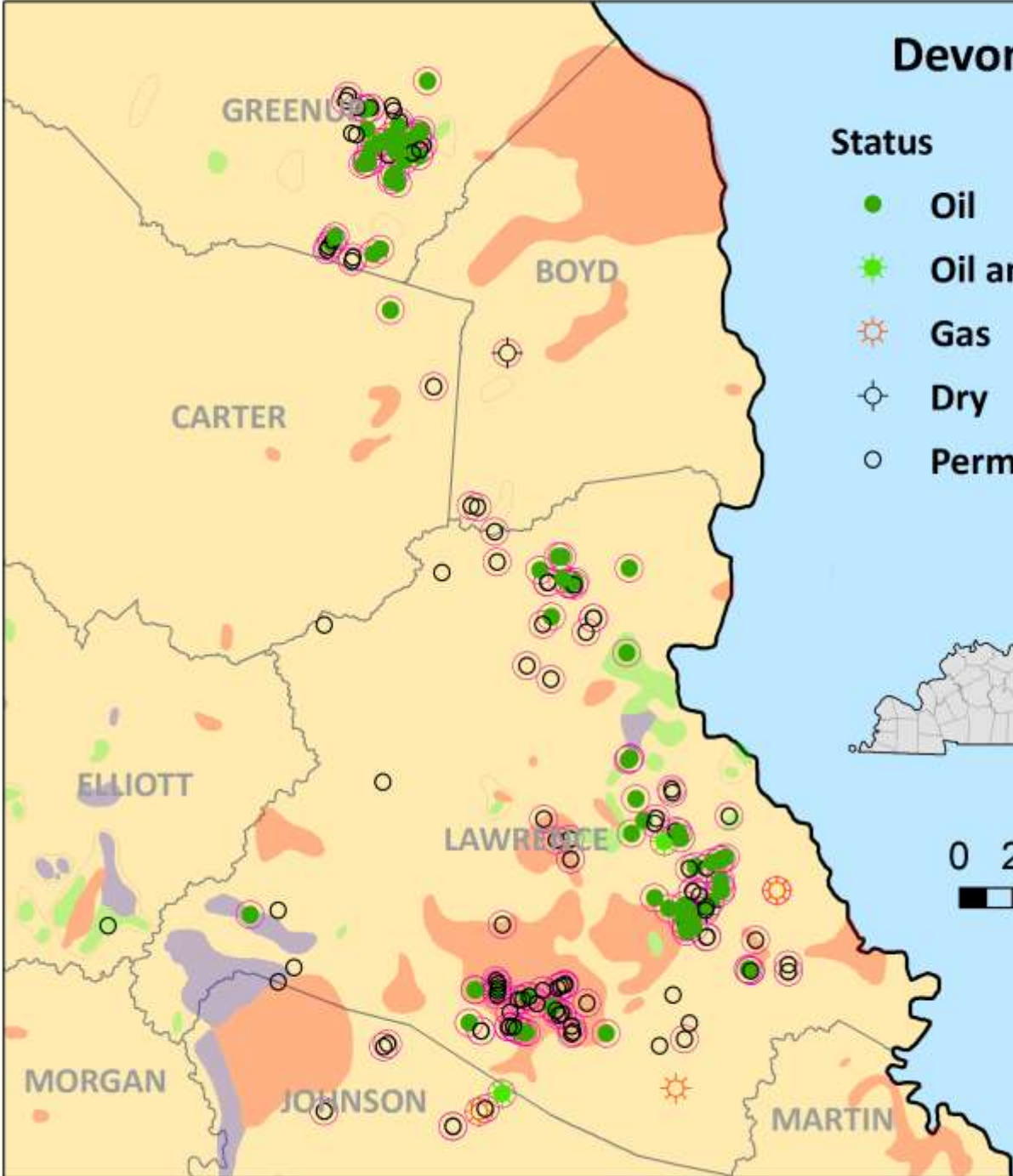
Horizontal Wells By Year



Berea Renaissance



Devonian Berea Activity

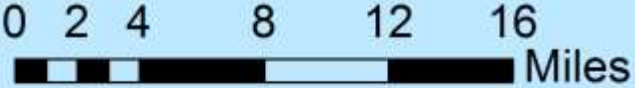


Status

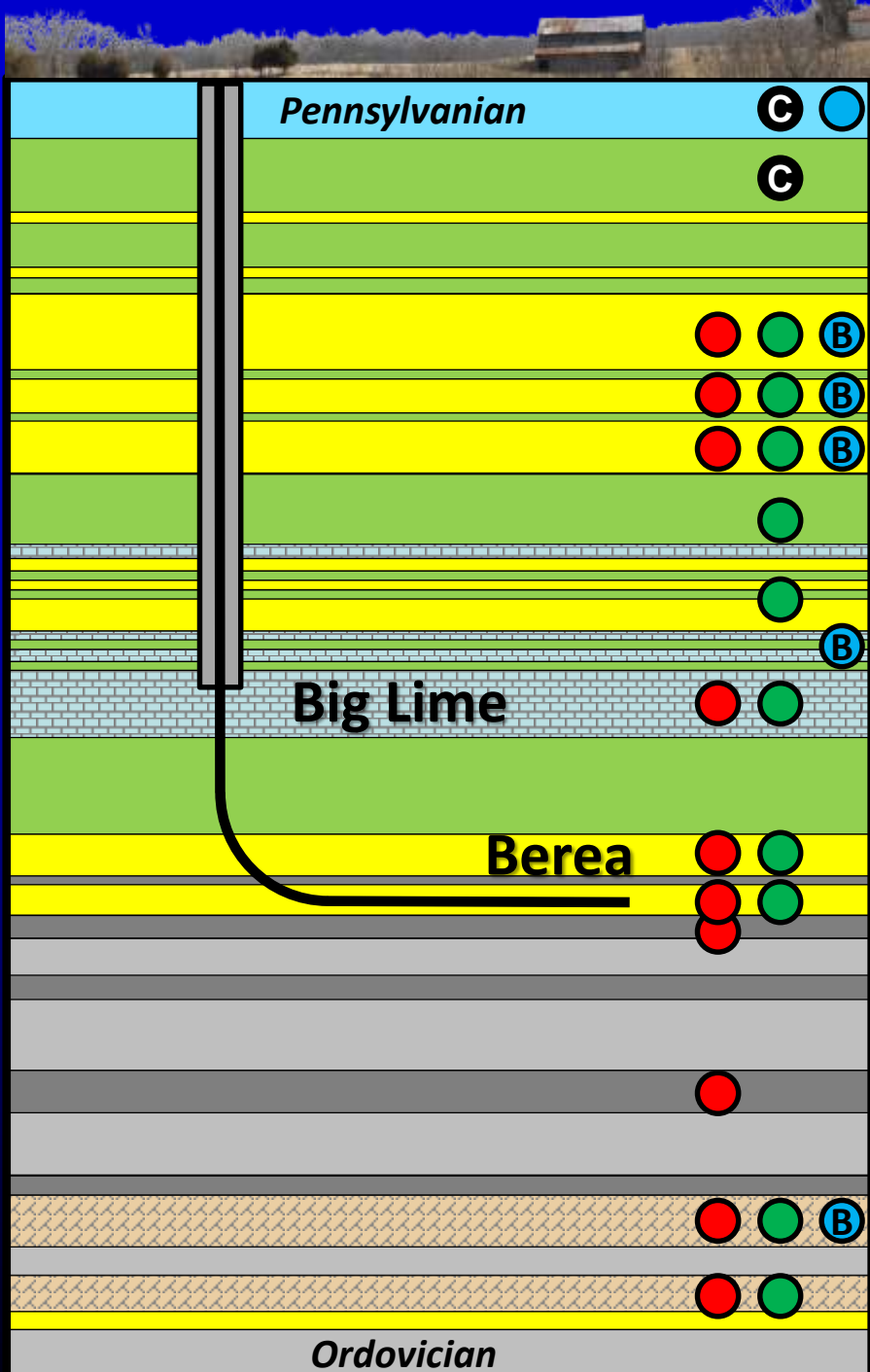
- Oil
- Oil and gas
- ☼ Gas
- ⊕ Dry
- Permitted

Historic fields

- Consolidated
- Oil field
- Gas field
- Waterflood
- Horizontal well



Typical Completions

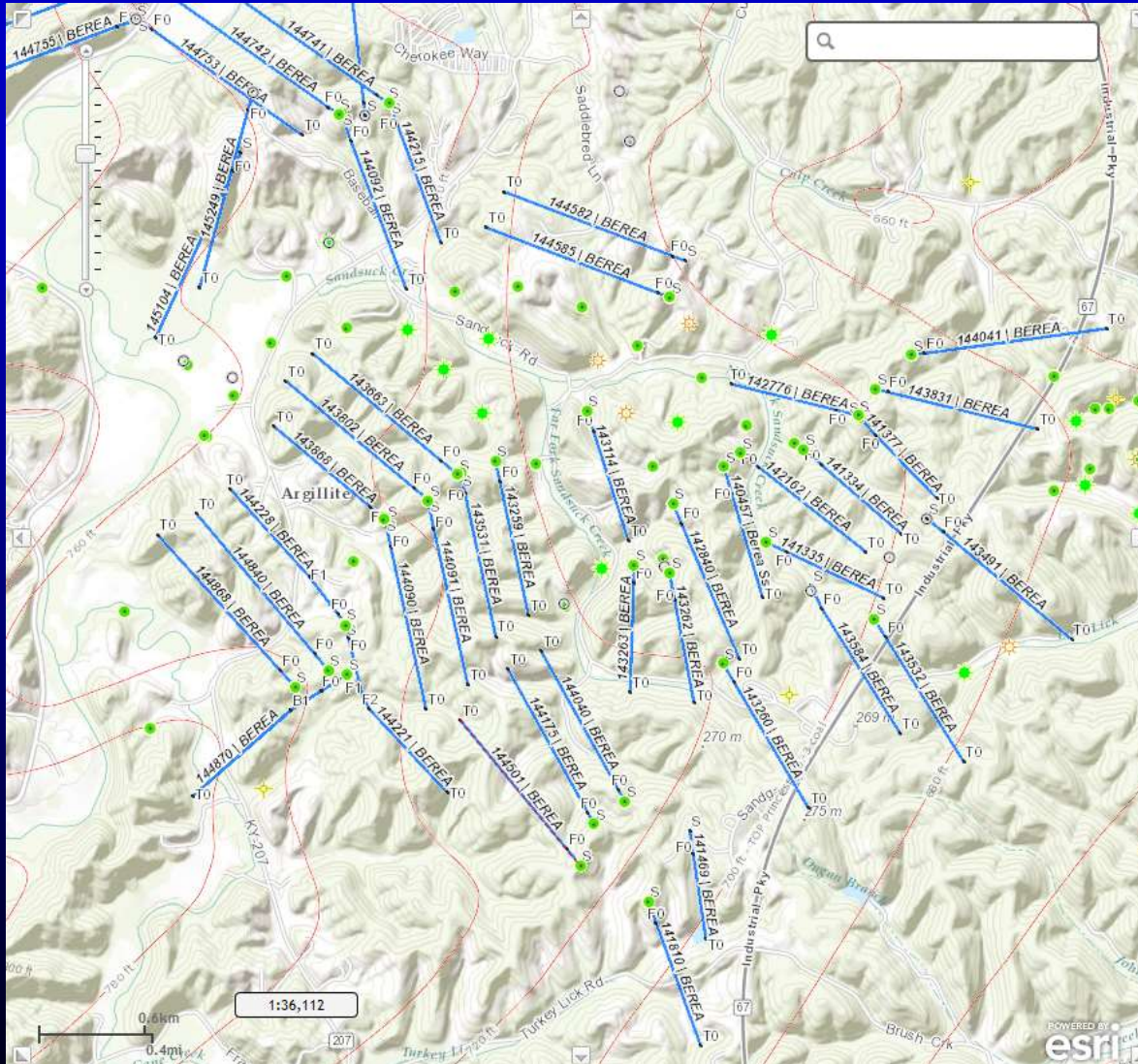


Lawrence & Greenup
1,000 ft to 2,000 ft

- C** Coal
- Water**
- Oil**
- Gas**
- B** Brine

Depth and thickness varies across Kentucky

Horizontals in Old Fields



- TVD
 - 1,000' to 2,000'
- Laterals
 - 2,000' to 3,500'
- Slickwater frac
 - Up to 5,000 bbl fluid
 - 175k to 200k lbs sand

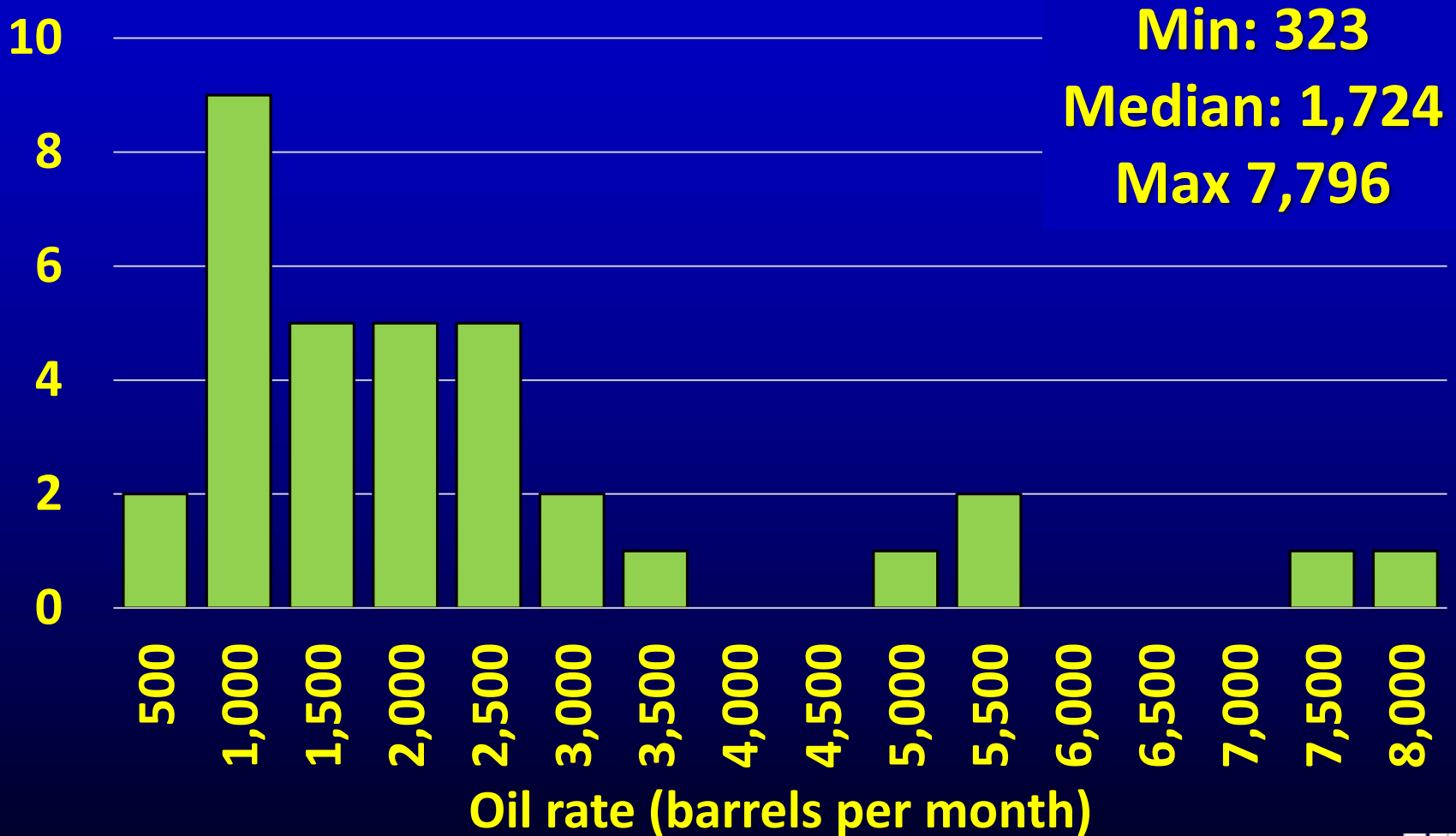
Public Production Data by Month



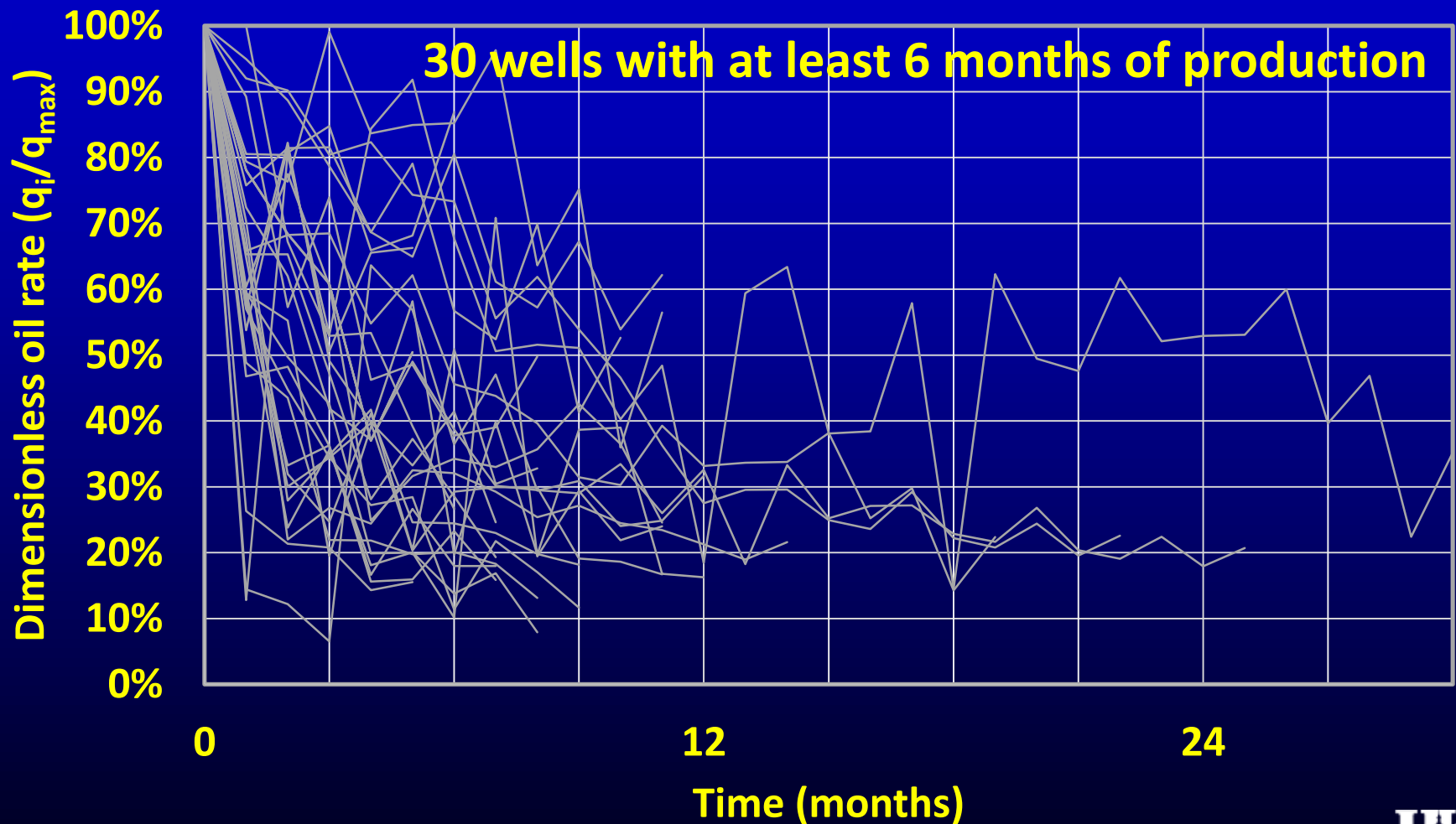
52 wells with at least 1 reported period of oil or gas production.

For comparison, month axis begins January, 2011

Reported Maximum Monthly Oil Rate

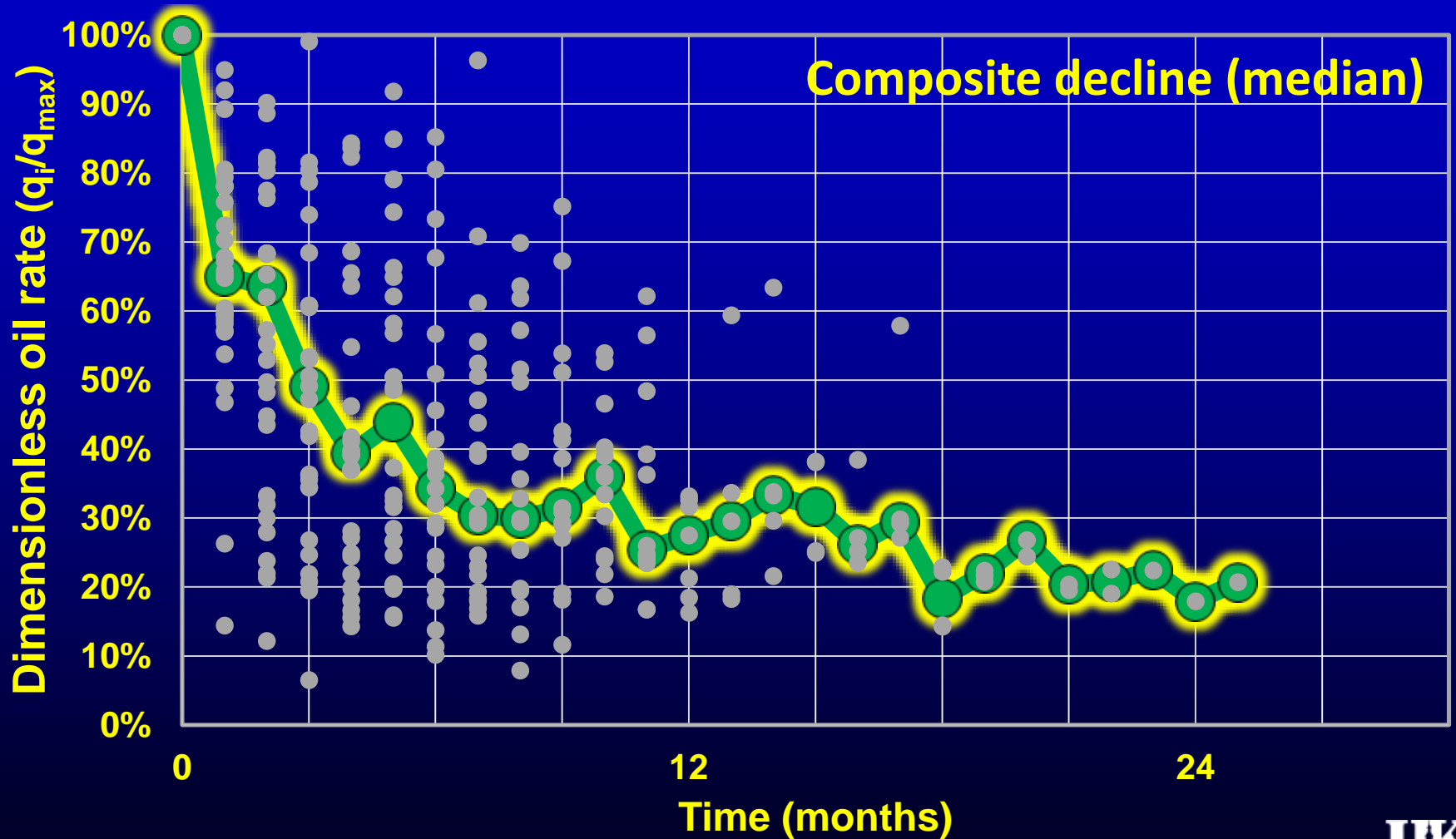


Berea Horizontal Well Oil Production



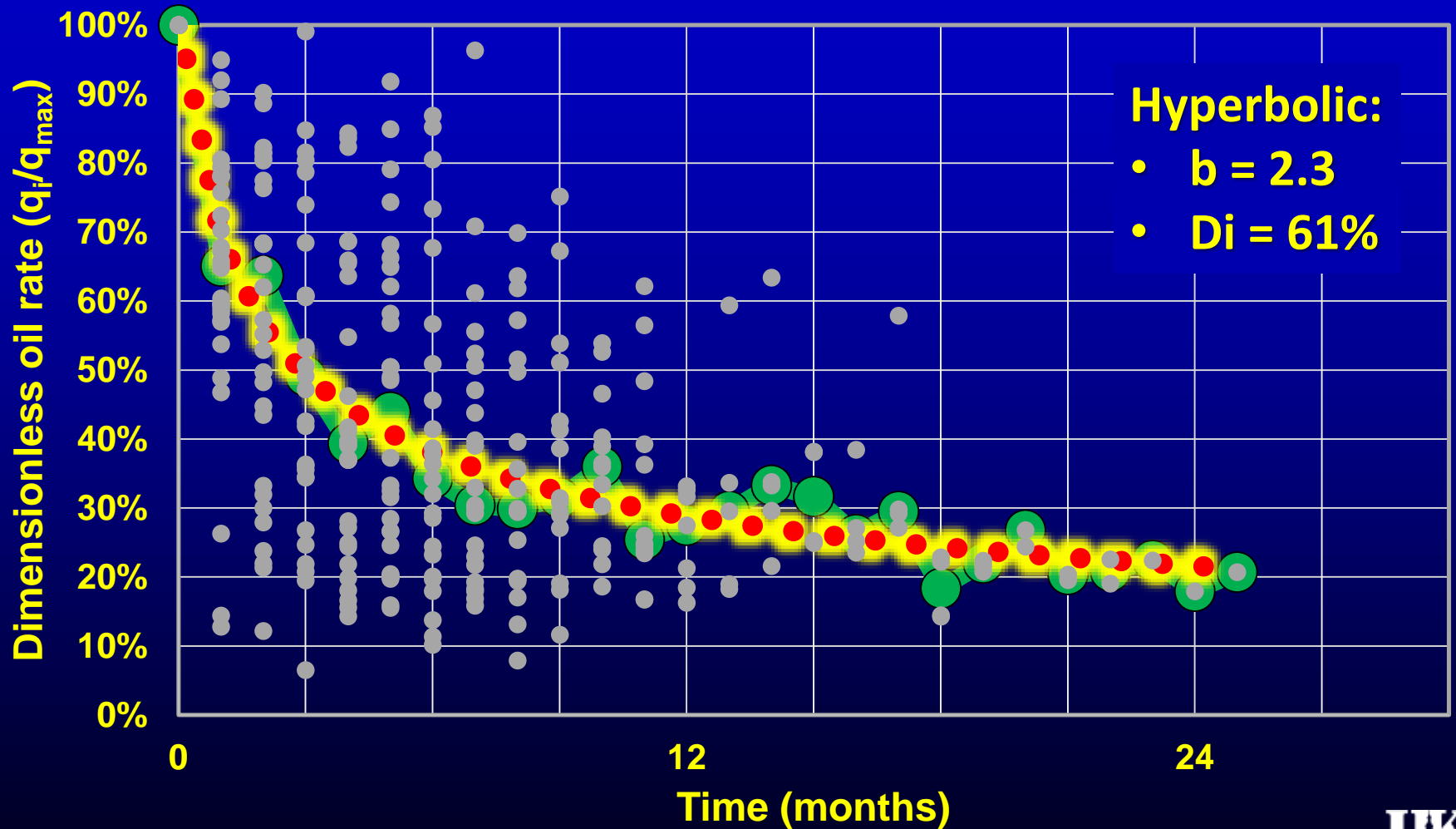
Time shifted so plots begin at period of maximum production

Berea Horizontal Well Oil Production



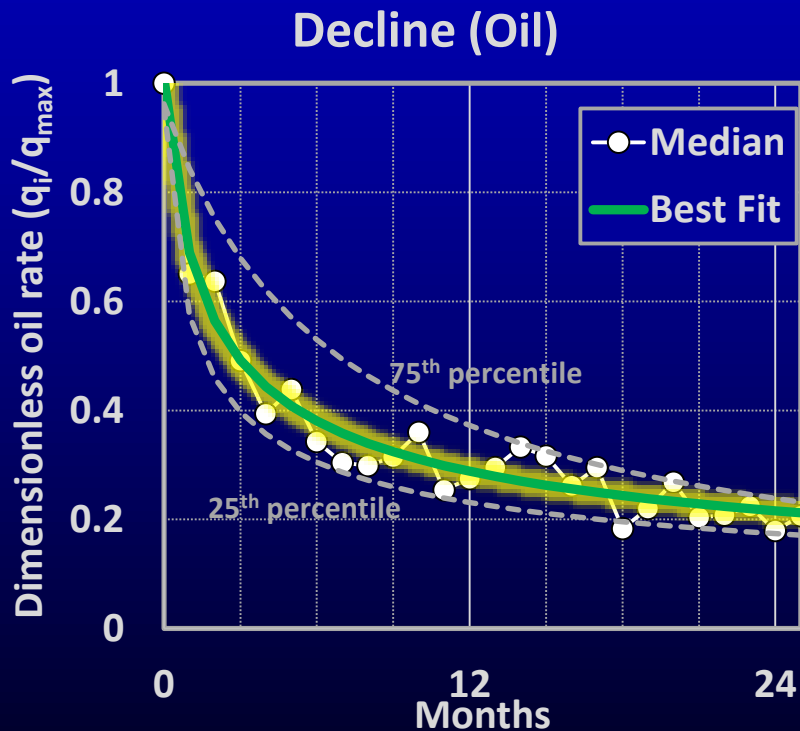
At time t, 50% produce at median rate or better.

Berea Horizontal Well Oil Production

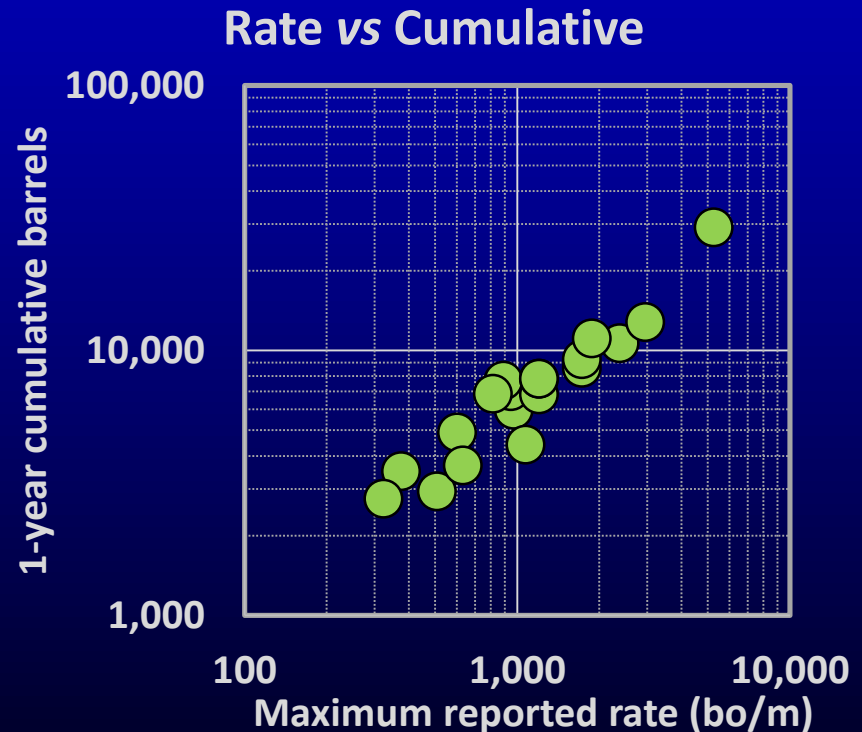


Berea Production Data

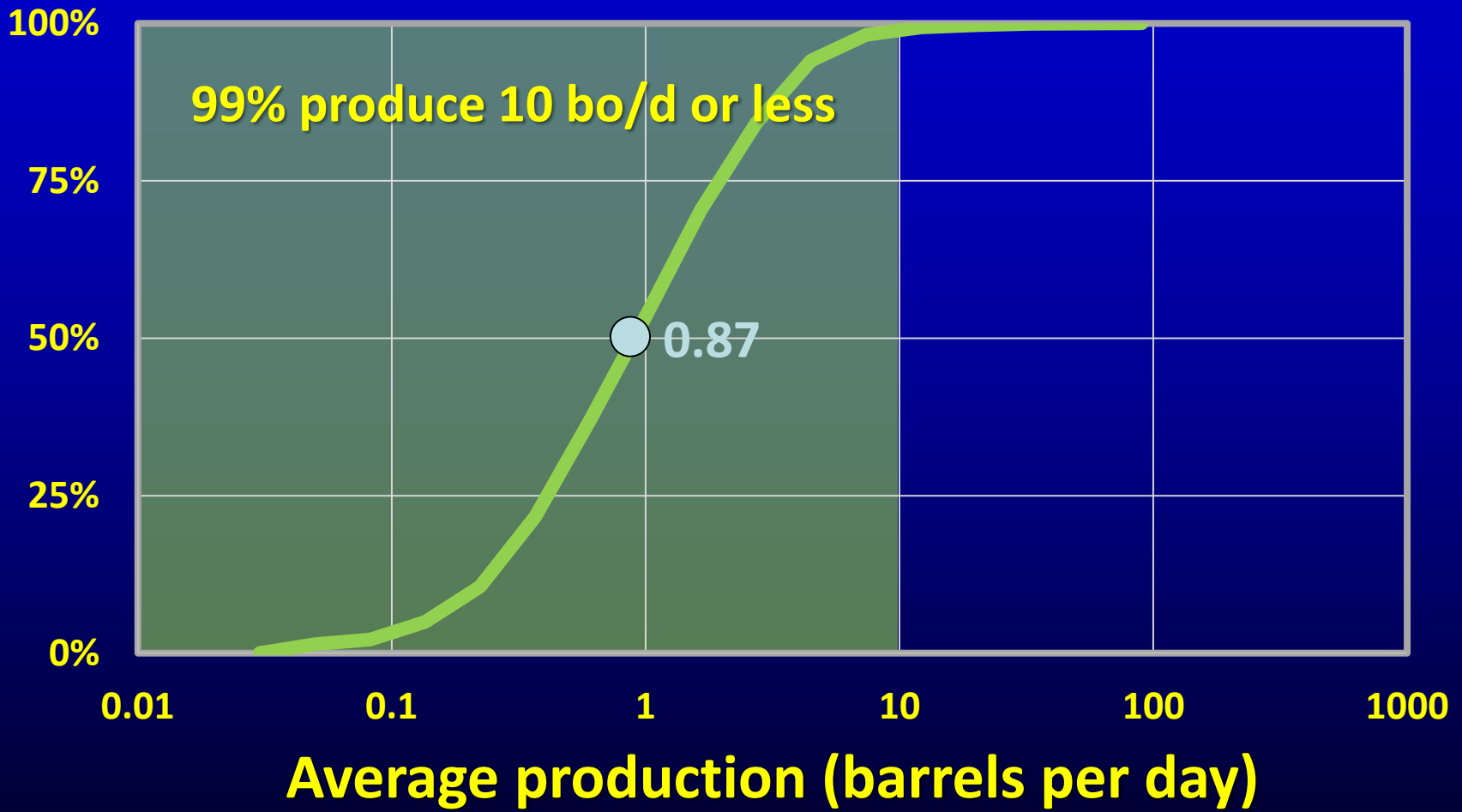
50% of wells are predicted to average 20 to 30 barrels per day for 2 years.



Median of observed production rates each period

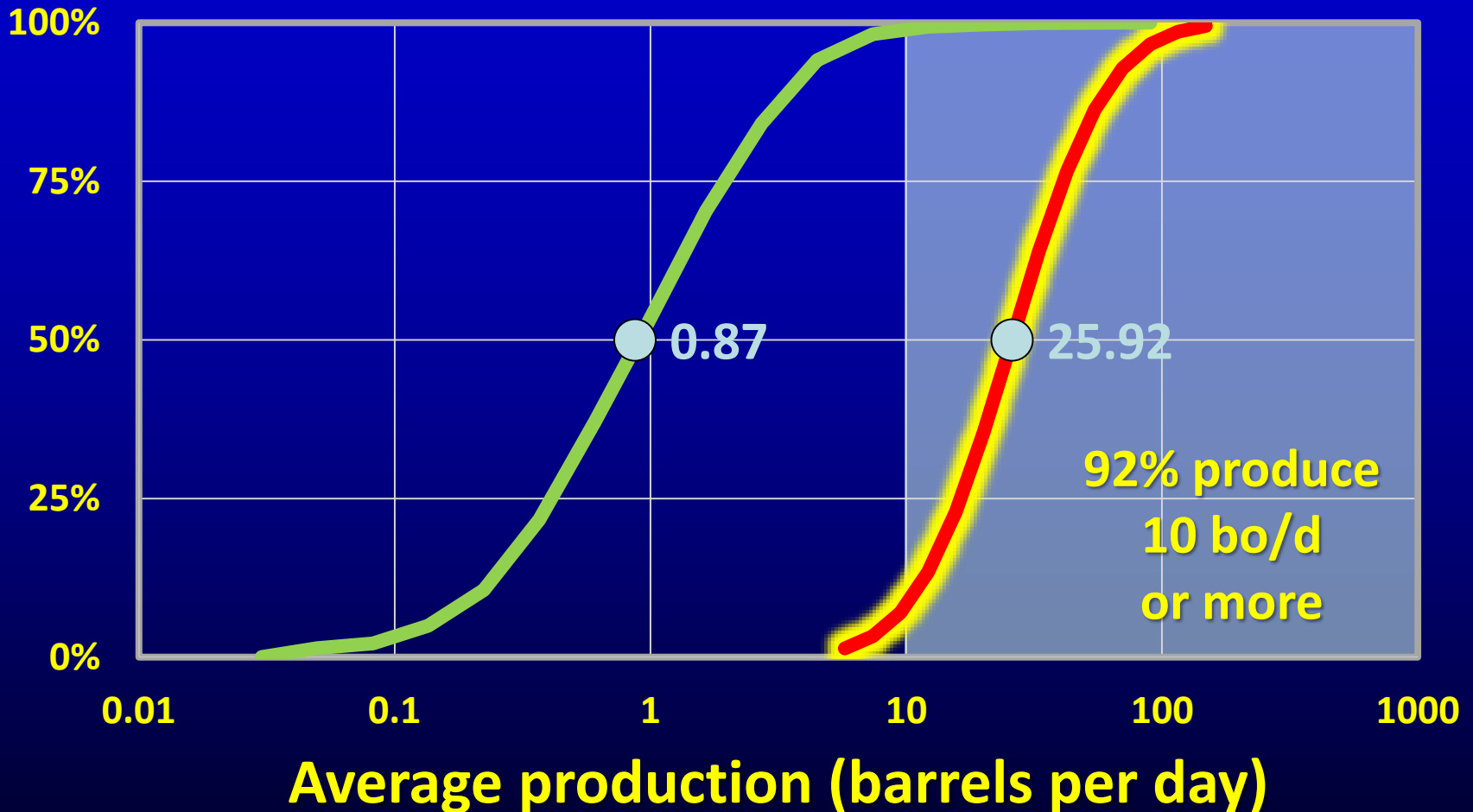


Comparing Oil Production Rates



— 2010 Study

Comparing Oil Production Rates



— Berea (horizontal) — 2010 Study

Which Wells Produce What?

GREENUP

BOYD

CARTER

ELLIOTT

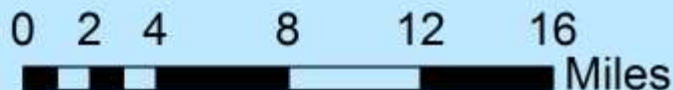
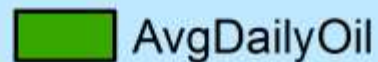
LAWRENCE

MORGAN

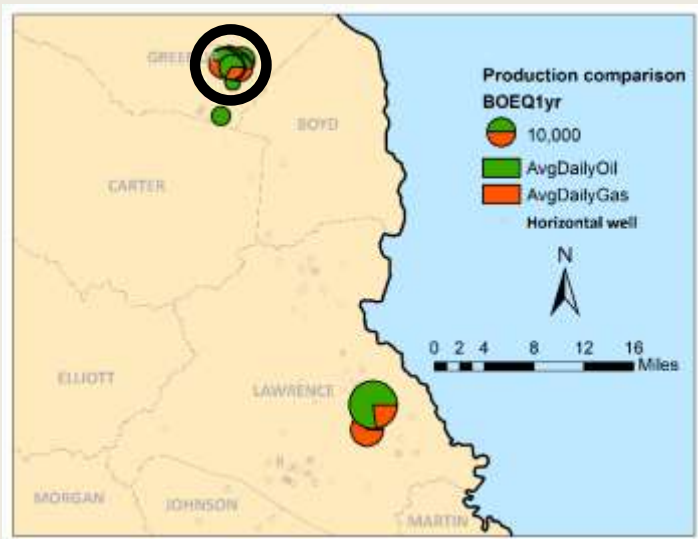
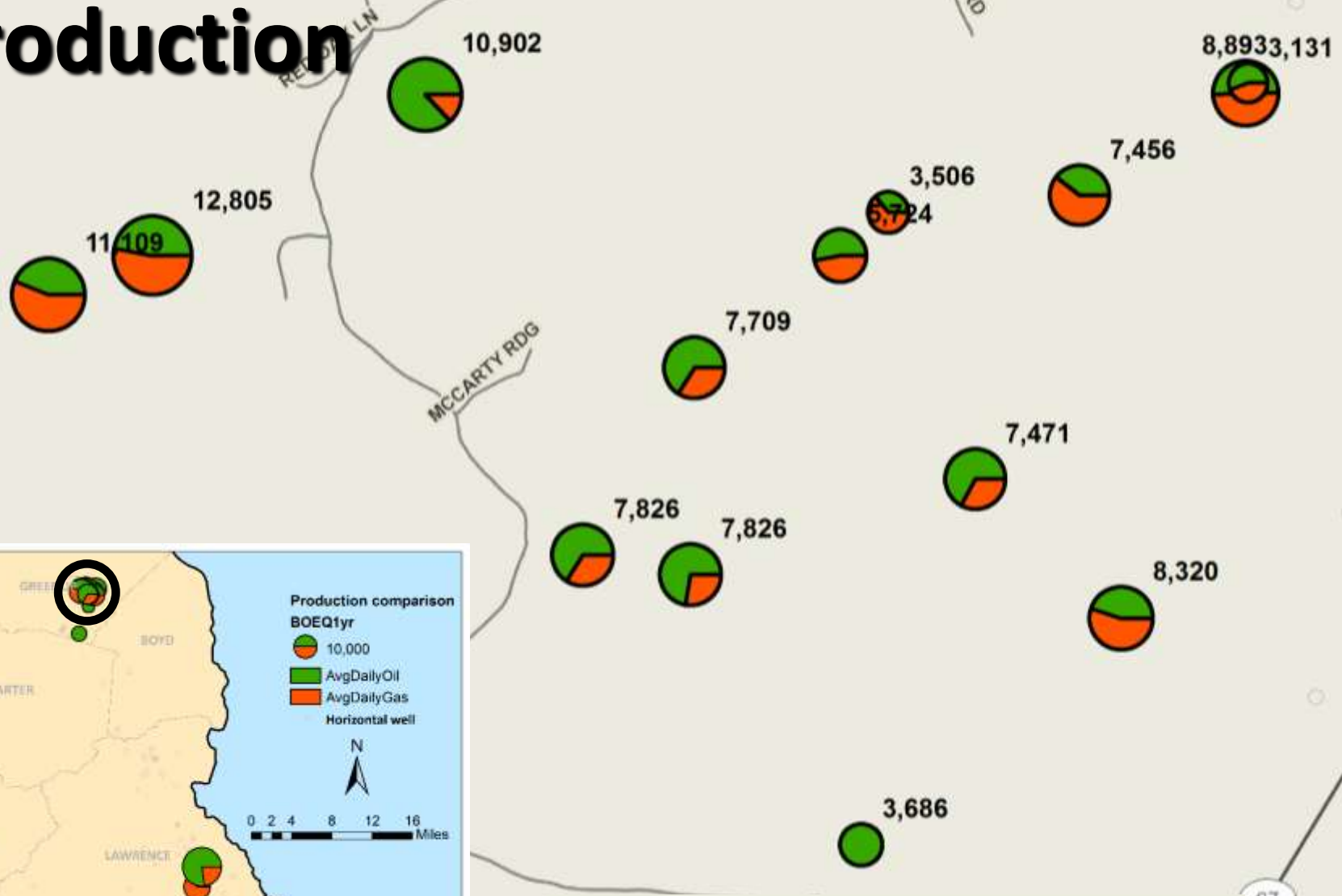
JOHNSON

MARTIN

Production comparison
BOEQ1yr



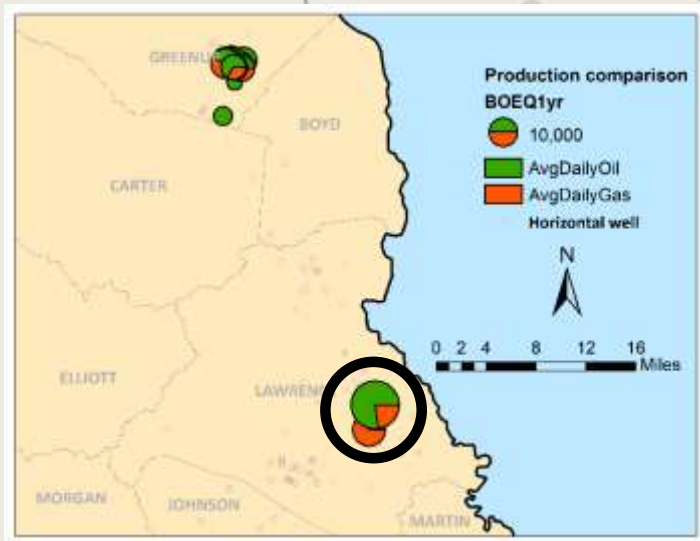
Greenup County Cumulative Production



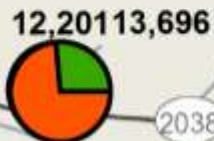
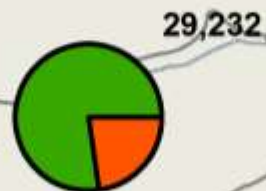
1st year oil and gas total (boeq)

Lawrence County Cumulative Production

1st year oil and gas
total (boeq)



LAWRENCE



Berea Sandstone Consortium

Sunbury

Berea

**Marty Parris, Stephen Greb, Cortland Eble,
Brandon Nuttall, Dave Harris**

Develop a better understanding of the
distribution and preservation of organic
matter and maturity with respect to
occurrence of production.

Berea &
Bedford

Berea

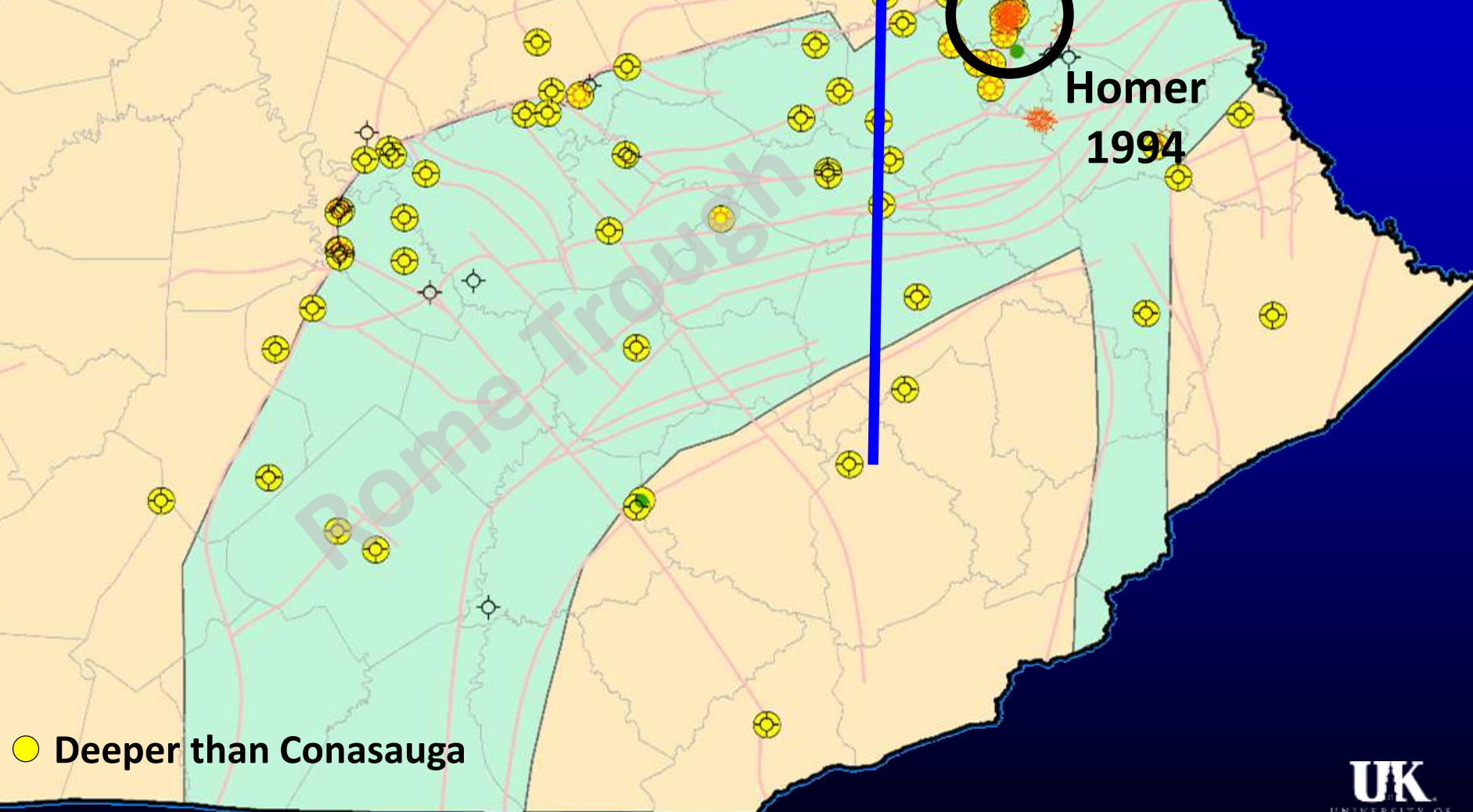


AA Highway, photo courtesy S. Greb

The Cambrian Rogersville Shale

*Part of the Rogersville interval in the U.S. Signal #1 Elkhorn,
Johnson Co., drilled 1973*

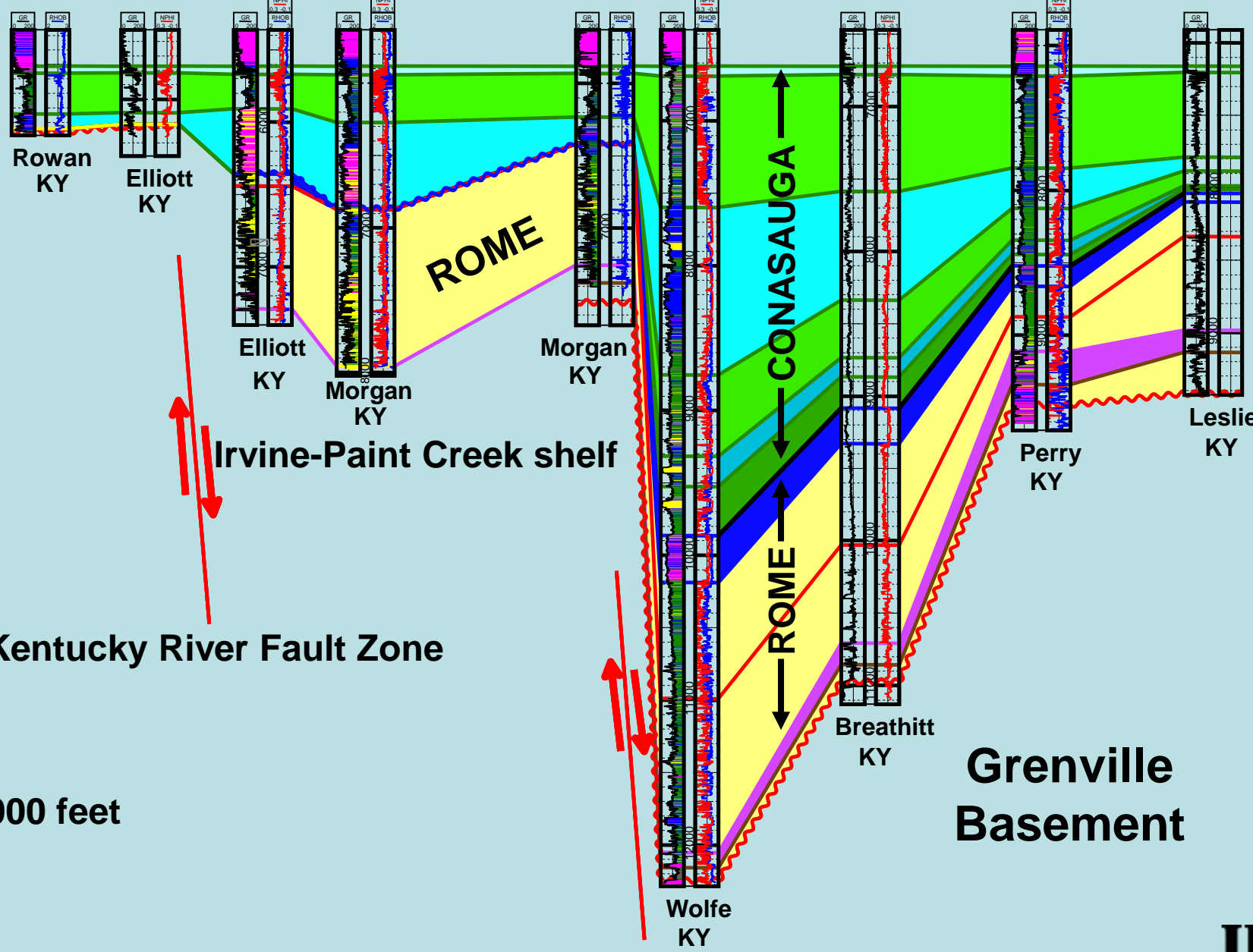
Exploration in the Rome Trough



● Deeper than Conasauga

Homer
1994

North <7.63MI> <7.86MI> <7.17MI> <16.66MI> <5.91MI> <12.60MI> <11.93MI> <11.95MI> South



1,000 feet

Dave Harris, KGS

Irvine-Paint Creek Fault Zone





Rogersville, 2004

- Dark, organic-rich shale
- Fine-grained white silt
- Mature source rock
- 5,000 to 10,000 feet deep in eastern Kentucky
- Before the “shale revolution”

Exxon #1 Smith, WV (core)

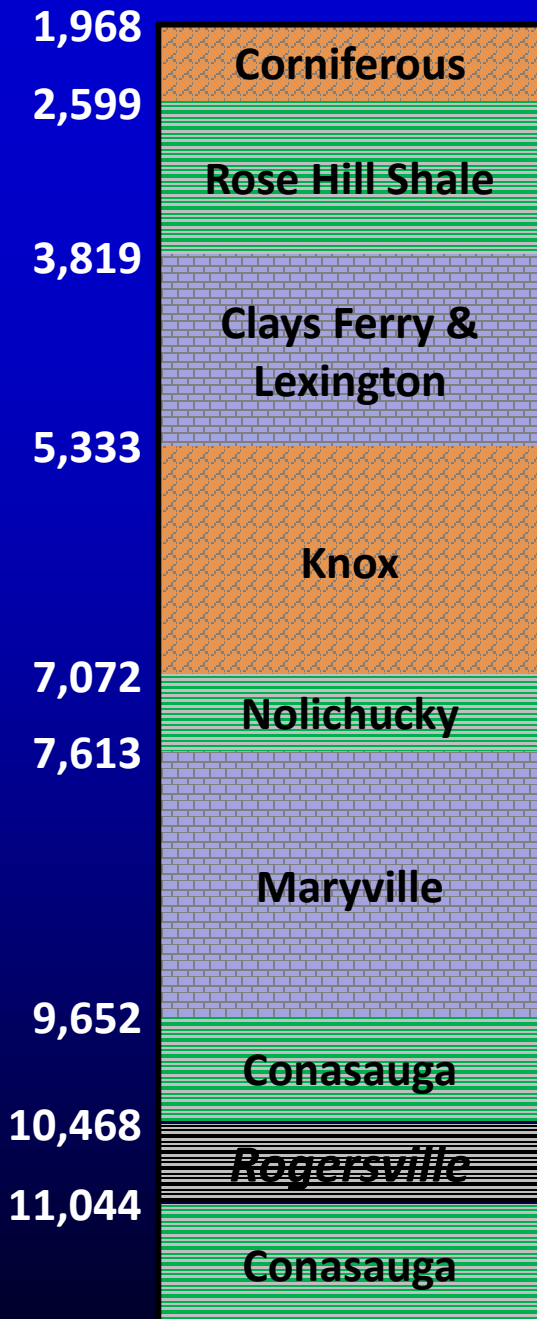
Photo courtesy Dave Harris, KGS

Rogersville Activity

COUNTY	WELL	TYPE	STATUS
Lawrence (KY)	Bruin #1 Young	V (H)	Gas Well
Lawrence (KY)	Bruin #1 Walbridge	H	Re-permitted
Putnam (WV)	Cabot #50 Amherst	V	Drilled (Gas)
Johnson (KY)	Horizontal Tech #572360 EQT	H	Fracked, SI
Lawrence (KY)	Strat test permit 111649	?	?
Lawrence (KY)	Strat test permit 111720	?	?
Lawrence (KY)	Strat test permit 111721	?	?
Lawrence (KY)	Strat test permit 111757	?	?

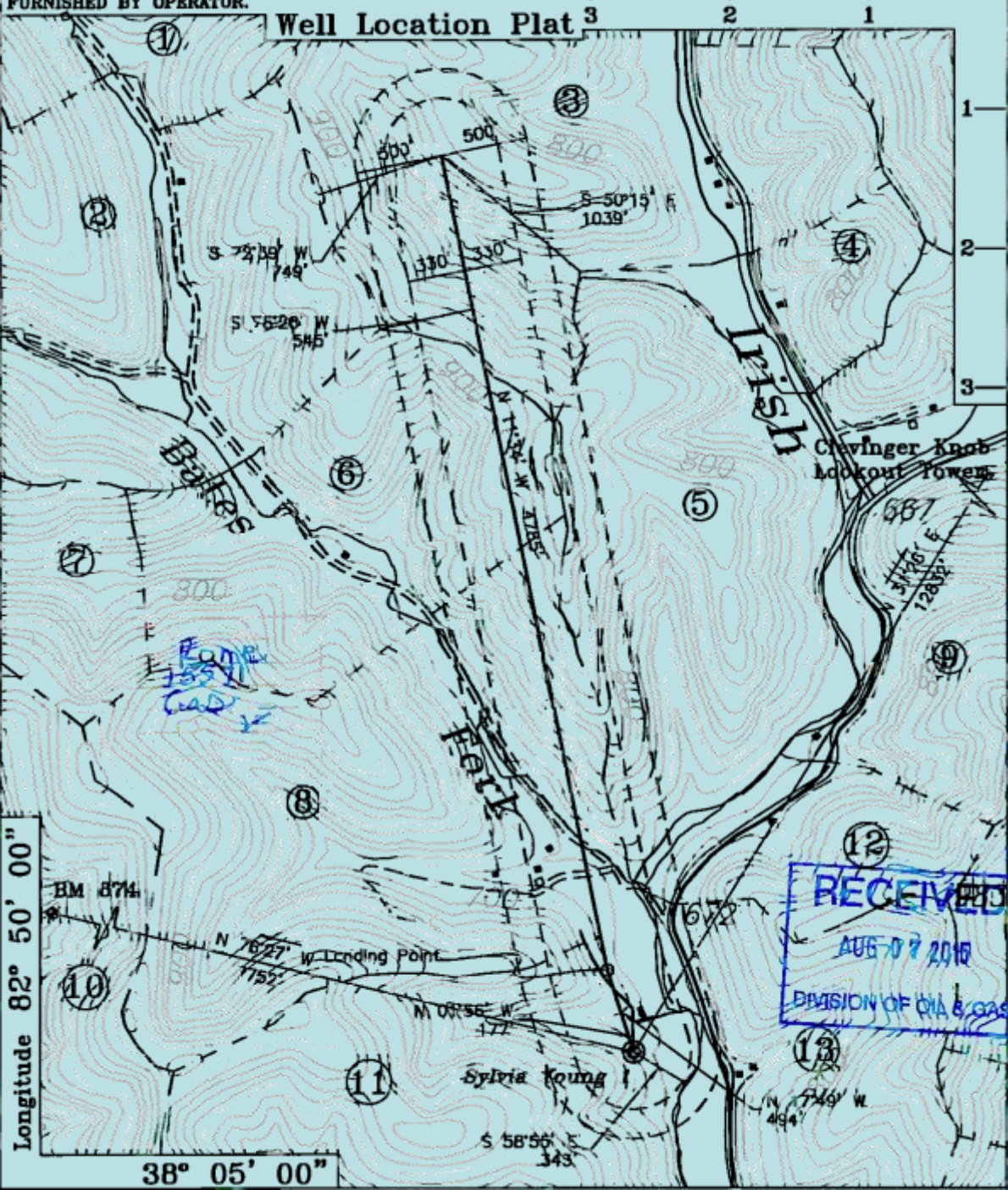
One of these drilled and evaluated for HVHF

Bruin #1 Young




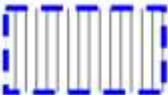


- Cased hole to TD
- Perforated 10,468 to 11,044
- Slickwater frac
- Tested 115 Mcf, 19 bo (5/6/2014)
- Shut-in 5/30/2014: 2,599 psi after 24 hours
 - Below expected hydrostatic pressure

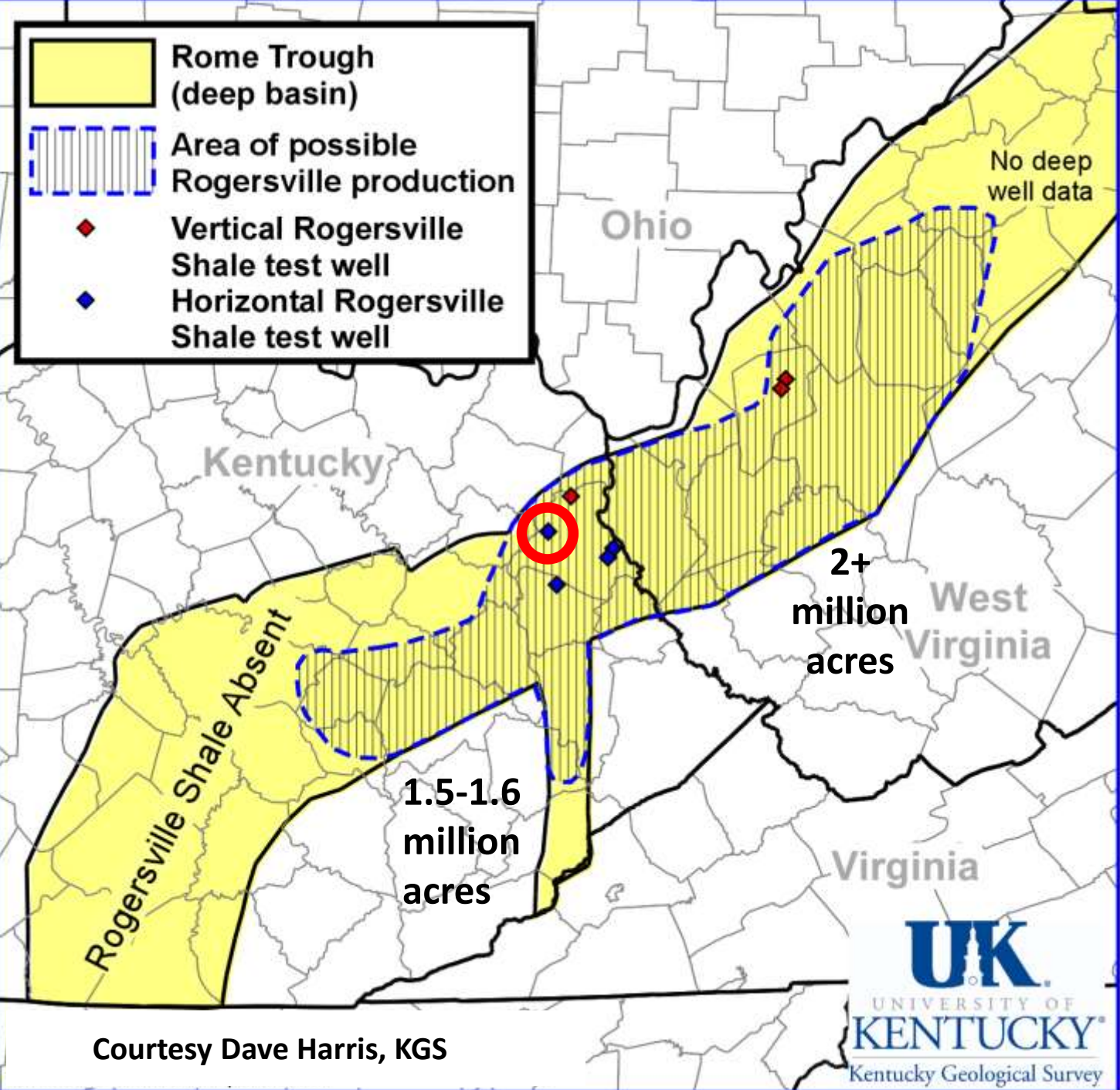
NOTE: ALL PROPERTY AND LEASE INFORMATION
FURNISHED BY OPERATOR.



Bruin #1 Young

- Horizontal lateral permitted
- Evaluate after "Flow to sales for 90 to 180 days"

-  Rome Trough (deep basin)
-  Area of possible Rogersville production
-  Vertical Rogersville Shale test well
-  Horizontal Rogersville Shale test well



Rogersville Play Area



Bruin #1 Young

(Based on data available in 2004)

Courtesy Dave Harris, KGS



In Conclusion

- **Devonian Berea**
 - A demonstrated oil producer
 - Additional potential across much of eastern Kentucky
- **Cambrian Rogersville**
 - Speculative
 - Limited data suggests potential
 - One shut-in gas well: Bruin #1 Young
- **It all depends on the price of oil and gas**

Thank you

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- www.uky.edu/KGS
- (859) 323-0544



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