

The Emerging Rogersville Shale Play: Hurry up and Wait...

AAPG Playmaker
Forum

Pittsburgh

April 13, 2016

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John Hickman

Kentucky Geological
Survey
University of Kentucky
Lexington



Google

180 ft

2004

Imagery Date: 10/18/2015 38°12'38.25" N 82°45'45.12" W elev 899 ft eye a

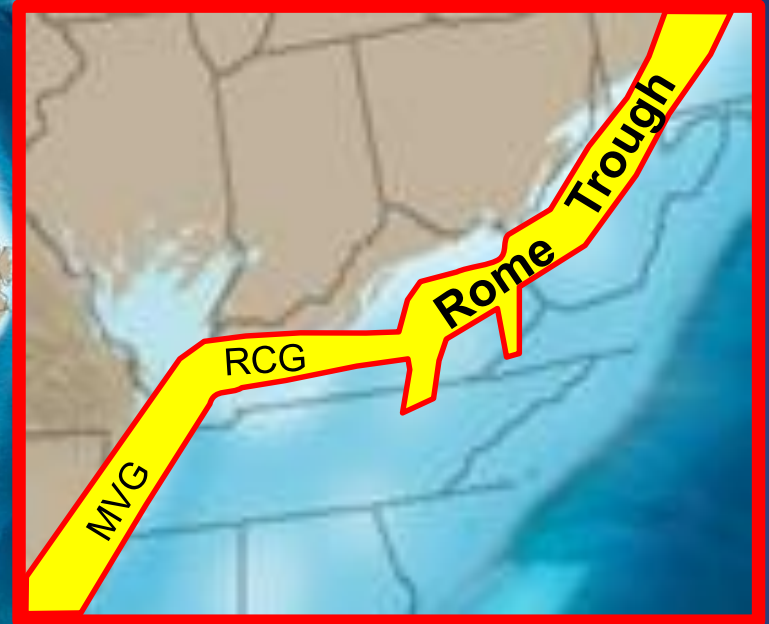
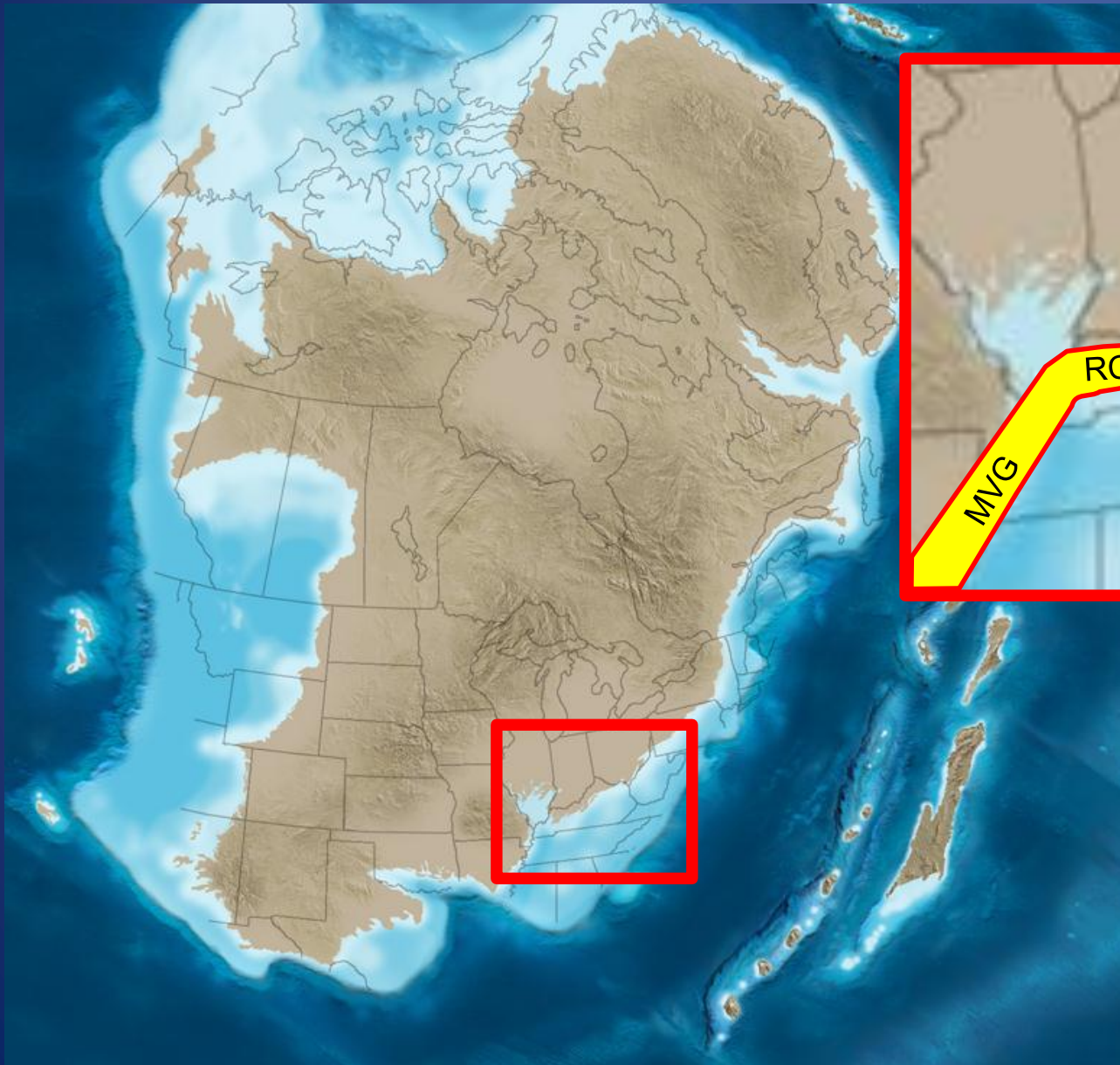
Outline of Presentation

- Rogersville geologic and geochemical framework
- Play status and recent activity
- KGS research initiatives and recent Kentucky legislation

Previous work

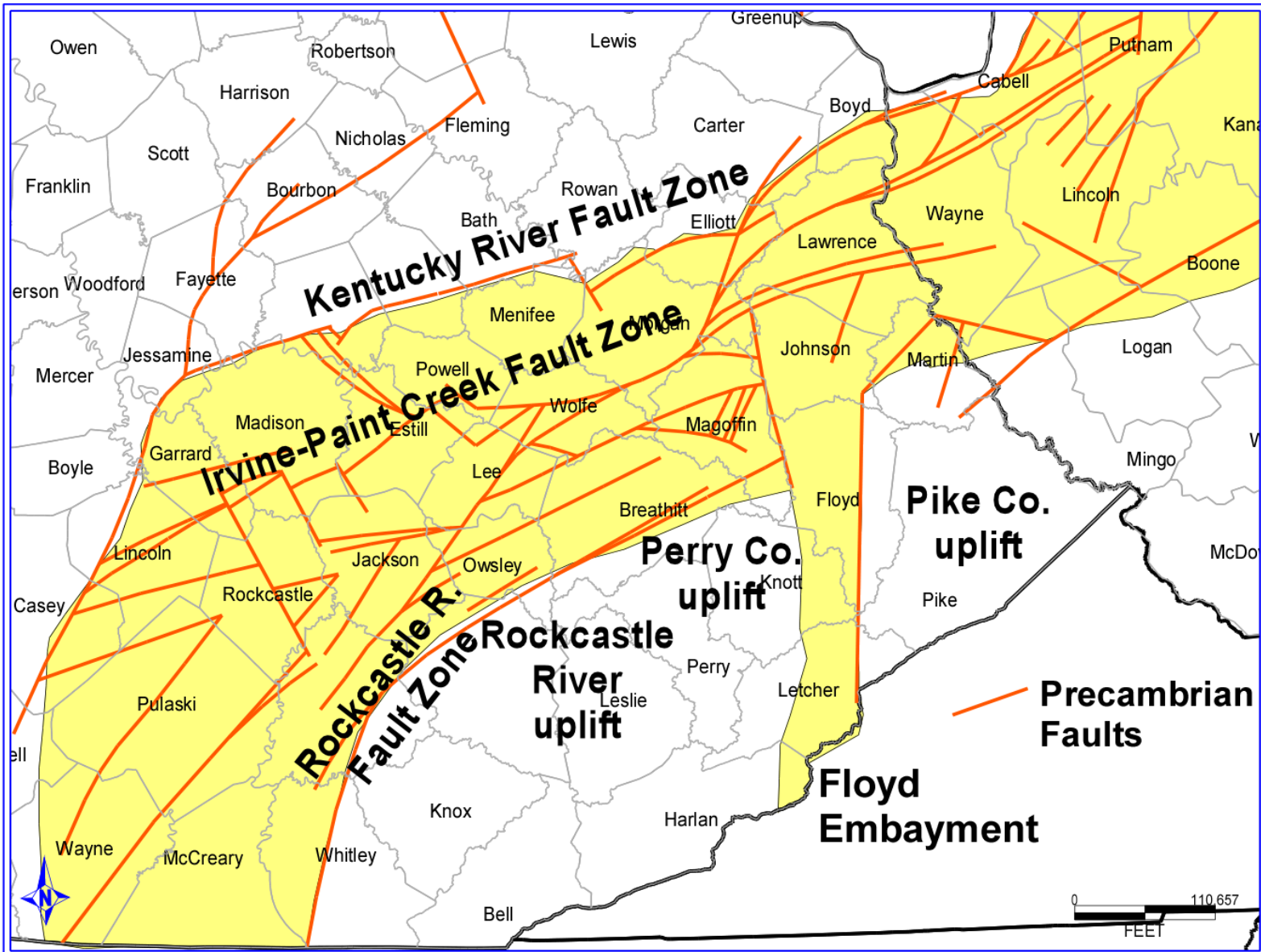
- Rome Trough Consortium (1999-2002)
- Regional stratigraphic and structural study
- Cross sections, core descriptions, maps, field study
- Hydrocarbon and source rock geochemistry
- 2004 Open-file report available at KGS
- **Study did not consider the unconventional resource potential of the Rogersville Shale**
- Bob Ryder (USGS) regional cross sections for Appalachian Basin– most available for download at usgs.gov

Middle Cambrian Paleogeography



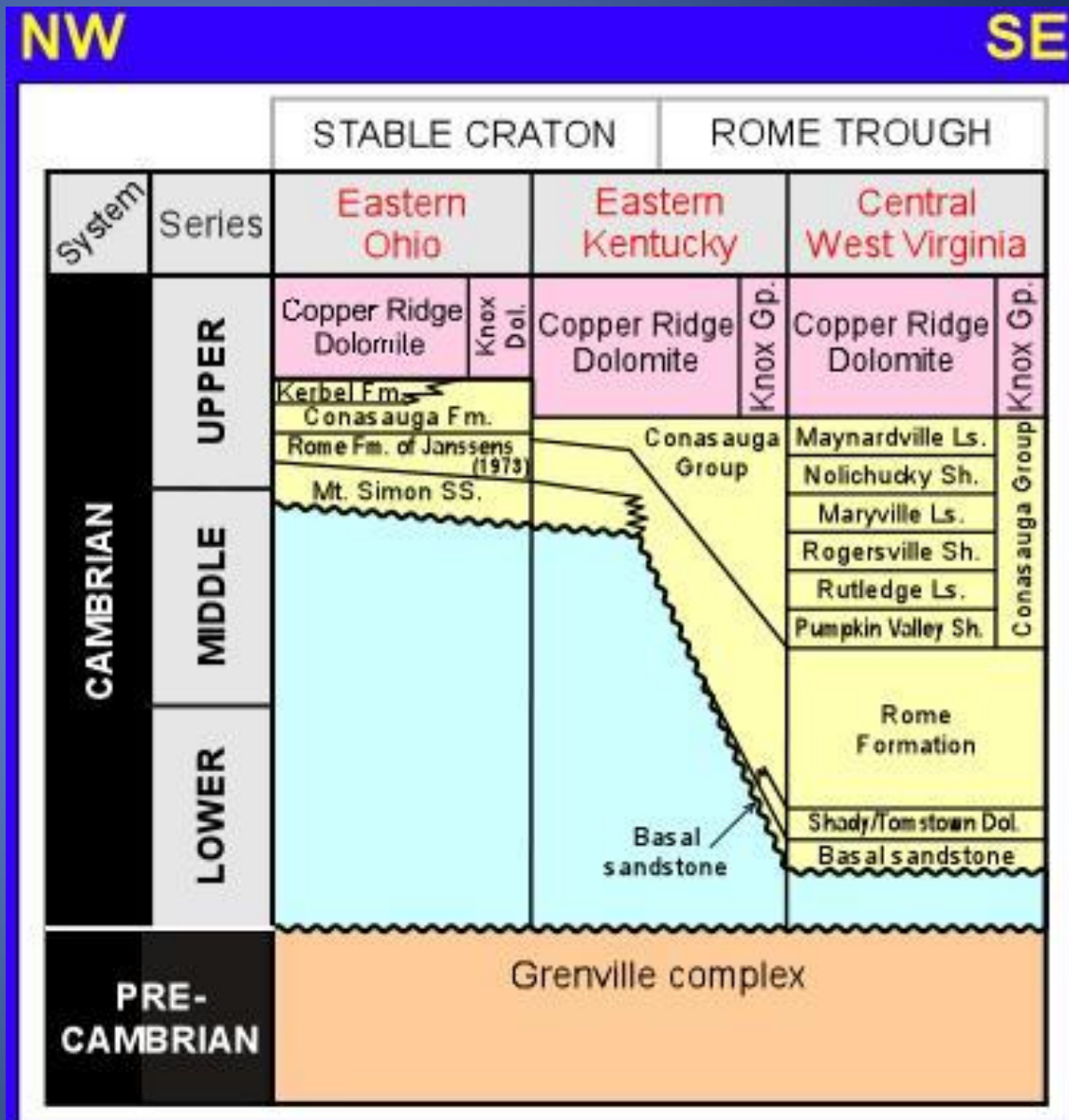
Ron Blakey, Colorado
Plateau Geosystems,
Arizona USA

Rome Trough Structural Features



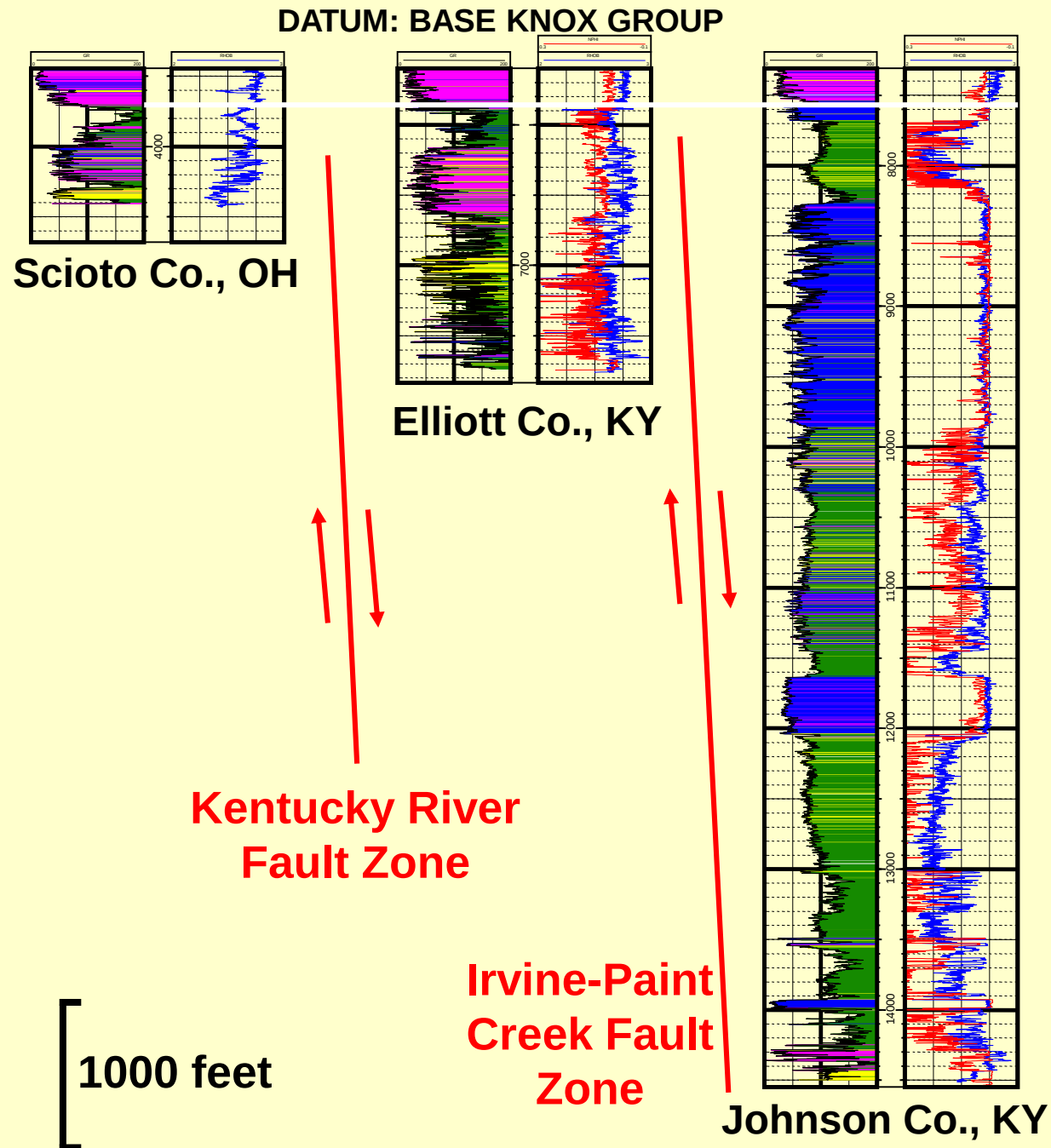
Pre-Knox Stratigraphy

- Inconsistent names across 3-state area
- Problems in defining Rome and Conasauga, Mt. Simon, basal sandstone
- Use of Rome in Ohio (Janssens, 1973)



Stratigraphic Problem

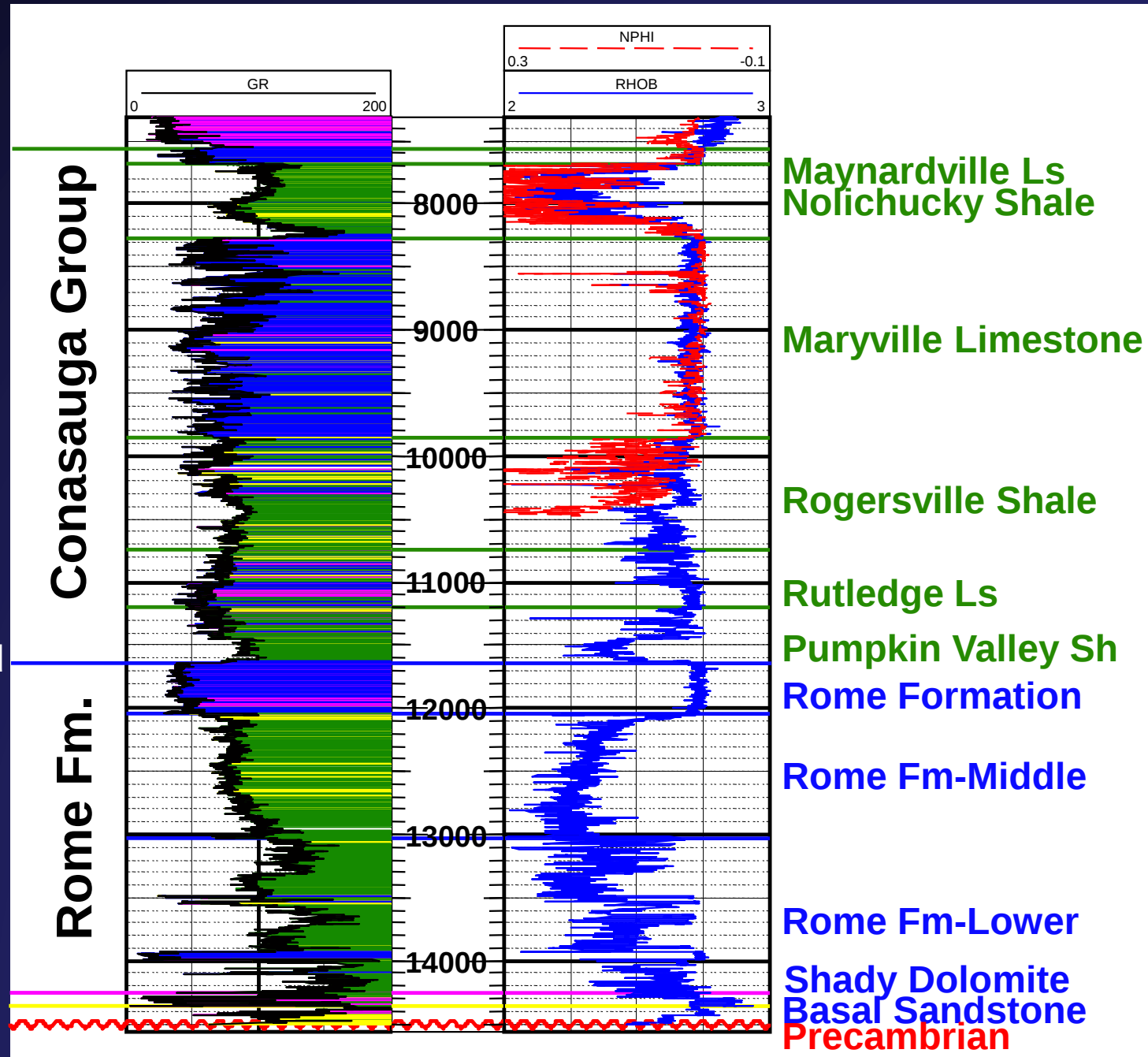
- Correlations across growth faults
- Biostrat data lacking
- Important for prediction of reservoir and source distribution



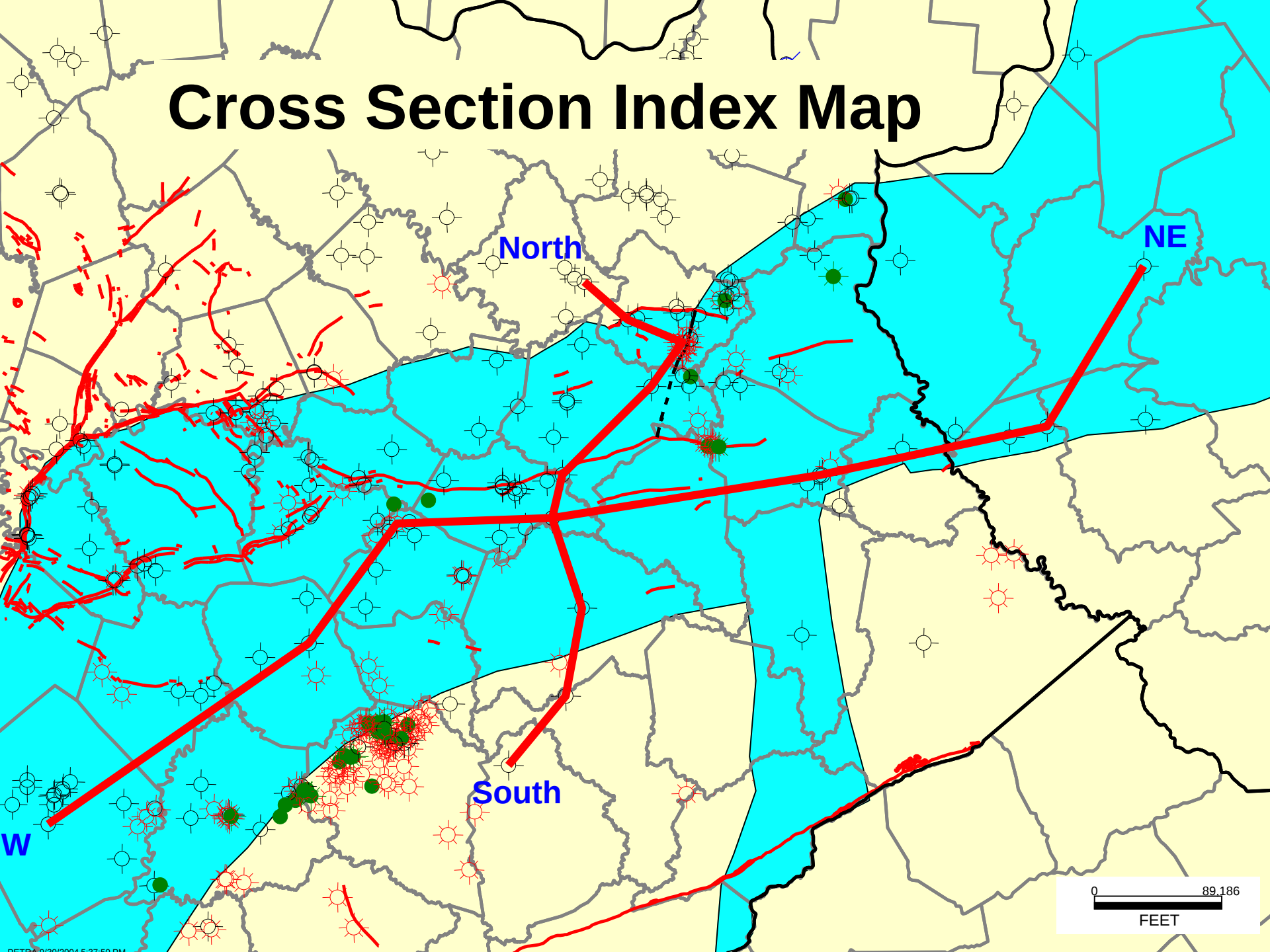
Pre-Knox Type Log

U.S. Signal
Elkhorn Coal
Johnson Co.
Kentucky

Gamma ray shaded
By log-calculated
lithologies

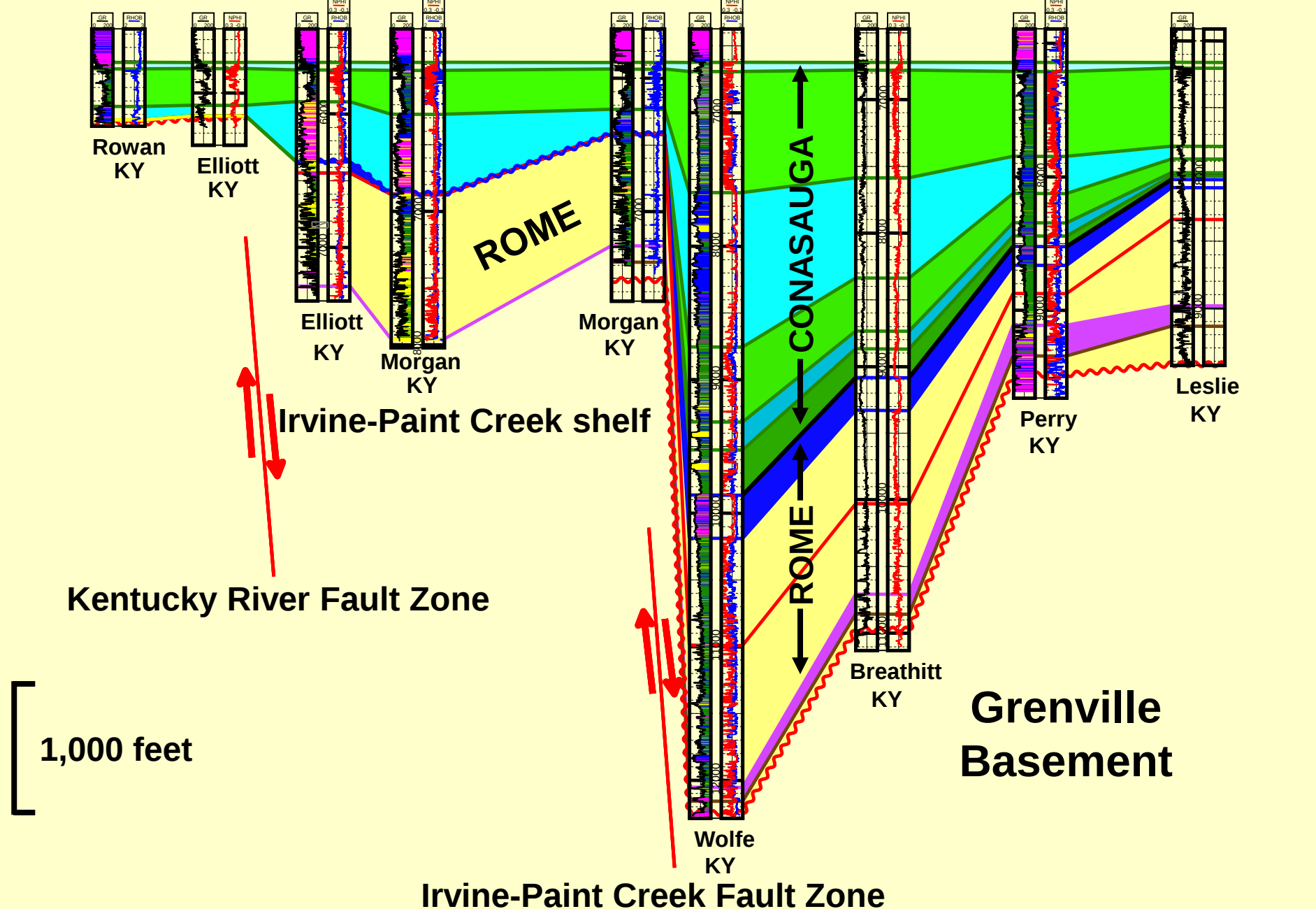


Cross Section Index Map

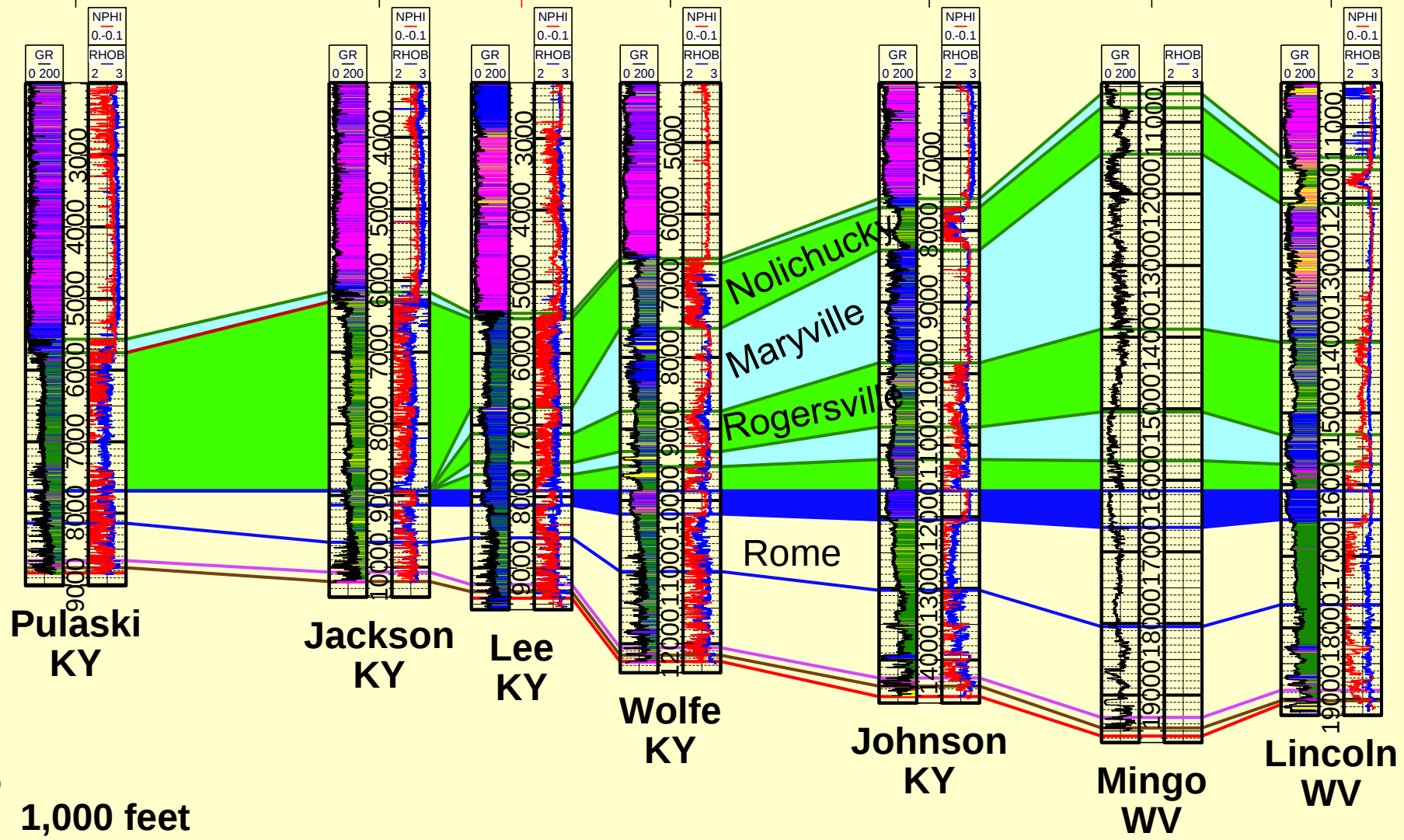


0 89,186
FEET

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



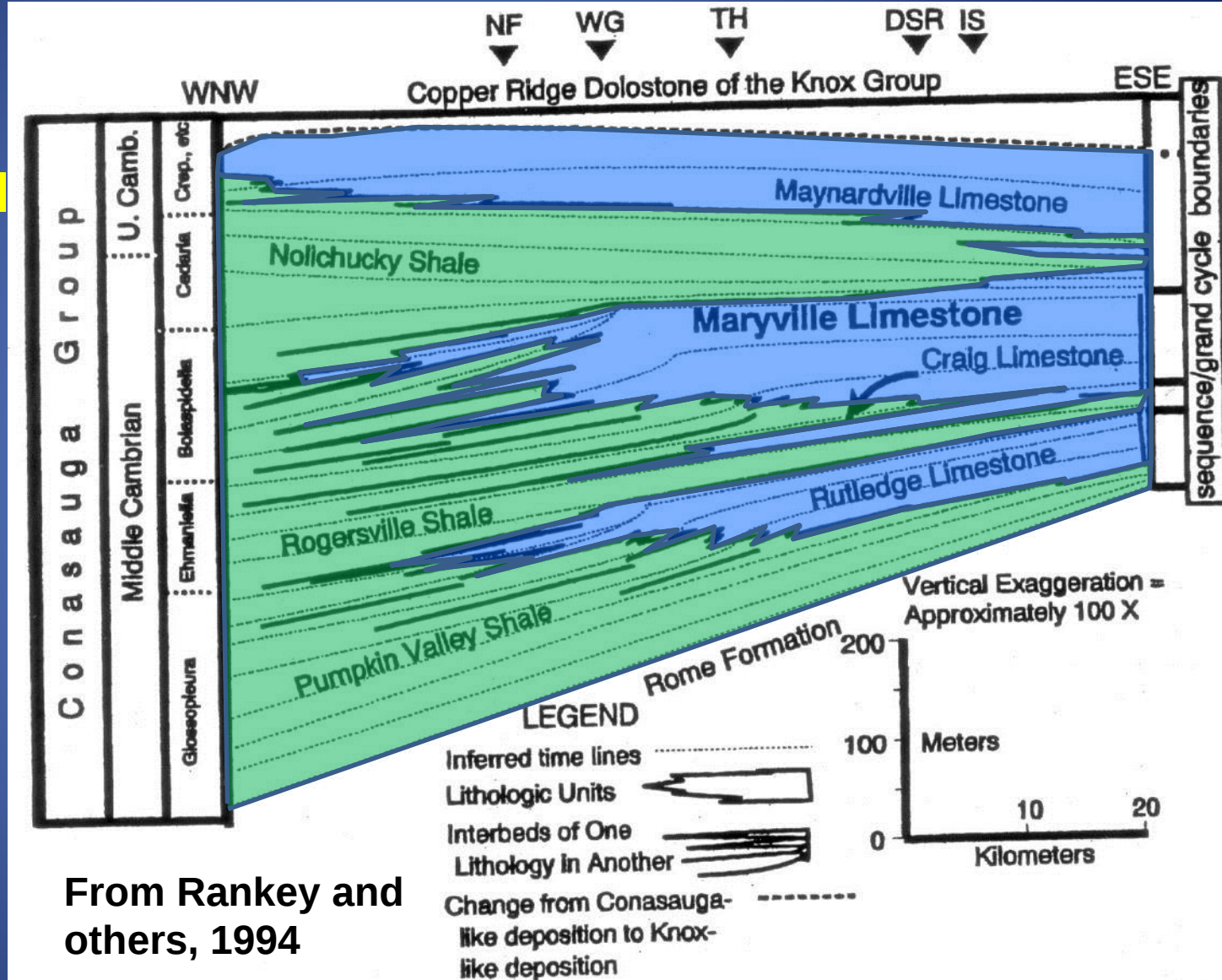
SW <42.20MI> <19.75MI> <20.67MI> <35.95MI> <30.91MI> <24.92MI> NE



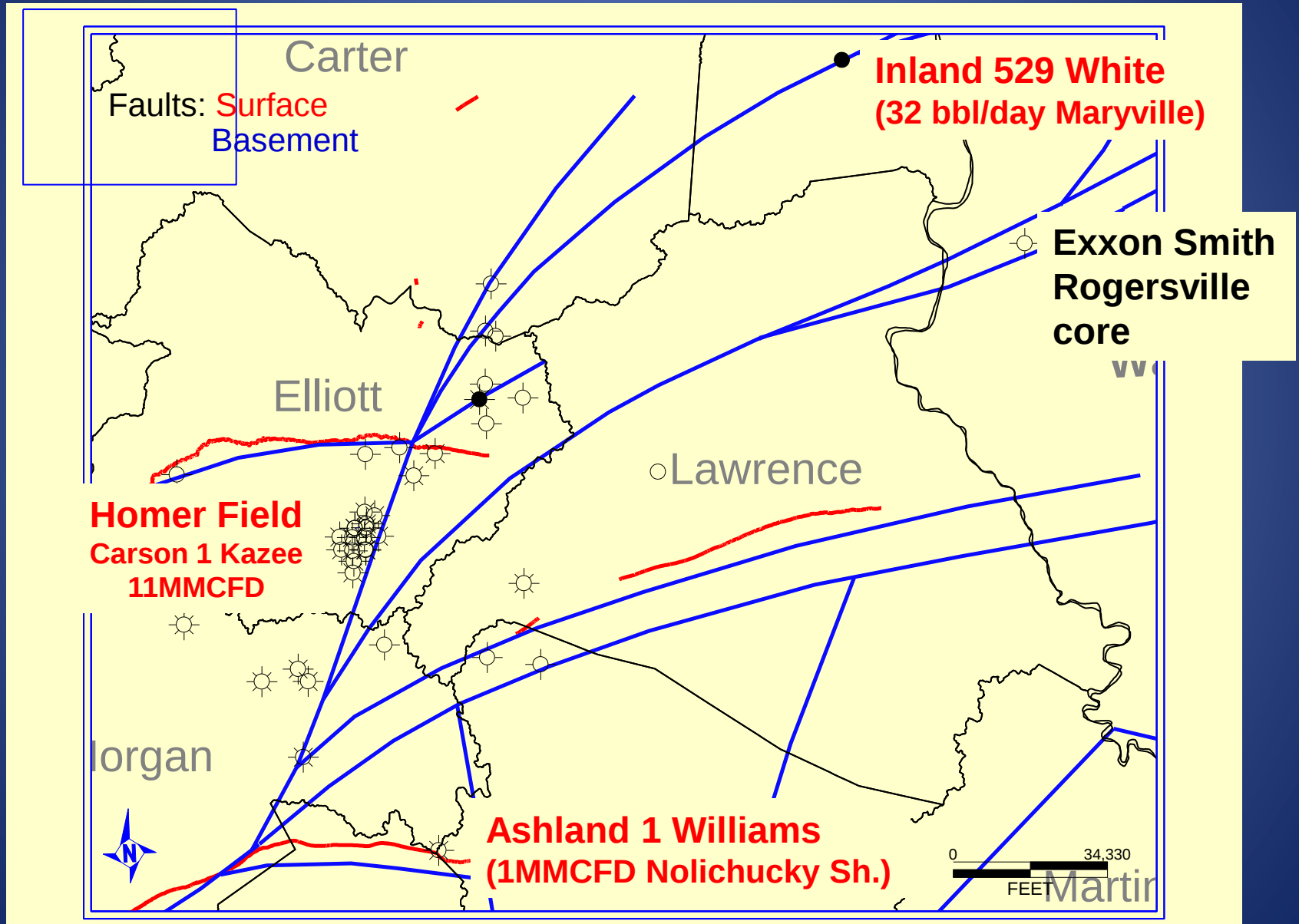
[1,000 feet
HS=175000

East Tennessee Conasauga Outcrops

- Large scale depositional cycles
- Carbonate ramp thickens to east
- Intrashelf shale basin to west



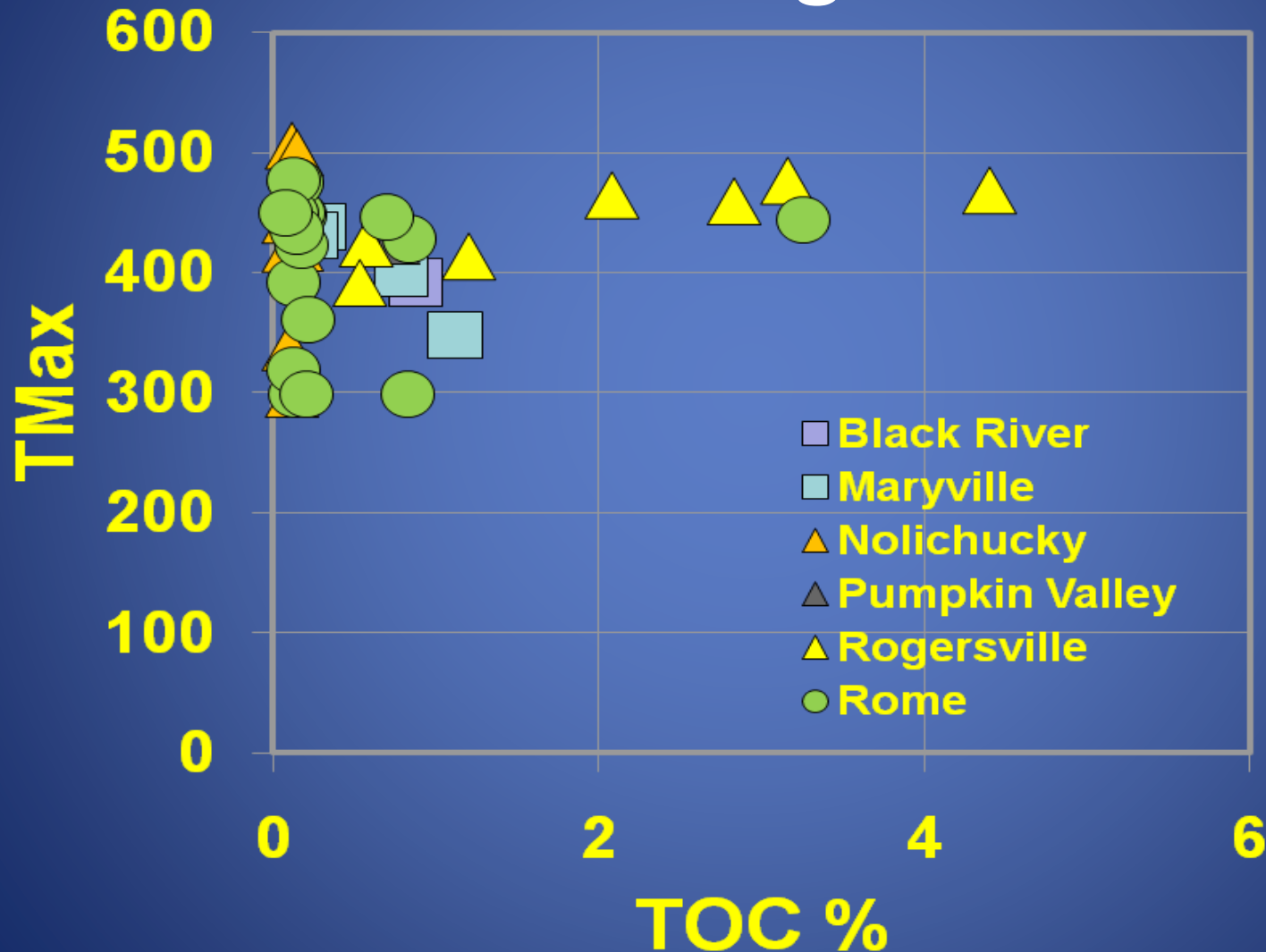
Rome Trough Production



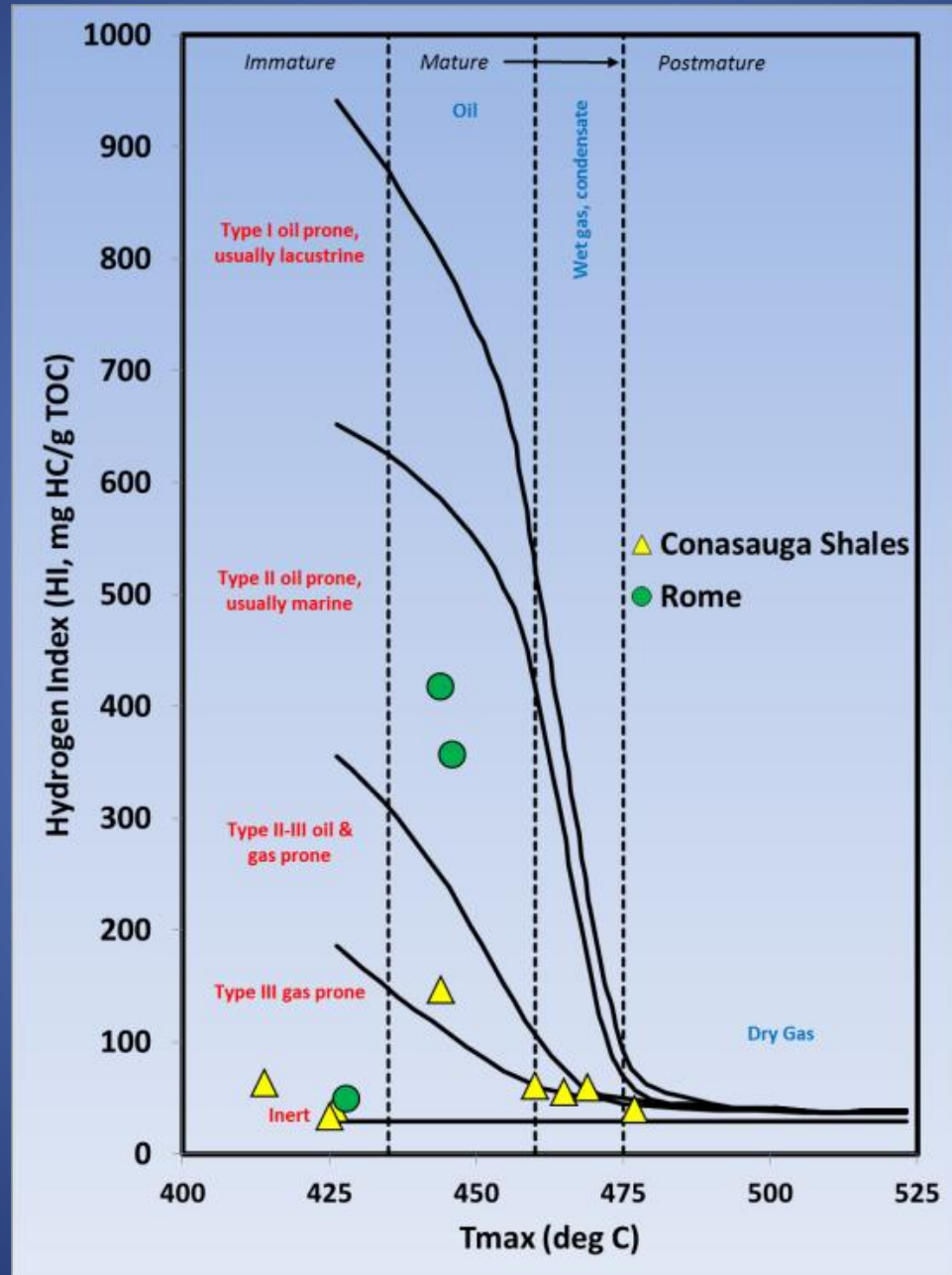
Exxon #1 Smith core: 11,191-11,200'



Cambrian Source Rocks in Rome Trough

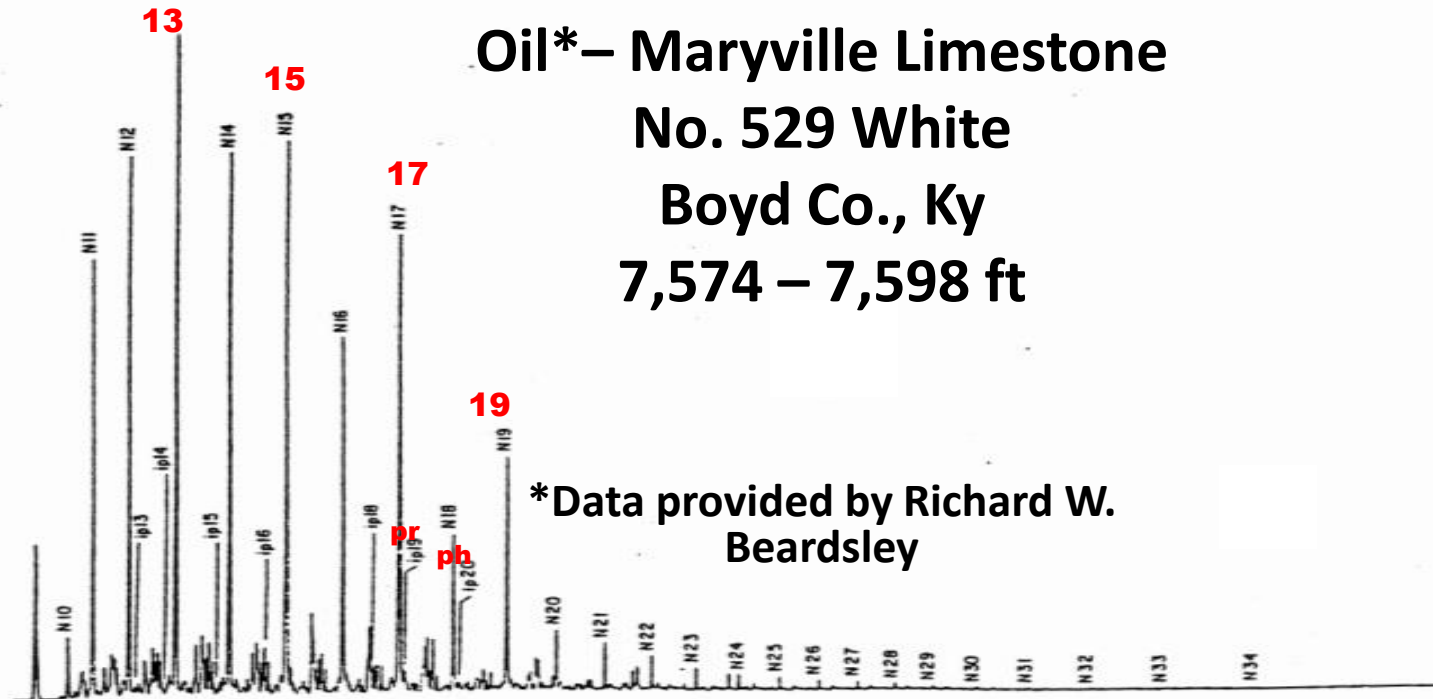


RTC Maturity and Kerogen Data



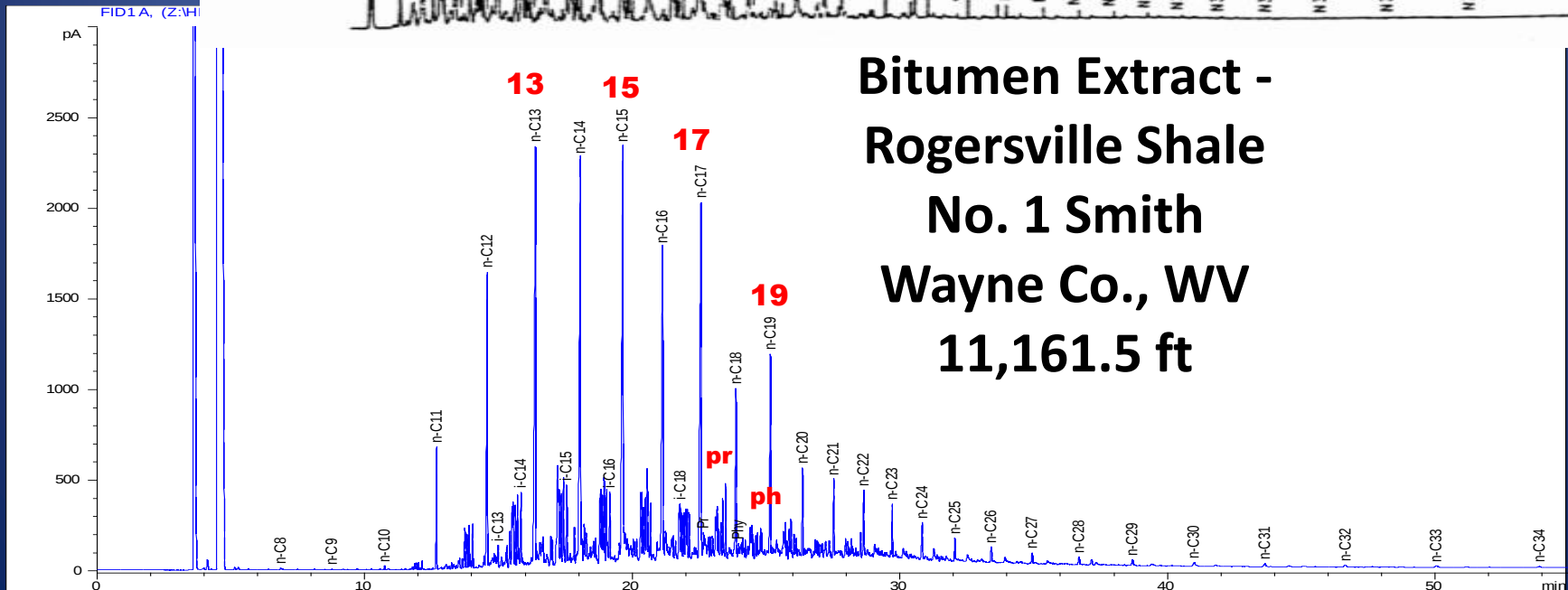
Oil – Source Rock Correlation

Oil* – Maryville Limestone
No. 529 White
Boyd Co., Ky
7,574 – 7,598 ft



*Data provided by Richard W. Beardsley

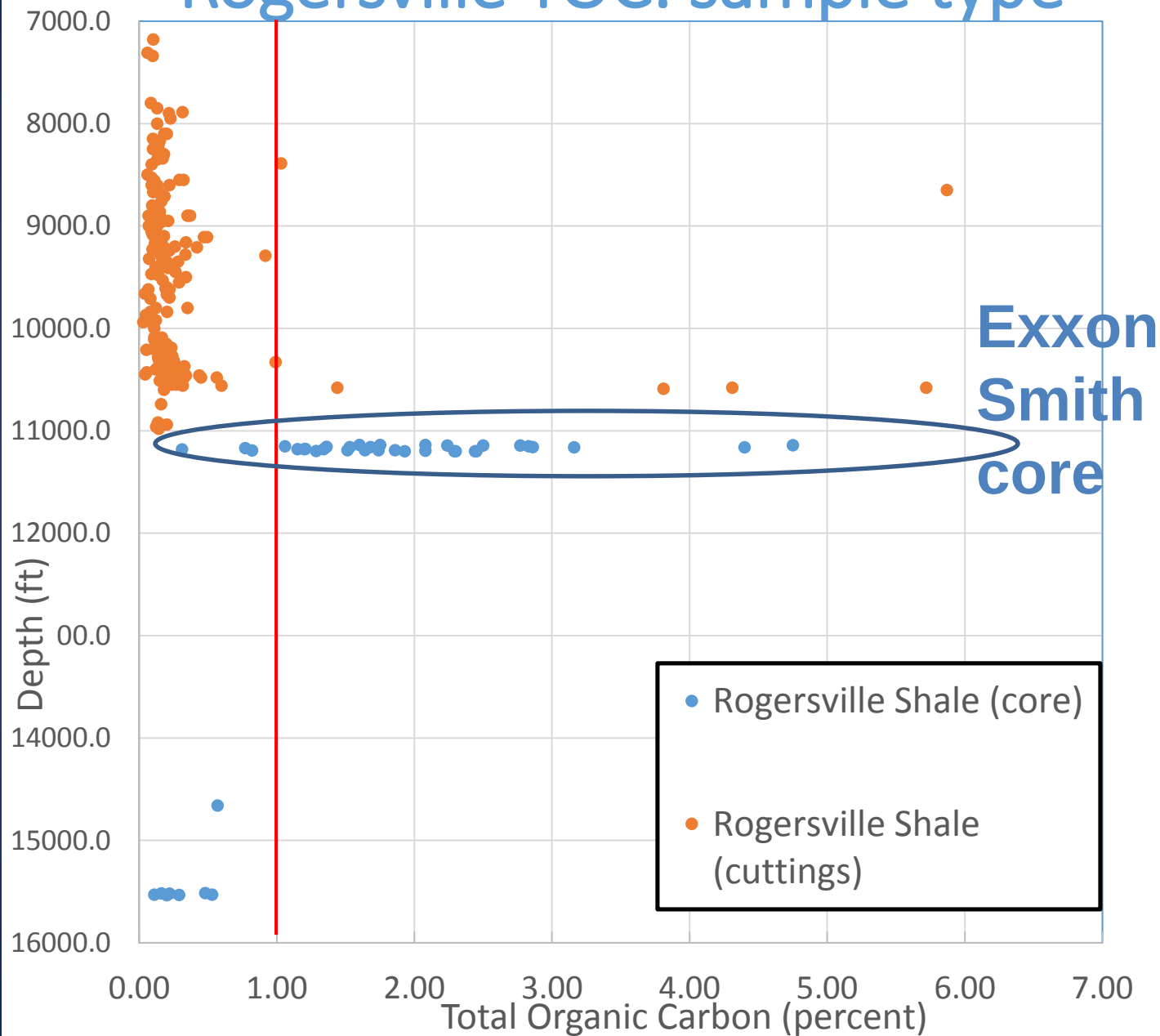
Bitumen Extract -
Rogersville Shale
No. 1 Smith
Wayne Co., WV
11,161.5 ft



Additional TOC/Rock-Eval Data

- GeoMark, 2007
- Talisman, 2009
 - 96 samples, 8 wells, no reliable results $> 1\%$
- Petro-Hunt, 2011
 - 137 samples, 12 Ky. Wells, highest TOC was 0.24%
- Cimarex data (2012 and 2014)
 - Sampled Rogersville cuttings in 12 wells
 - Of 131 samples, only 4 had TOC $> 1\%$ (Exxon Smith and Ashland Williams wells)

Rogersville TOC: sample type



Rogersville Shale Summary

- 5,000 to 10,000 ft deep in eastern Kentucky
- 2–4.8% TOC in parts, and has generated gas & condensate
- Up to 1,100 ft thick in Kentucky, but limited to deeper parts of Rome Trough— not all is organic rich

Rogersville Play Concept

- **Clues:** mature source rock, a few mud logs shows, scattered deep shows and production, reports of overpressure (Gates & Watson, 1975, SPE 5447)
- **Challenges:** mostly 1970's-vintage logs, poor log data due to borehole washouts, few cores, limited production, precipitous fall in oil and gas prices

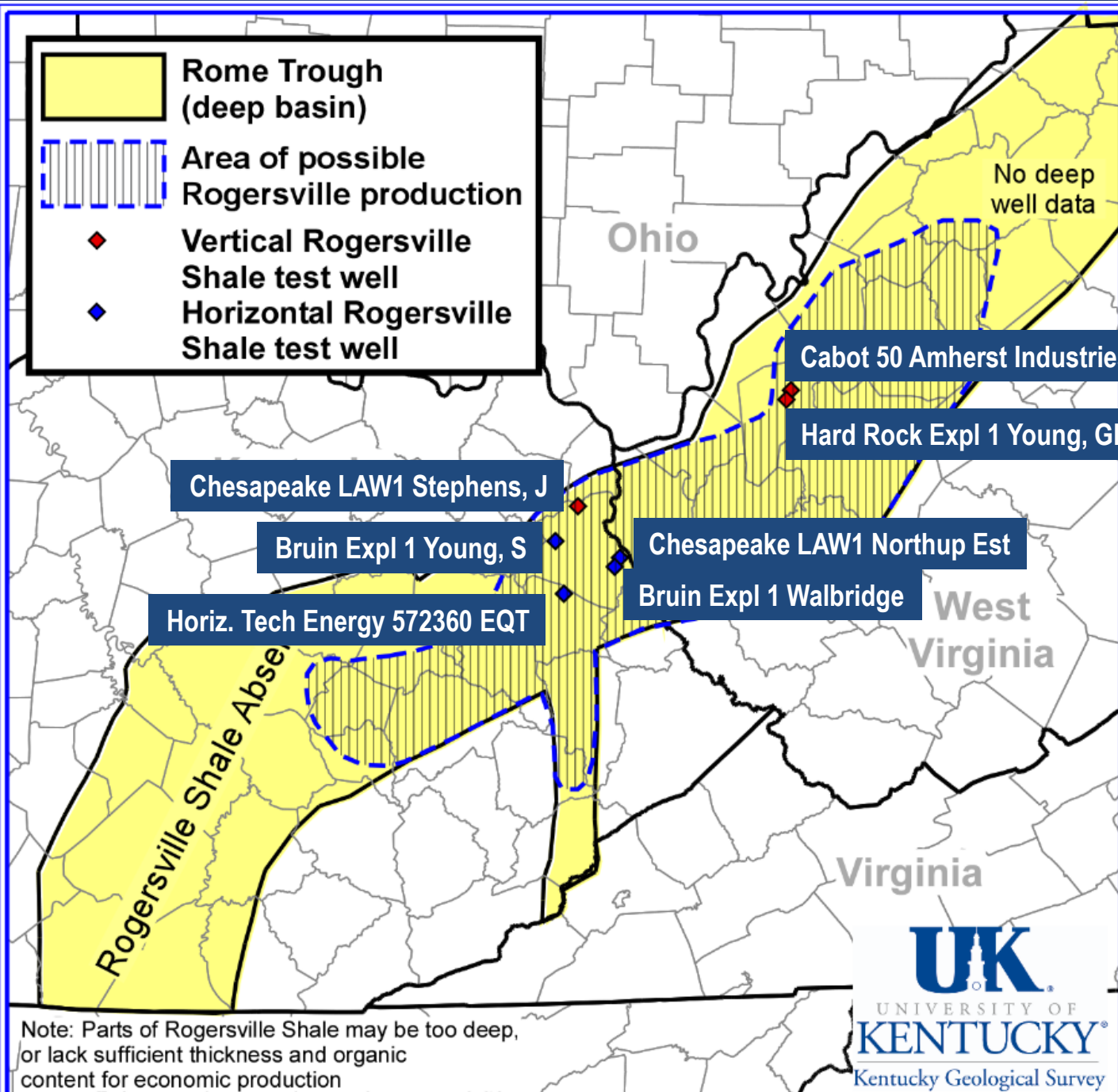
Keys to proving the concept

- Confidence in one good data point (Exxon core)
- Explaining other discouraging TOC results
- Targeting wet gas/condensate area for liquids
- Exploiting gray area in regs to keep data tight for 5 years—stratigraphic test drilling permits
- Securing strong lease position after first well

Current Play Status

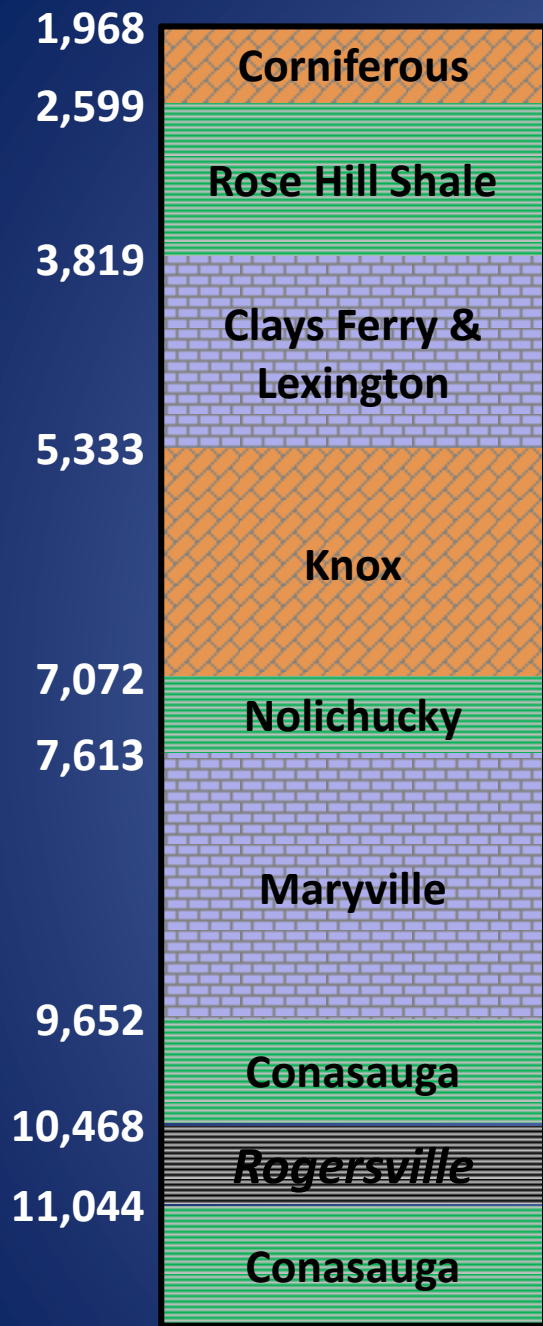
- Five wells drilled to date
 - *Bruin Expl. (Cimarex)*: apparent discovery (shut-in) Lawrence Co., Kentucky
 - *Cabot Oil & Gas*: 1 vertical, Putnam Co., West Virginia, producing dry gas, zone unknown
 - *Chesapeake Energy*: 2 verticals (shut-in), Lawrence County, Kentucky
 - *Horiz. Tech. Energy (EQT)*: 1 horizontal, (under evaluation?), Johnson Co., KY
- Three undrilled horizontal lateral permits
- Activity on hold due to low prices

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



Bruin #1 Young Lawrence County

- Slickwater frac (677,000 gal fluid, 600,000 lb sand), 576 ft interval
- Tested 115 MCFPD and 19 BOPD (5/6/2014), 2599 psi SIP
- Shut-in 5/30/2014
- 4,800 ft horizontal lateral permitted



TD 11,967, Rome

Resulting Leasing Boom

- Key Ky. counties: Johnson, Magoffin, Lawrence
- More than 4,275 deep leases in 18 months ending 6/15
- Prices per acre: \$250-300 (\$25-50 was common 5 years ago)

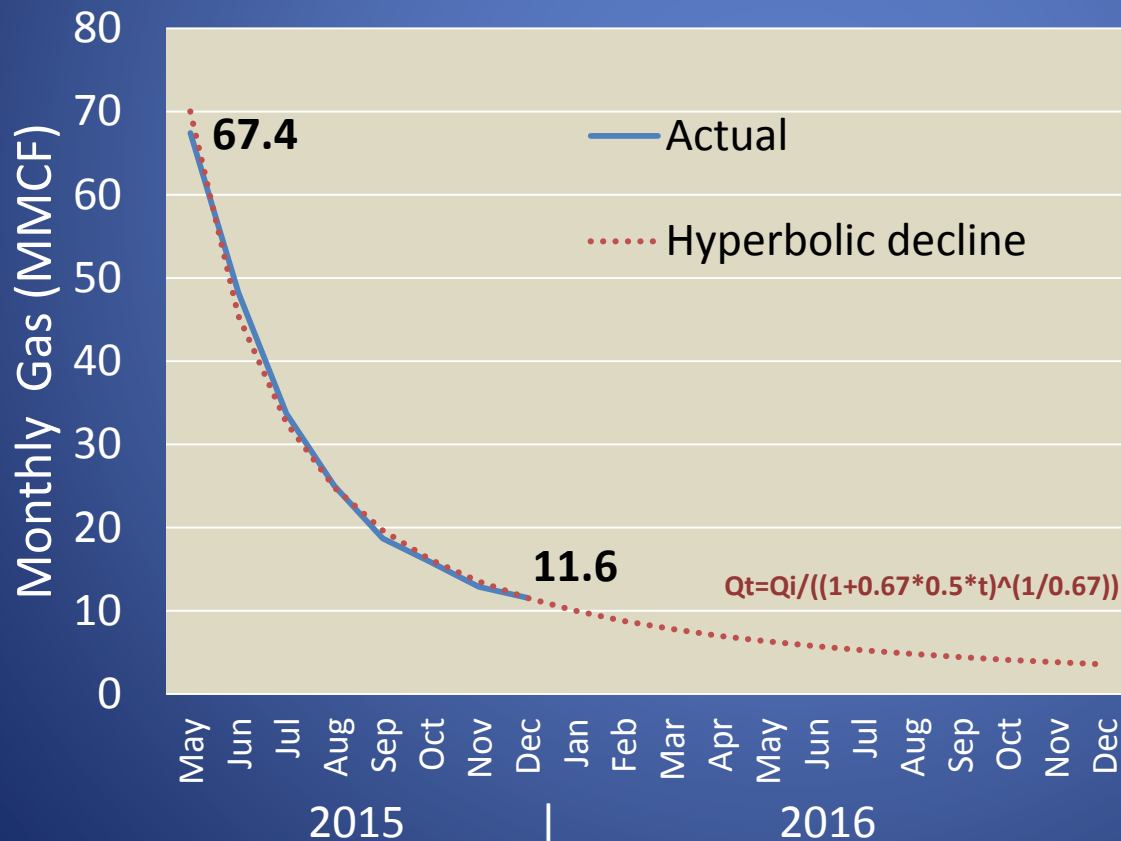
Wes Cate,
Global Natural Resource Mgmt, 2015

LAWRENCE, JOHNSON & MAGOFFIN	
Company Name	Total Number of Leases
Gulfland Appalachian	1073
Exterra Resources	466
EQT	400
Cimarex	378
G3 Royalty	350
Abarta Oil & Gas	329
Terra Nova Exploration, LLC	167
Nytis	140
Deep Creek Resources	112
Chesapeake	105
Stephen P. Bell	72
Troublesome Creek	55
Echelon Energy	53
East KY Fuels	45
Licking River Resources	42
Hay Exploration	33
Fireborn Energy, LLC	22
APP Energy, LLC	21
TOTAL	3863

Cabot #50 Amherst Industries, Putnam County, WV

- Completed in 2015; producing dry gas from ??

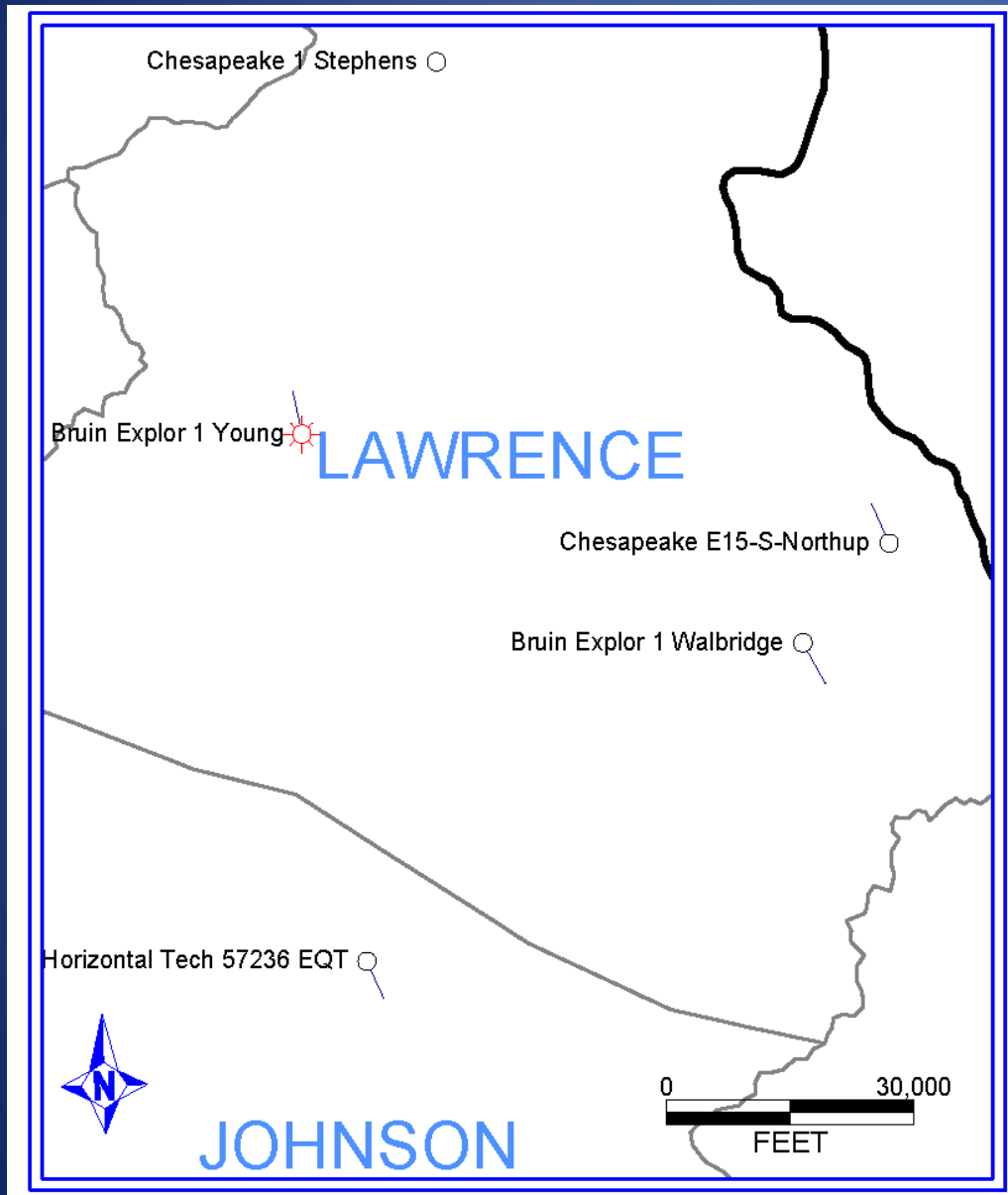
079-01538 Cabot 50 Amherst Industries



**Projected
20-month
cumulative:
305 MMCFG**

Decline analysis by
Brandon Nuttall, KGS

Other wells



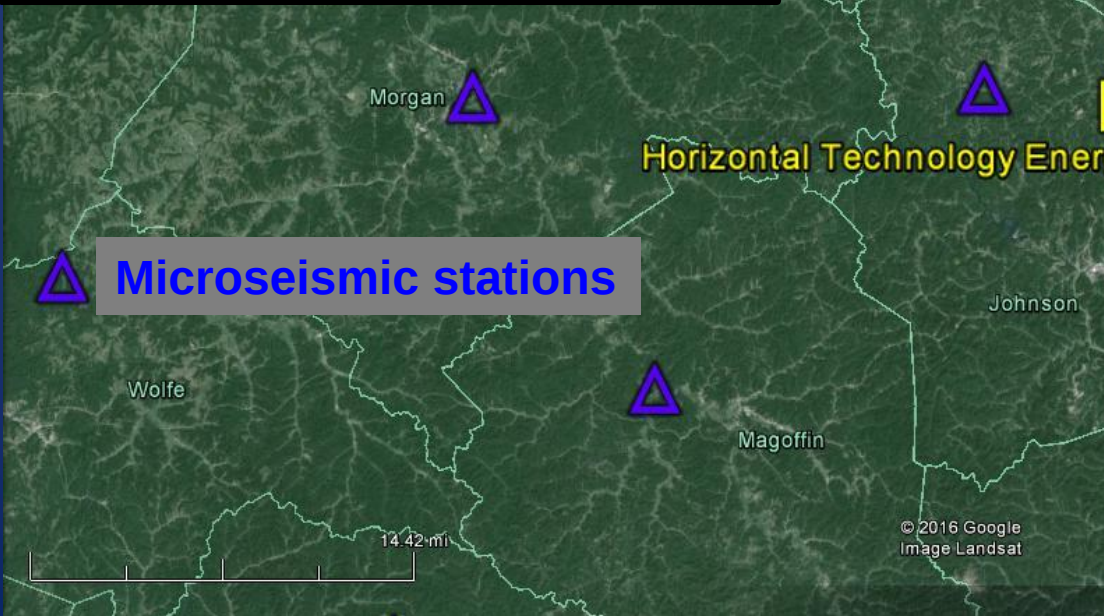
- *Horizontal Technology Energy Corp. (EQT)*
 - Johnson County, KY: 4,300 ft lateral drilled/tested
- *Chesapeake Energy*
 - Two vertical wells re-permitted as oil & gas wells, the Northup as a 5,200 ft lateral

KGS Research Efforts

- Two monitoring programs to collect baseline data:
 - Microseismic: 12 stations installed; partnering with Cimarex Energy, Nanometrics
 - Groundwater quality from domestic wells
- Establishing background data prior to development will allow recognition of natural vs. man-made events
- Goal: avoid induced seismicity, fracking concerns seen in other areas



KGS Microseismic Station
Installation 10/19/2015



Chesapeake #1 Stephens
10/19/2015

New Regulations: 2015

- Senate Bill 186 passed
 - Provides regulatory certainty for deep shale dev.
 - New deep well definition (>6,000 ft)
 - High-volume horizontal fracs: >80,000 gal per stage or 320,000 gal total
 - For deep HVHF, notify surface owners within 1,000 ft of well head before frac, and surface water/groundwater testing required
 - FracFocus disclosure required for HVHF within 90 days

New Regulations: 2016

- Senate Bill 188 passed
 - Clarifies confidentiality on stratigraphic test permits
 - Limit of 3 years confidentiality on strat tests
 - Converting strat test to oil and gas permit reduces confidentiality to 1 year (same as oil and gas permit)

Conclusions

- Cambrian Rogersville Shale petroleum system exists in Rome Trough
- Rogersville unconventional play concept has been proven— economic success has not
- Data is very scarce, leading to hype and speculation
- Activity on hold due to low prices
- Play status: WOD (waiting on data)