The Emerging Rogersville Shale Play: Hurry up and Wait…

AAPG Playmaker Forum

Pittsburgh

April 13, 2016

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Outline of Presentation

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

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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

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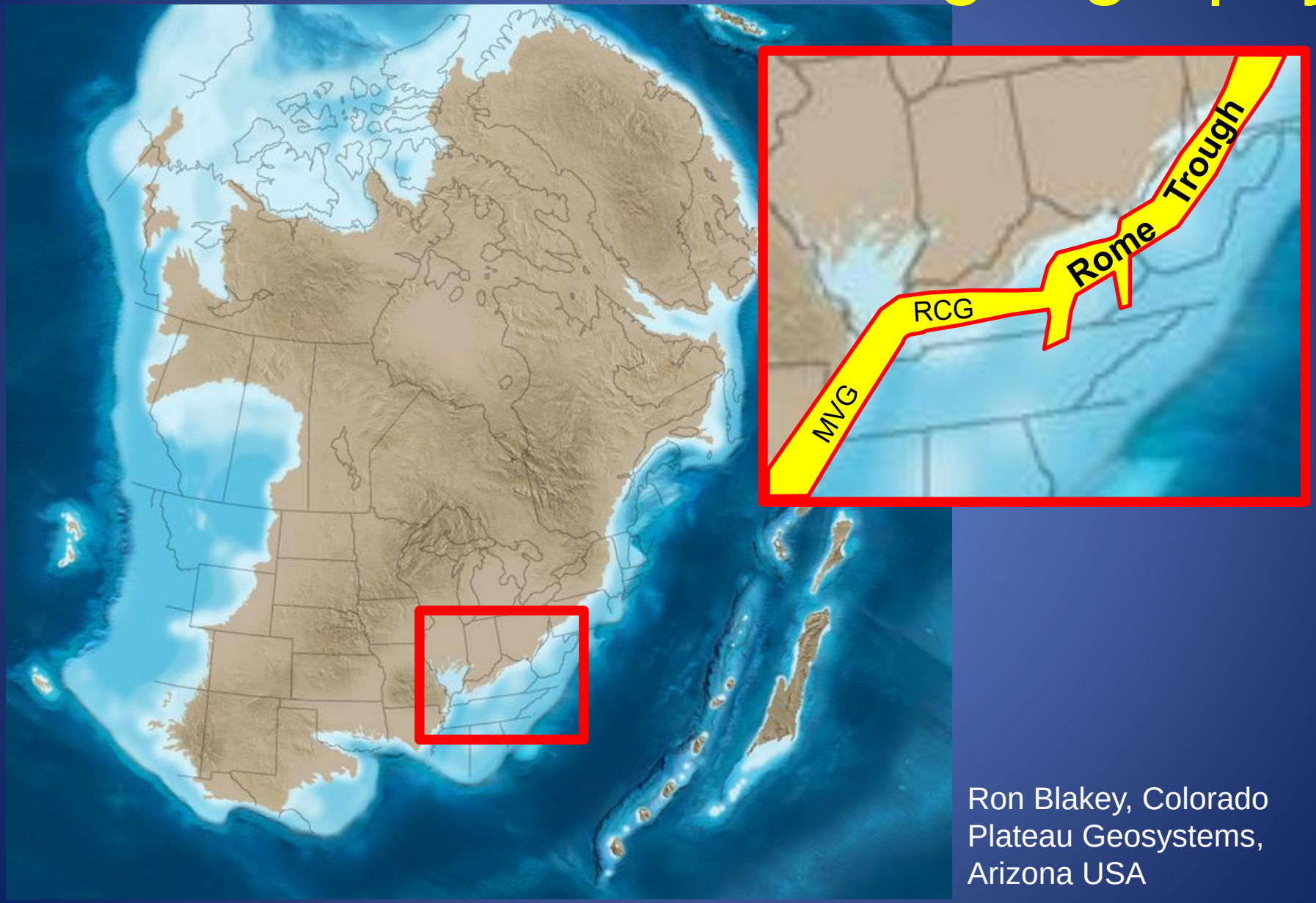
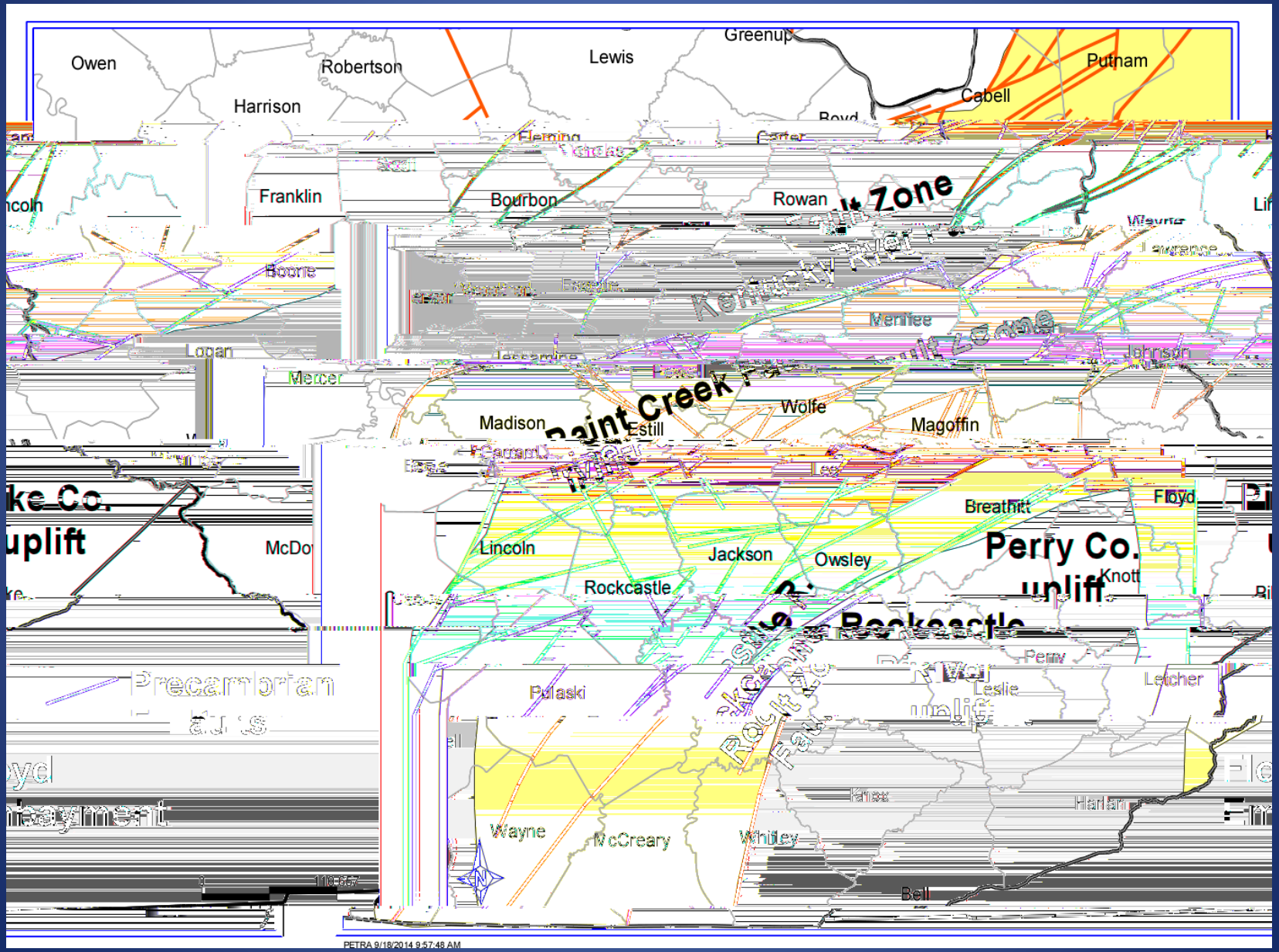
Middle Cambrian Paleogeography



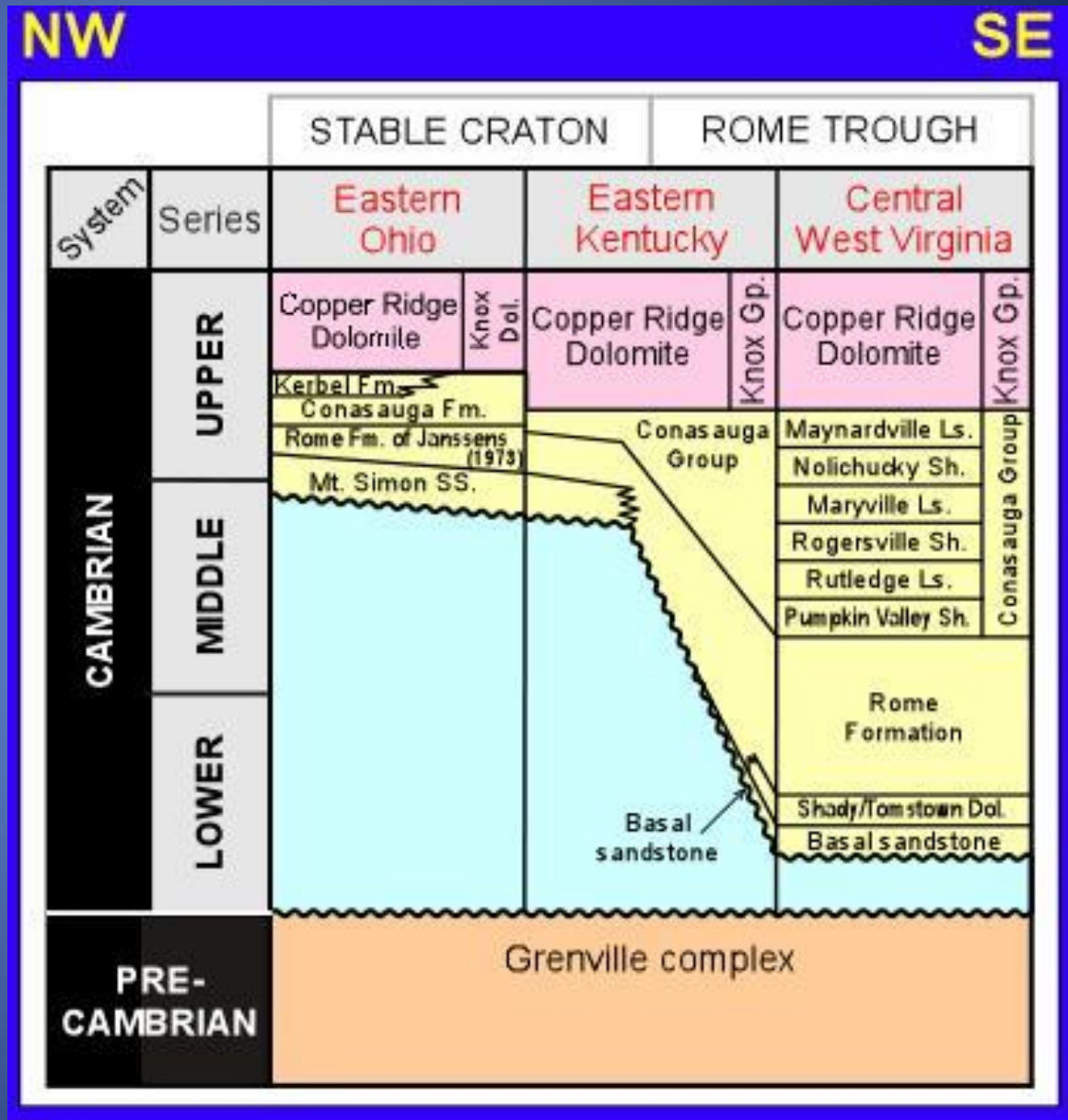
Ron Blakey, Colorado Plateau Geosystems, Arizona USA

Rome Trough Structural Features



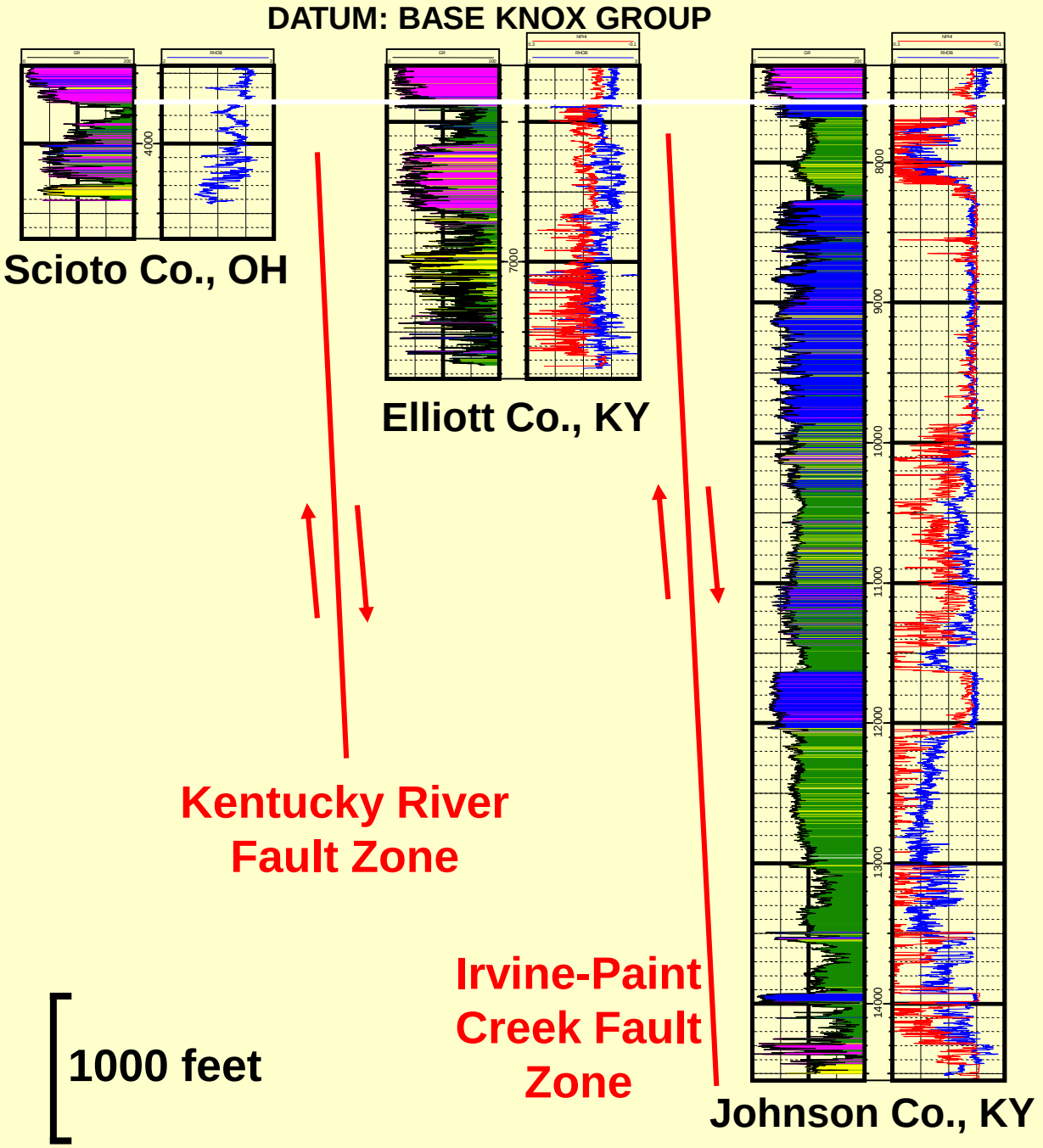
Pre-Knox Stratigraphy

- 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



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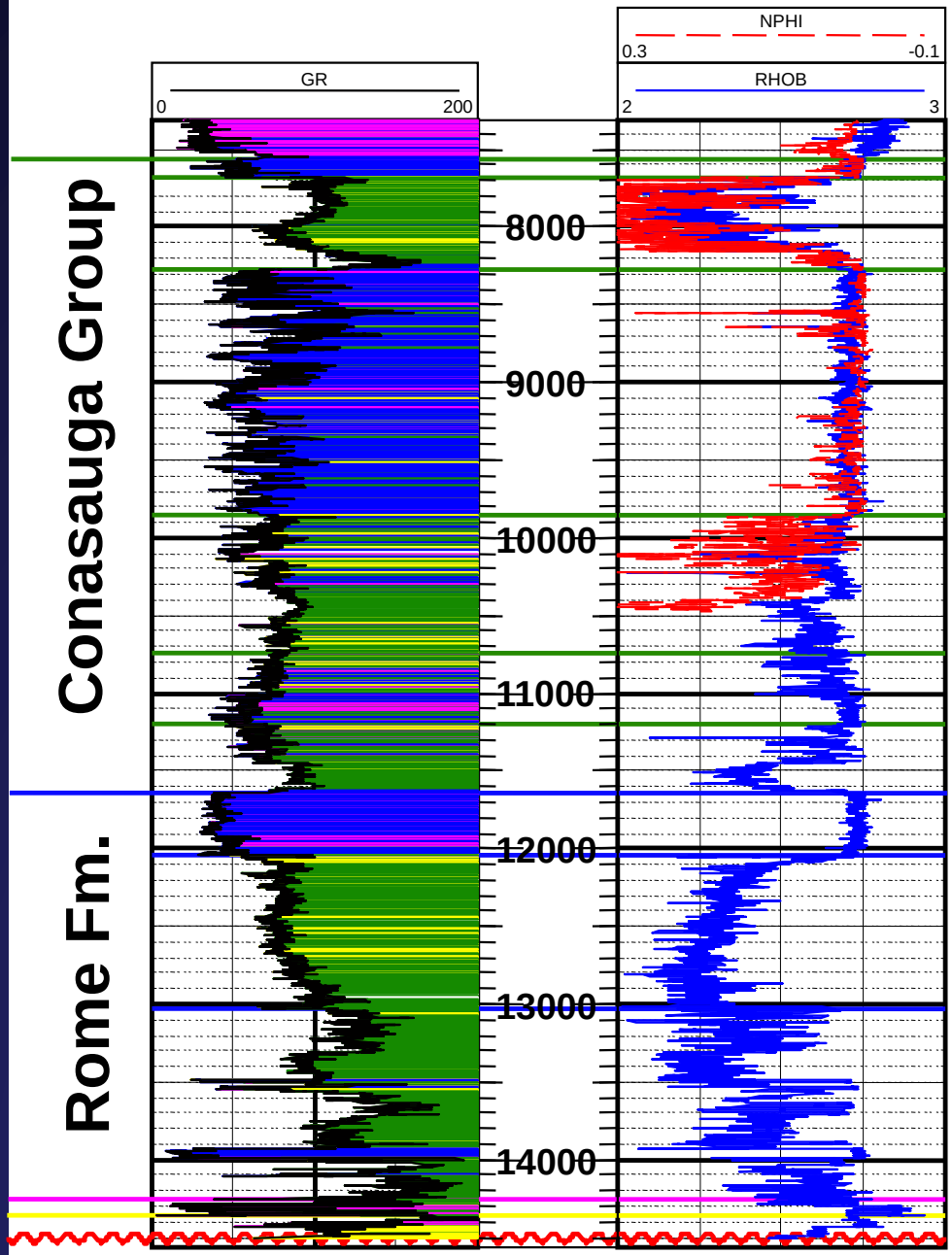
Pre-Knox Type Log

U.S. Signal
Elkhorn Coal
Johnson Co.
Kentucky

Gamma ray shaded By log-calculated lithologies



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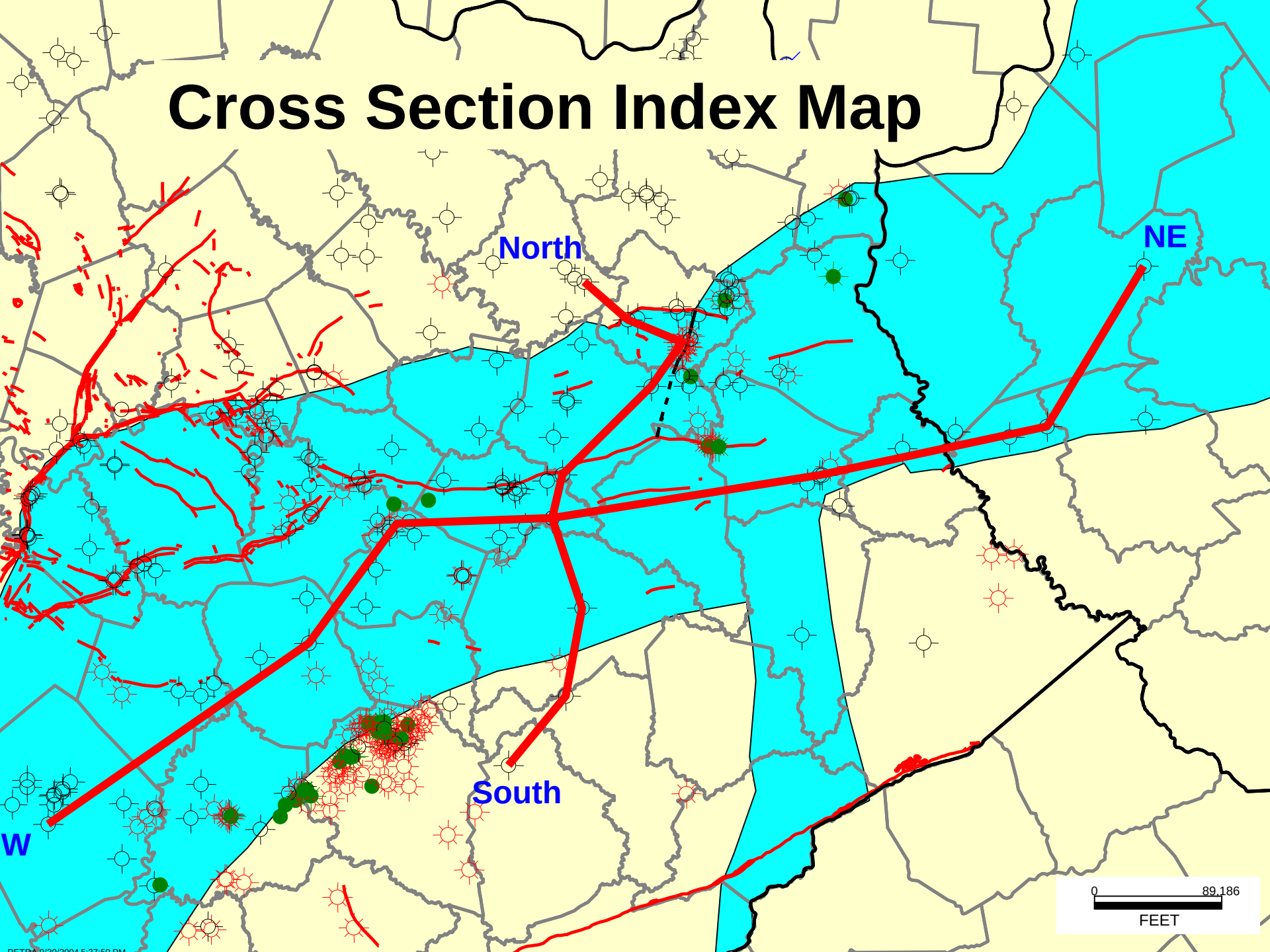
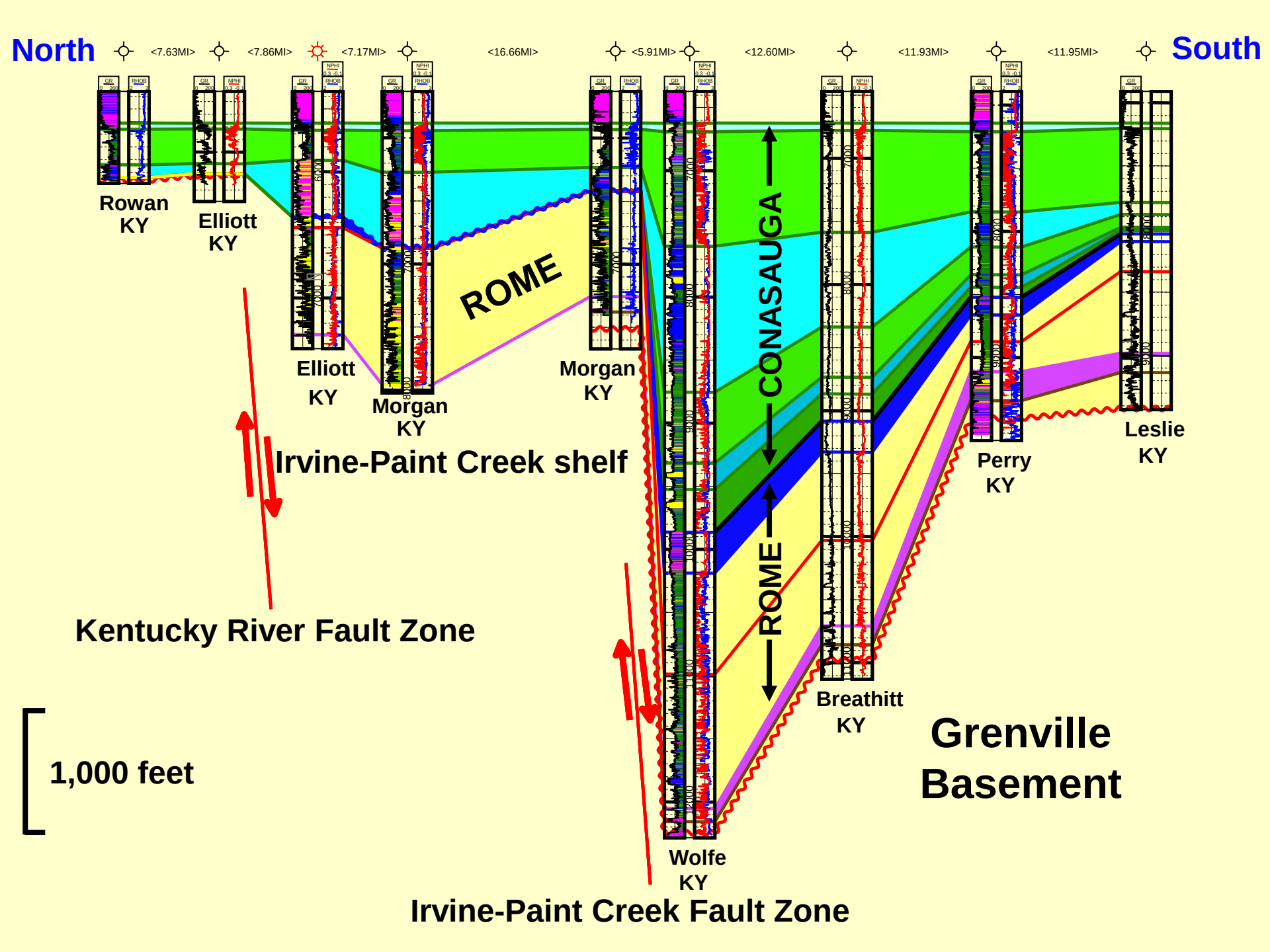
Cross Section Index Map

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<7.86MI>
<7.17MI>
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<12.60MI>
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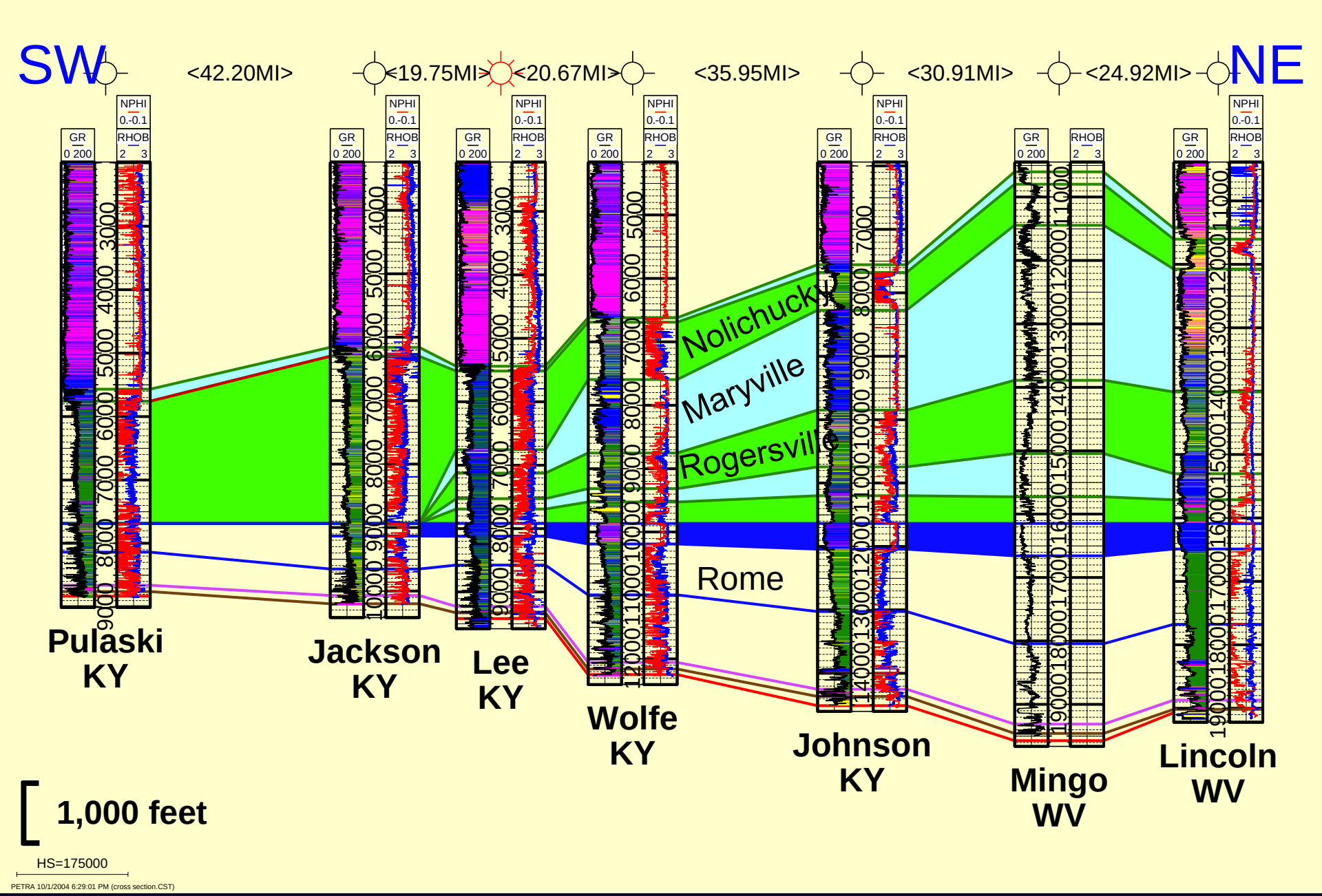
South
Rowan KY
Elliott KY
Elliott KY
Morgan KY
Morgan KY
ROME
CONASAUGA
ROME
Perry KY
Leslie KY
Breathitt KY
Wolfe KY
Irvine-Paint Creek shelf
Kentucky River Fault Zone
Irvine-Paint Creek Fault Zone
1,000 feet
Grenville Basement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<35.95MI>
<30.91MI>
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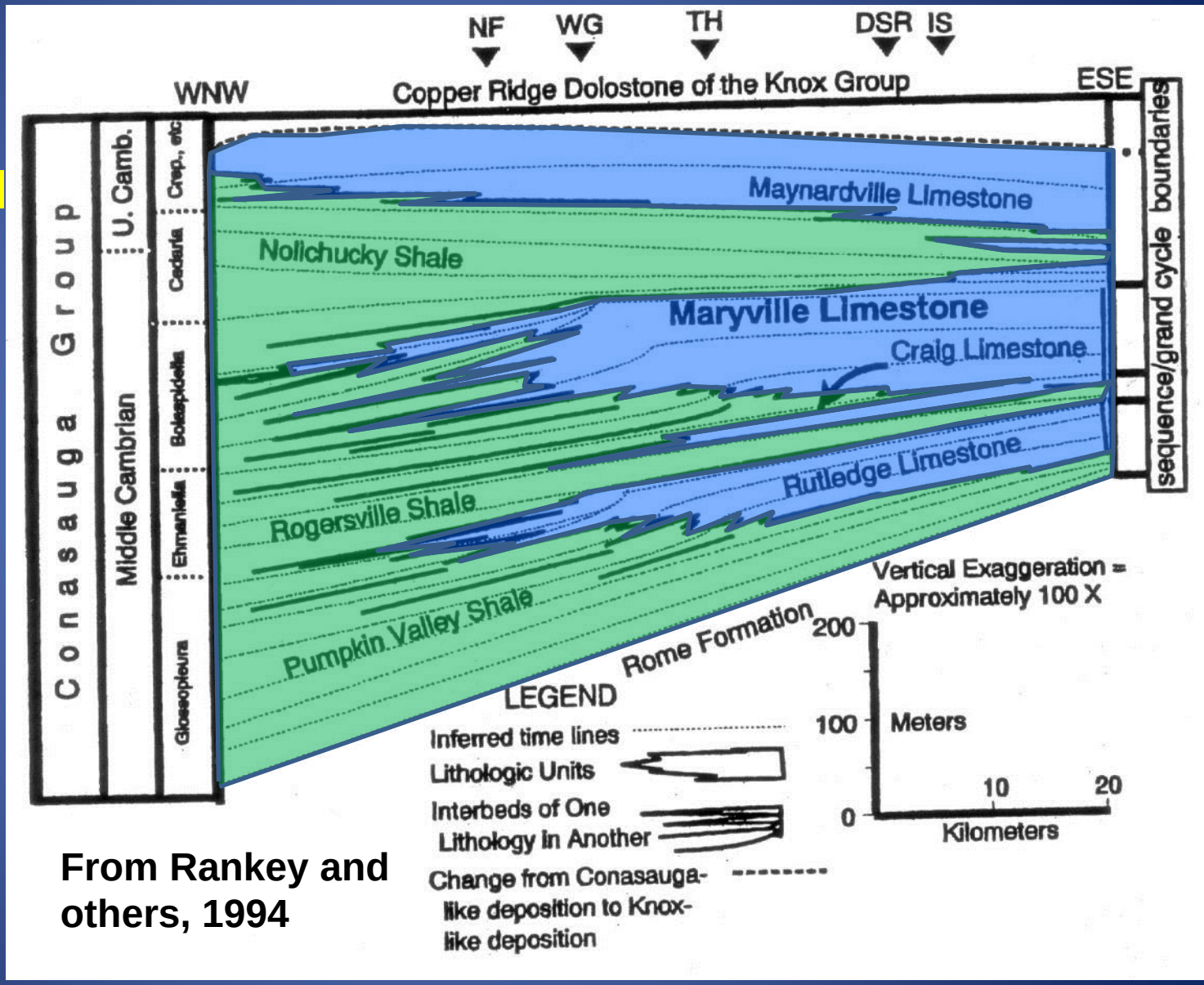
NE
NPHI
0.-0.1
RHOB
2 3
GR
0 200
Nolichucky
Maryville
Rogersville
Rome
Pulaski KY
Jackson KY
Lee KY
Wolfe KY
Johnson KY
Mingo WV
Lincoln WV
1,000 feet
HS=175000
PETRA 10/1/2004 6:29:01 PM (cross section.CST)

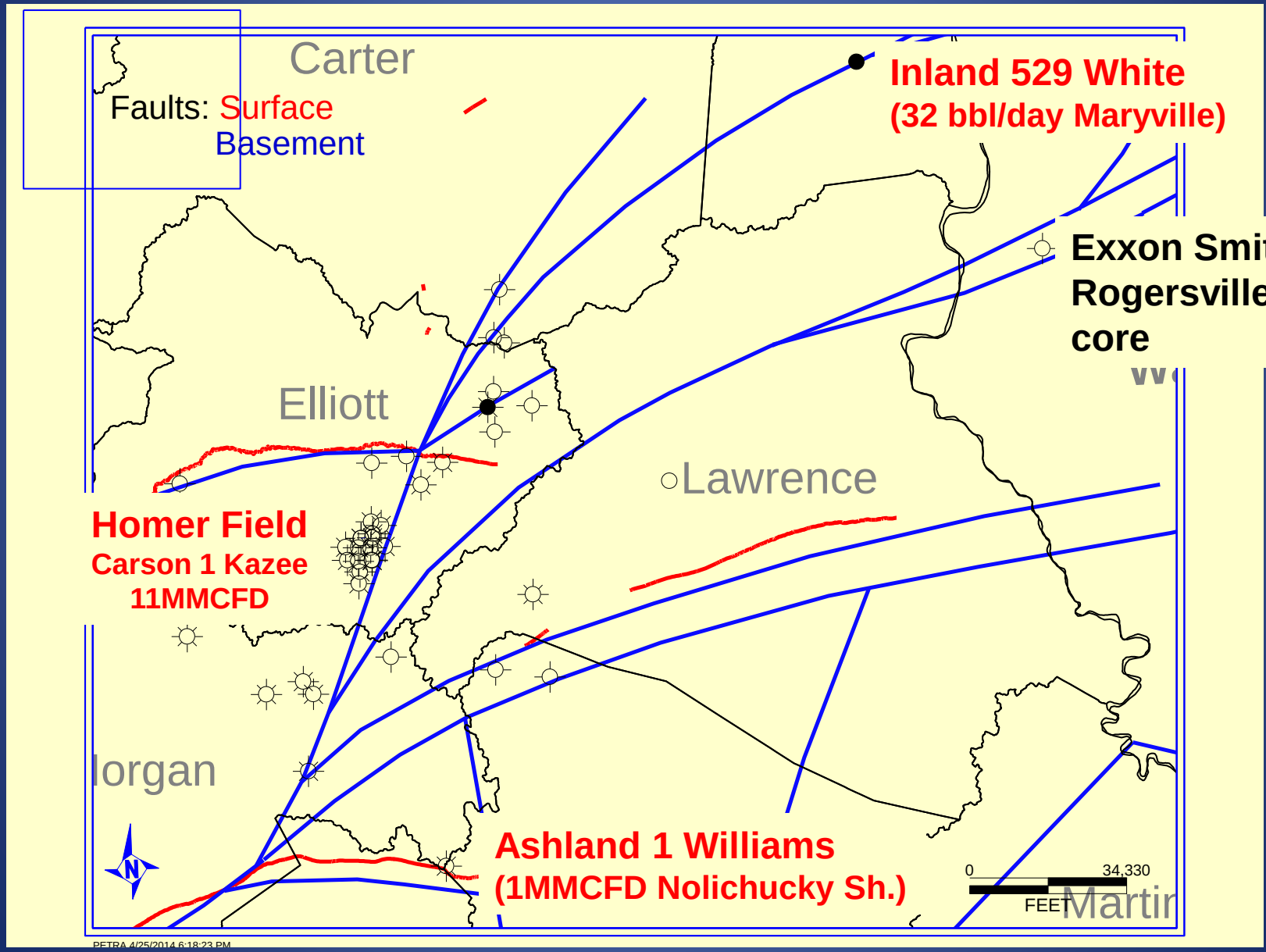
East Tennessee Conasauga Outcrops

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



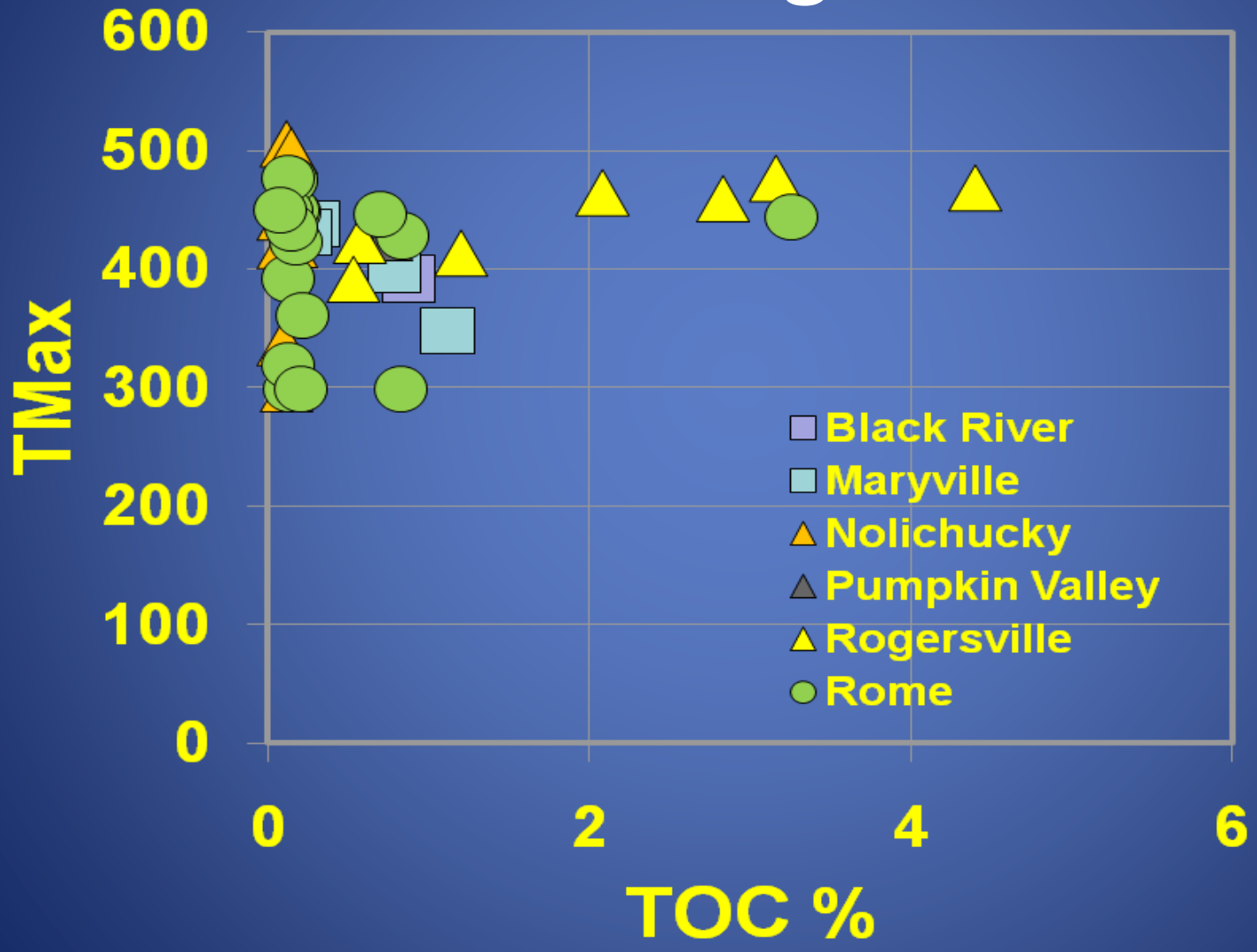
From Rankey and others, 1994

Rome Trough Production



Exxon #1 Smith core: 11,191-11,200’

Cambrian Source Rocks in Rome Trough



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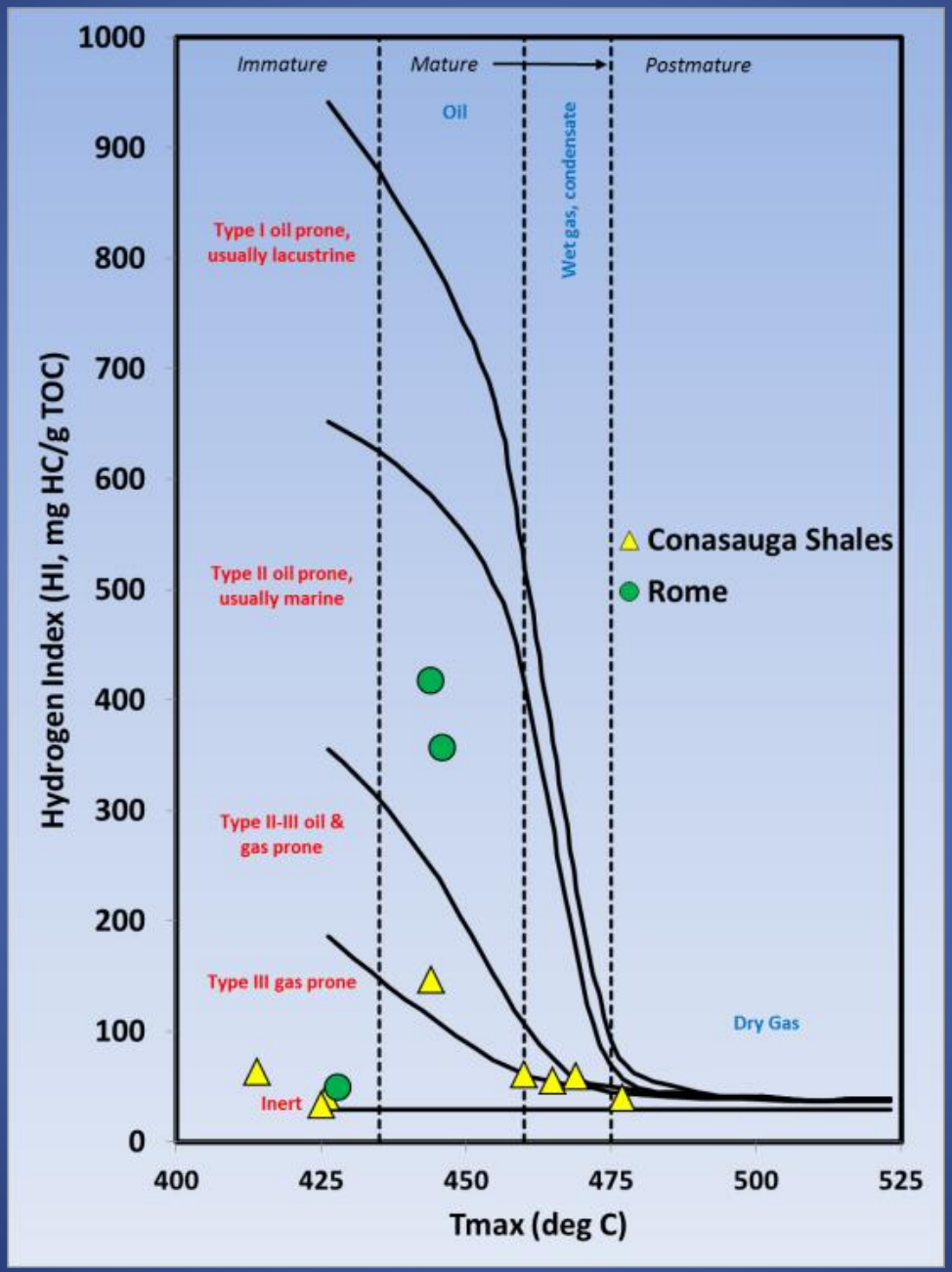
RTC Maturity and Kerogen Data



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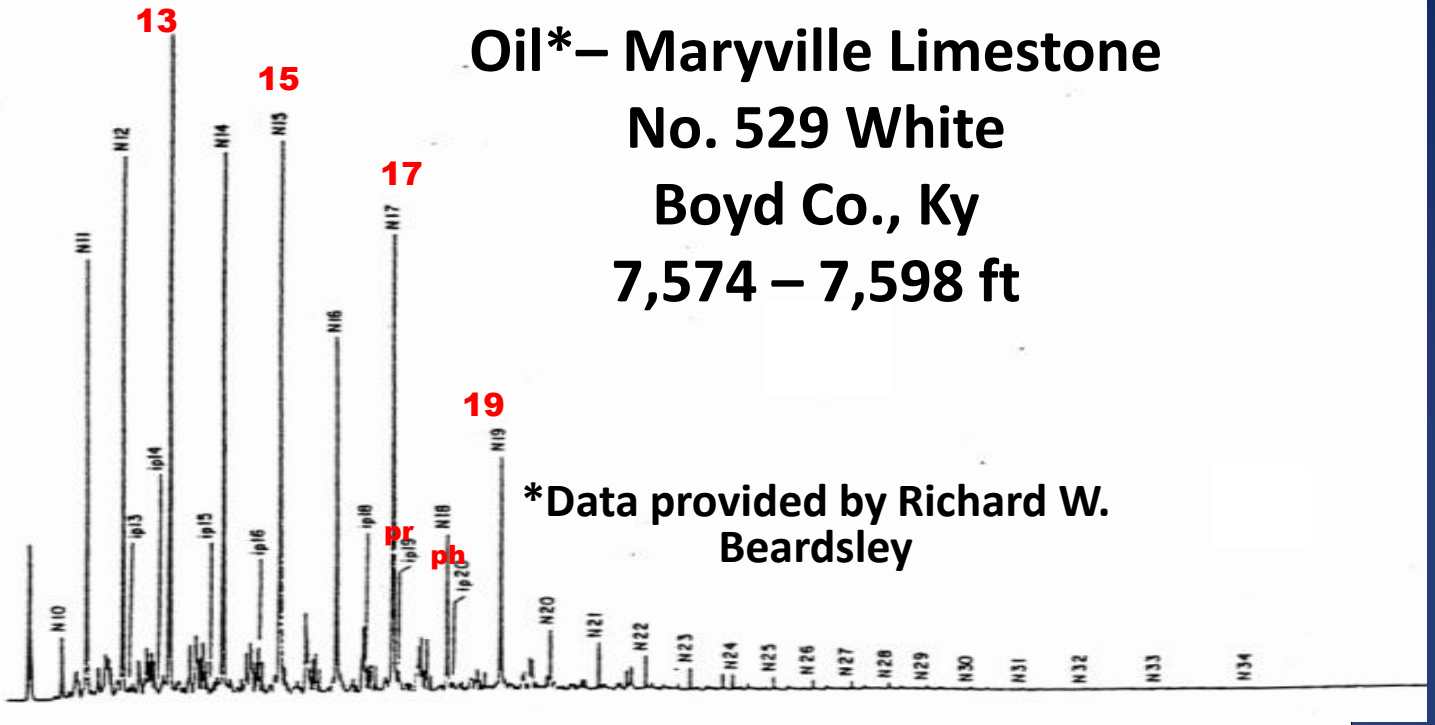
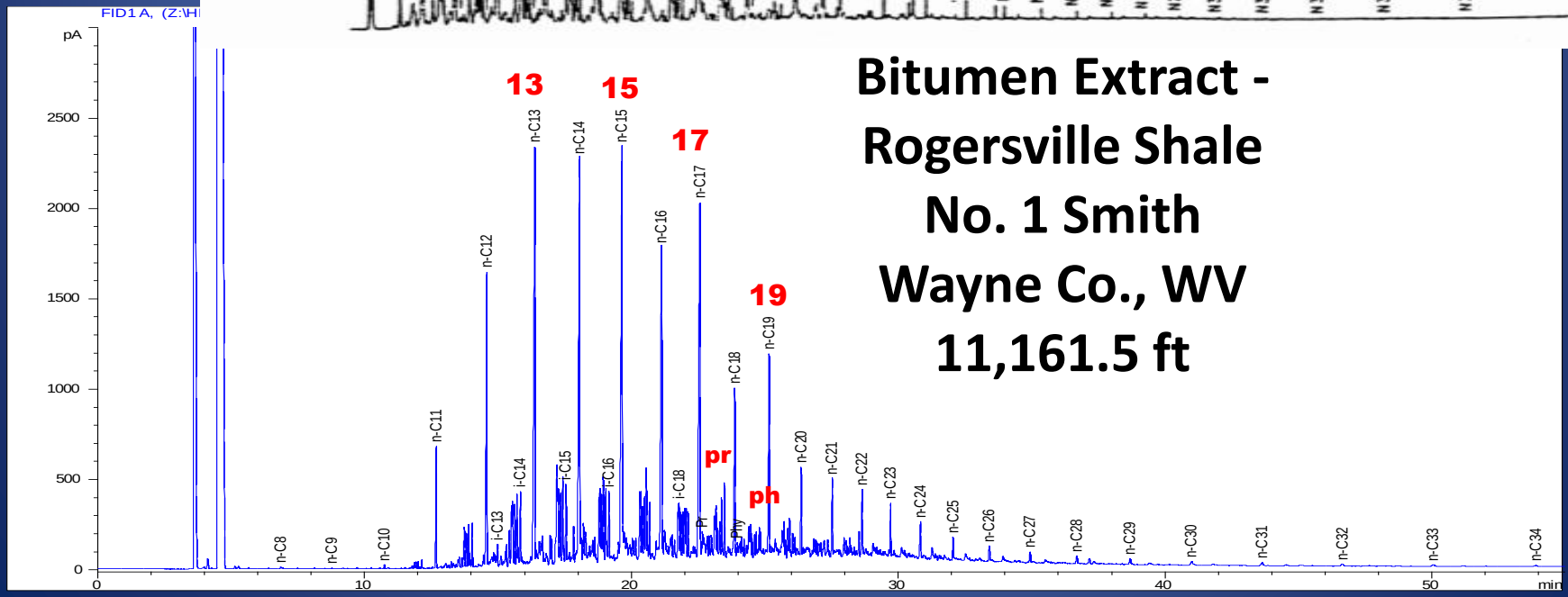
Oil – Source Rock Correlation



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)

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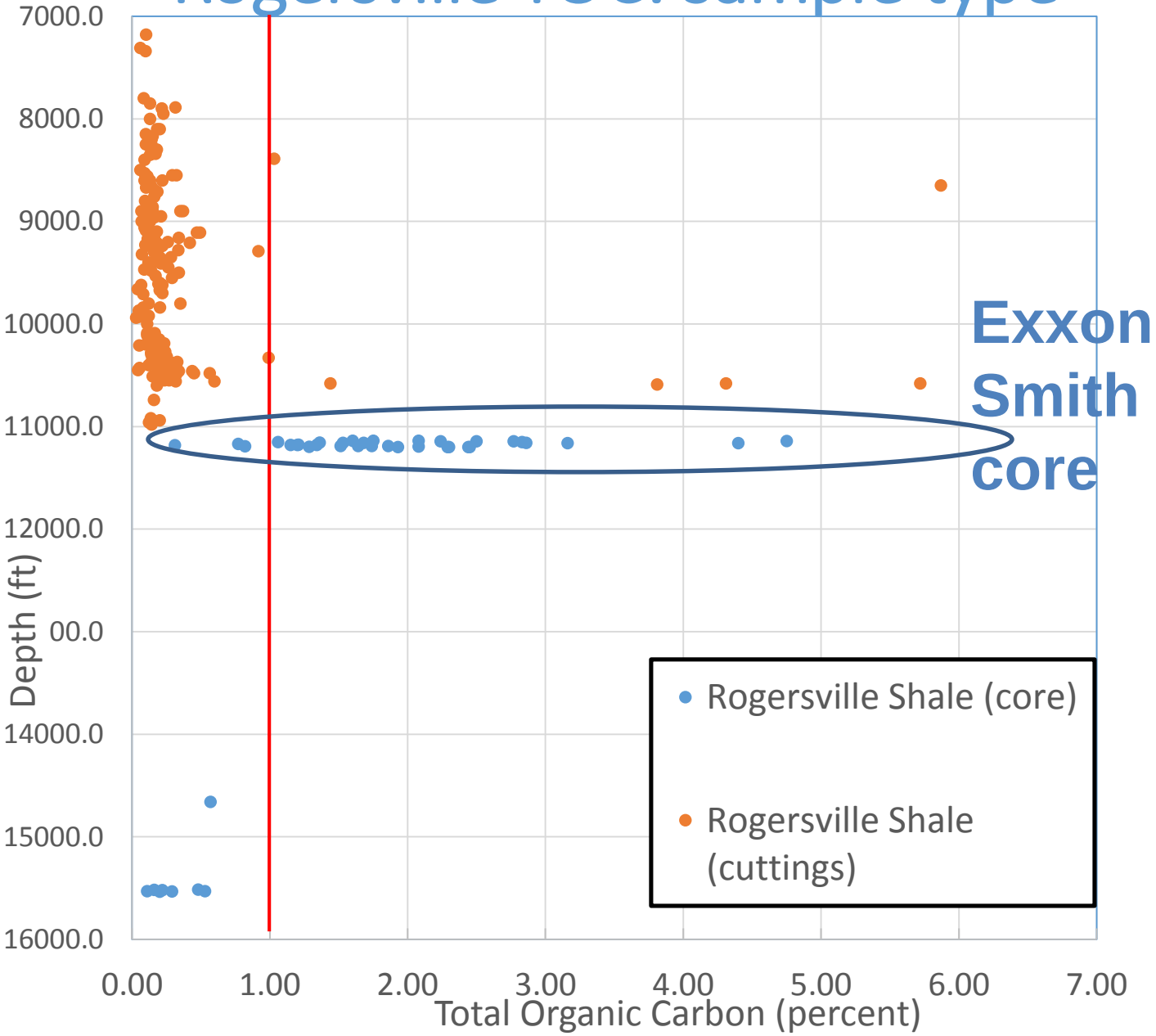
Rogersville TOC: sample type



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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

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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

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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

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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

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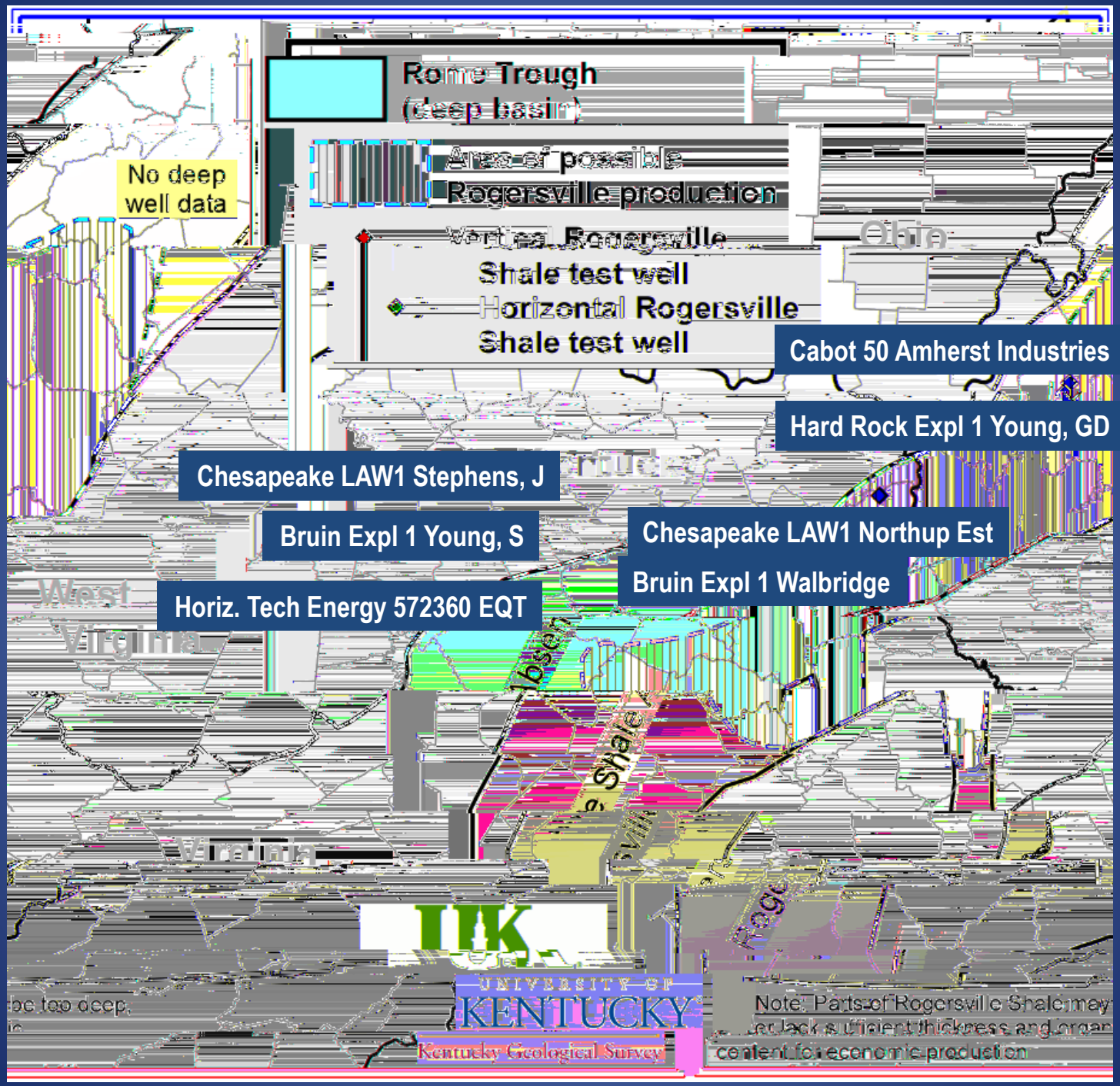
Rome Trough
(deep basin)
Area of possible
Rogersville production
Vertical Rogersville
Shale test well
Horizontal Rogersville
Shale test well
No deep
well data
Ohio
Cabot 50 Amherst Industries
Hard Rock Expl 1 Young, GD
Chesapeake LAW1 Stephens, J
Bruin Expl 1 Young, S
Chesapeake LAW1 Northup Est
Bruin Expl 1 Walbridge
Horiz. Tech Energy 572360 EQT
West
Virginia
Virginia
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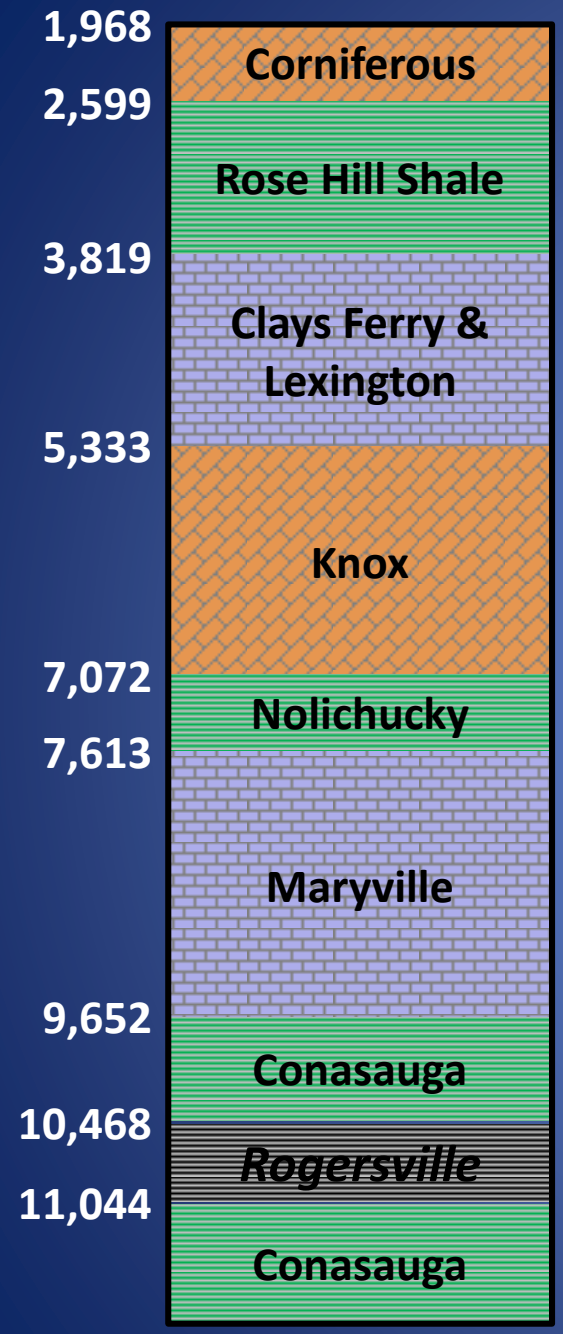
be too deep.
Note: Parts of Rogersville Shale may
content for economic production



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

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Resulting Leasing Boom

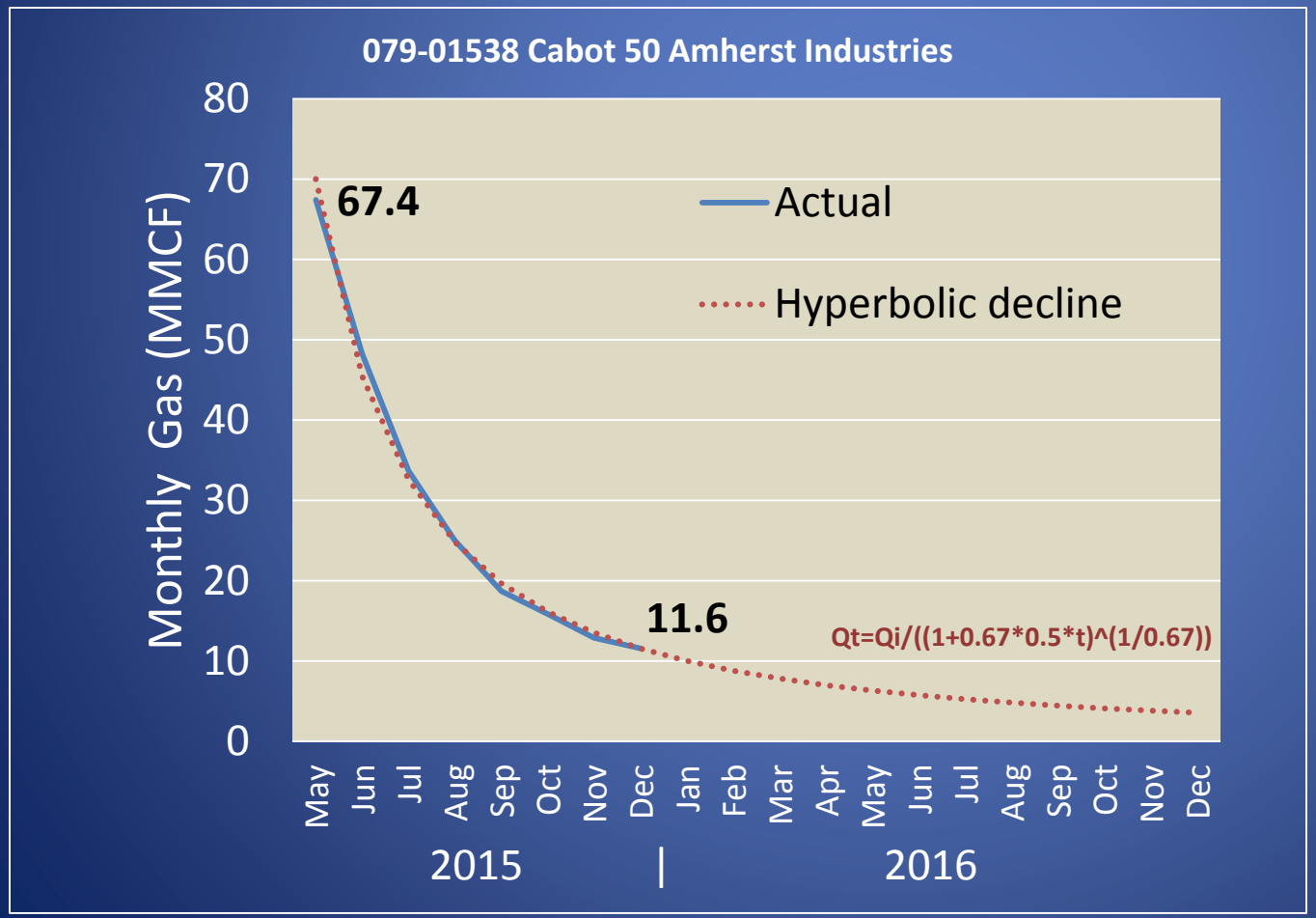
- Key Ky. counties: Johnson, Magoffin, Lawrence
- More than 4,275 deep leases in 18 months ending 6/15
- Prices per acre: $250-300 ($25-50 was common 5 years ago)

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 ??



Projected 20-month cumulative: 305 MMCFG

Decline analysis by Brandon Nuttall, KGS

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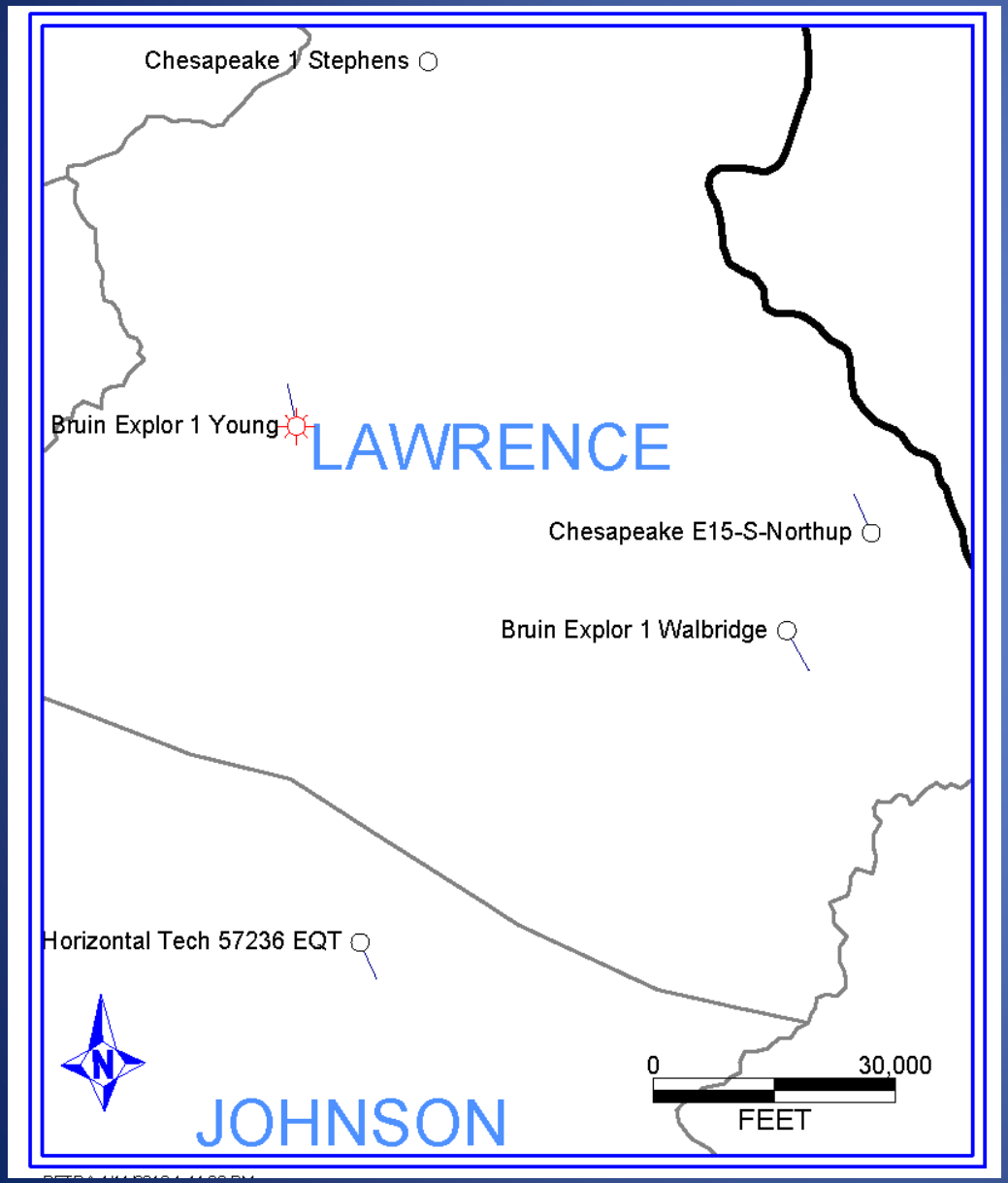
Other wells



- *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

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KGS Microseismic Station
Installation 10/19/2015

Chesapeake #1 Stephens
10/19/2015

Microseismic stations

sapeake #1 Stephens

Exxon #1 Smith

Wayne

oration #1 Young

Bruin

Morgan

Horizontal Technology Ener

Johnson

Wolfe

Magoffin

14.42 mi

© 2016 Google
Image Landsat

Google earth

Imagery Date: 4/9/2013 37°59'20.66" N 82°55'00.34" W elev 785 ft eye alt 62.19 mi

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

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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)