OVERVIEW OF THE ROGERSVILLE SHALE IN WEST VIRGINIA

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West Virginia Geological & Economic Survey

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ACKNOWLEDGEMENT

- Dave Harris, John Hickman, Kentucky Geological Survey

DATA NOTE

- All Data Presented is publicly available and/or acquired from publicly available material

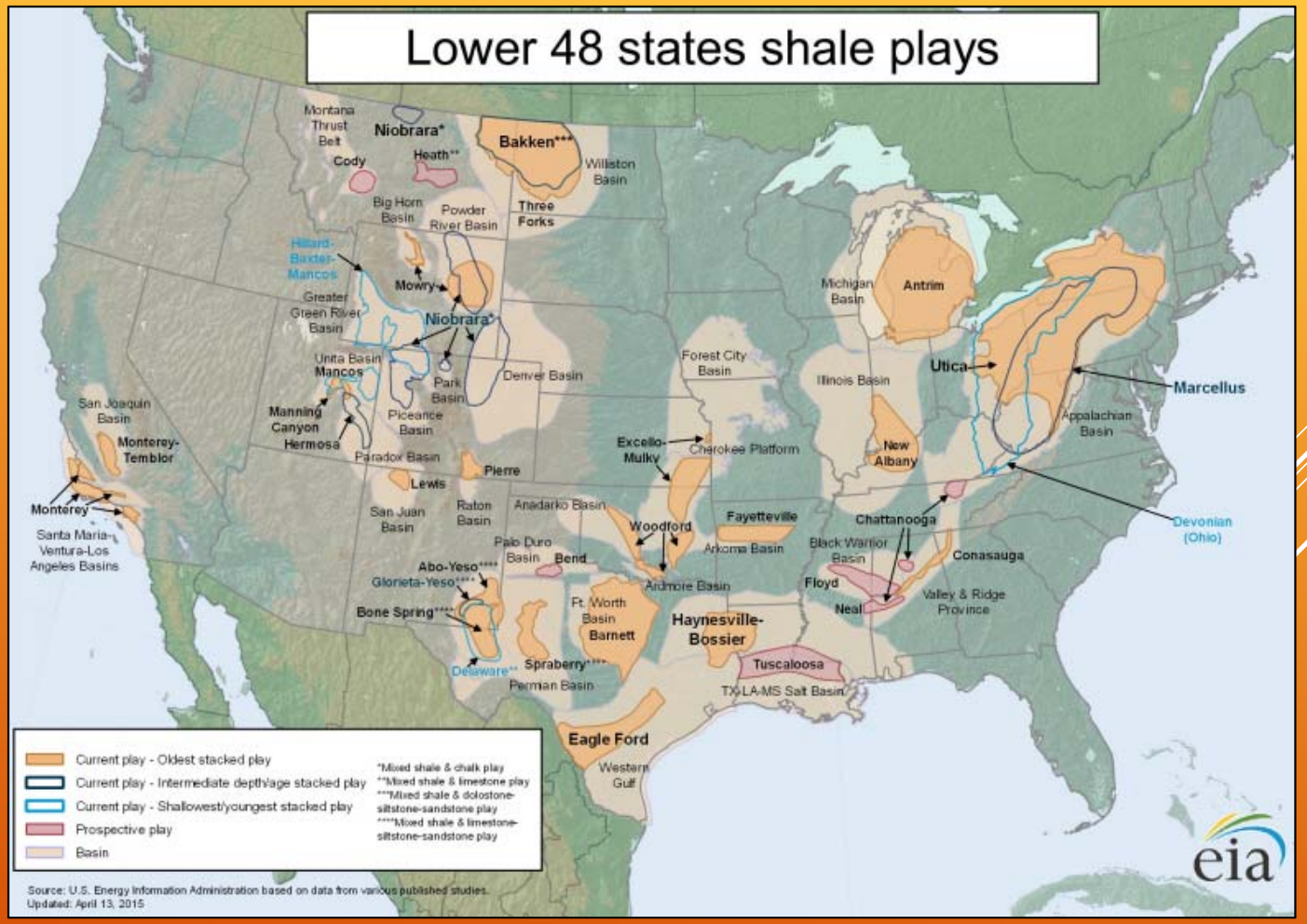
OUTLINE

- ROGERSVILLE SHALE INFORMATION
- ROME TROUGH
- PREVIOUS AND ONGOING WORK
- CORE DATA
- RECENT ACTIVITY

IN THE APPALACHIAN BASIN THE MARCELLUS AND UTICA-POINT PLEASANT DOMINATE SHALE GAS PRODUCTION,

WHILE THE ROGERSVILLE IS NOT LISTED AS A CURRENT OR PROSPECTIVE PLAY…..

WILL THIS CHANGE?



AN EMERGING PLAY?

- What makes the Rogersville different than the Marcellus or Utica-Point Pleasant?
- Does the Rogersville have the potential to be a productive play in West Virginia?
- If it does have potential, what are the reasons it has not been developed yet?

GENERAL ROGERSVILLE SHALE INFORMATION

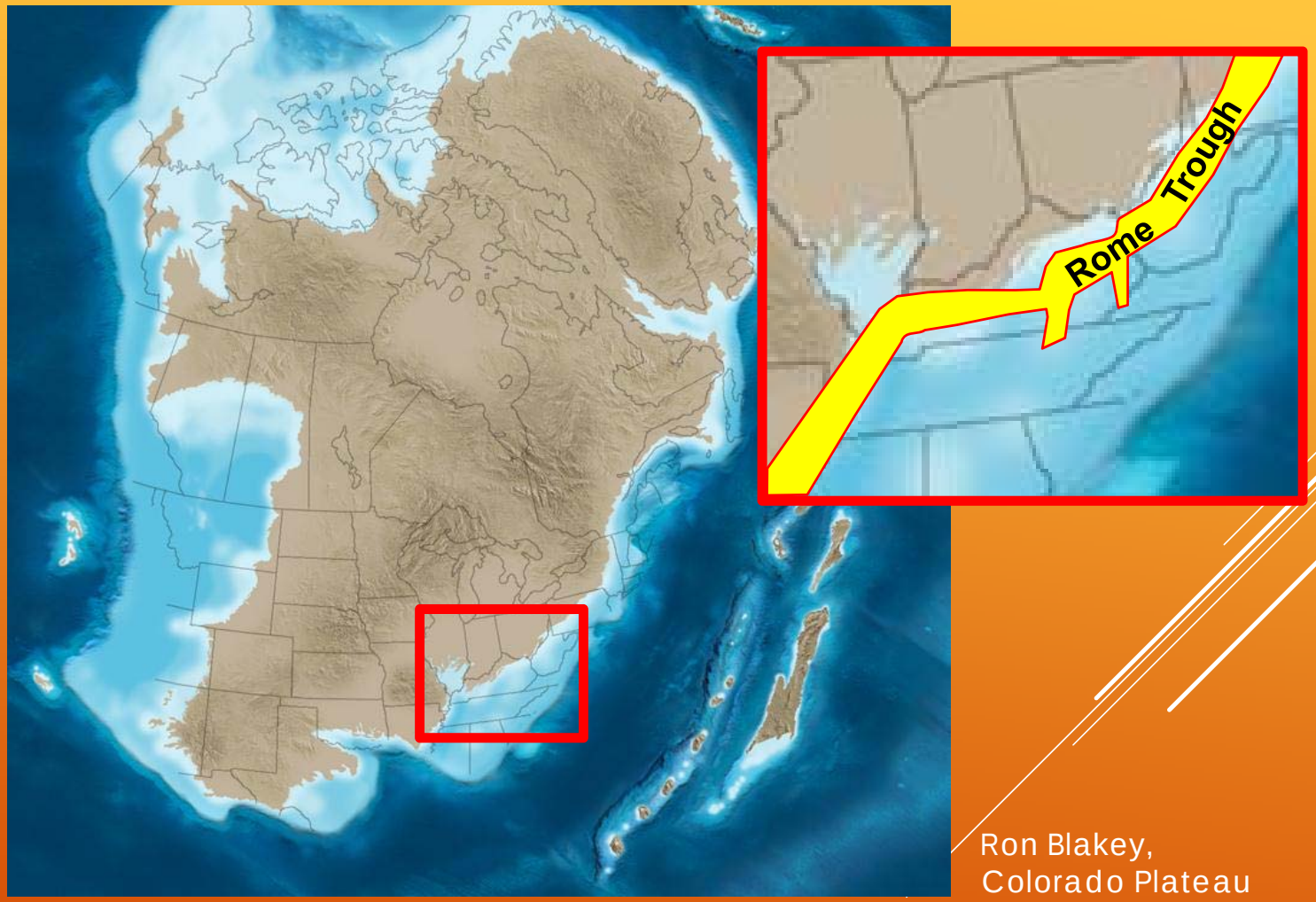
- Unit within the Cambrian-age Conasauga Group
- Middle Cambrian ~500 Million Years Old
- Organic-rich dark shale mixed with siltstone and carbonates
- Depth ~10,000-17,000 feet in WV (in KY 5,000-10,000 feet deep)
- Thickness 0 - 1,000+ feet **(not all is organic rich)**

WHERE IS THE ROGERSVILLE IN WEST VIRGINIA?

- Rogersville-(depending on location) is…..
- 7,000-9000 feet below Marcellus
- ~5,000 feet below Utica-Point Pleasant
- Deposition limited to within the Rome Trough

Middle Cambrian Paleogeography

Rogersville Deposition



Ron Blakey,
Colorado Plateau
Geosystems, Arizona
USA

ROME TROUGH

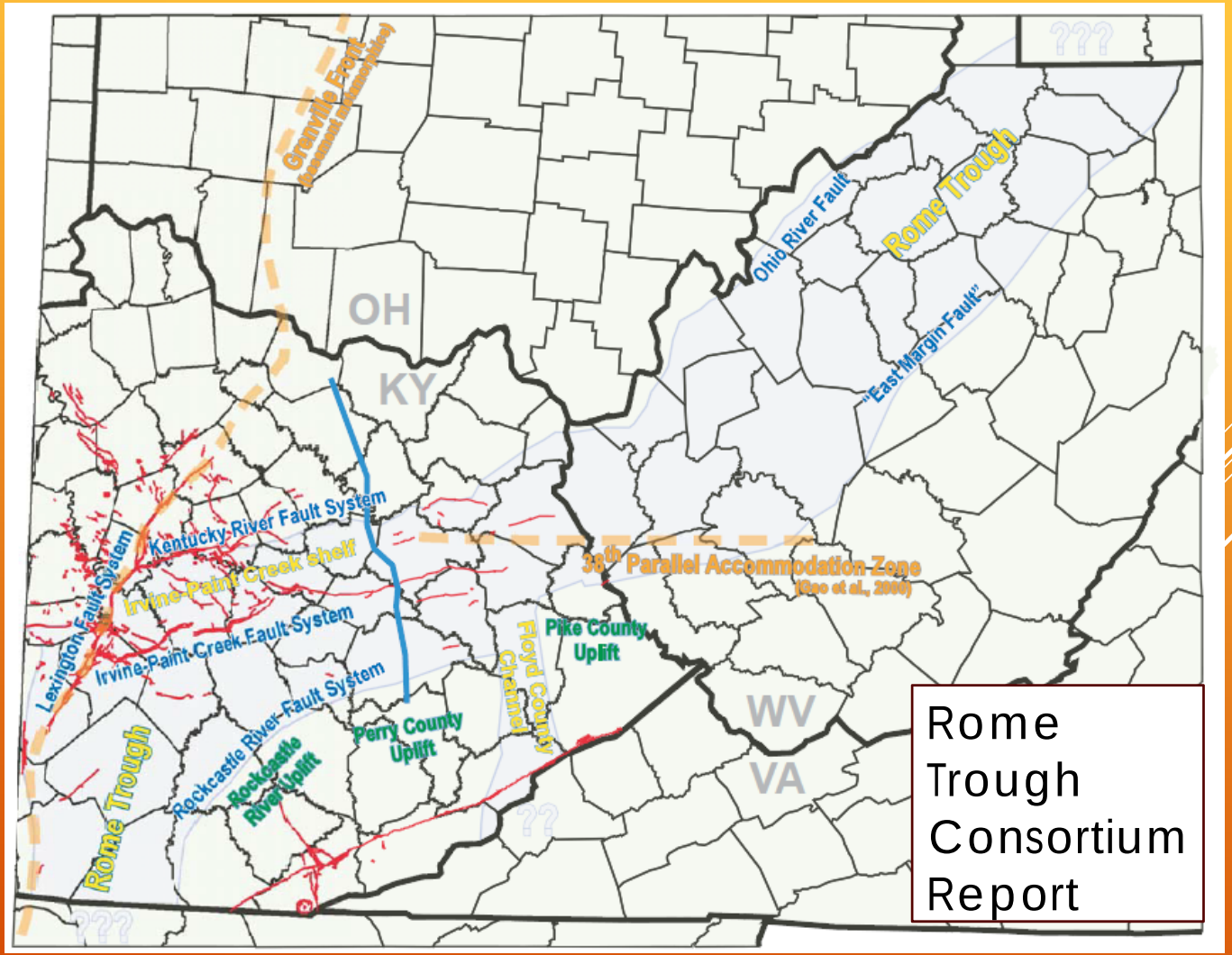
Early to Middle Cambrian extensional graben

Extends from northern Tennesse northeastward into southwestern Pennsylvania, possibly into southern New York

Part of interior rift system formed with opening of Iapetus Ocean

Major boundaries are formed by basement rooted faults

Faults are high angle normal faults.



ROME TROUGH

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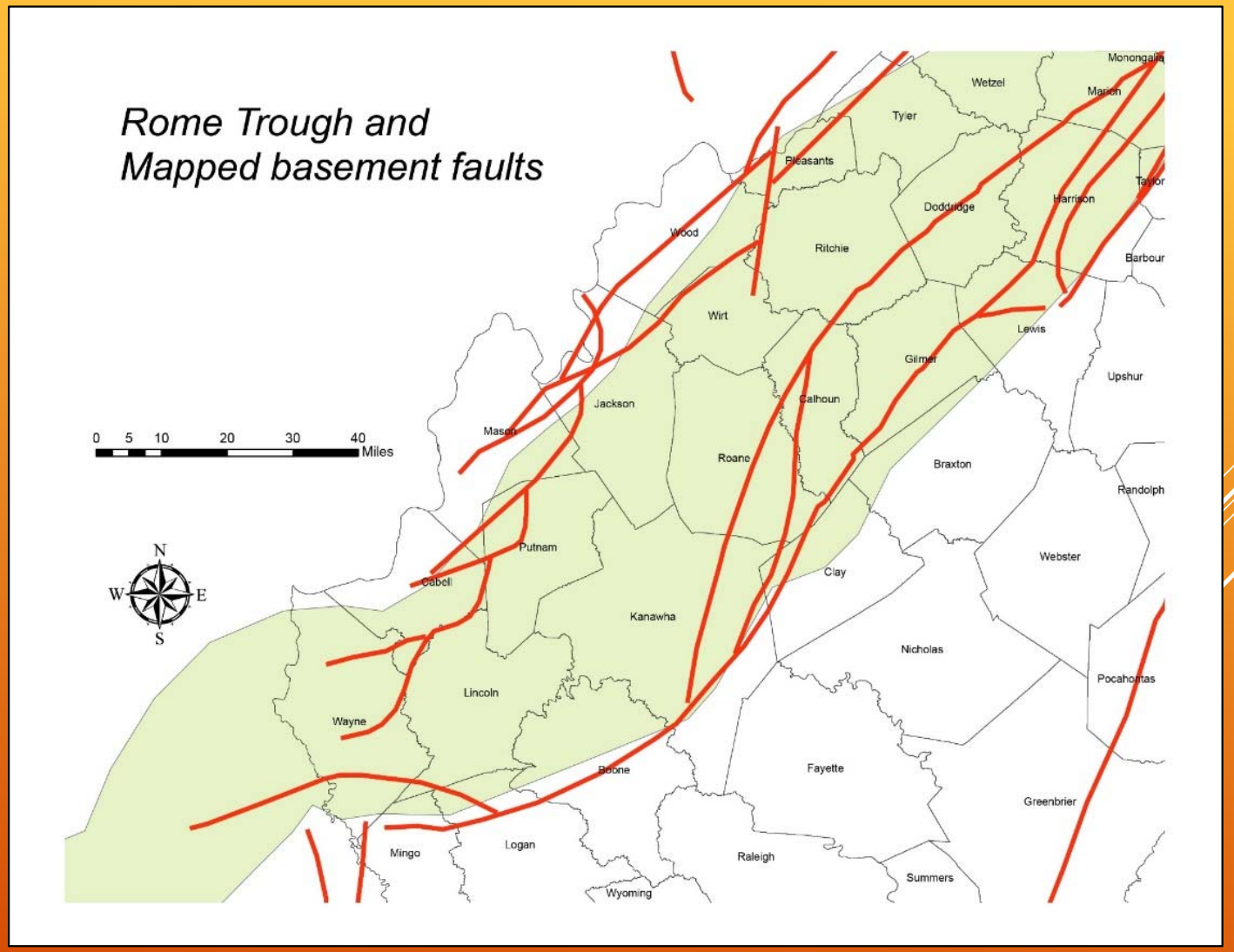
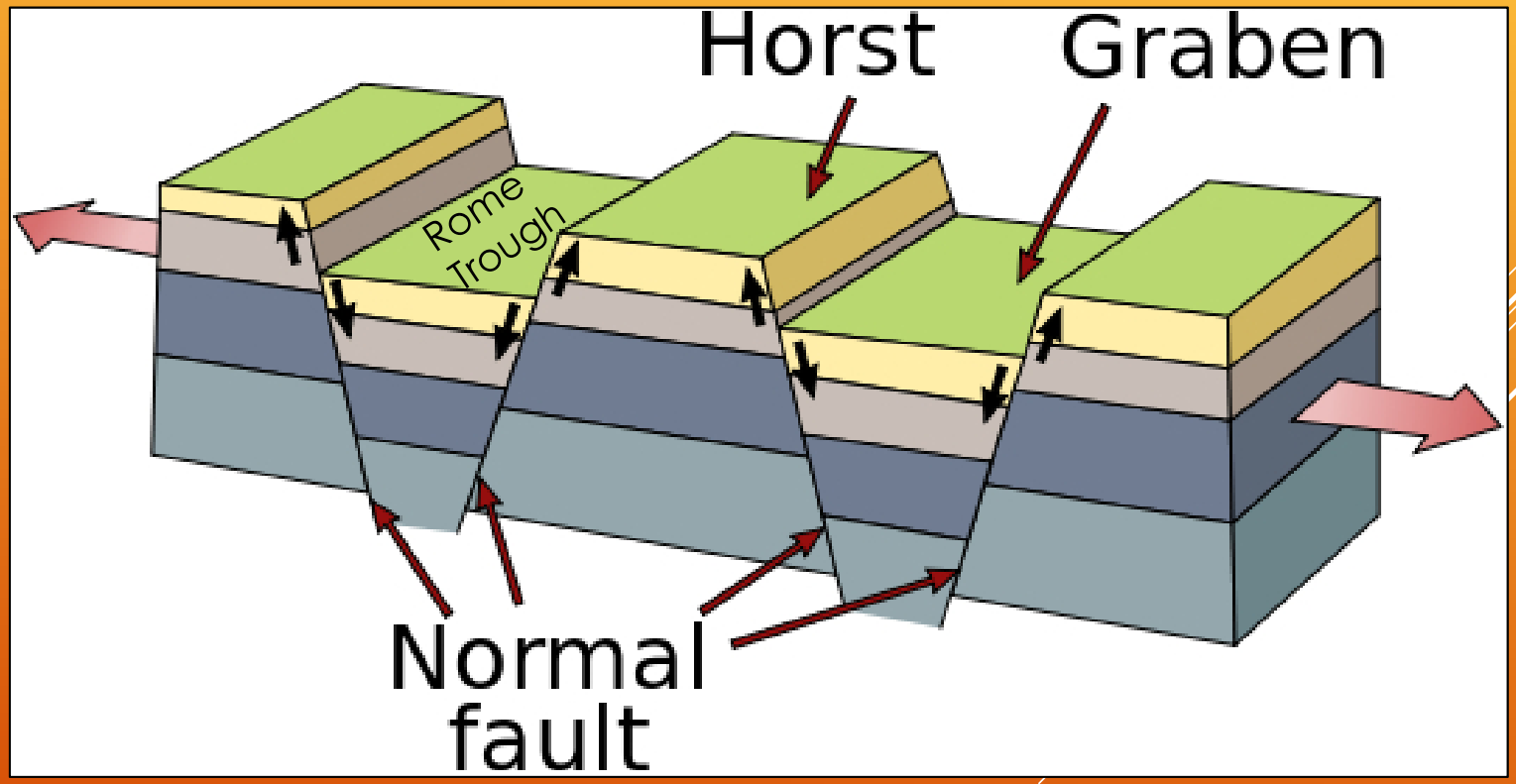
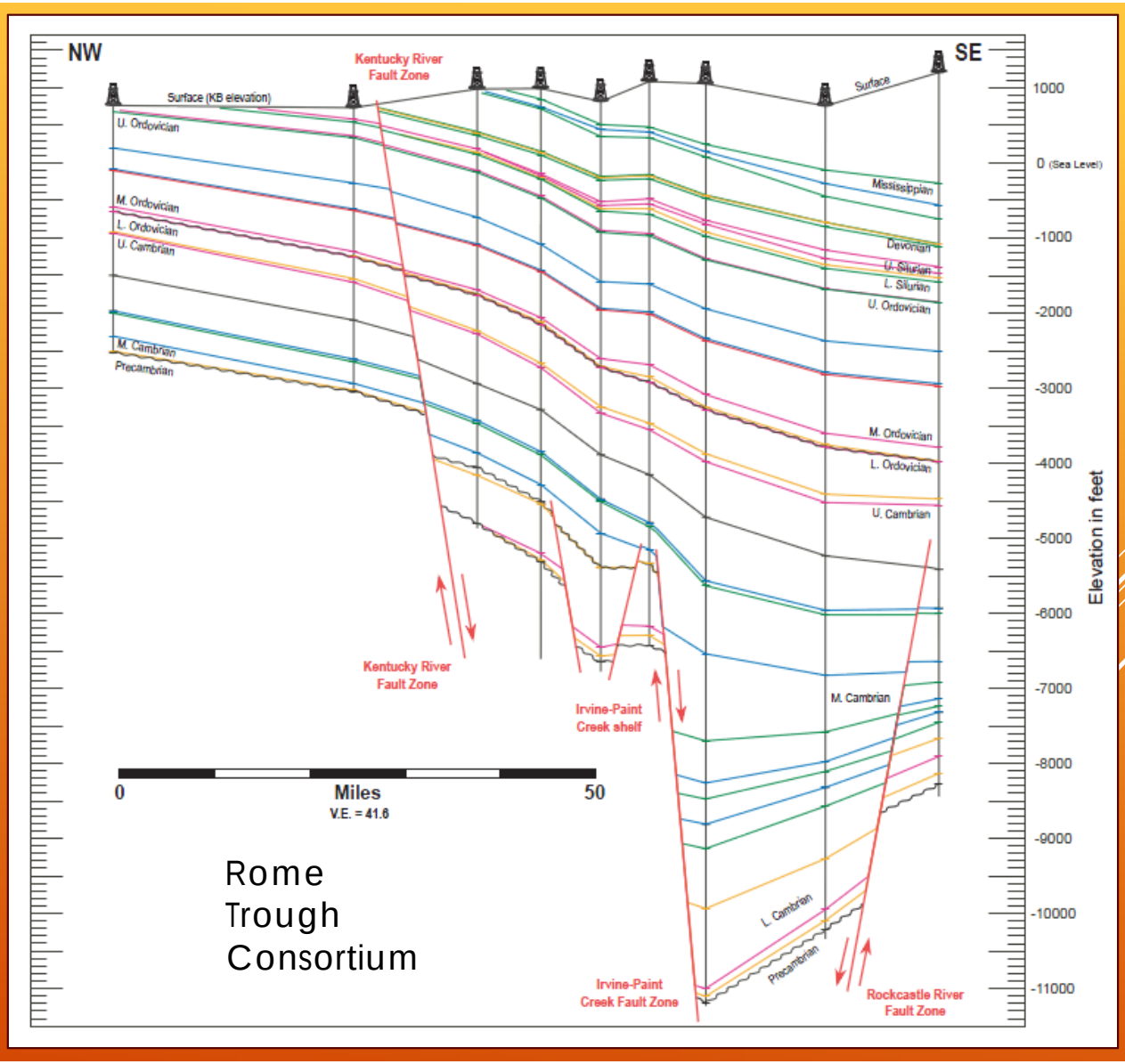


GRABEN ARCHITECTURE

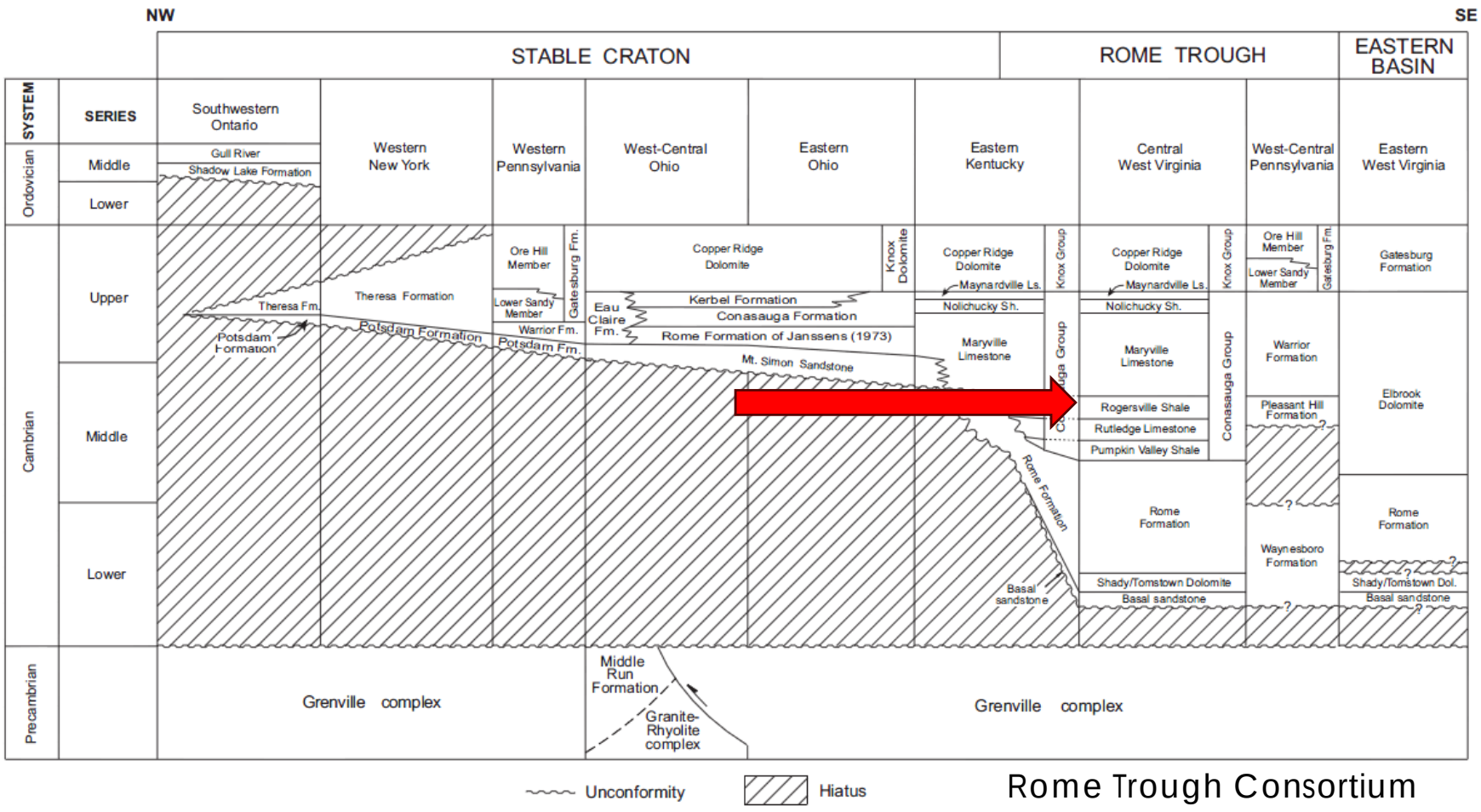
- Extensional setting
- "Pulling apart" of landmass



SCHEMATIC SHOWING DIFFERENCE IN GEOMETRY OF ROME TROUGH

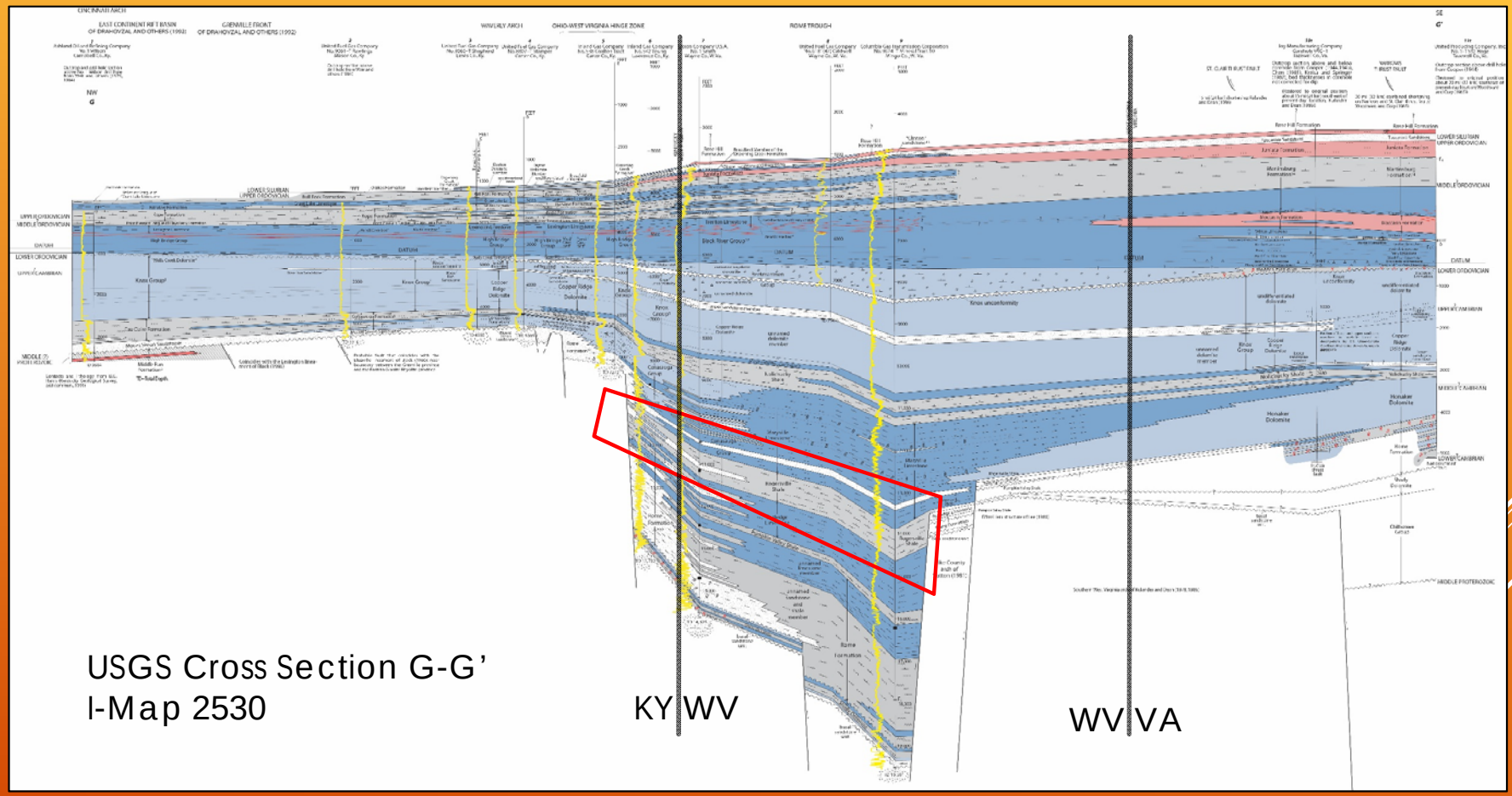


ROME TROUGH STRATIGRAPHY



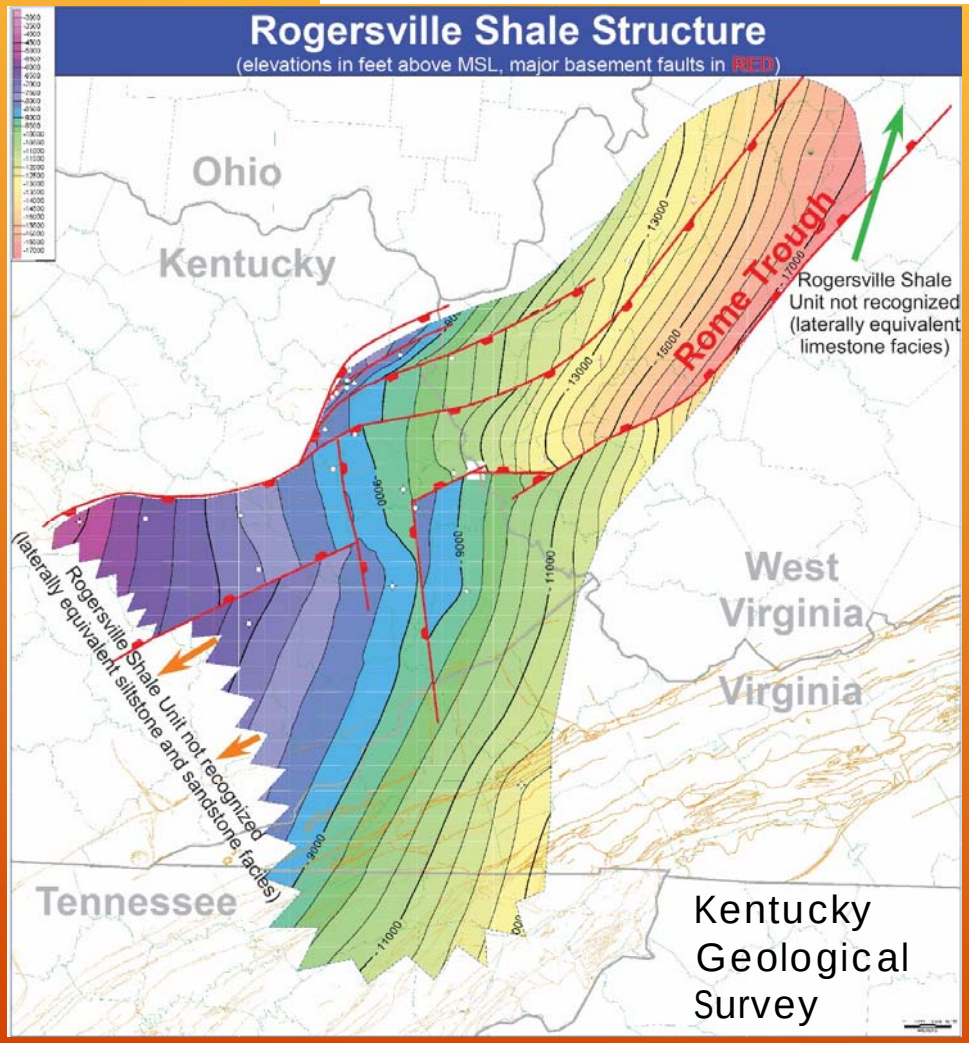
Rome Trough Consortium

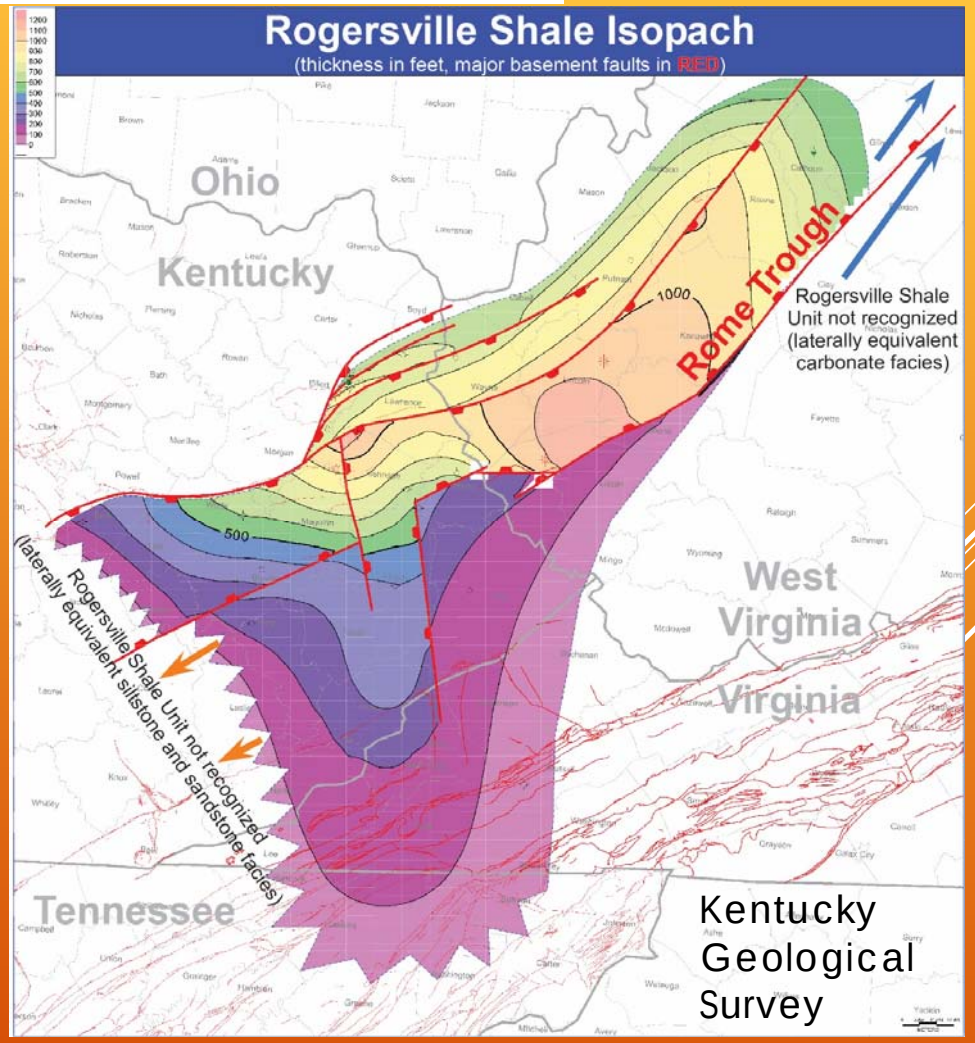
ROME TROUGH (ROGERSVILLE HIGHLIGHTED)



USGS Cross Section G-G'
I-Map 2530

STRUCTURE AND ISOPACH MAPS





WHAT IS OUR DATA BASED UPON?

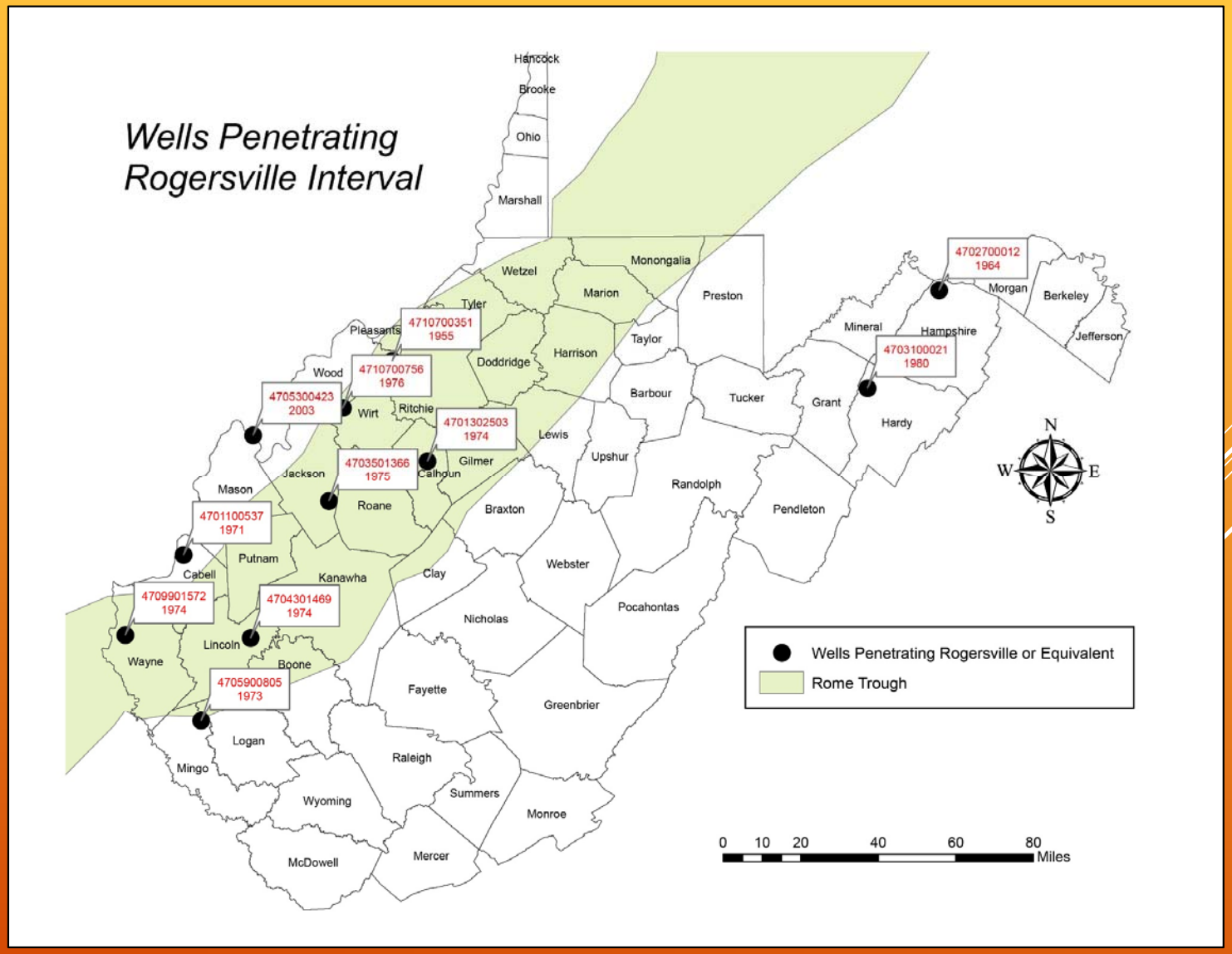
West Virginia

12 Wells Penetrate Rogersville Equivalent Interval

2 Wells are in structurally complex eastern part of state, and outside of Rome Trough-therefore Rogersville

Most wells were drilled in 1970's

Well in Mason County, drilled in 2003, was a CO_2 sequestration test, no Rogersville present.

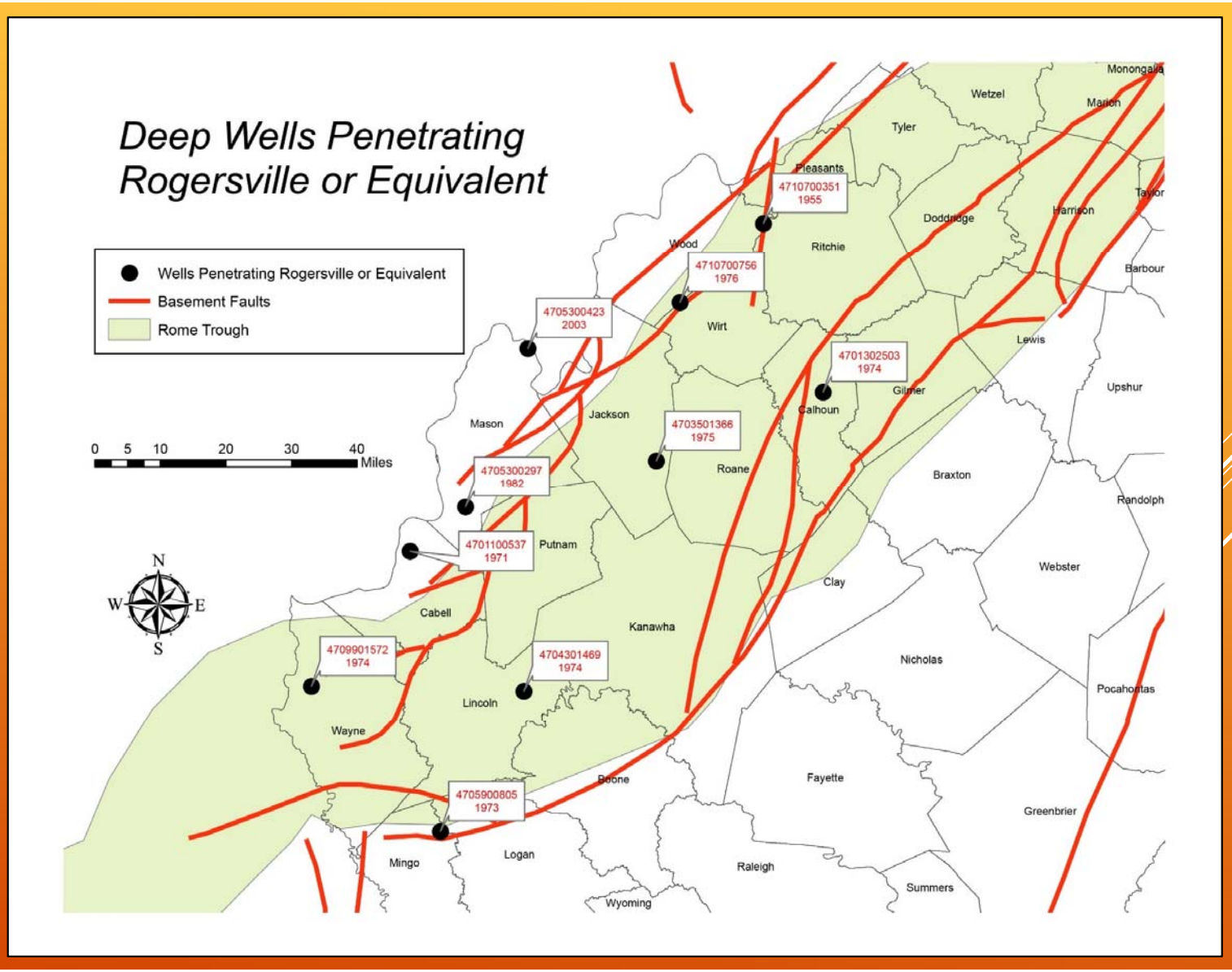


West Virginia

Most wells are on fringes of Rome Trough

4 wells are located more in the middle of the basin

Rogersville Shale only recognized in those 4 wells

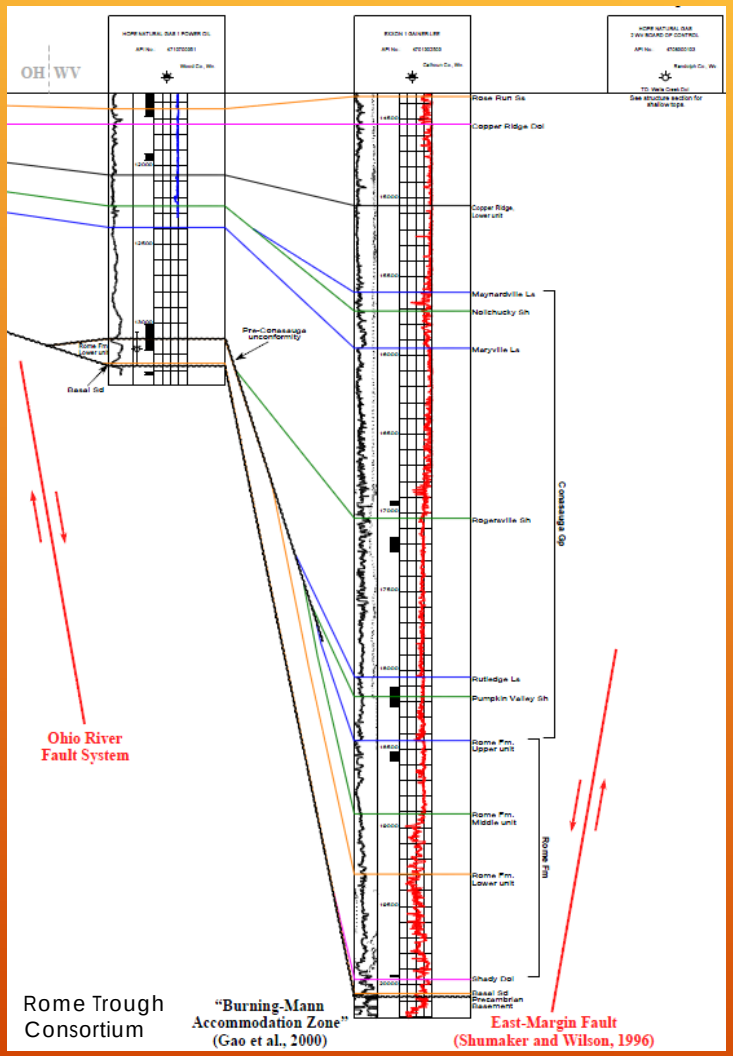


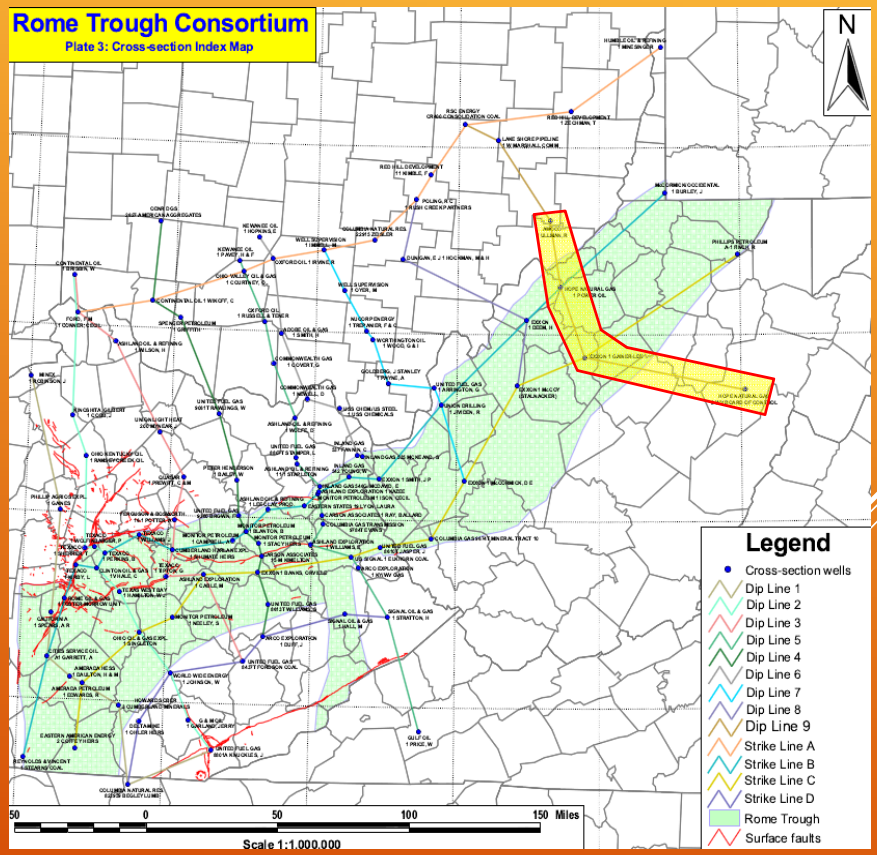
PREVIOUS AND ONGOING WORK

PREVIOUS WORK

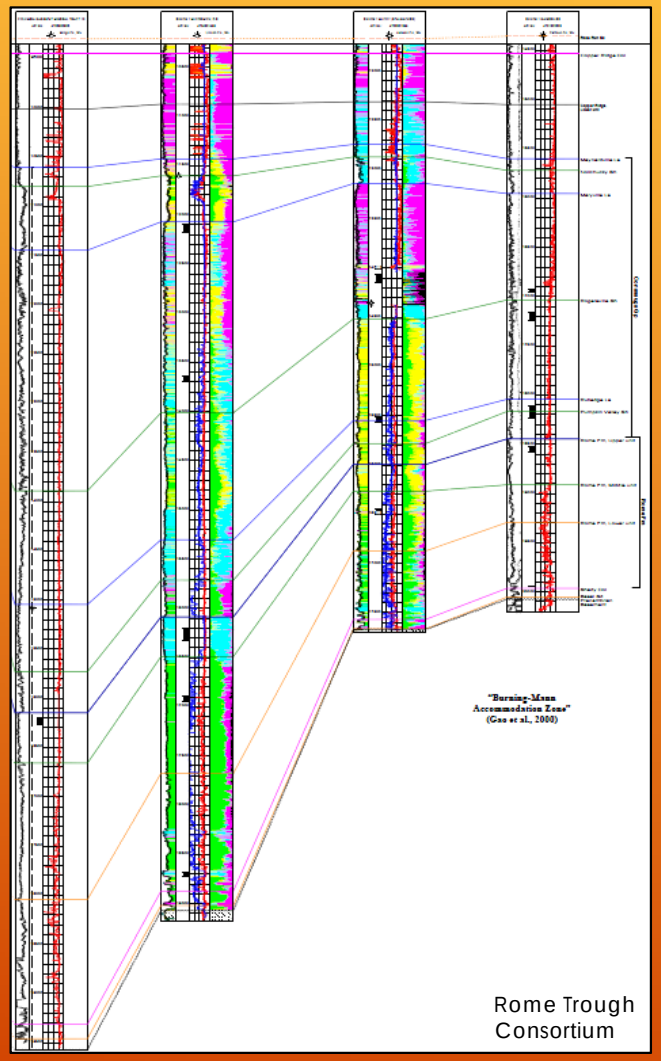
- Rome Trough Consortium (1999-2002, Report Available)
  - Multistate project (WV, KY, OH)
  - Mapped individual units in the Rome Trough
  - Correlated across state lines
  - Focused on conventional reservoirs
- U.S. Geological Survey Open File Report 05-1443
  - https://pubs.usgs.gov/of/2005/1443/2005-1443.pdf

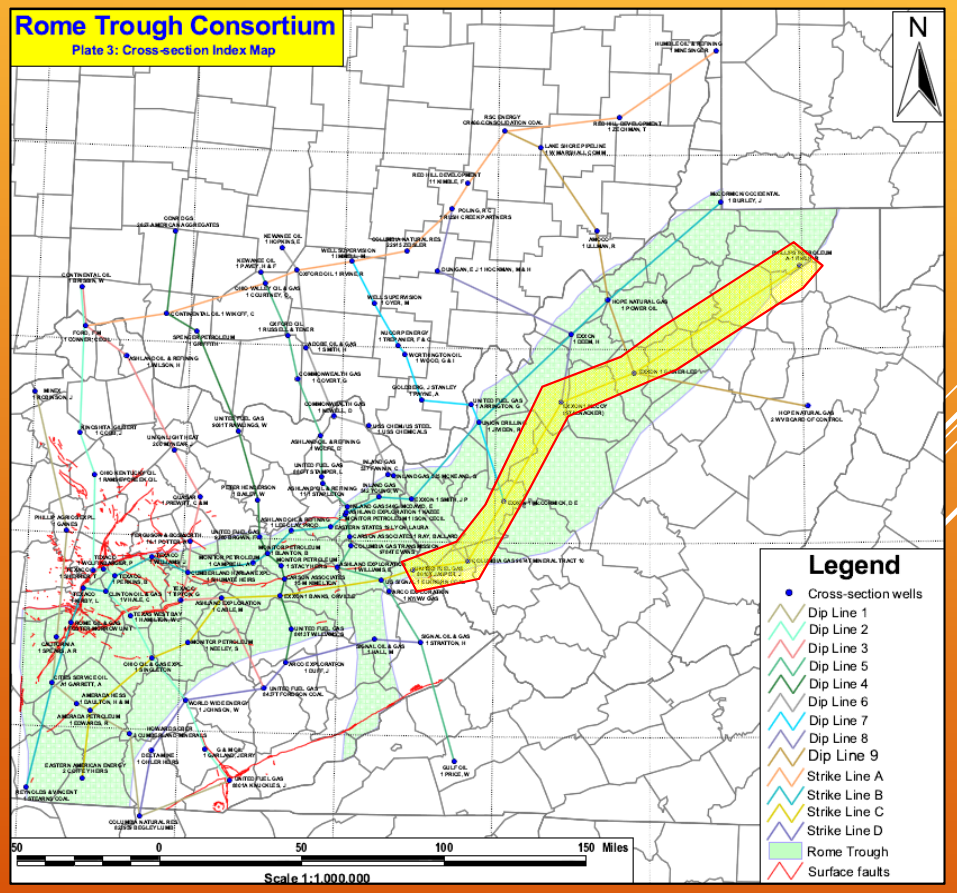
DIP CROSS SECTION ACROSS NORTH CENTRAL WEST VIRGINIA





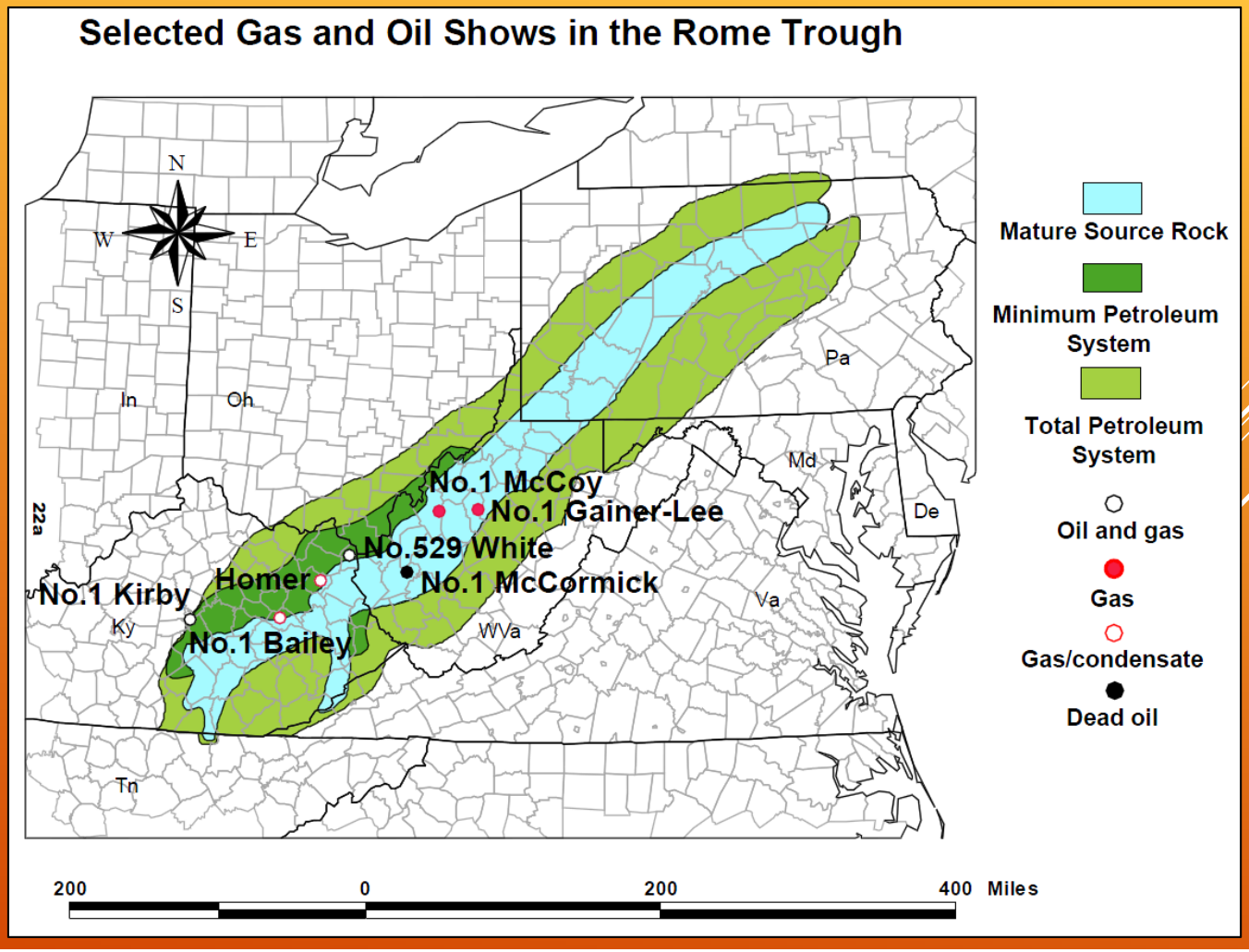
STRIKE CROSS SECTION THROUGH ROME TROUGH, WEST VIRGINIA





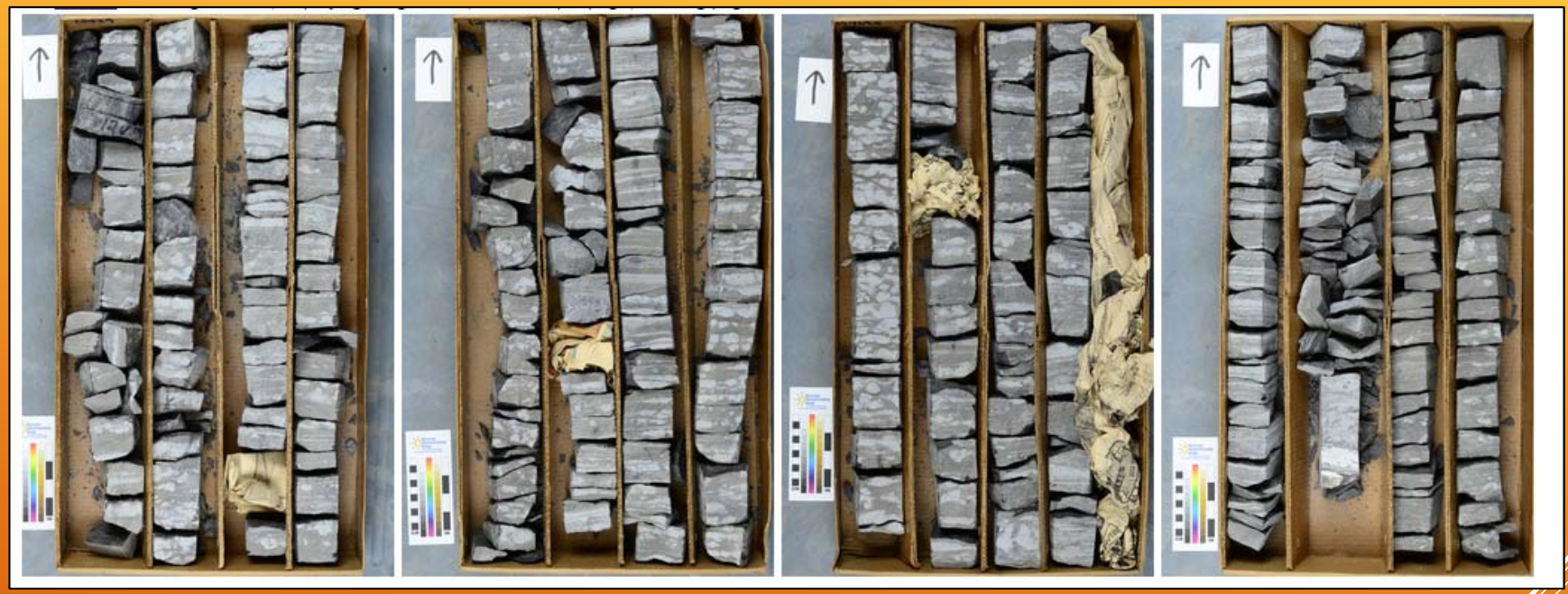
USGS OPEN FILE REPORT 05-1443

- Noted that Rogersville could be a source rock



CORE DATA

EXXON JAY SMITH #1-*THE CORE THAT STARTED IT ALL*

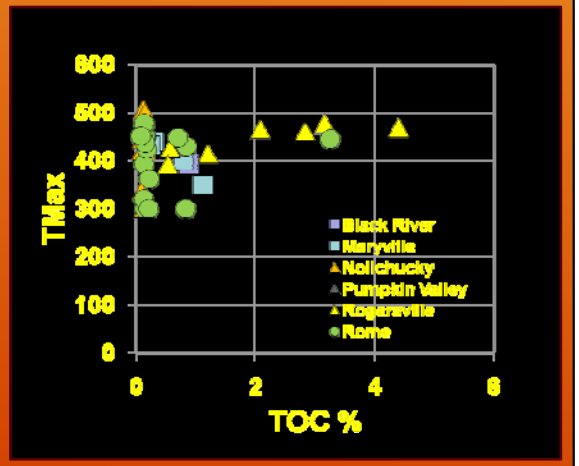


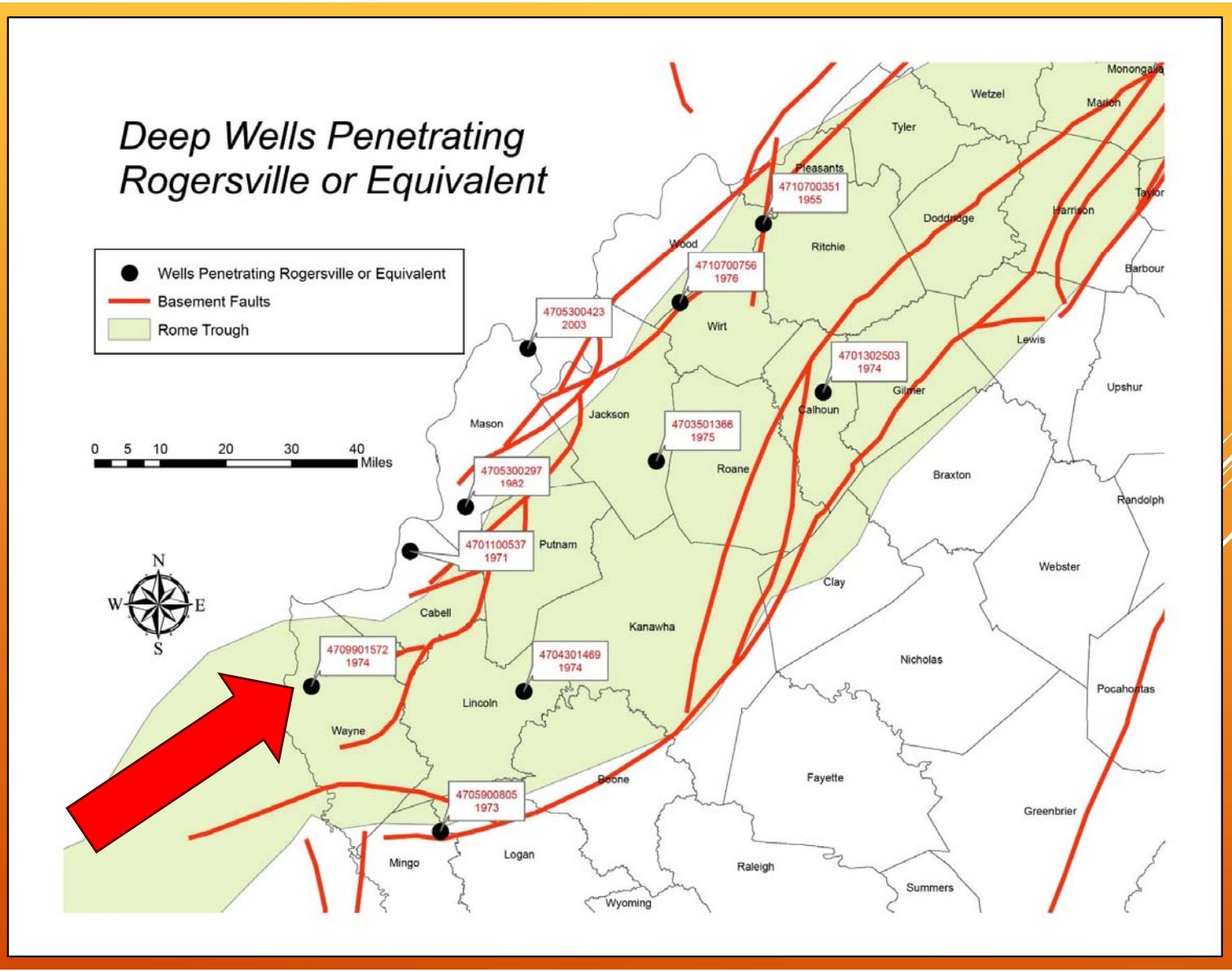
- Well Drilled in 1974
- Depth-14625 Feet to Precambrian
- Plugged in 1975
- WVGES has core from several intervals in this well.
- Rogersville core is 11,135-11,200 Feet

Jay P Smith #1
API 4709901572

TOC in Rogersville 4.4% from Rome Trough Consortium work

TOC measurements similar or higher than Utica-Point Pleasant





RECENT SMITH CORE DATA

Lower Depth (ft)	Leco TOC (wt%)
8,590.00	0.13
8,690.00	0.12
8,790.00	0.10
8,840.00	0.10
8,890.00	0.10
10,740.00	0.13
10,840.00	0.08
10,890.00	0.11
10,990.00	0.16
11,089.00	0.26
11,095.00	0.22
11,139.50	1.82
11,150.50	2.16
11,155.50	1.51
11,161.50	3.74
11,171.30	0.81
11,178.40	1.28
11,183.50	0.16
11,189.20	1.72
11,195.50	1.61
11,200.00	2.12
11,290.00	0.33
11,390.00	0.39
11,490.00	0.47
11,640.00	0.19
11,790.00	0.29
11,840.00	0.30
11,940.00	0.25
11,990.00	0.25
12,090.00	0.21
12,140.00	0.25
12,210.00	0.34

Rogersville Interval

TOC: Total Organic Carbon

-indicator for the concentration of organic material in a source rock.

-0.5% is minimum for effective source rock

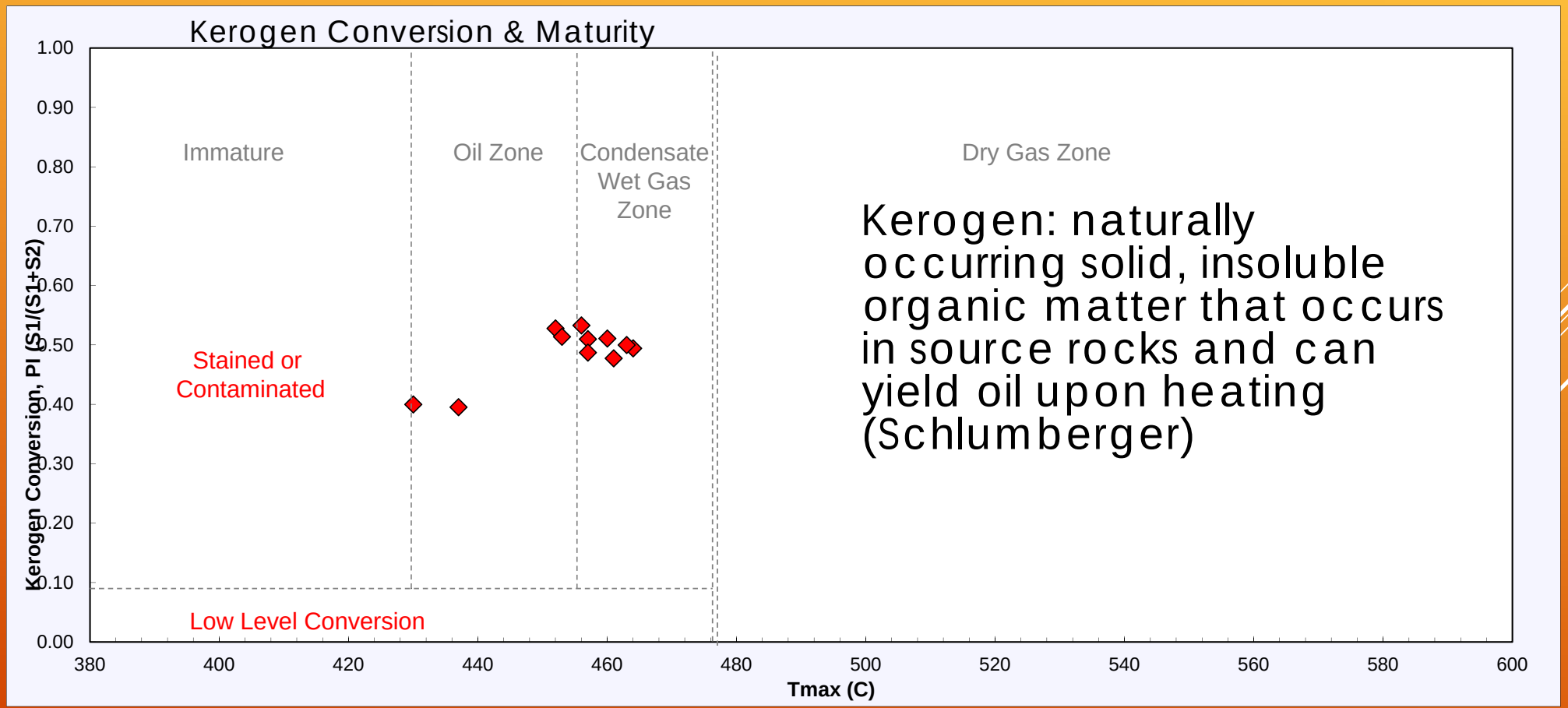
-2% is minimum for shale gas reservoirs

Source: Schlumberger

Highest TOC% 3.74

Was 4.4% in previous Rome Trough Consortium Testing

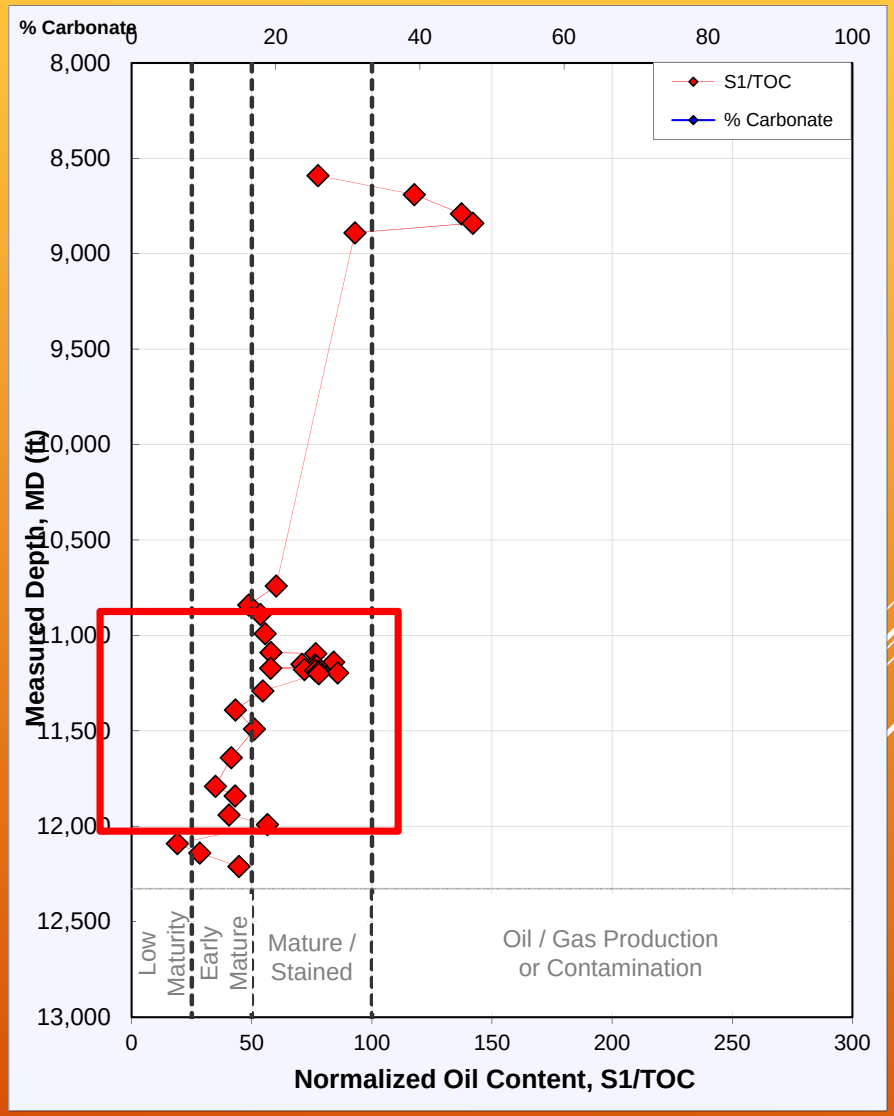
EXXON SMITH CORE DATA CONTINUED



Kerogen: naturally occurring solid, insoluble organic matter that occurs in source rocks and can yield oil upon heating (Schlumberger)

EXXON SMITH CORE DATA CONTINUED

- Graph shows depth vs normalized oil content
- Indication of Maturity



RECENT CORE DATA FROM SEVERAL WV WELLS

- Other wells show much lower TOC% (nothing over 0.5%)
- Not all are from Rogersville interval

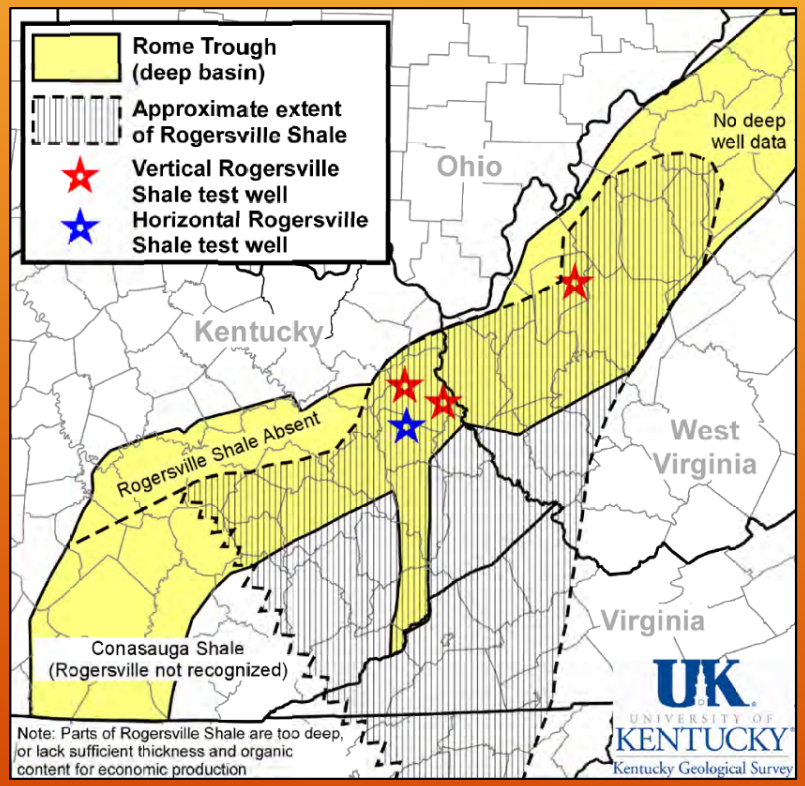
Client ID	Depth () Top	Leco TOC
Jay Smith 1:		
1	11000	0.29
2	11139	1.59
2	11139	1.41
3	11144	2.20
3	11144	1.49
4	11150	1.78
4	11150	1.90
5	11153	1.93
5	11153	1.81
6	11161	2.82
6	11161	2.90
7	11189	0.45
7	11189	0.13
8	11198	1.63
9	11200	1.83
9	11200	1.94
10	11590	0.27
McCoy:		
11	14530	0.18
12	15030	0.19
McCormick:		
13	14146	0.28
14	14240	0.27
15	14280	0.16
Fee 9674:		
16	14004	0.37
17	14380	0.19

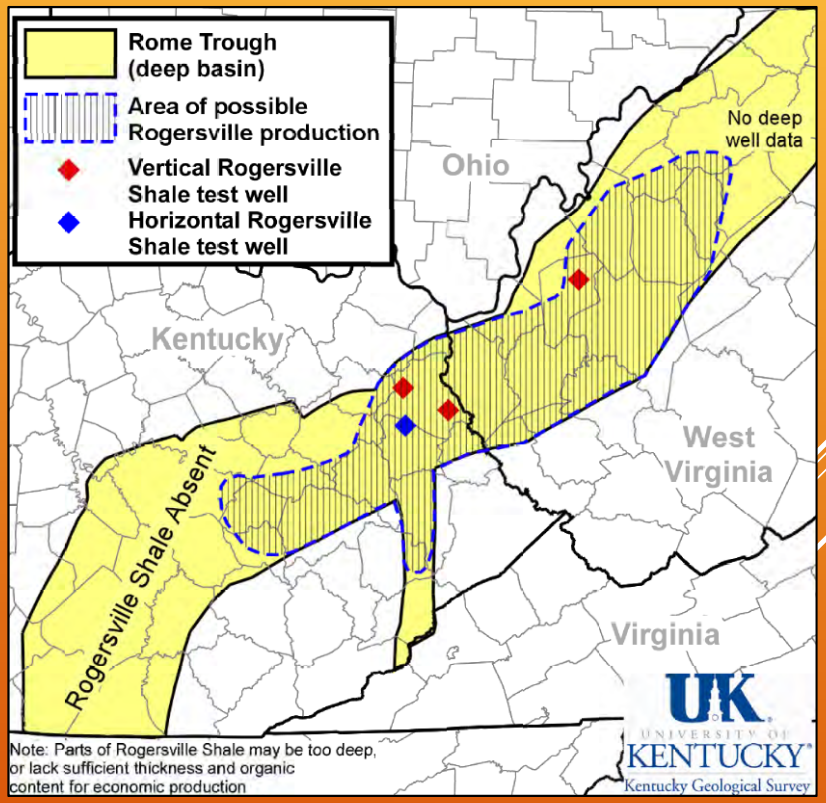
CORE DATA CONCLUSIONS

- Up to 4.4% TOC, but TOC is highly variable within wells and within Rome Trough
- Rogersville has generated gas and condensate. West Virginia is in the wet to dry gas transition zone
- Most of the Rogersville in West Virginia is thermally mature
- Only the Smith core shows good source rock data.

RECENT ACTIVITY

ROGERSVILLE DEPOSITION AND POSSIBLE PRODUCTIVE AREAS



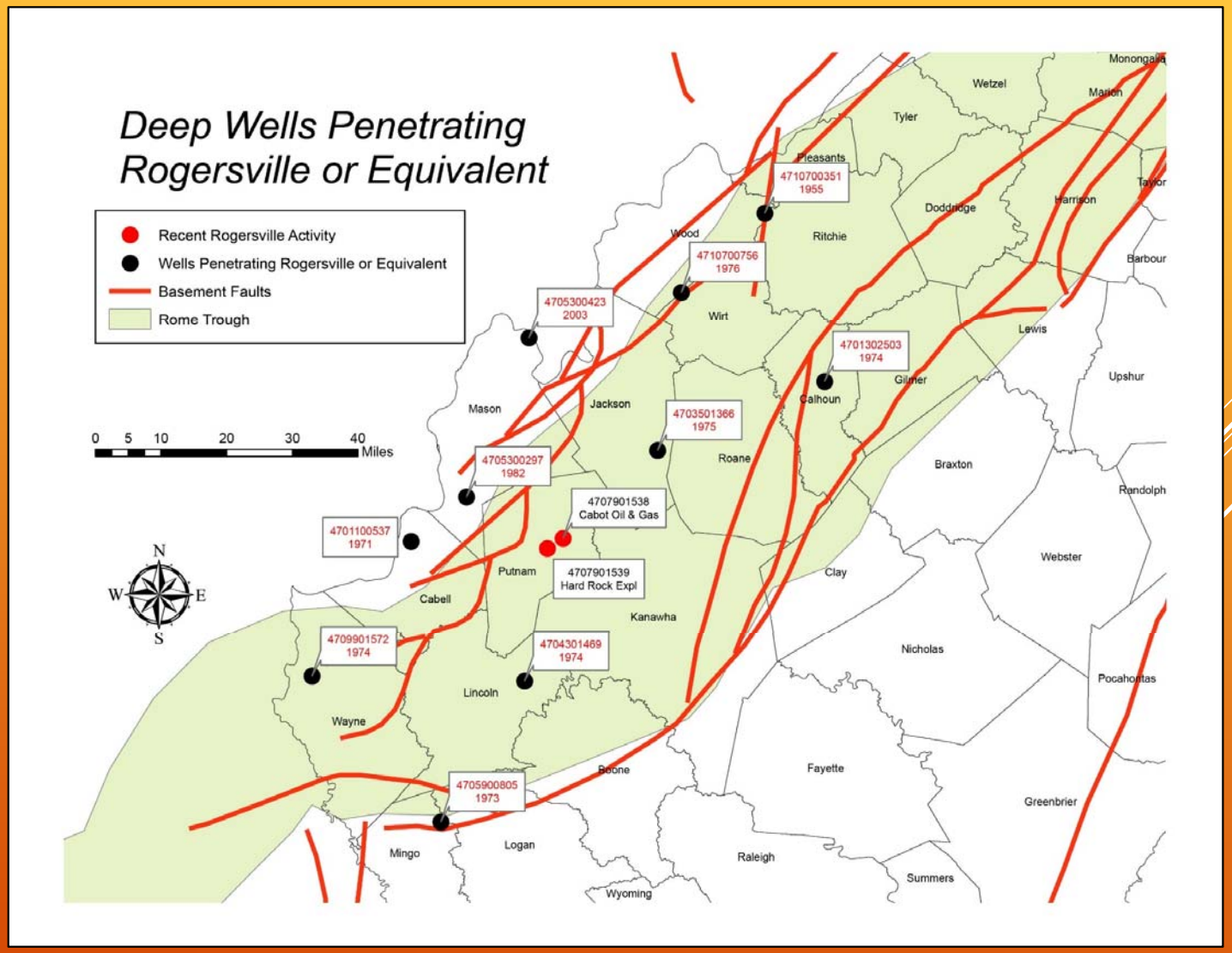


RECENT WV ACTIVITY

Two wells in Putnam County

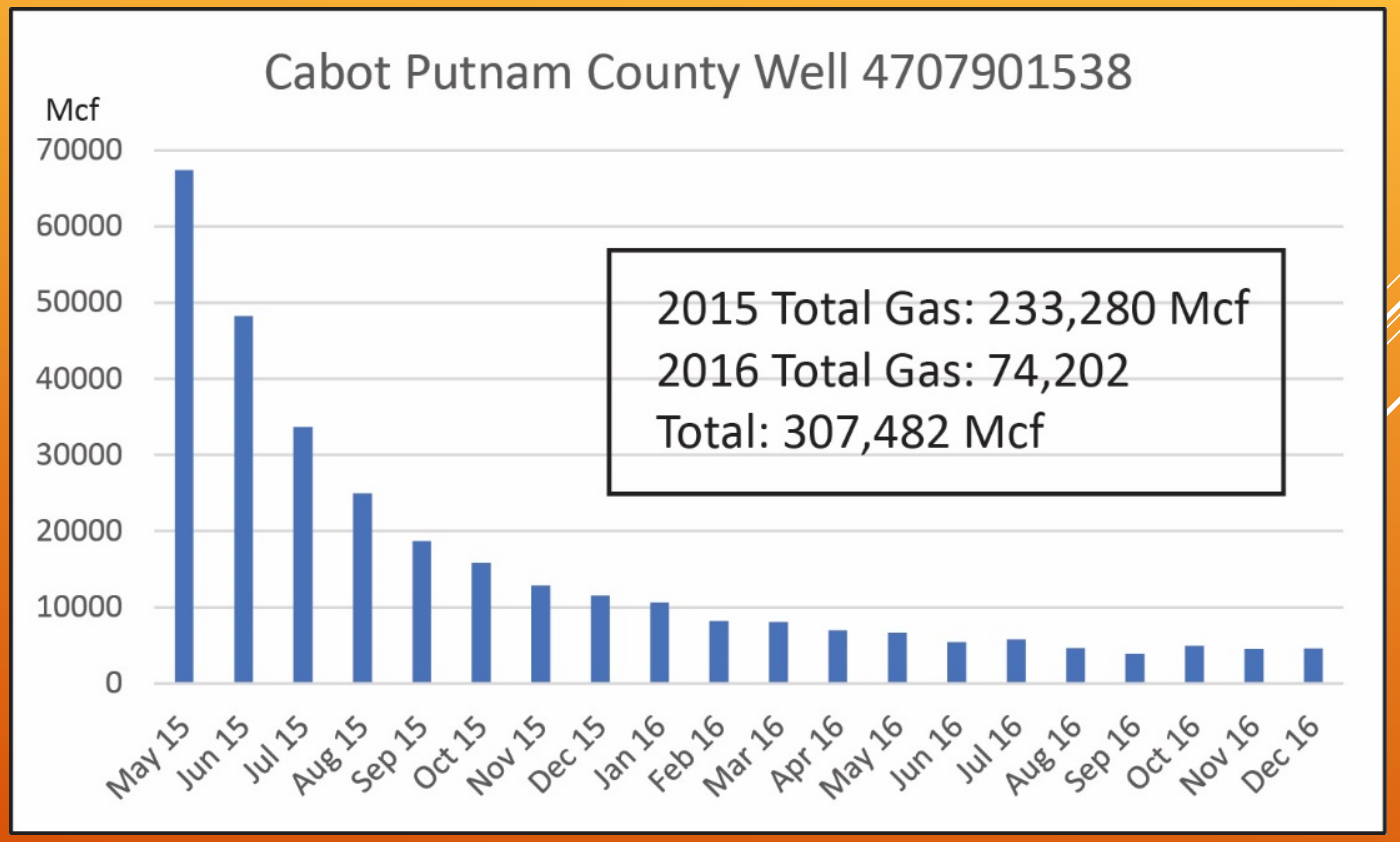
1. Cabot Oil & Gas
API 4707901538
Cabot 50
Surface Owner-Amherst Industries
Completed late 2014

2. Hard Rock Exploration
API 4707901539
Surface Owner G D Young
Permitted 11/2015



CABOT 50

- Vertical Well
- Unsure if producing zone is Rogersville
- Records held confidential by WV Conservation Commission



CURRENT ACTIVITY

Six wells drilled to date:

1. Bruin Expl. (Cimarex): apparent discovery (shut-in) Lawrence Co., KY

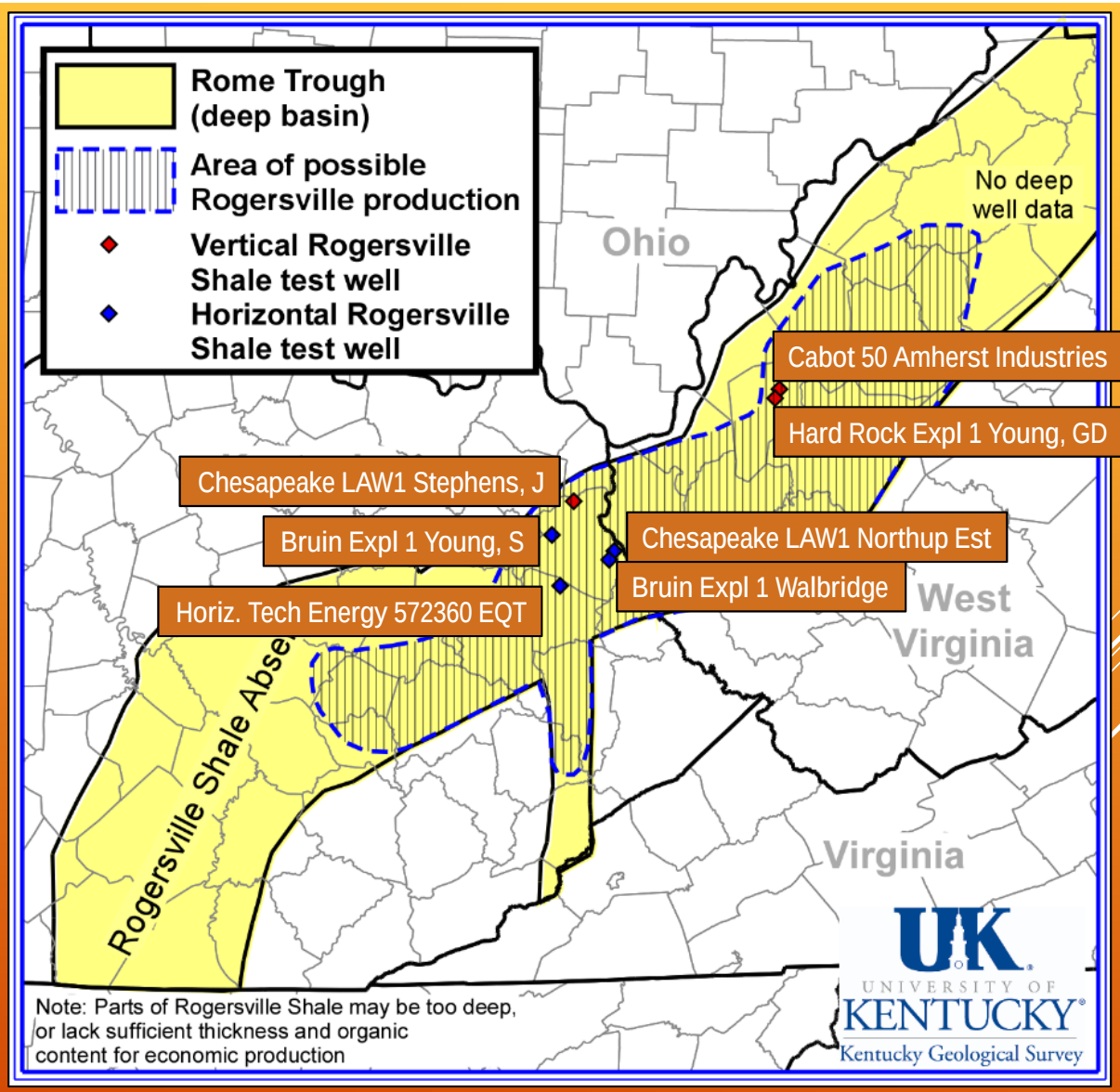
2. Cabot Oil & Gas: 1 vertical, Putnam Co., West Virginia, producing dry gas

3 & 4. Chesapeake Energy: 2 verticals (shut-in), Lawrence County, KY

5. Horiz. Tech. Energy (EQT): 1 horizontal, (under evaluation?), Johnson Co., KY

6. Bruin Expl. (Cimarex): 2nd well, horizontal, Lawrence Co., Ky.

Two undrilled horizontal lateral permits in KY

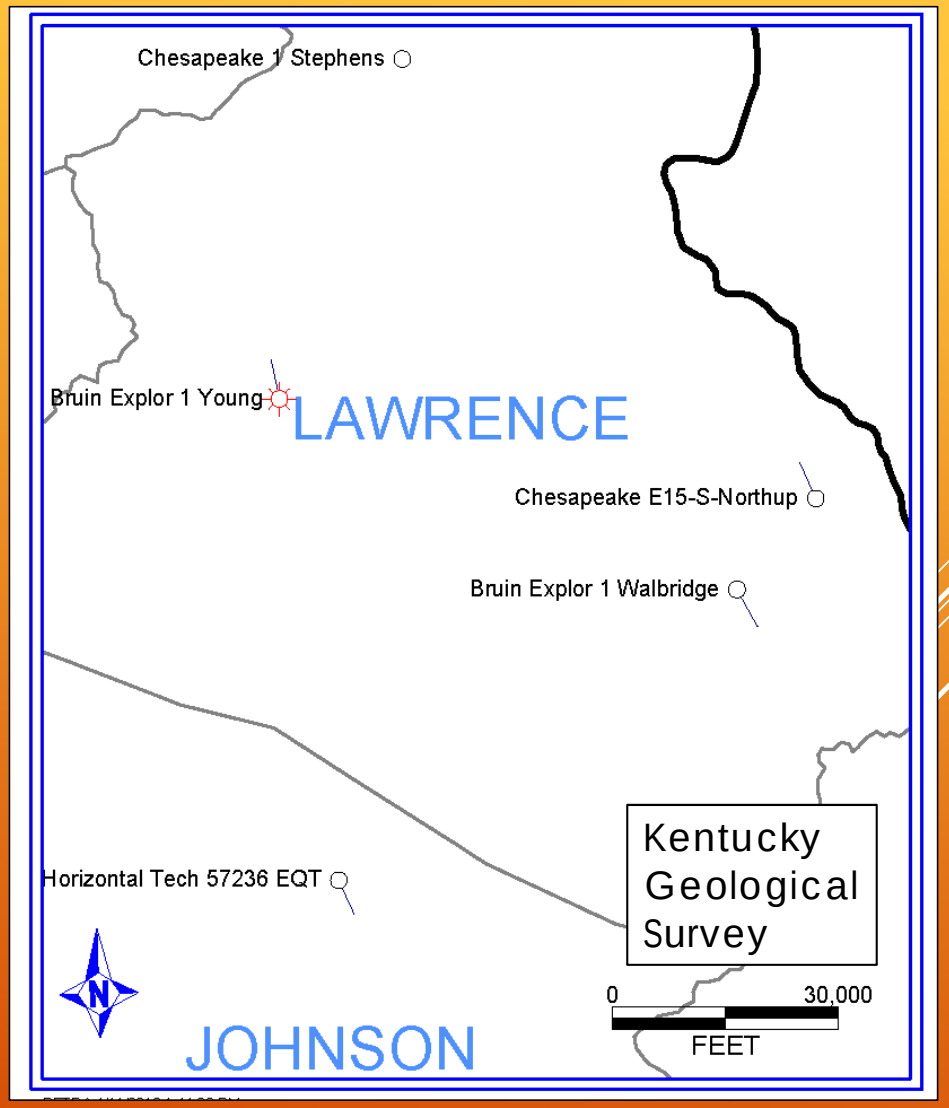


CURRENT KENTUCKY ACTIVITY

Horizontal Tech. Energy (EQT)
- Johnson County, KY: 2,000 ft lateral drilled/tested

Chesapeake
- Two vertical wells , one re-permitted as a 5,200 ft lateral

Bruin Exploration (Cimarex)
- 2nd well: Walbridge
- 5,300 ft horizontal in Rogersville Sh.
- 27-stage frack, testing



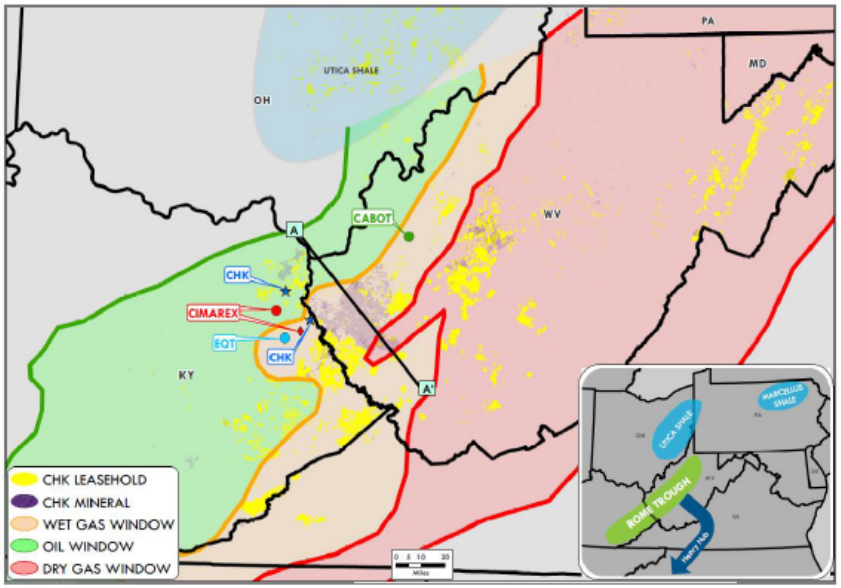
IMPLICATIONS

This activity has generated active leasing

Stacked potential is limited

However, could easily connect to pipeline and refinery infrastructure

1,600,000 ACRES – CHK ADVANTAGE
ROME TROUGH



- Multi-zone stacked potential
  - > ~1 to 4.5 bboe recoverable in single zone
- 1.4mm acres HBP/minerals
  - > Two vertical core wells drilled
- Competitors de-risking around CHK HBP position
- Access to Gulf Coast markets

Chesapeake Investor Report

AN EMERGING PLAY?

- **What Makes the Rogersville Different than the Marcellus or Utica-Point Pleasant?**
  - Depth, Complex Structural System, Depositional System
- **Does the Rogersville have the potential to be a productive play in West Virginia?**
  - Yes, but may not be as geographically expansive as Marcellus or Utica-Point Pleasant
- **If it does have potential, what are the reasons it has not been developed yet?**
  - Sparse dataset, Depth (Increases Cost, some Horizontal Utica-Point Pleasant wells have price tags north of $20 Million, Most Likely Dry Gas

AN INTRIGUING TARGET…..

CIMAREX WALBRIDGE 1H FLARE (4-26-2017)

THANK YOU

QUESTIONS?