

SHALE HYDROCARBON RESOURCES OF WEST VIRGINIA

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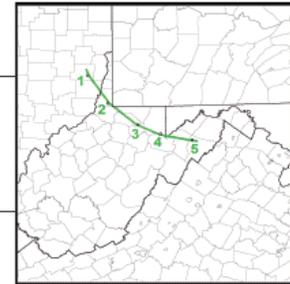
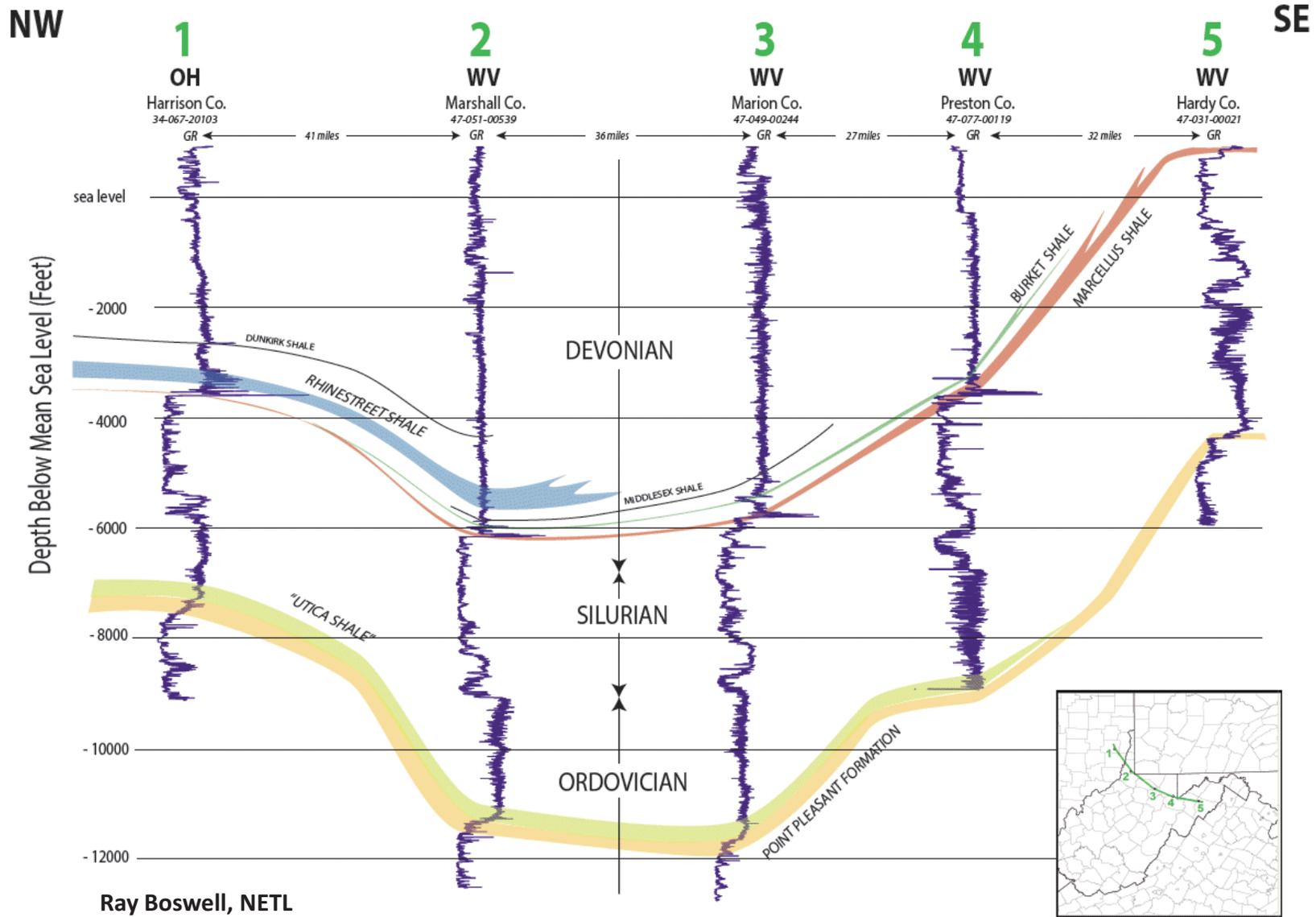


Stonewall Resort October 27, 2015

Outline

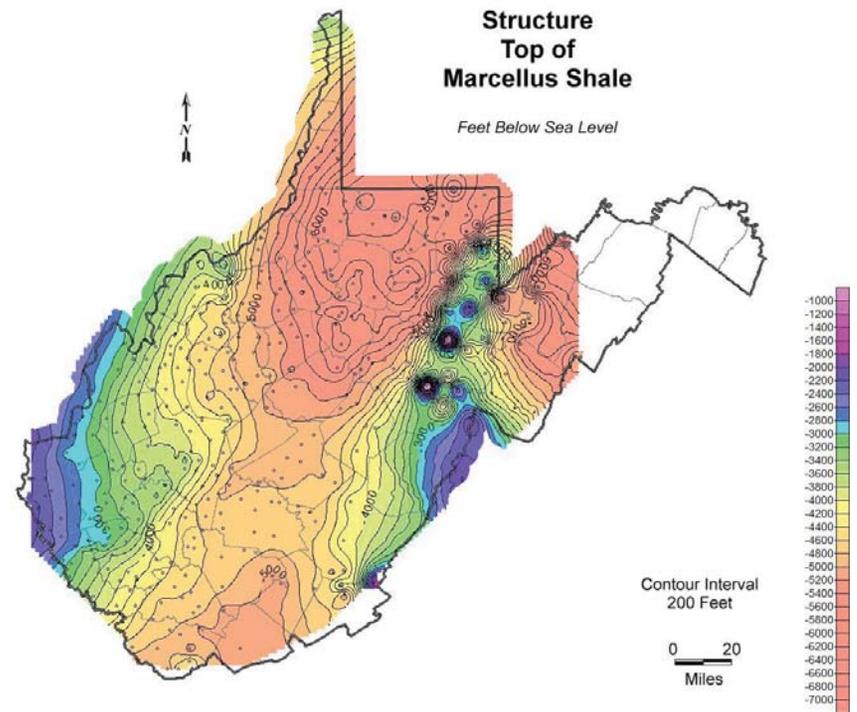
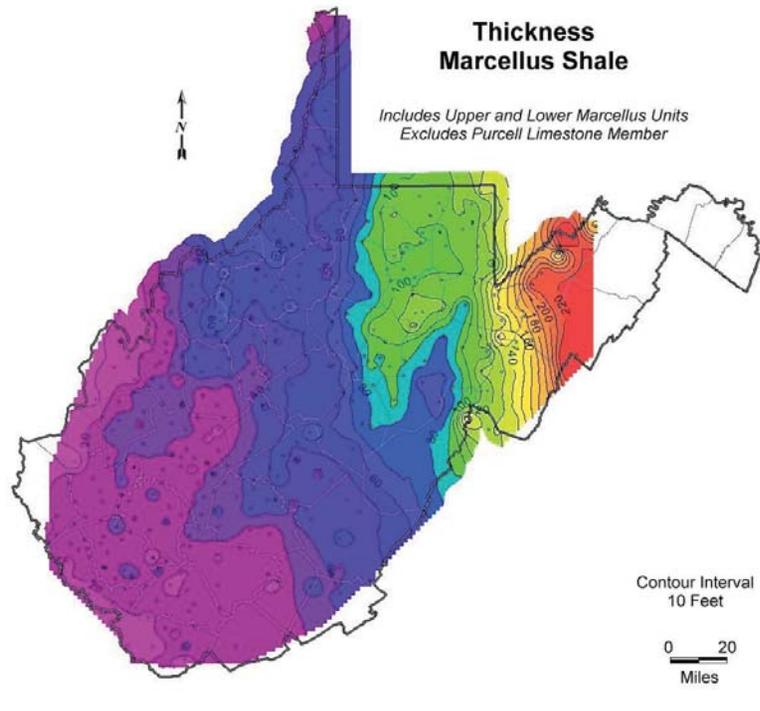
- **Marcellus Shale:**
 - **Geology and Engineering**
 - **In-place and recoverable resource**
- **Utica Shale:**
 - **Current activity**
 - **Resource**
- **What's next?**
 - **Rogersville: Geology and Challenges**
 - **Horizontal drilling in old reservoirs**
- **Getting it to market: New pipelines**

STRUCTURAL CROSS-SECTION FROM HARRISON CO., OHIO TO HARDY CO., WEST VIRGINIA



Marcellus Shale

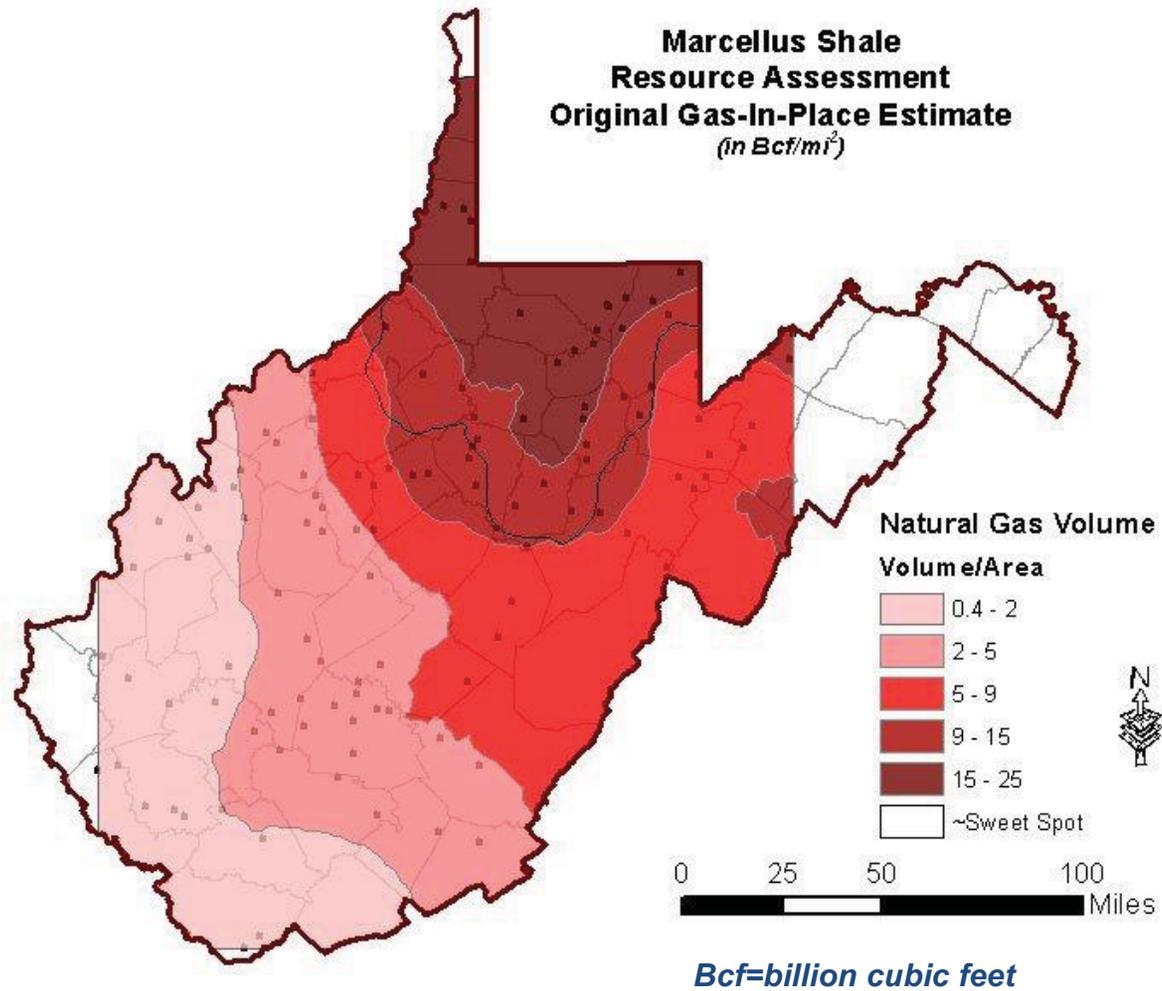
Thickness and Structure



DISCLAIMER: These maps are preliminary drafts which reflect data and analyses current as of September 14, 2015. The maps will likely change as additional data become available and techniques are refined. Users are cautioned that these maps represent only a best estimate of trends given available data and should not be used as a stand-alone product.

Marcellus Shale

Original Gas In-Place Volume Per Unit Area

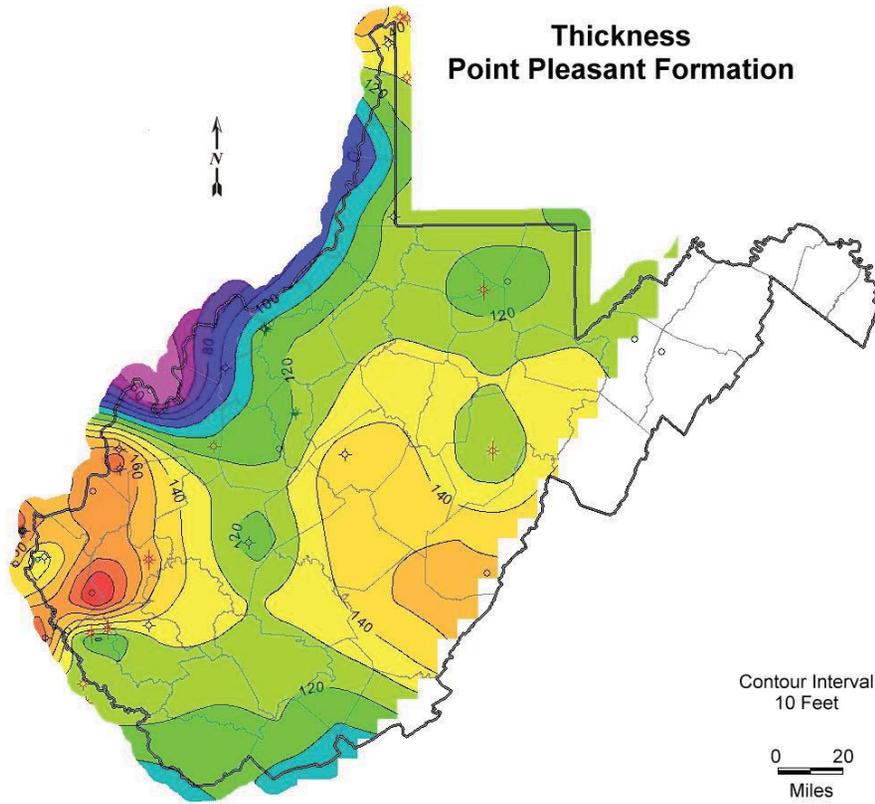


Marcellus Resource

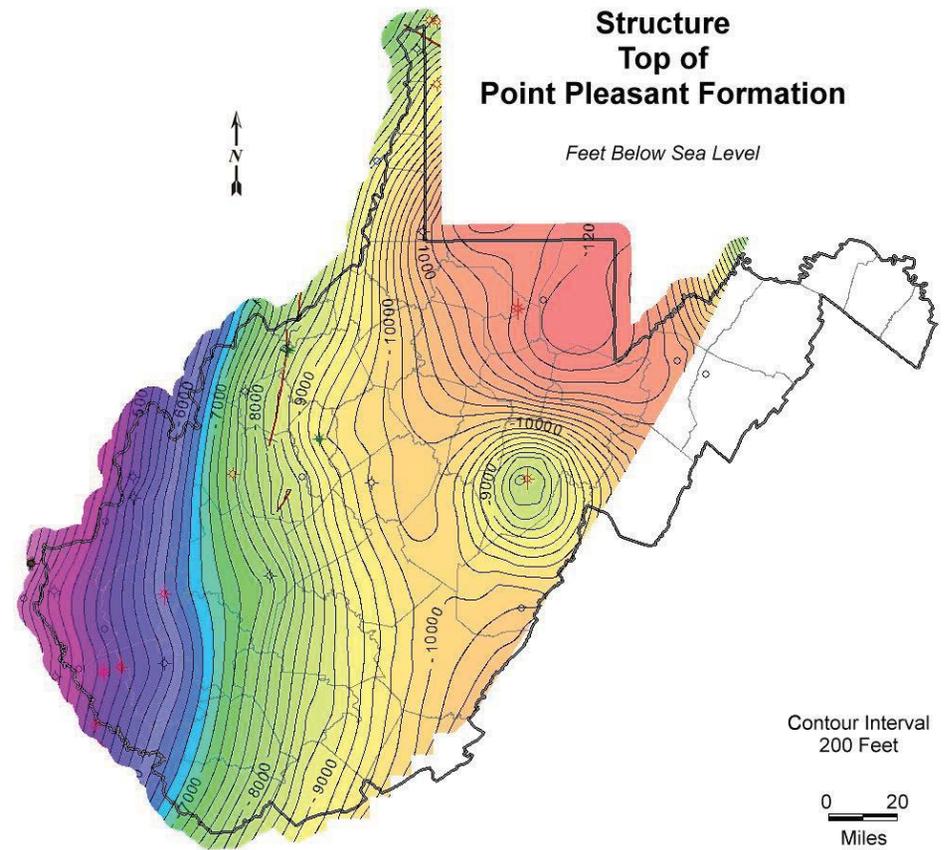
Resource	Source	Gas (Tcf) <i>Minimum</i>	Gas (Tcf) <i>Average</i>	Gas (Tcf) <i>Maximum</i>
Remaining Recoverable	U.S. Geological Survey (2011)	-	18.5	-
Original In-Place	West Virginia Geological Survey	119.6	142.3	165.3
Recovery Factor		15%	13%	11%

Tcf = Trillion cubic feet

Utica Shale

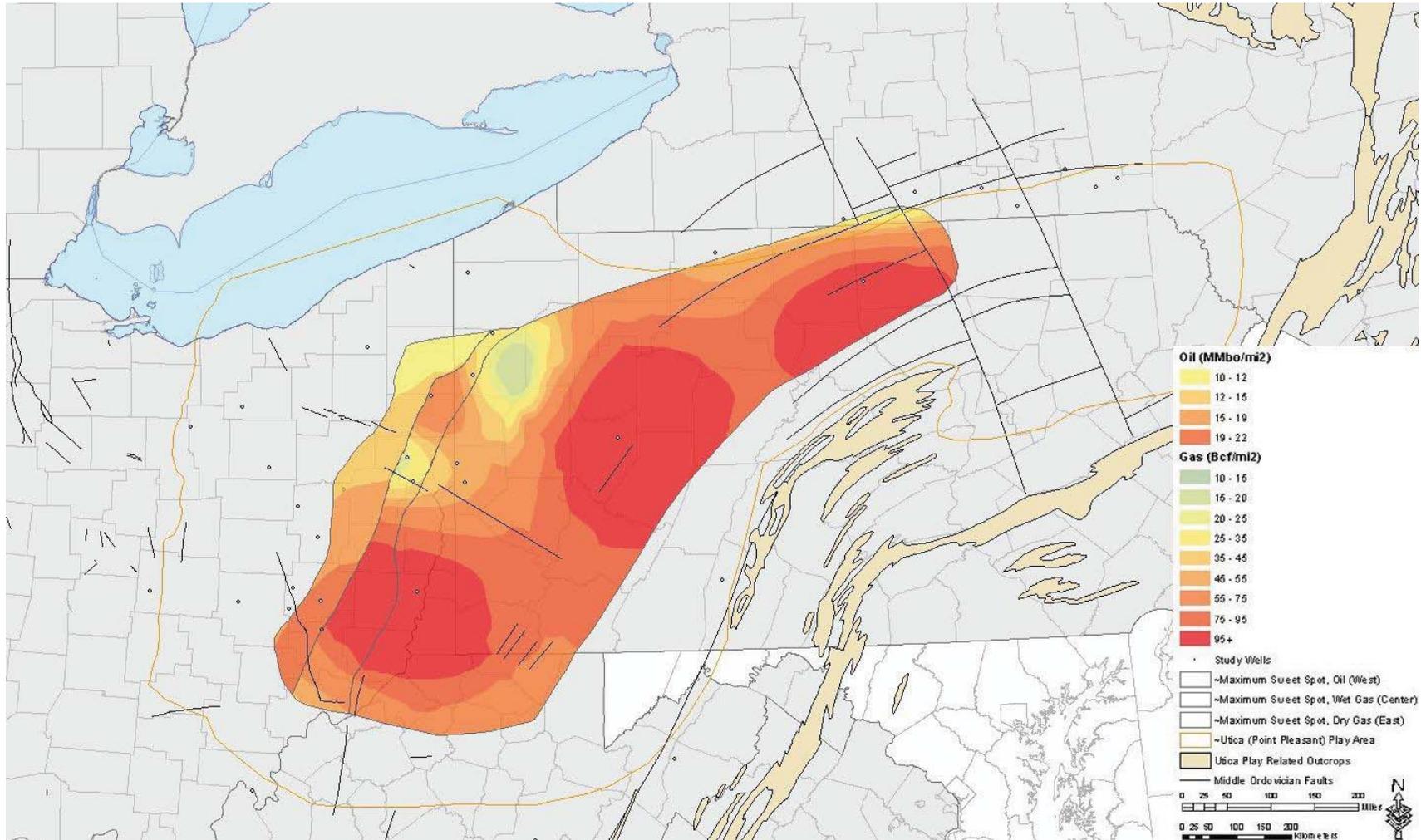


**Point Pleasant=primary "Utica Shale" resource*



Utica Resource

Original Gas In-Place Volume Per Unit Area*

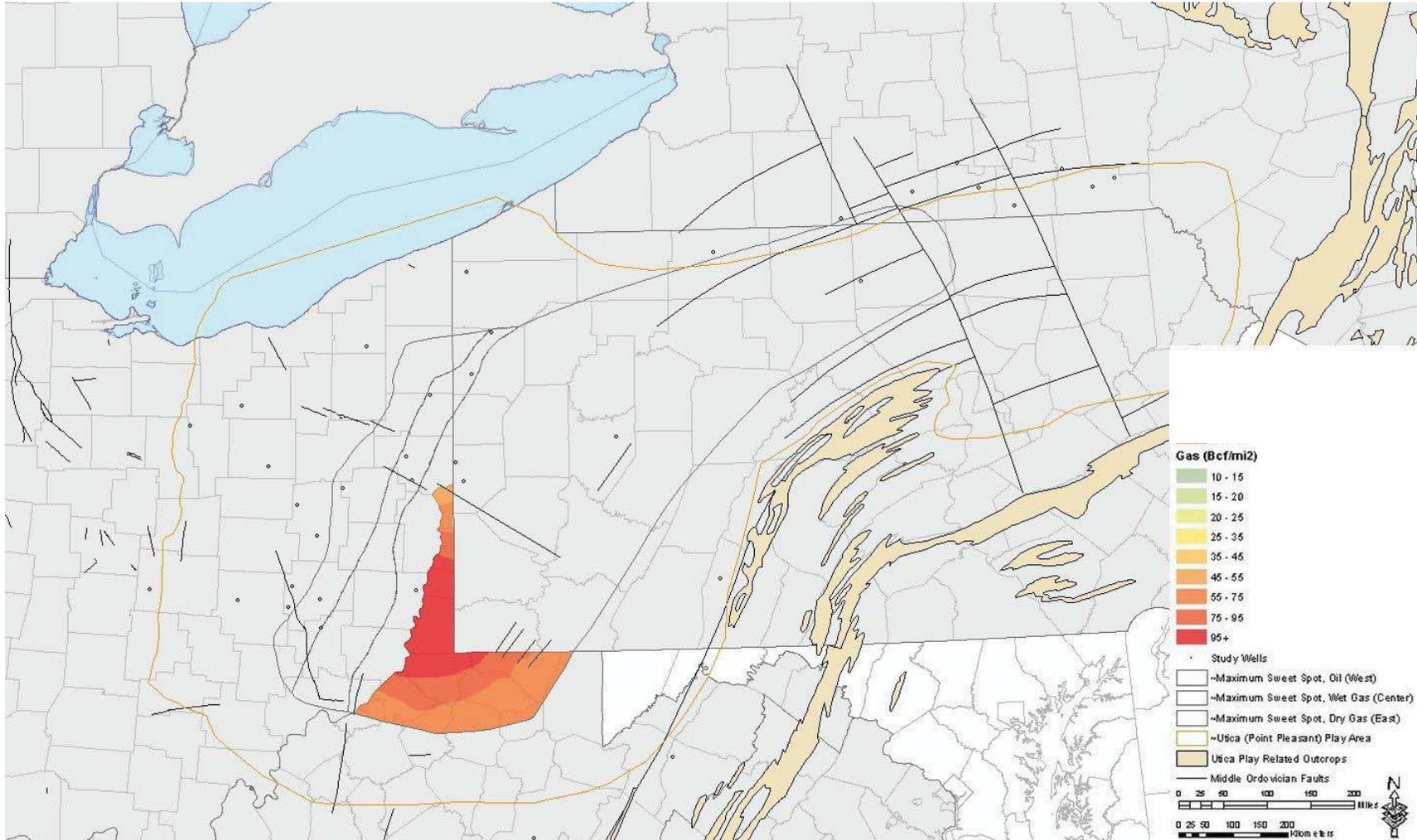


MMbo=million barrels oil; Bcf=billion cubic feet

*average volume per square mile in the "sweet spot" area

Utica Resource

Original Gas In-Place Volume Per Unit Area*



MMbo=million barrels oil; Bcf=billion cubic feet

*average volume per square mile in the "sweet spot" area

Utica Resource

	Region	Volume*	
		Oil (Bbo)	Gas (Tcf)
Remaining Recoverable**	West Virginia	N/A	97
	Appalachian Basin	2.6	890
Original In-Place	West Virginia	N/A	271
	Appalachian Basin	83	3,192
Current Overall Recovery Factor		3%	28%

Bbo=Billion barrels oil; Tcf=Trillion cubic feet

**estimated volume in the “sweet spot” area; **remaining technically recoverable*

Utica Resource

Stratigraphic Unit	Region	Original In-Place Resources, Total Volume		West Virginia Resource as Percentage Of Appalachian Basin
		Oil (MMbo)	Gas (Bcf)	
Utica Shale	West Virginia	N/A	48,879	4.5
	Appalachian Basin	43,508	1,098,119	
Point Pleasant Formation	West Virginia	N/A	203,465	11.7
	Appalachian Basin	33,050	1,745,803	
Logana Member of Trenton Limestone	West Virginia	N/A	18,857	5.4
	Appalachian Basin	6,345	348,476	

MMbo=million barrels oil; Bcf=billion cubic feet

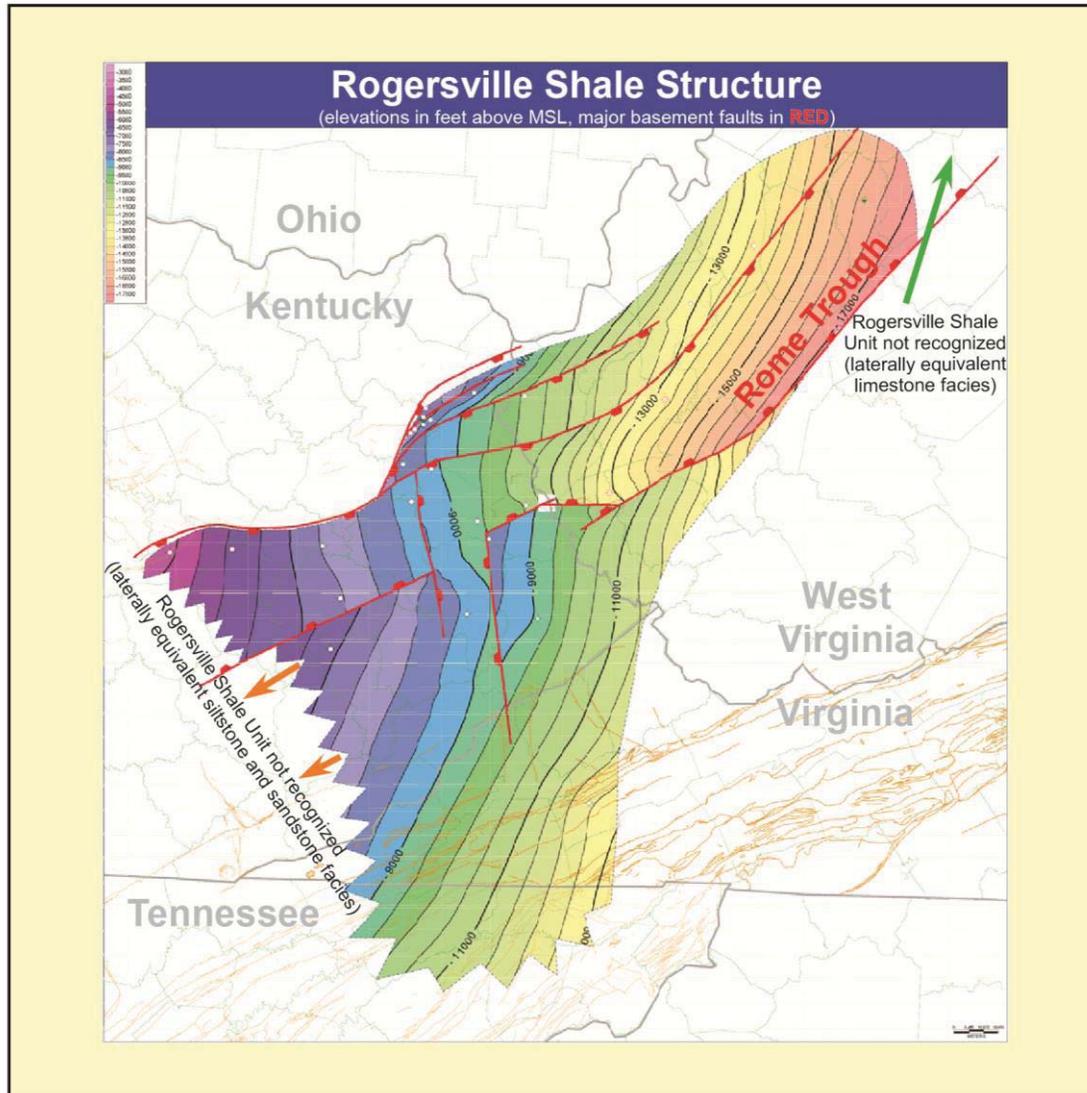
Rogersville Shale

An Opportunity?

- Organic-rich shale
- Thick
- Favorable mineralogy

But:

- Deep
- Faulted
- Poorly mapped



Hickman, Harris and Eble, Kentucky Geological Survey

Horizontal Wells Completed and Active Permits (Excluding Marcellus)

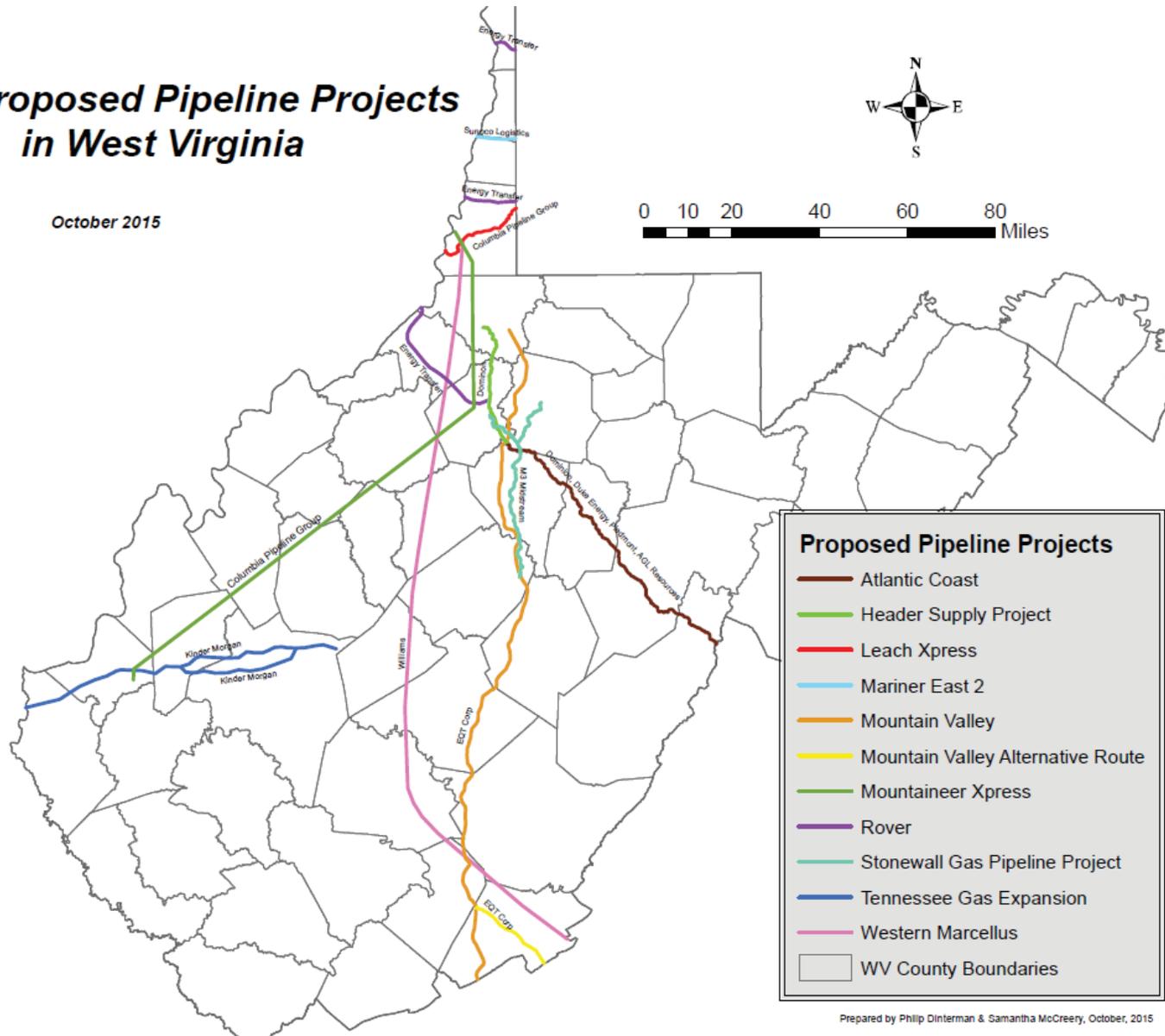
Target Formation	Completions 2006-present	Active Permits issued after 9/30/2013
Berea Sandstone	15	42
Big Injun	10	27
Burket Shale/Geneseo Shale	16	58
Lower Huron	445	8
Middlesex Shale	2	5
Upper Devonian	8	4
Utica Shale/Point Pleasant Fm.	5	14

Major Proposed Pipeline Projects in West Virginia

October 2015



0 10 20 40 60 80 Miles



Proposed Pipeline Projects

- Atlantic Coast
- Header Supply Project
- Leach Xpress
- Mariner East 2
- Mountain Valley
- Mountain Valley Alternative Route
- Mountaineer Xpress
- Rover
- Stonewall Gas Pipeline Project
- Tennessee Gas Expansion
- Western Marcellus
- WV County Boundaries

Prepared by Philip Dinterman & Samantha McCreery, October, 2015

Thank you and have a safe trip home!

For more information:

<http://www.wvgs.wvnet.edu/>