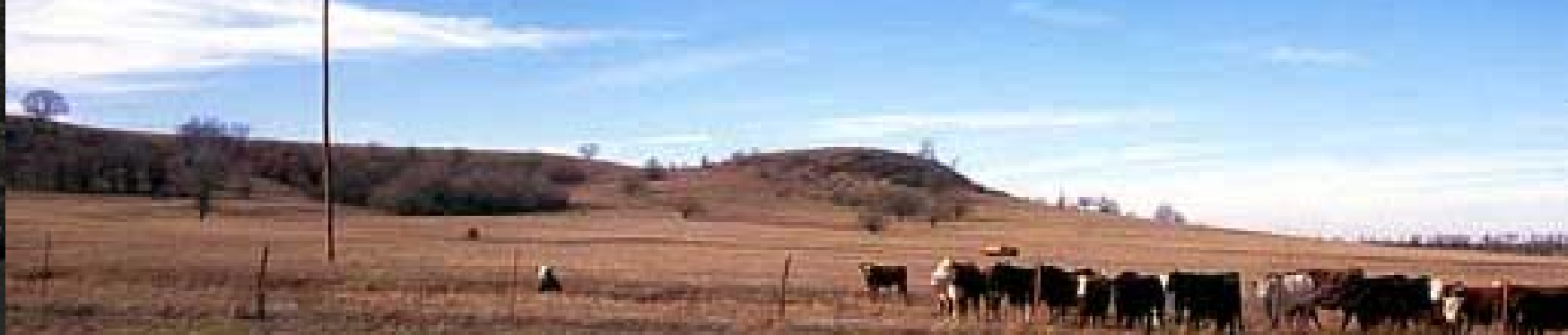




Overview of Coal Gas Reservoir Properties of Western Interior Research Coreholes

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TICORA Geosciences, Inc.

Mid-Continent Coalbed Methane Symposium

*November 8, 2004
Crowne Plaza Hotel
Tulsa, OK*

Do it Right the First Time

The added cost of *doing it right the first time* is minor when compared to the potential economic consequences of basing important decisions on insufficient data

Presentation Outline

- Research Project Objectives
- Corehole Location & Reservoir Characteristics
- *Regional Relationships*
- Compare Carboniferous versus KT
- Potential Gas Productivity

Project Objectives

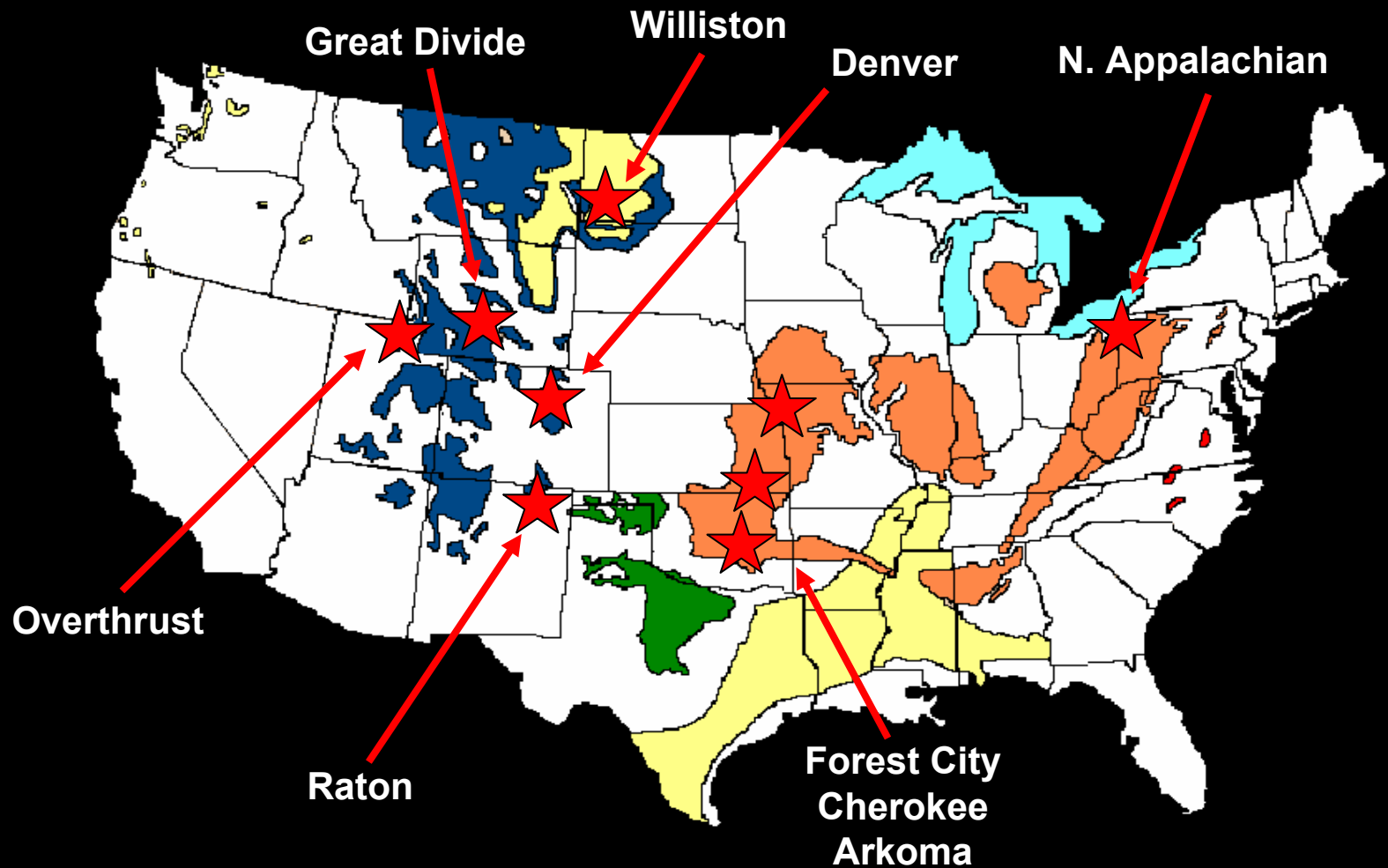
- Characterize Reservoir Properties of Frontier Areas

Formations from which there has been little or no large-scale commercial coal gas production

- Design & Build Isotherm Equipment

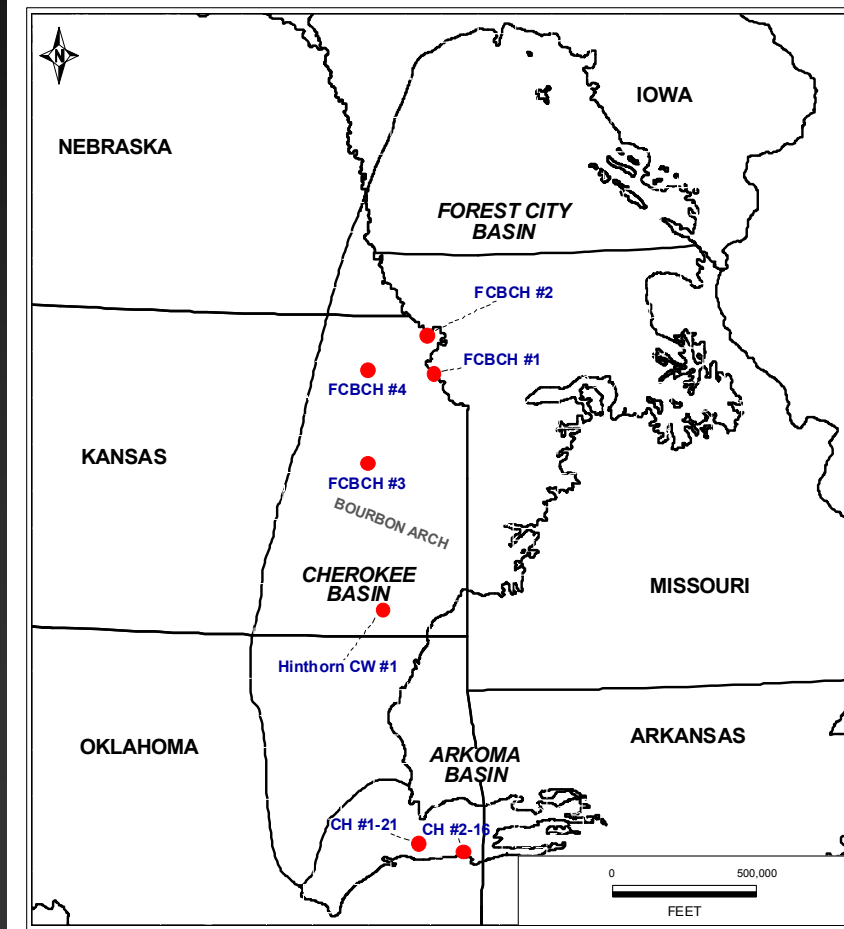
To accurately determine sorption characteristics of Frontier reservoirs - low rank, low gas content, low pressure reservoirs

Study Areas

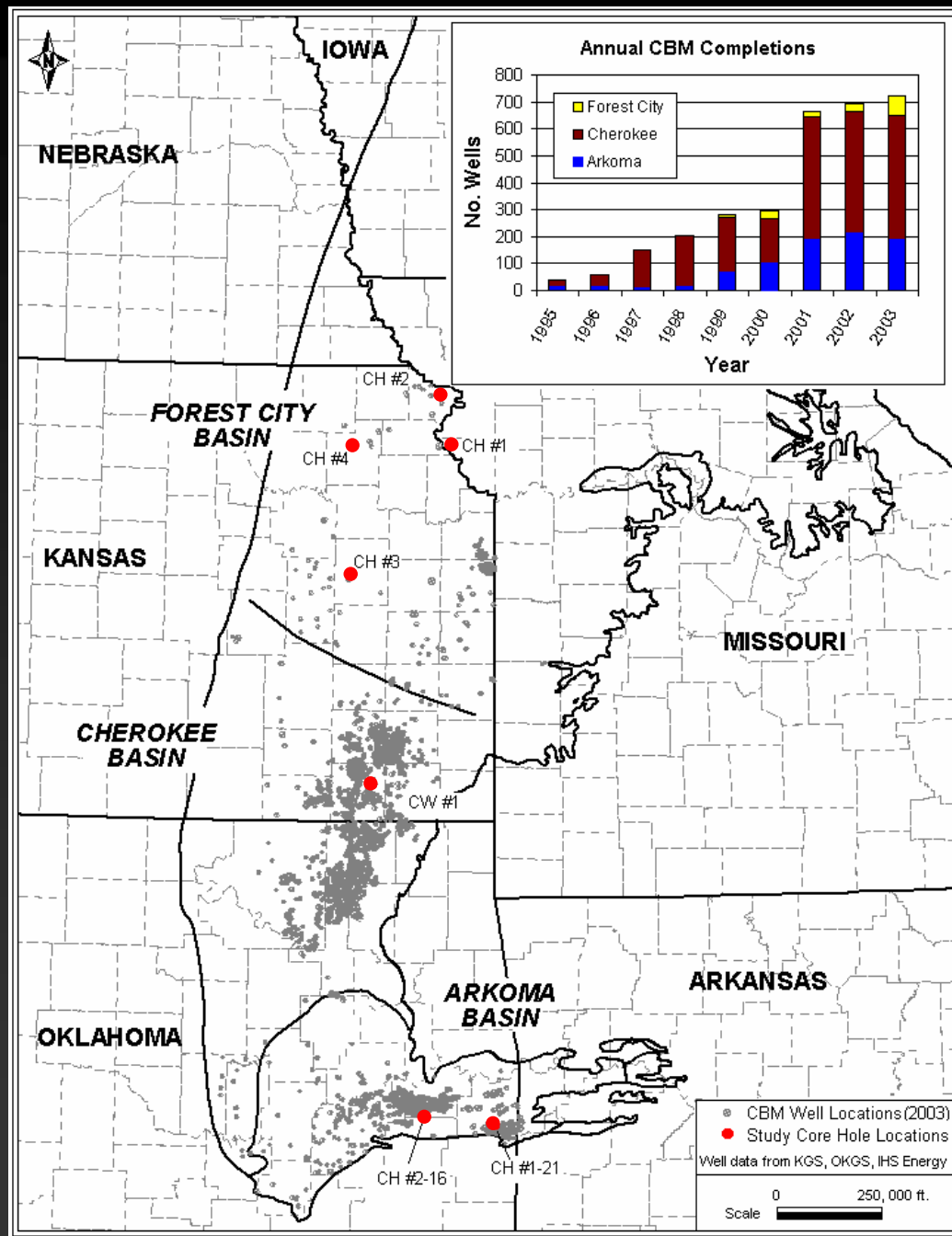


Corehole Locations

Basin	Core Holes	Canister Samples	Co-Op Partner
n = 3	n = 7	n = 197	n = 2
Forest City	4	140	El Paso
Cherokee	1	20	Colt Energy
Arkoma	2	37	El Paso



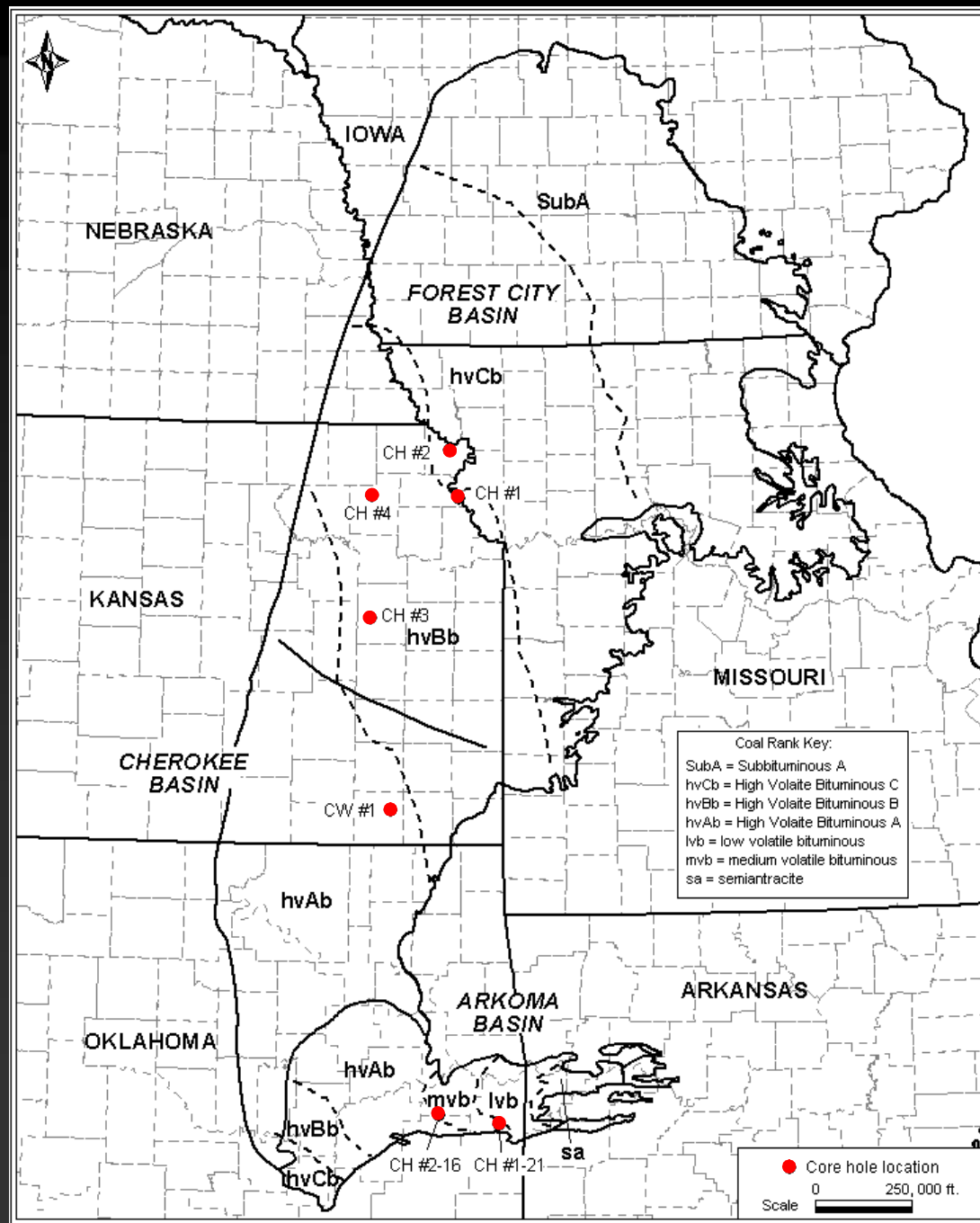
Completions



Reservoir Characteristics

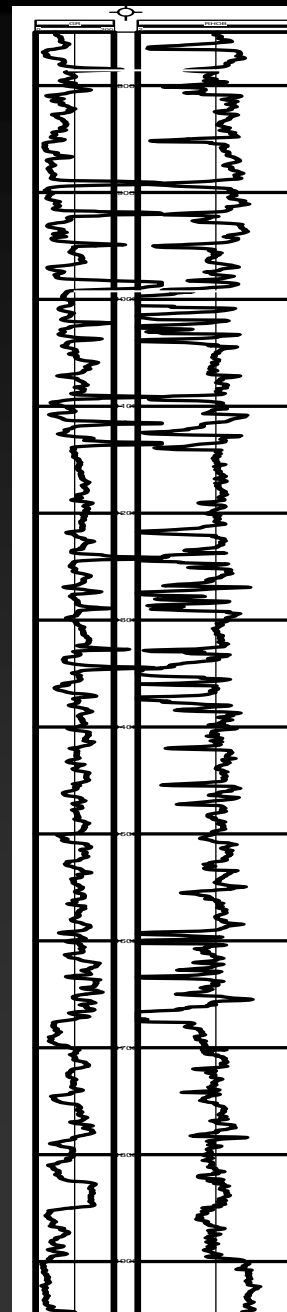
Parameters	Forest City (n = 4)	Cherokee (n = 1)	Arkoma (n = 2)
No. of Seams	14	11	7
Seam Thickness (ft.)	0.1 - 3.0	0.1 - 2.5	1.0 - 5.0
Net Coal Thickness (ft.)	~14 – 21	~10	~7 – 12
Net Reservoir Thickness (ft.)	~30 – 41	~ 20	~16 – 20
Max. Vitrinite Reflectance	0.43 – 0.70 (Sub B to hvAb)	? - 0.87 (? to hvAb)	0.95 – 2.30 (hvAb to sa)

Coal Rank



Forest City Basin Type Log & Nomenclature

Group n = 3	Seams n = 14
Kansas City	Hushpuckney Stark
Marmaton	Lexington Mulberry Summit
U. Cherokee	Bevier Croweburg Mineral Weir
L. Cherokee	Blue Jacket Drywood Rowe* Neutral Riverton*



Kansas City
Group

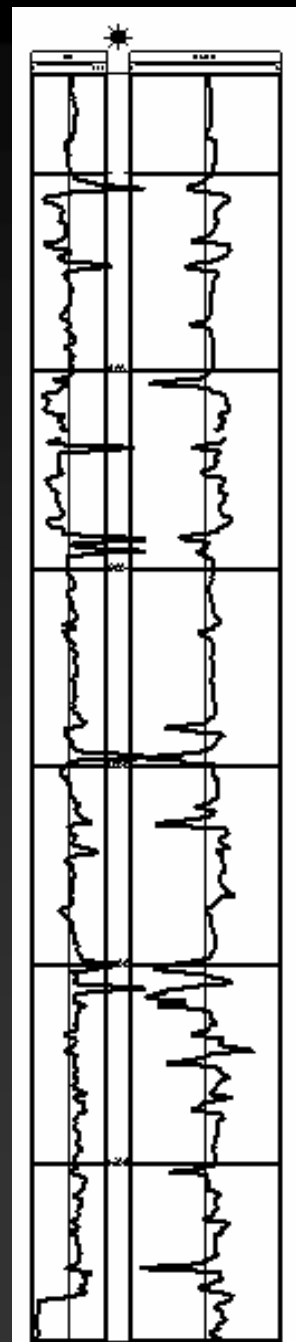
Marmaton Group

Cherokee Group

Mississippian

Cherokee Basin Type Log & Nomenclature

Group n = 2	Seams n = 11
Marmaton	Lexington Mulberry Little Osage
Cherokee	Mulky* Bevier Croweburg Mineral Scammon Tebo Weir* Riverton*



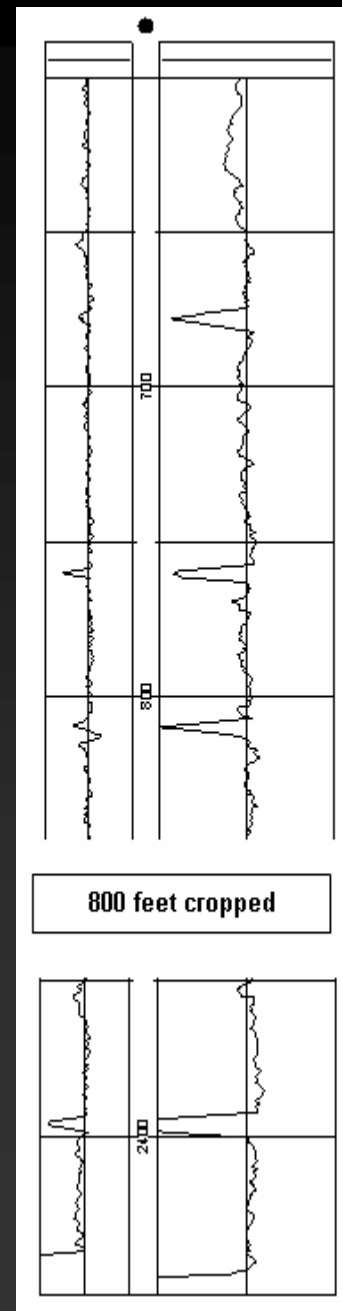
Marmaton Group

Cherokee Group

Mississippian

Arkoma Basin Type Log & Nomenclature

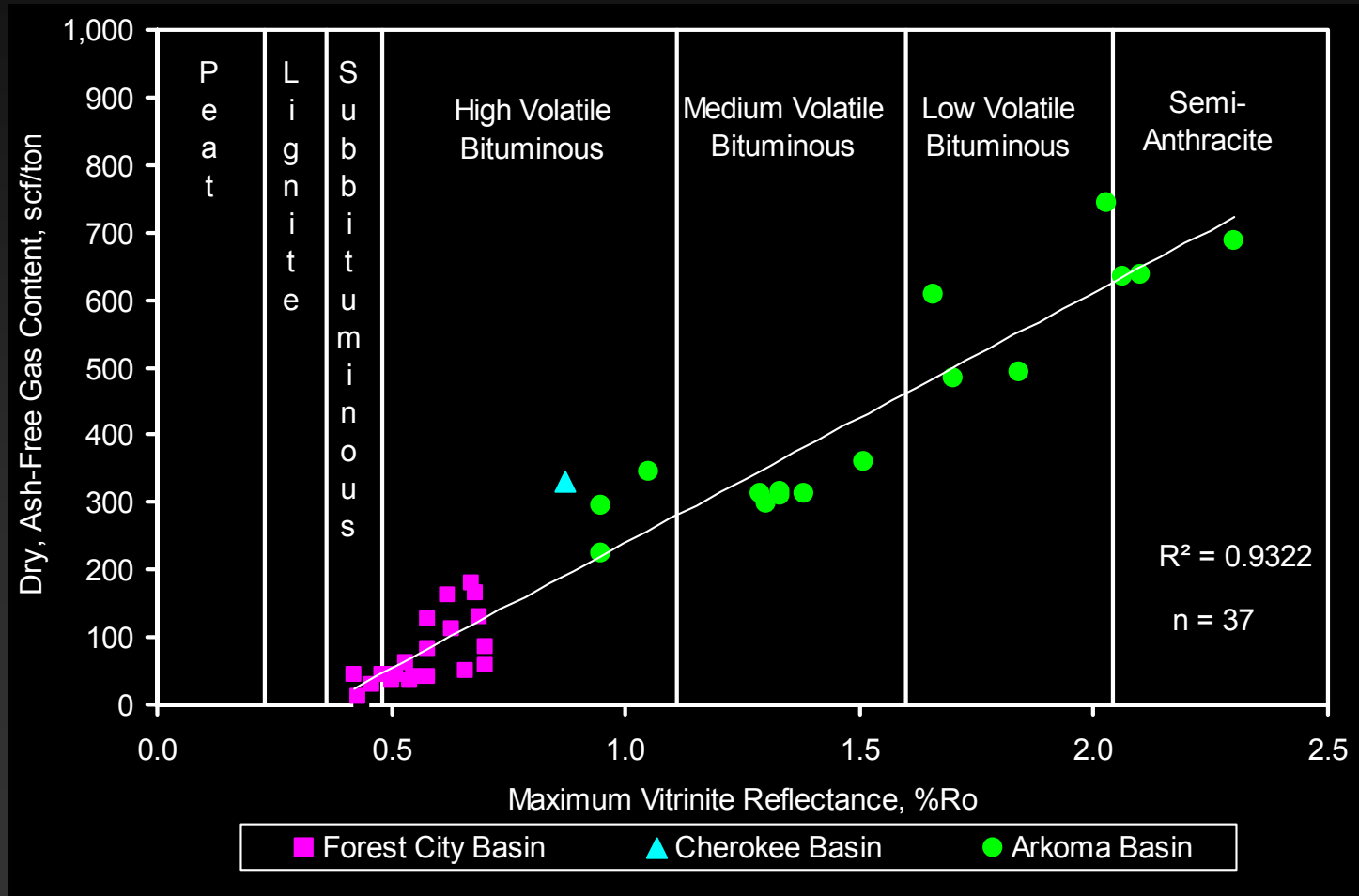
Formations n = 2	Seams n = 7
McAlester	McAlester #1 McAlester #2 McAlester #3 McCurtain Booch
Hartshorne	Upper Hartshorne Hartshorne*



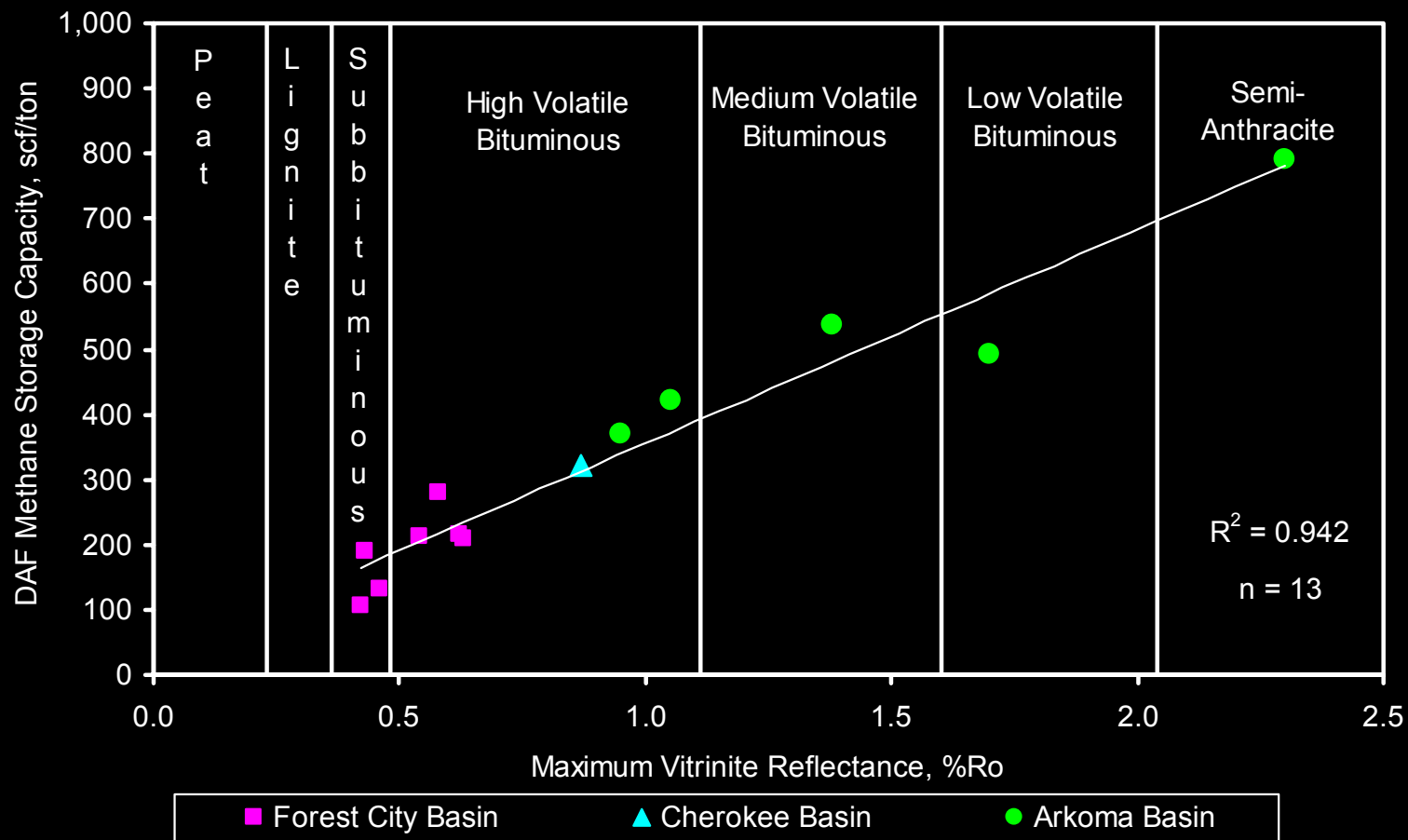
**McAlester
Formation**

**Hartshorne
Formation**

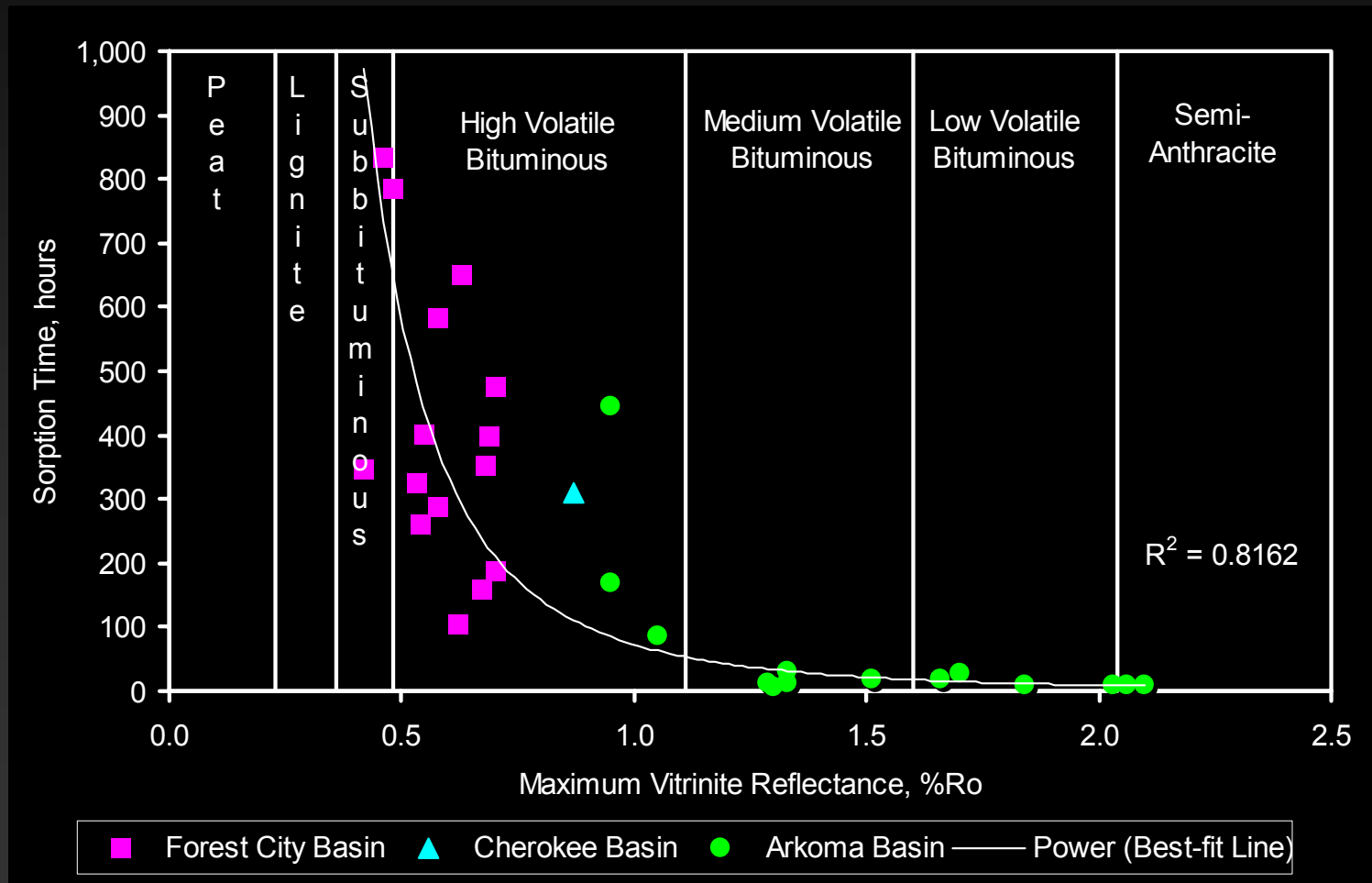
Gas Content versus Vitrinite Reflectance



Methane Storage versus Vitrinite Reflectance



Sorption Time versus Vitrinite Reflectance



Reservoir Property Comparison

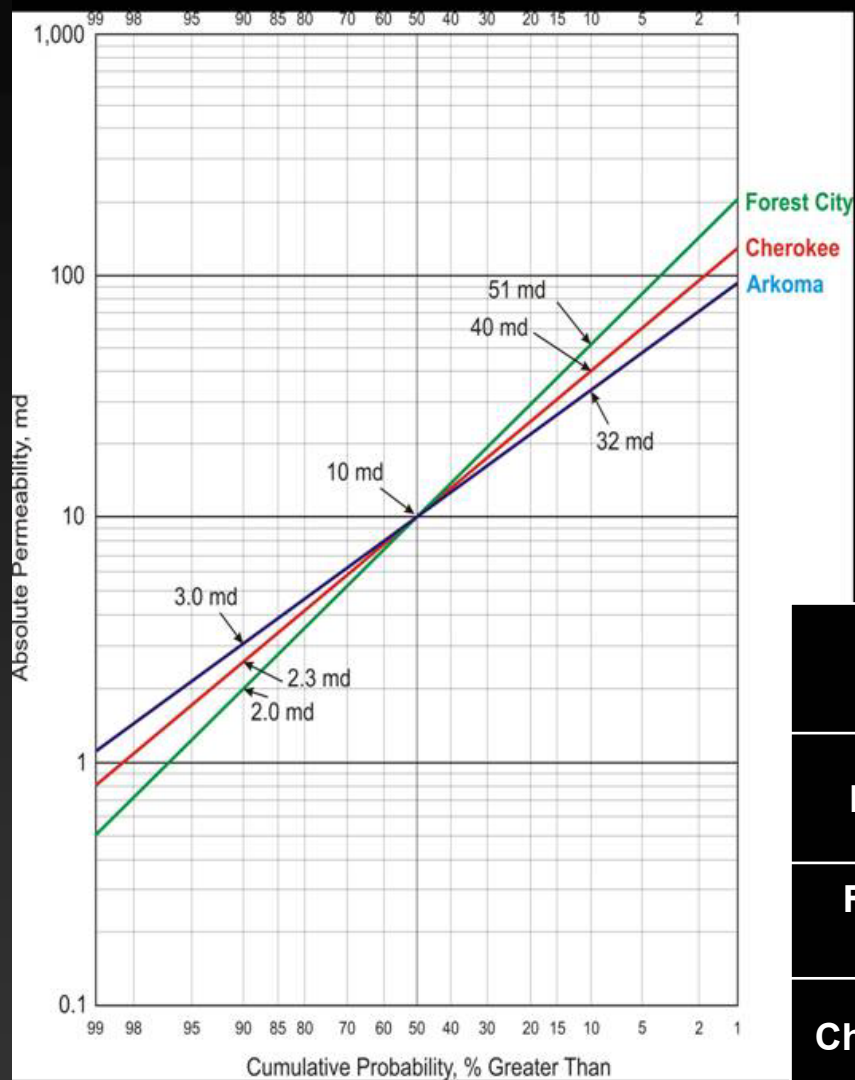
Tertiary-Cretaceous vs. Carboniferous

Parameters	Units	Forest City Basin	Powder River Basin
Seam	-	Bevier	Canyon
Rank	-	Sub B	Sub C
Depth	Feet	1,123	621
In-Situ Gas Content	scf/ton	24	22
Sorption Time	Hours	655	51

Arkoma Basin	San Juan Basin
Hartshorne	Fruitland
Semi-Anthracite	hvAb
2,398	3,148
574	561
13	4

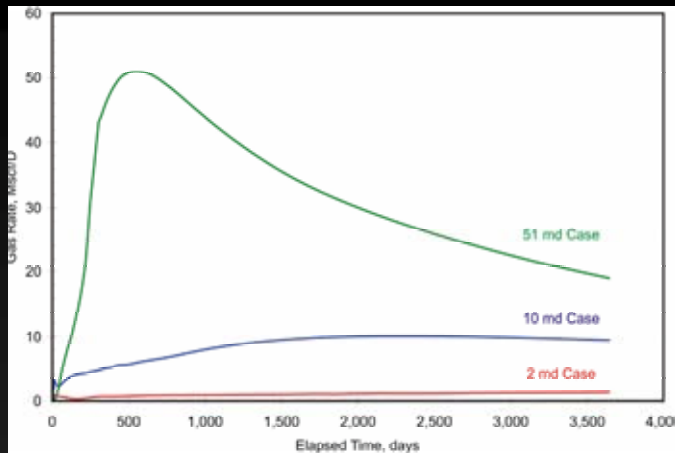
Potential Gas Productivity

- Seam Thickness (bulk ρ log or core)
- Gas Content (core analysis)
- Gas Storage Capacity (core analysis)
- Sorption Time (core analysis)
- Relative Permeability (core analysis or published)
- *Initial Pressure (well test)*
- *Absolute Permeability (well test)*

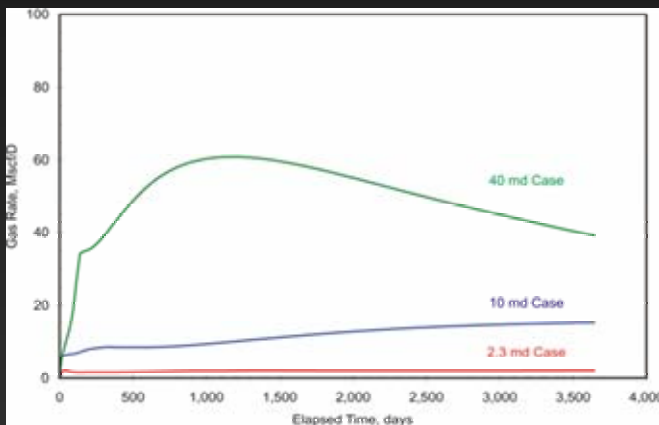


Assumptions

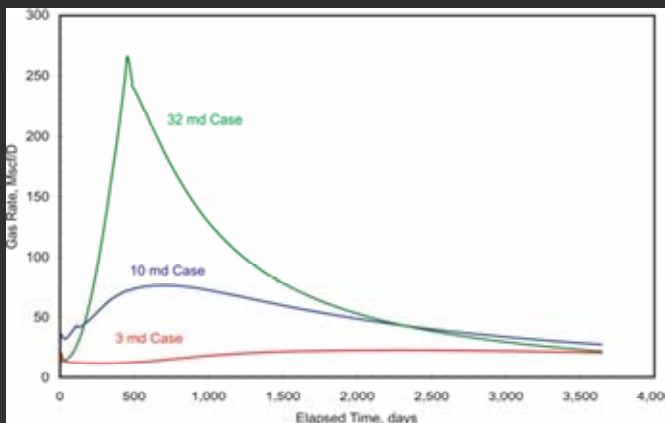
Basin	Fracture Permeability		
	Worst Case	Intermediate Case	Best Case
Forest City	2.0 md	10 md	51 md
Cherokee	2.3 md	10 md	40 md
Arkoma	3.0 md	10 md	32 md



Lower Cherokee
Forest City Basin
Peak Gas Rate - 51.1 Mscf/D
Cumulative Gas (10 years) – 110 MMscf
Recovery Factor - 37%



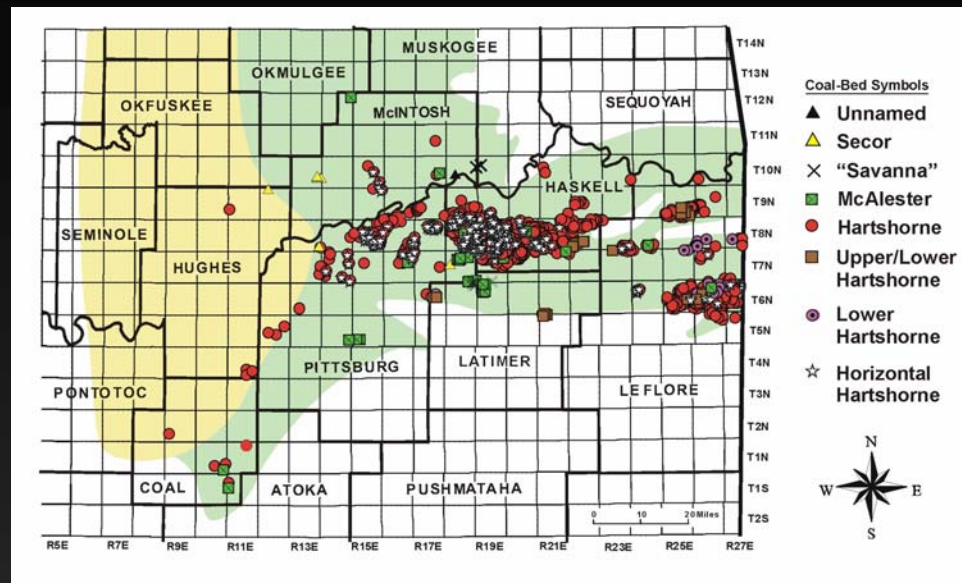
Lower Cherokee
Cherokee Basin
Peak Gas Rate - 61 Mscf/D
Cumulative Gas (10 years) – 182 MMscf
Recovery Factor - 29 %



Hartshorne
Arkoma Basin
Peak Gas Rate - 266 Mscf/D
Cumulative Gas (10 years) – 280 MMscf
Recovery Factor – 67 %

Hartshorne Production Data Vertical versus Horizontal

Source: OGS (1988 to early 2004)

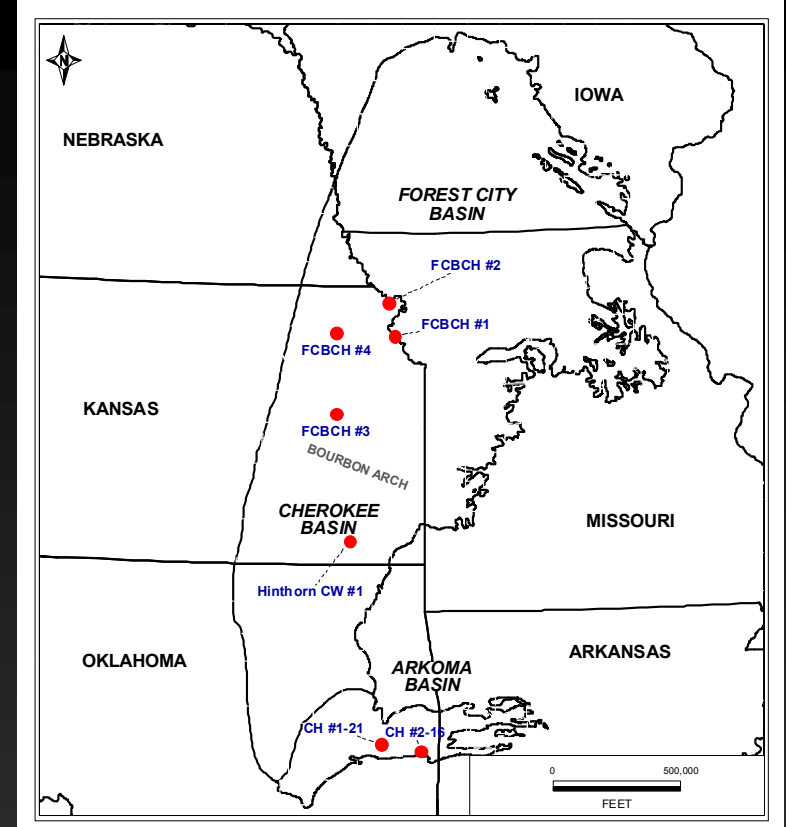


County	Completion Type	Initial Gas Production	Initial Water Production	Lateral Length	Number of Wells
		Mscf/day	STB/day	feet	
Pittsburg	Vertical	97	9	NA	113
	Horizontal	460	49	1980	75
LaFlore	Vertical	36	18	NA	276
	Horizontal	139	46	1857	13
Haskell	Vertical	52	16	NA	455
	Horizontal	341	62	1787	158

Summary

- This project offered a unique opportunity to evaluate reservoir properties over a large geographic area and a wide rank range
- General trends across the Forest City, Cherokee, and Arkoma Basins were observed
- Gas storage and movement characteristics become more favorable with increasing rank
- There appears to be a better opportunity to encounter higher initial gas saturations in the higher rank coals
- To obtain similar reservoir properties the older WICR reservoirs must be of a higher rank than the younger RM reservoirs
- The potential gas productivity estimates would have been vastly improved with the measurement of permeability and pressure data
- DO IT RIGHT THE FIRST TIME

Corehole Location Information



Basin	Core Hole Names	Operator	County	State	Location
Forest City	FCB Core Hole #1	El Paso	Platte	Missouri	S26 T54N R37W
	FCB Core Hole #2	El Paso	Doniphan	Kansas	S6 T3S R21E
	FCB Core Hole #3	El Paso	Osage	Kansas	S35 T15S R14E
	FCB Core Hole #4	El Paso	Jackson	Kansas	S34 T6S R14E
Cherokee	Hinthorn #CW1	Colt Energy	Montgomery	Kansas	S14 T32S R16E
Arkoma	Core Hole #2-16	El Paso	Haskell	Oklahoma	S16 T6N R25E
	Core Hole #1-21	El Paso	LeFlore	Oklahoma	S21 T17N R20E