

***The Unconventional Mississippian Play
Early Producing and Completion
Statistics (& Observations)***

Mississippian and Arbuckle Workshop
Oklahoma Geological Survey
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Play Evaluation

- Clients and Companies providing or agreeing to provide confidential information include many of the companies active in the Mississippian Play of Northern Oklahoma and Kansas i
- Have collected Completion, Production, and/or Geological Information on over 800 Horizontal Mississippian wells throughout the Play

Purpose of Data Gathering and analysis was to improve understanding of Mississippian Play and be a source of reliable information/statistics.

- Approximately 1100+ HZ Wells have been Drilled in the Play to date
- 600+ Wells in Miss Play overall with sufficient Daily or Monthly Data to forecast EUR's with Confidence (to an economic limit)
- 800+ Wells in Miss Play overall with some completion data for use in comparing EUR results

“The conventional view serves to protect us from the painful job of thinking”

- John Kenneth Galbraith, quoted in the Associated Press

Profile of Mississippian Play

- Still Very early in the Development of the play
 - ~1100 wells into a Potential 100,000 well play
- Statistical Play with Wide Variation of Results – but Companies that Study and Understand the Mississippi will Prosper
- Wide Range of Reported Initial Rates & Projected EURs
 - Unfortunately, no identified correlation of IP's to EURs.... yet
- Very Complex Geology - (Chats, Cherts, Dolomites, Limestones) with changes occurring vertically and horizontally - sometimes rapidly
- Completion/Stimulation Designs Matter – and should vary by area
- Expect low Oil Cuts, varying GORs, and to move significant volumes of Water in most areas
- Reservoir appears to be a perfect application of Horizontal Drilling
- Large Contiguous acreage blocks necessary to reduce project costs

“I’ve Learned one thing – people who know the least seem to know it the loudest” - Cartoonist Al Capp, quoted in the Buffalo News

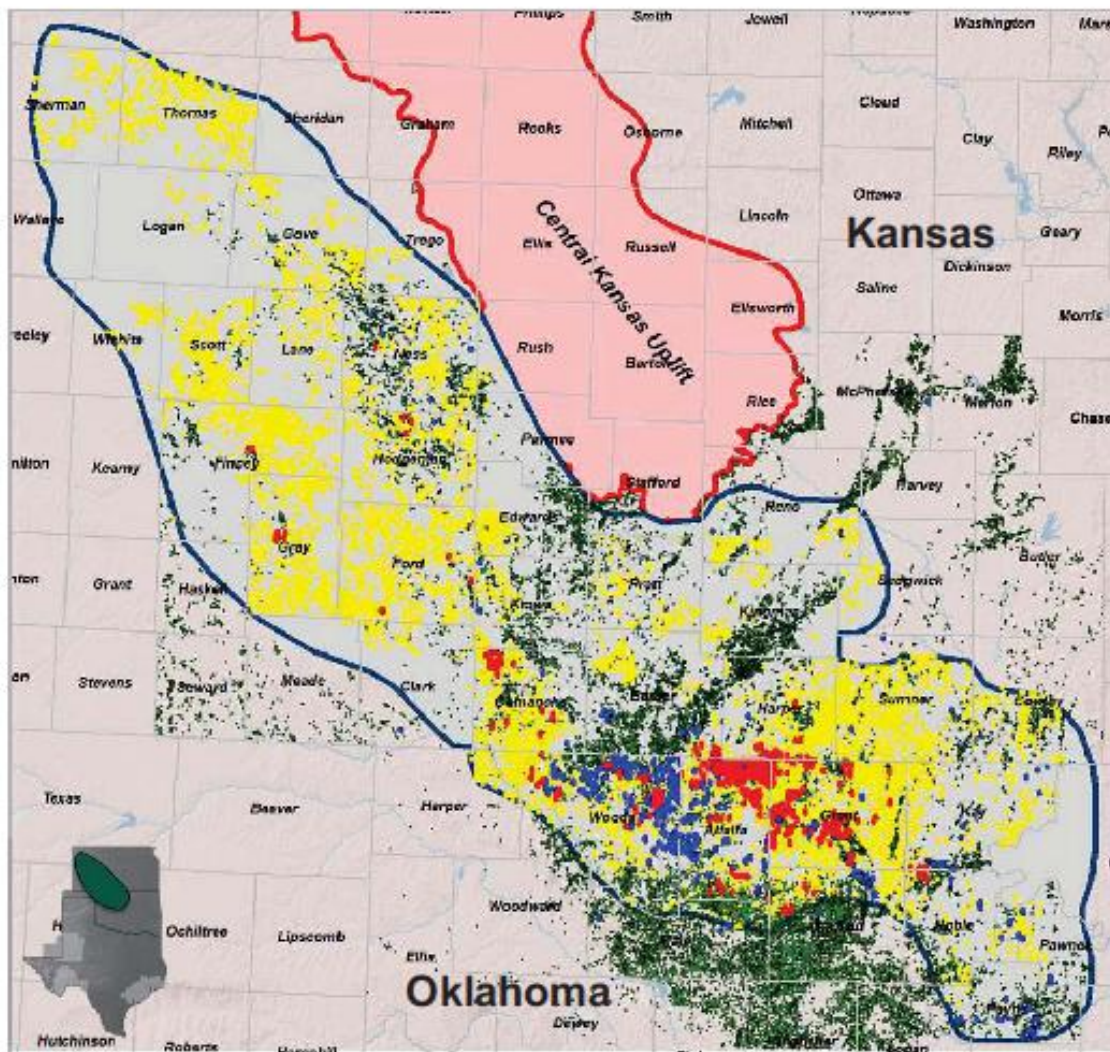
Major On-shore US Oil Play

- ✓ **Vast Area with potential – covering in excess of 17mm acres across the whole play**
- ✓ **Commercial trend which has produced from thousands of vertical wells for over 50 years**
- ✓ **Large amount of vertical well data**
 - Provides extensive reservoir control through area correlation and facies distribution and continuity
- ✓ **Shallow depths -1,600 to 7,000 ft. in “Main” Play**
- ✓ **- but HZ Miss wells as deep as 10,500 TVD**
- ✓ **Gross thickness of up to 800+ ft.**
- ✓ **Areas with High liquids content**
 - Primarily mod sweet crude and gas BTU's ranging from 1050 -1500, some Areas with low H2S
- ✓ **Lower HP industry equipment required and good infrastructure (& improving) to service the play**



Mississippi Lime in a road cutting, near Branson MO

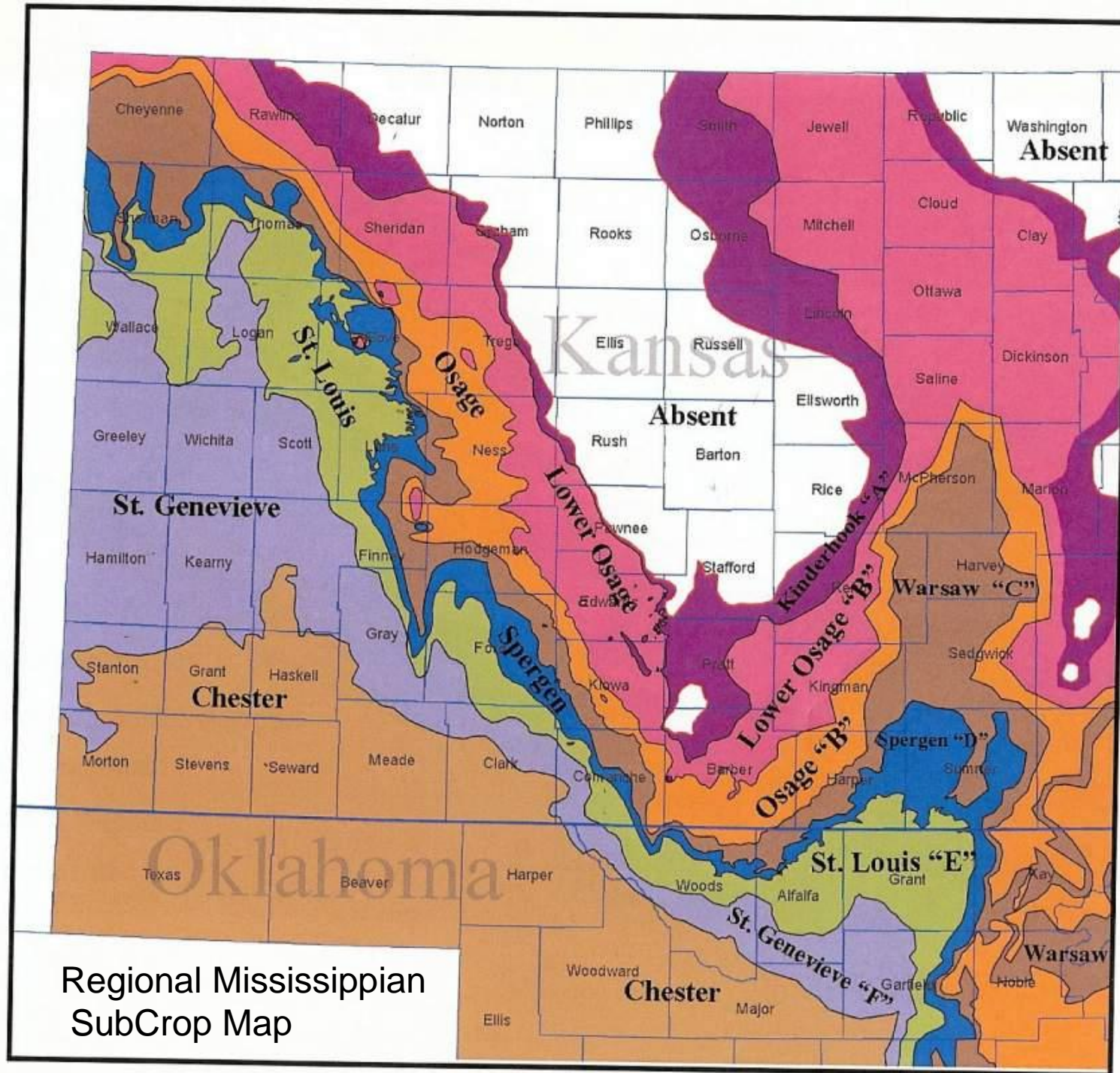
Mississippian – 962 Drilled Wells and 85 Active Rigs



	Wells Drilled	Active Rigs
SandRidge	432	30
Chesapeake	266	15
Eagle	58	2
Calyx	22	0
Range	23	3
Plymouth	15	1
Shell	17	1
Territory Res.	10	1
Panther	8	0
Chaparral	9	0
Devon	10	6
Other	92	26
TOTAL ALL	962	85

- **432 SandRidge horizontal wells** ^(b)
 - 380 Hz operated wells planned in 2012
 - SD \approx 8,000 potential locations ^(a)
- **530 Industry horizontal wells** ^(b)
- **14,700 Vertical Miss wells**
- **SD \approx 1.75 Million net acres**

(a) Based on 3 wells per section
(b) Drilled well counts as of 08/29/12



Regional Mississippian
SubCrop Map

Horizontal Mississippian Wells Analysis

- Relationship between IP's (O,G,W) and EUR's
- Relationship between Horizontal Wells and Vertical Wells
- Relationship between Frac/Acid/Prop Volumes and HZ EURs
- HZ Target Depth of Formation and EUR Comparison
- EUR improvements over time, by area
- Initial Rate Forecasts & Decline Parameters (De, b)
- Log Derived Volumetric Search for necessary Thickness
- Reservoir and Performance Differences by Area
- Varying Oil Cuts, GORs by area

“If you are out to describe the truth, leave elegance to the tailor”

- Albert Einstein, Quoted in the Asheville, N.C., Citizen-Times

Problems faced in Conducting an Evaluation of the Mississippian Play

- **Limits Confidence of New Companies & Investors to Invest in the Play**
- Confidentiality of Information from both Operators & Regulatory Bodies
 - Limits outside evaluation of Play
- Partial or Non-Disclosure of Information
 - Information usually excludes # Stages, Stage Lengths, Perforation Details, Proppant Size, Stim Fluids and rates, etc.
- Consistency of Reported Data
 - How are IP's reported (Max Rates, Ave 1st Mo, Last Day, Guess, etc)
 - When is data released – sometimes 6 months or 1-2 years before info Released
- Production Analysis
 - For analyzing during first 2 years, Best to use Daily Production Data to forecast to get reasonable estimates of Reserves due to downtimes and changes in production methods from Flowing to Gas Lift to ESP's, etc.
 - Monthly Production issues of Lag Time, Inaccuracies, Omissions, Common Meters, Sales vs Production, Water Volume reporting, Pressures

Statistics and Metrics

“Statistics are like bikinis. They show a lot but not everything”

- Former baseball manager Lou Piniella, quoted in the Cassville Mo., Democrat

Overall Play Averages

860 Wells with Completion or Rate information

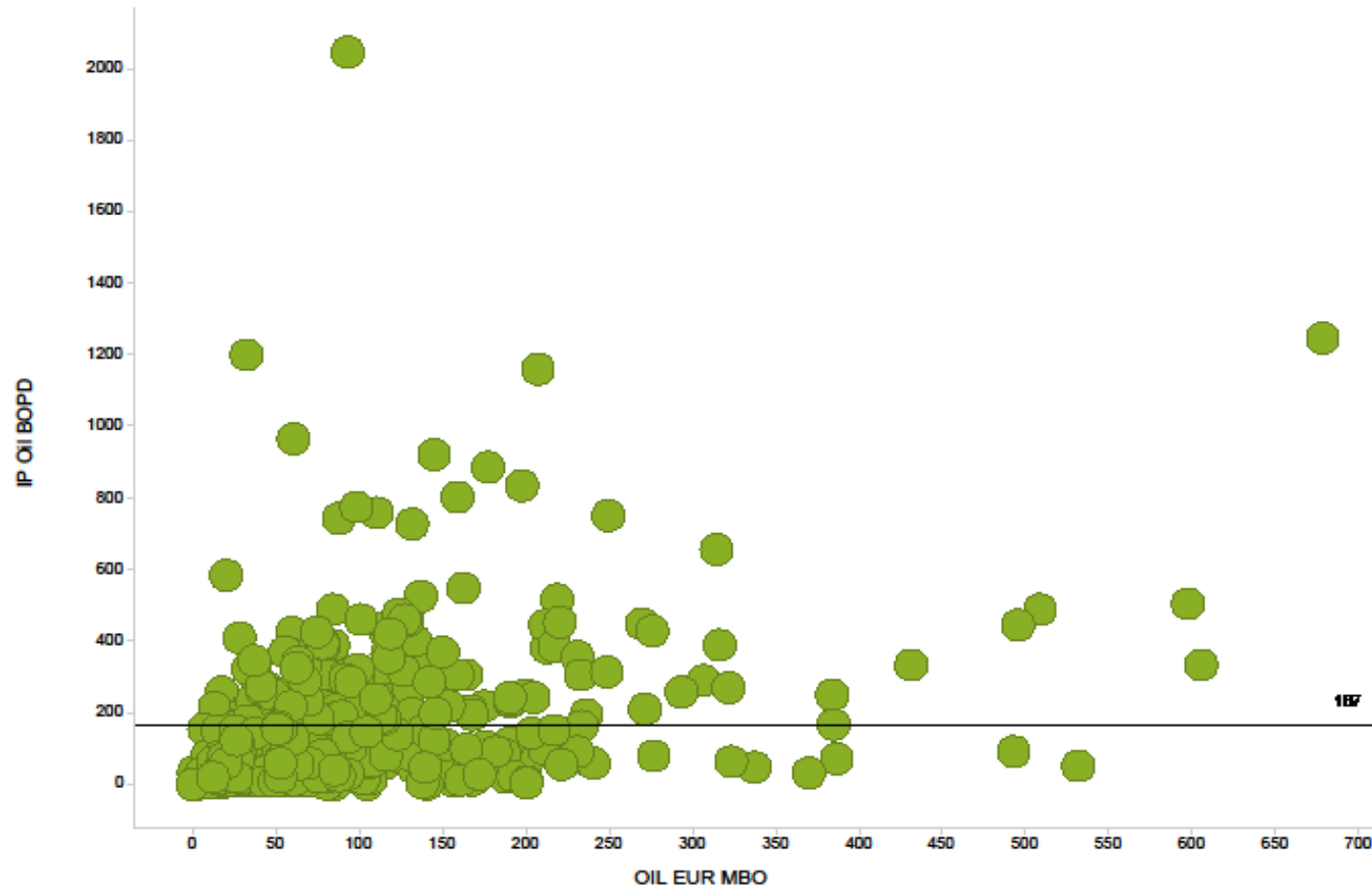
Ave MD	9,496	Ft				
Ave TVD	5,198	Ft				
Ave Drld in Miss	(83)	Ft				
Ave Oil IP	168	BOPD			Per Compl Ft	
Ave Gas IP	777	Mcf/d	Ave HZ Compl	3,826		
Ave IP Water	2,569	BWPD	Ave IP BOPDE/ft		0.09	
Ave BOPDE	297	BOPDE	Ave BBI Acid	1,261	14.5	Gal/Ft
Ave IP Oil Cut %	10.0%		Ave BBIs Frac Fl	46,194	13.1	BBI/Ft
Ave IP GOR	10,339	scf/bbl	Ave Proppant	1,104,724	313.5	#/ft

616 Wells with EUR's

	Overall	Wells w/ Compl Info	Normalize to 4400'
Ave Oil EUR	91	98	131
Ave Gas EUR	793	818	1,090
Ave Wtr EUR	1,885		
Ave MBOE	222	235	313
Ave Oil Cut	8.0%		
Ave EUR GOR	15,820		

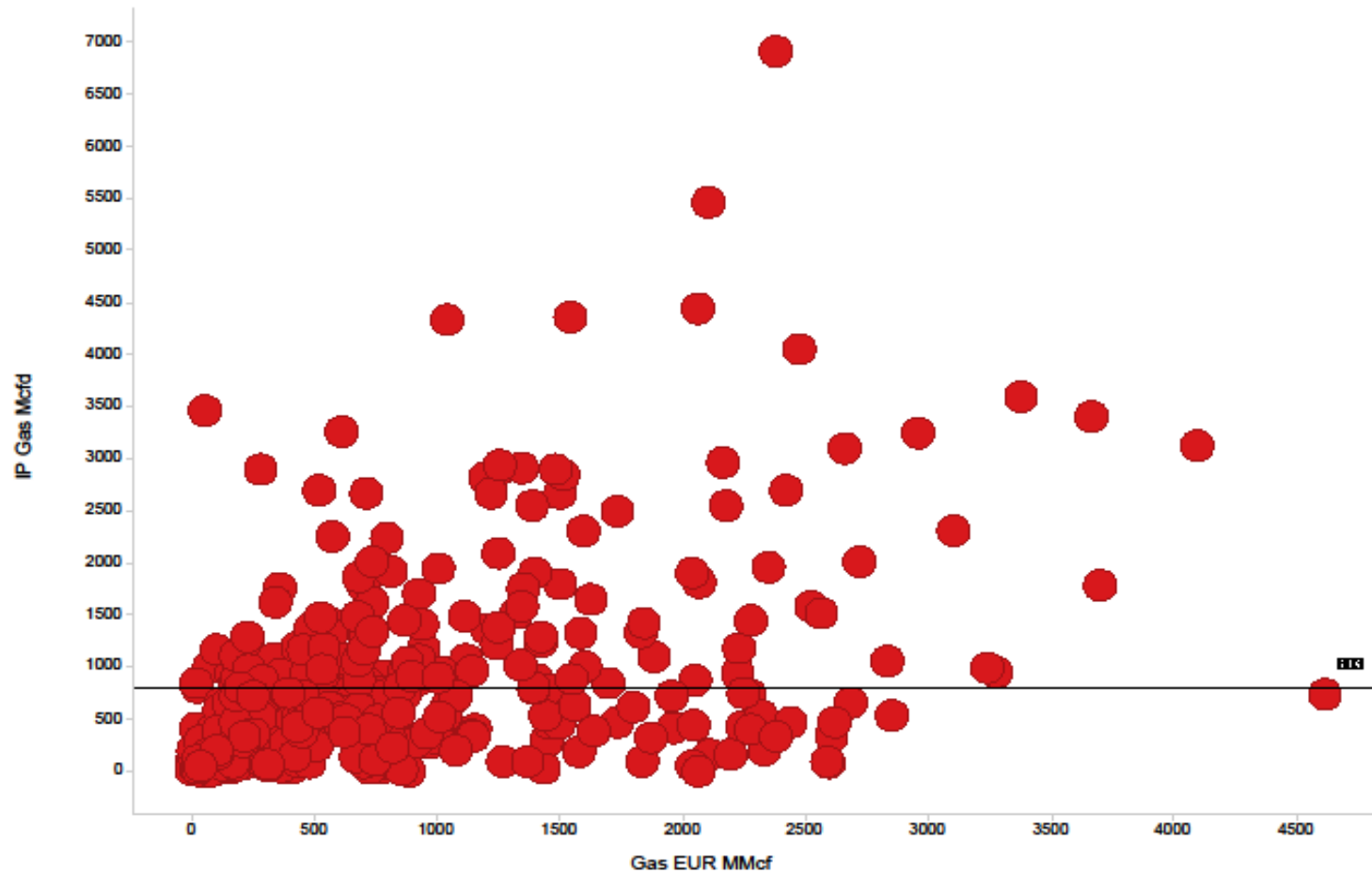
Oil IP's vs Oil EURs

615 MISSISSIPPI WELLS - OIL IP vs. EUR OIL



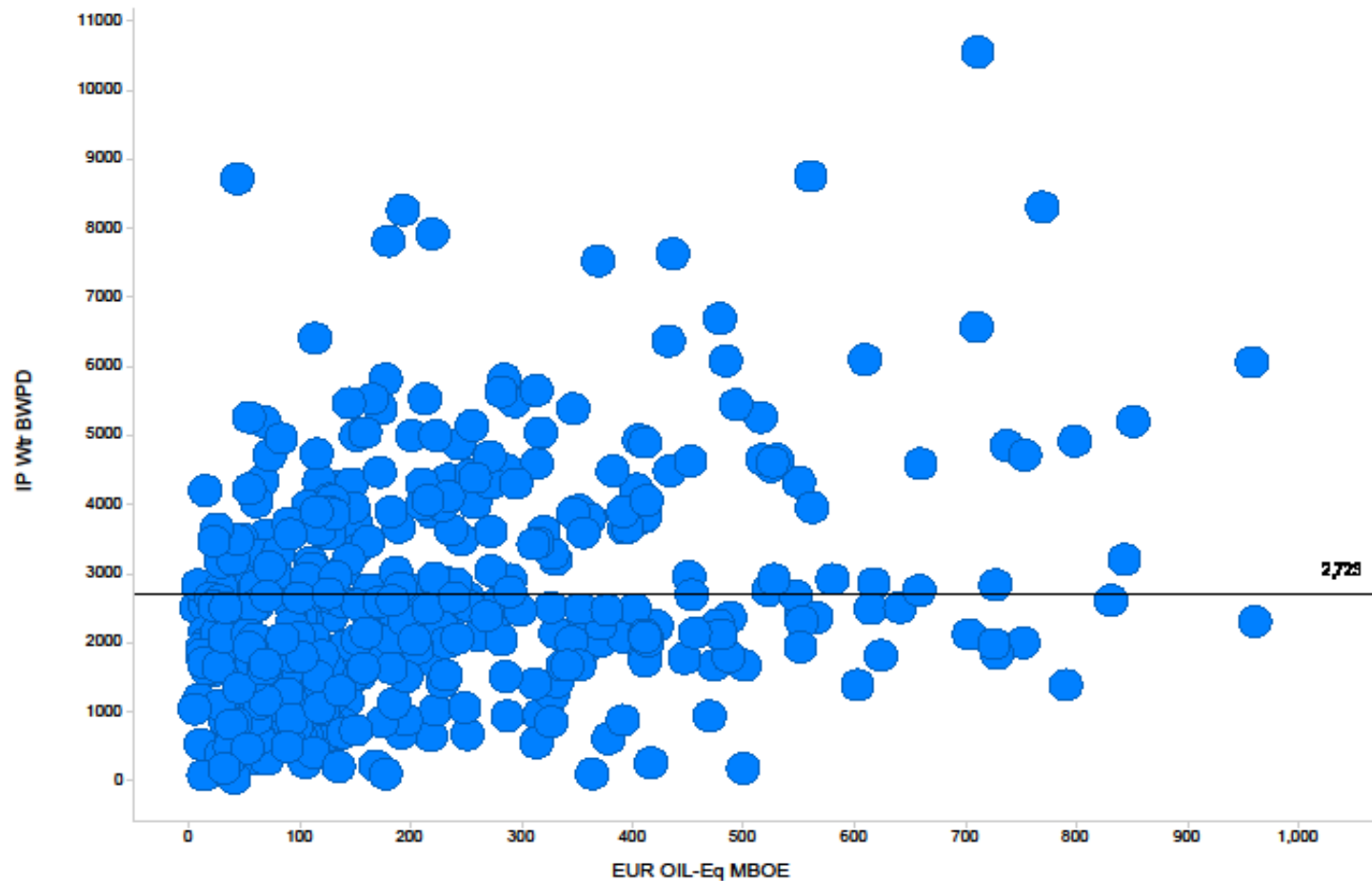
Gas IPs vs Gas EURs

615 MISSISSIPPI WELLS - GAS IP vs. EUR GAS

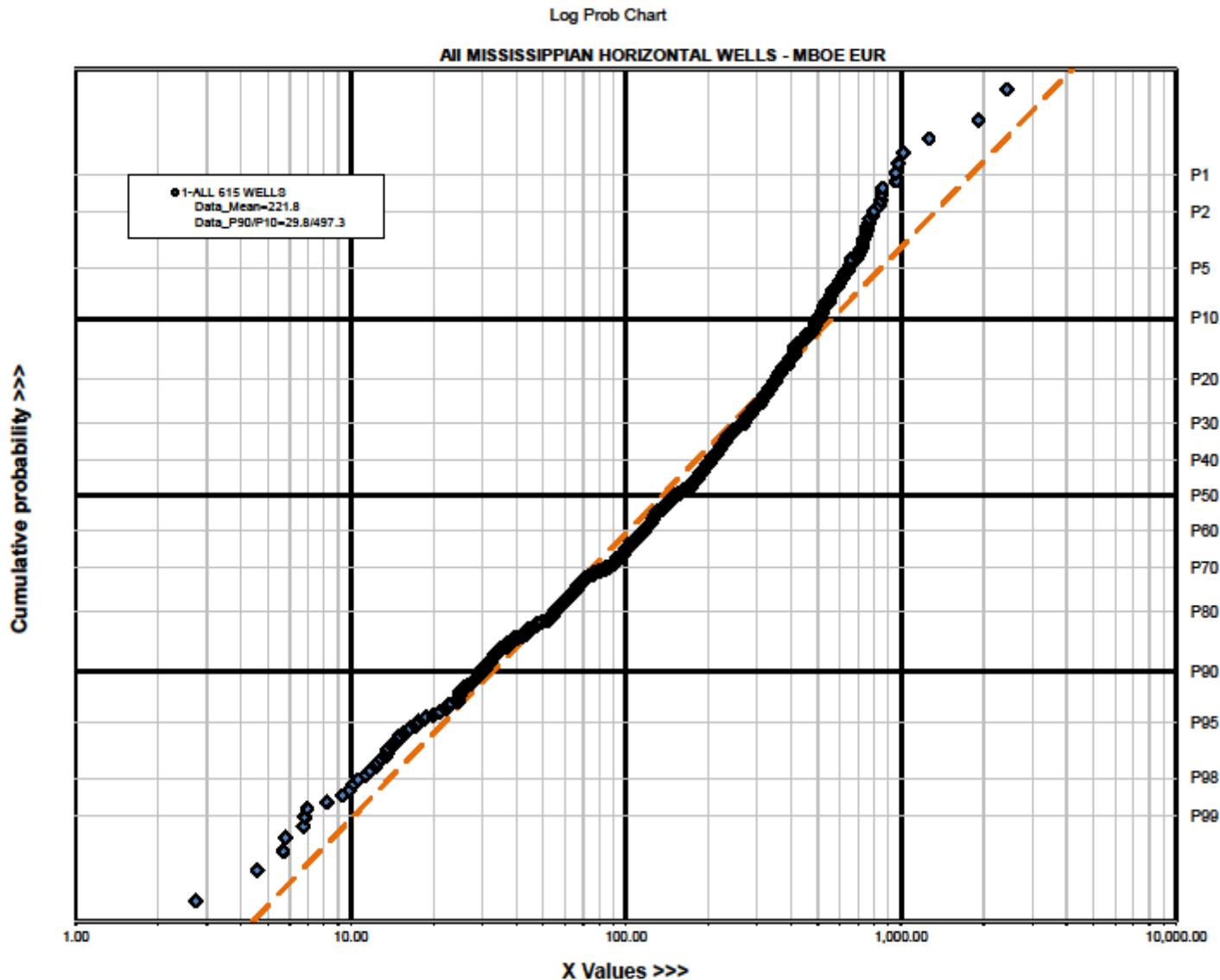


Water IP vs MBOE EURs

615 MISSISSIPPI WELLS - WATER IP vs. MBOE EUR



All Mississippian Play – MBOE EUR's



All Wells

All Areas

All Operators

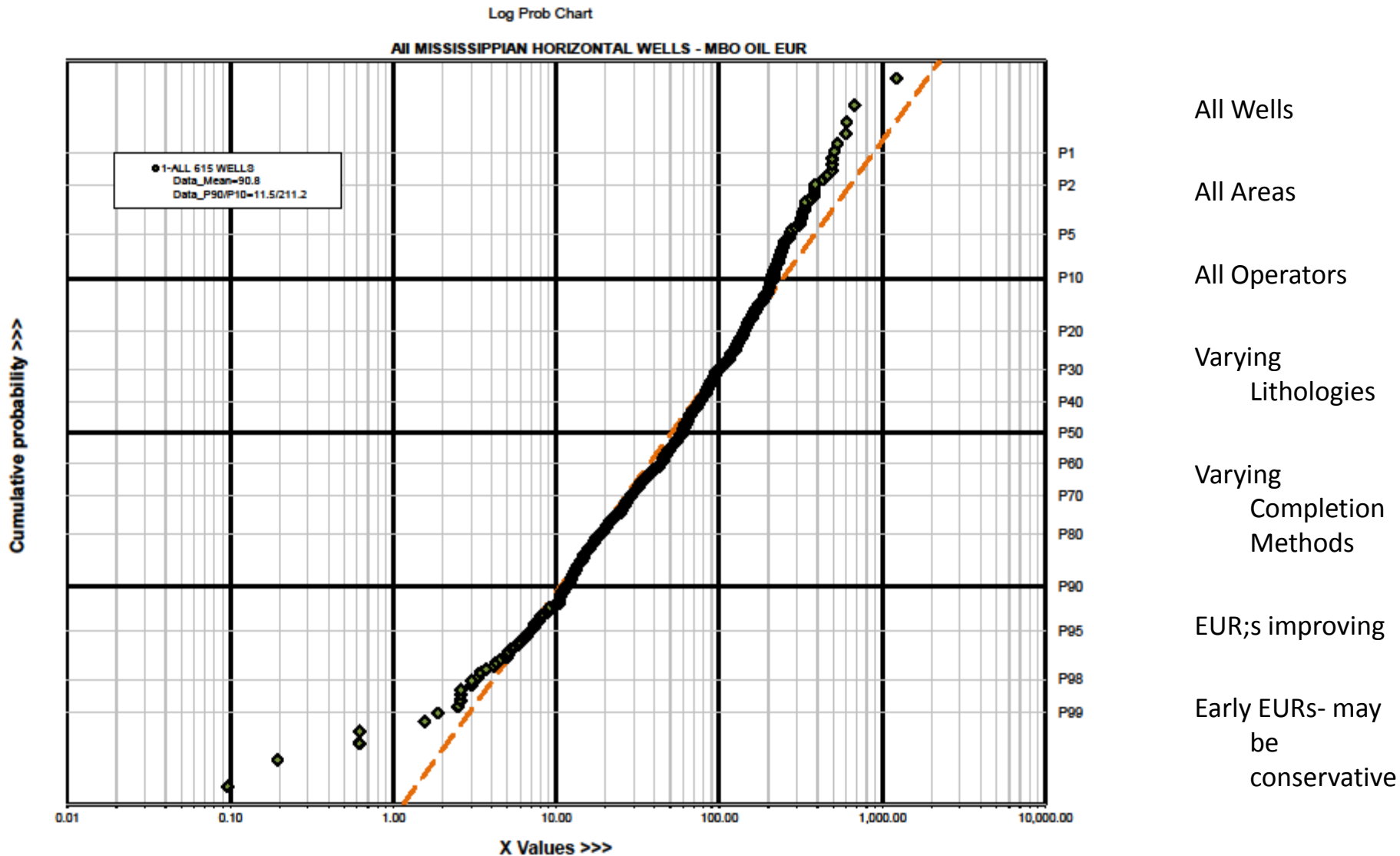
Varying
Lithologies

Varying
Completion
Methods

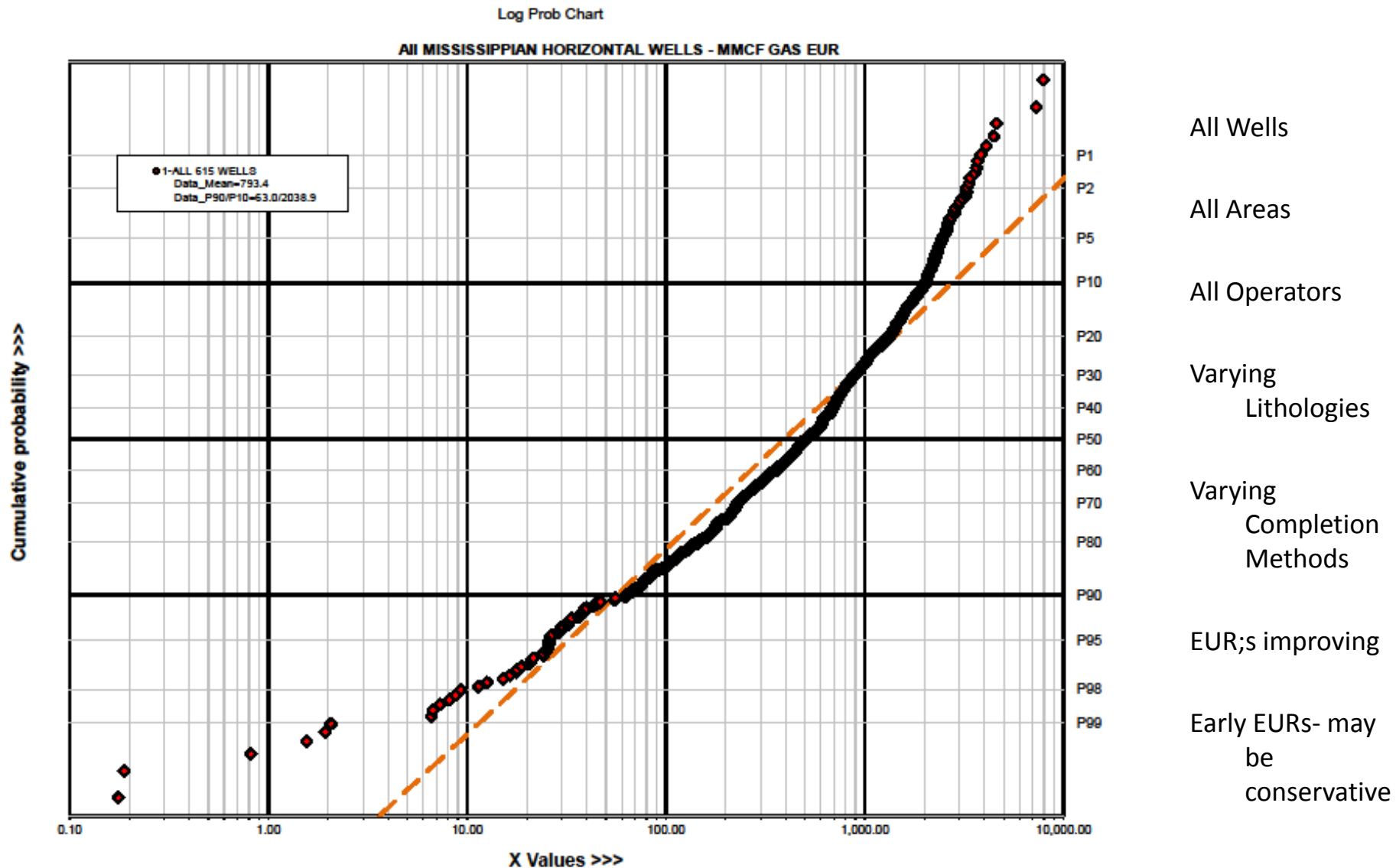
EUR;s improving

Early EURs- may
be
conservative

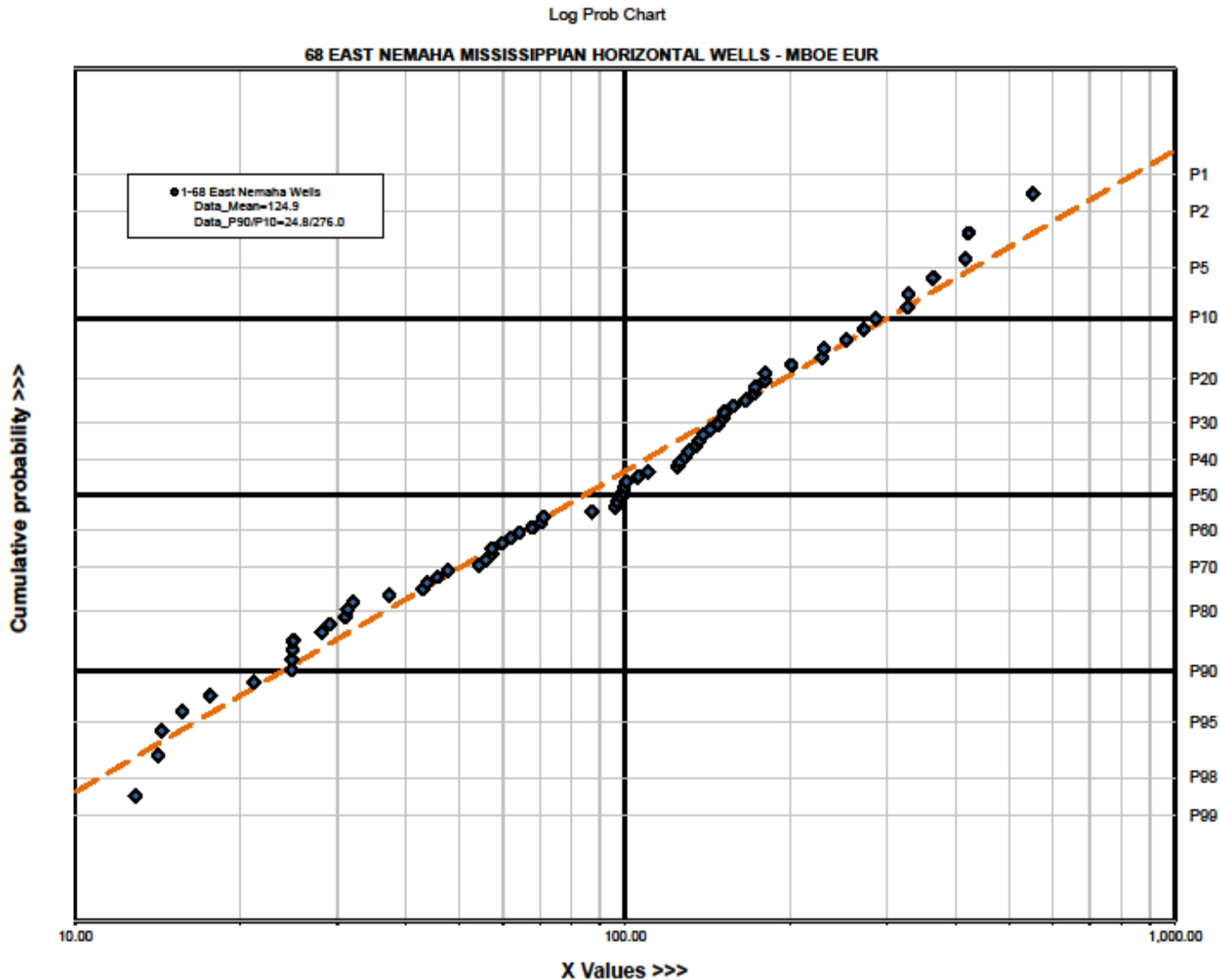
All Mississippian Play – Oil (MBO) EUR's



All Mississippian Play – Gas (MMcf) EUR's



Mississippian Play – East of Nemaha Ridge – MBOE



Six OK Counties

Shorter Laterals

Generally Lower
GOR's

Varying
Lithologies

Varying
Completion
Methods

Limited well
count

EUR;s improving

OH Completions Comparison to Plug & Perf

- Very encouraging results from Open-Hole Packers Method
 - About 40+ wells have employed system utilizing casing with OH packers completion design
 - Only have completion + production data on 15 confirmed wells
 - Additional work to be done. Reports have not been filed nor production reported on many of the wells – performing analysis at this time would result in skewed numbers

Keys to Unlocking the Mississippian Liquids Play

- Use Core, Vertical & HZ Petrophysical (Log) Data/Analysis, Micro-Seismic & Seismic data to determine Structure, Lithology and formation Characteristics – fractures, faults, Porosity, Thickness, etc
- Targeting the correct interval(s) within the Mississippian formation to Minimize drill time and to Maximize Rate and Reserves
- Designing and Performing the “Right” Completions/Stimulations
 - Number of Stages, Perforations, Fluid Volumes/Types,
 - Proppant Types and Amounts, Injection Rates
 - Adapt Designs to area geology and lithology
- Determine what you need to get what you want

Example - Area/Thickness Necessary for Recoveries

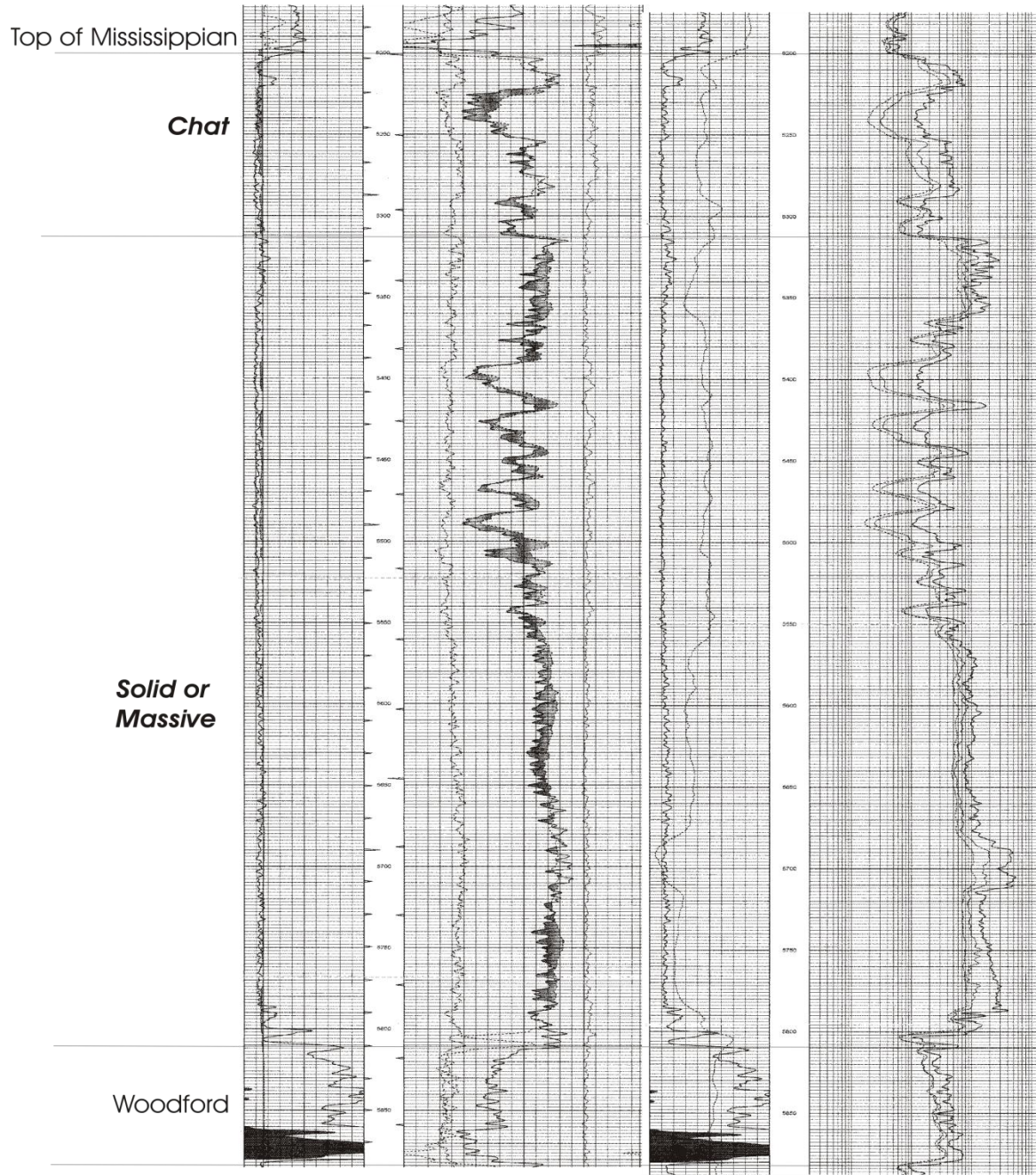
- $L = 4400 + 400 = 4,800'$
- $W = 2 * 600' = 1,200'$
- $A = 5,760,000 \text{ ft}^2 = 132 \text{ acres}$

- **$\Phi = 20\%$, $S_w = 65\%$, $R_f = 10\%$, $B_o = 1.4$**
 - $H = \underline{30'}$, Oil EUR = 153,608 BBls Oil

- **$\Phi = 5\%$, $S_w = 65\%$, $R_f = 7.5\%$, $B_o = 1.4$**
 - $H = \underline{160'}$, Oil EUR = 153,608 BBls Oil

- **$\Phi = 5\%$, $S_w = 65\%$, $R_f = 5.0\%$, $B_o = 1.4$**
 - $H = \underline{240'}$, Oil EUR = 153,608 BBls Oil

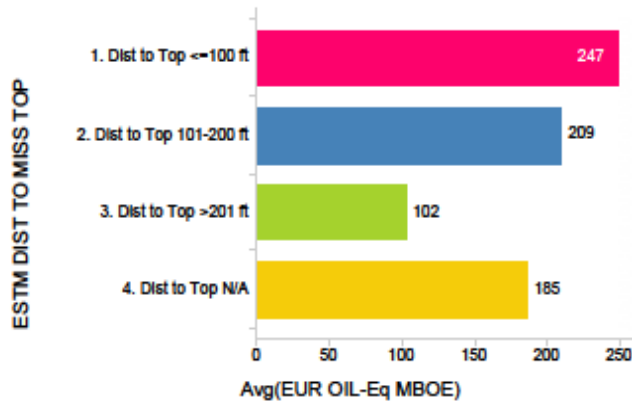
TYPE LOG OF MISSISSIPPIAN FORMATION



HZ Well TVD vs Top Mississippian

612 Miss HZ Wells - Estimated Distance to Miss Top

AVG EUR



% Count of Distribution of Estimated Dist to Miss Top

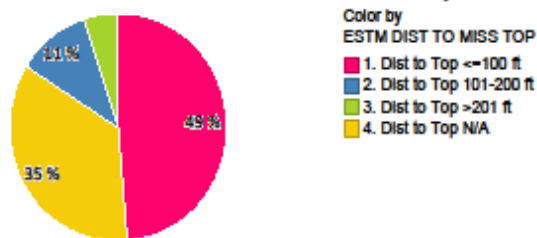
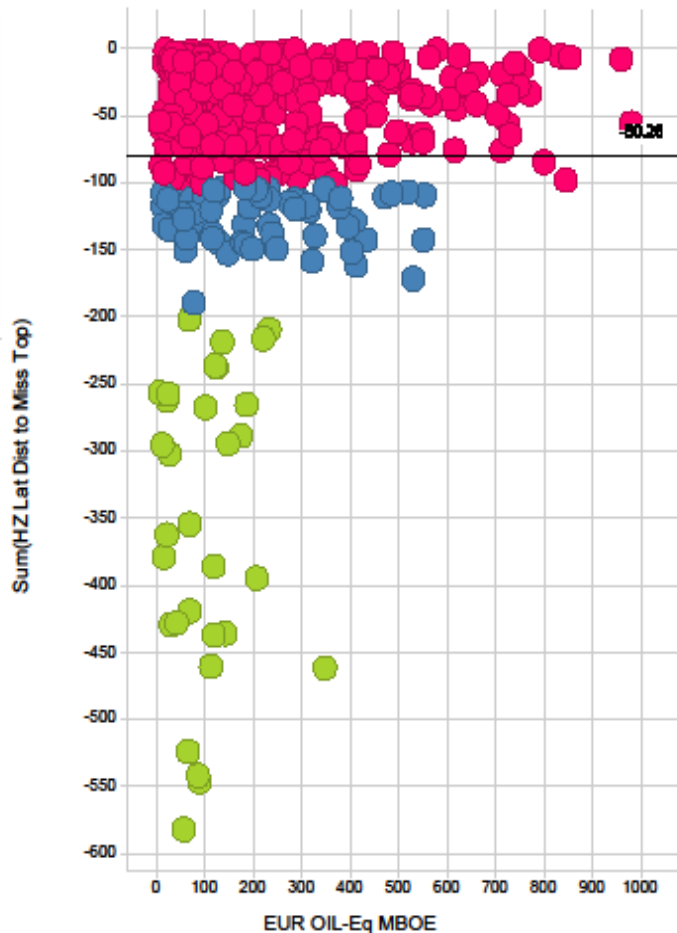


Table - Estimated Dist to Miss Top

ESTM DIST TO MISS TOP	Avg(EUR OIL-Eq MB...	Count(LEASE NAME)
1. Dist to Top <=100 ft	247	298
2. Dist to Top 101-200 ft	209	67
3. Dist to Top >201 ft	102	31
4. Dist to Top N/A	185	216
Grand total	214	612

Avg(EUR OIL-Eq MBOE), Count(LEASE NAME)

Estimated Dist to Miss Top vs. EUR



Analyzing Depth of HZ Wells

Most wells concentrated in Top 150'

All Areas

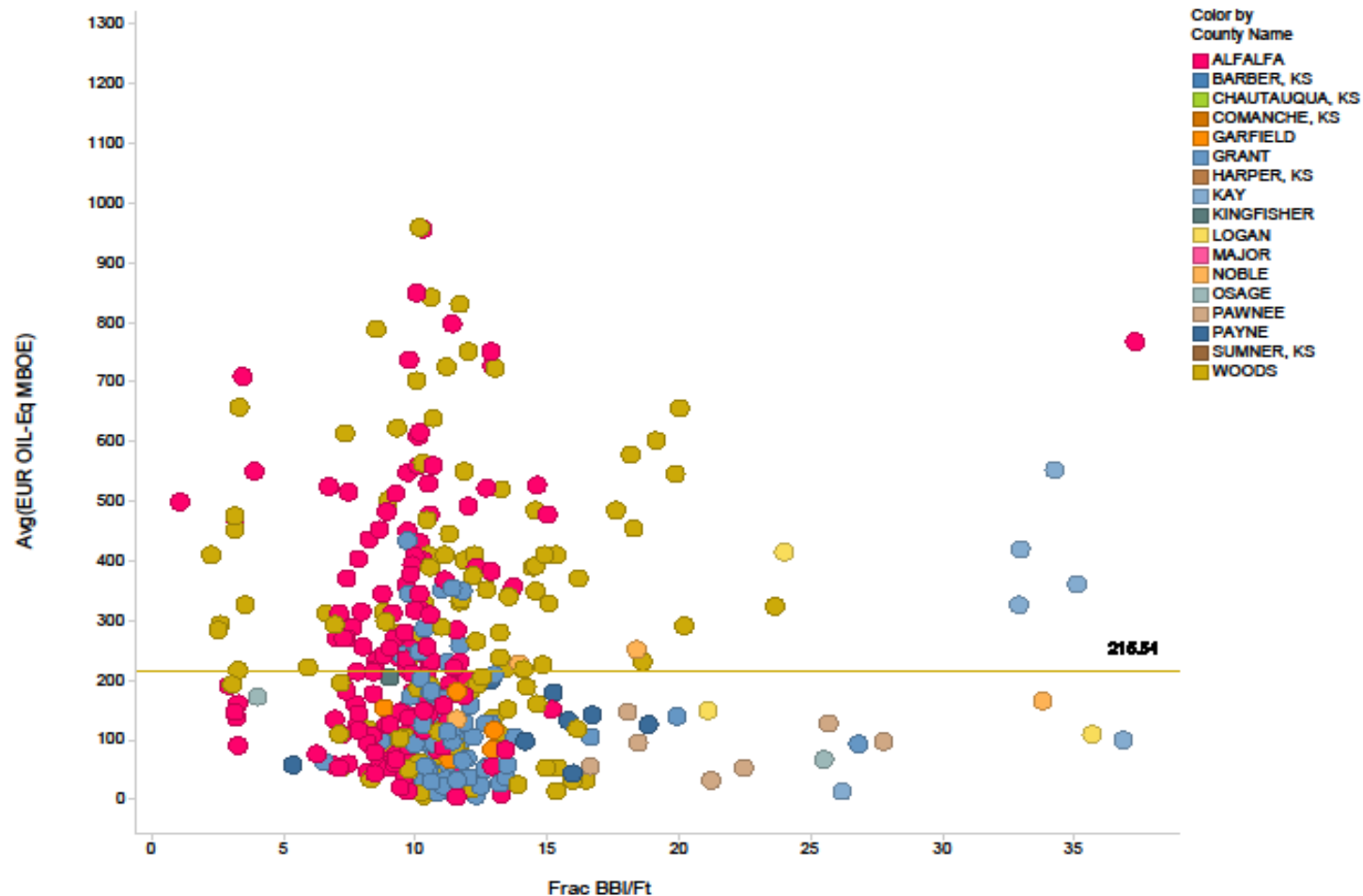
All Operators

Varying Lithologies

Varying Completion Methods

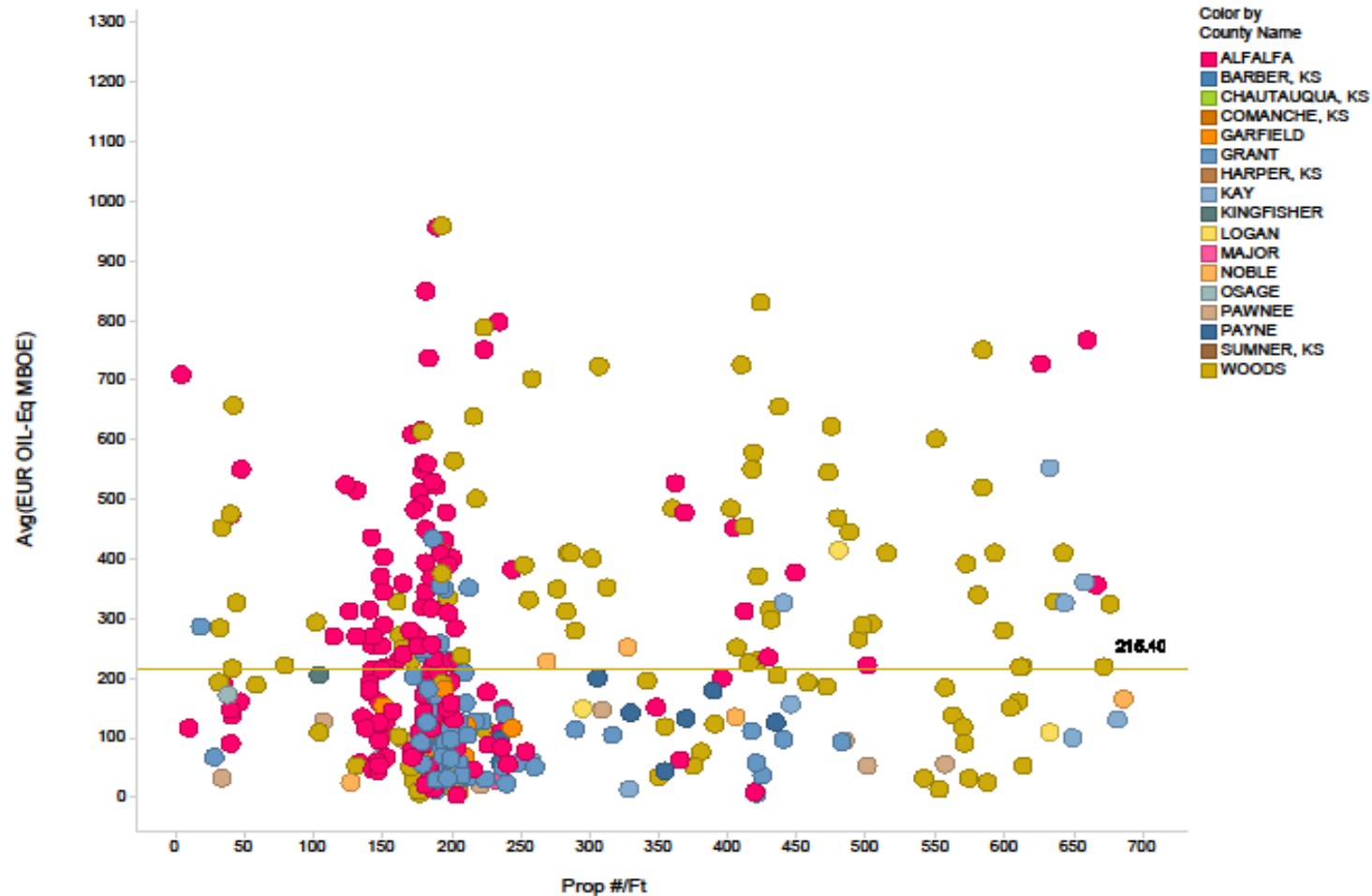
Frac Fluid Volumes, BBIs Fluid per Ft HZ Completed

MISSISSIPPI HZ - 615 WELLS MBOE EUR vs. FRAC WATER PER FT



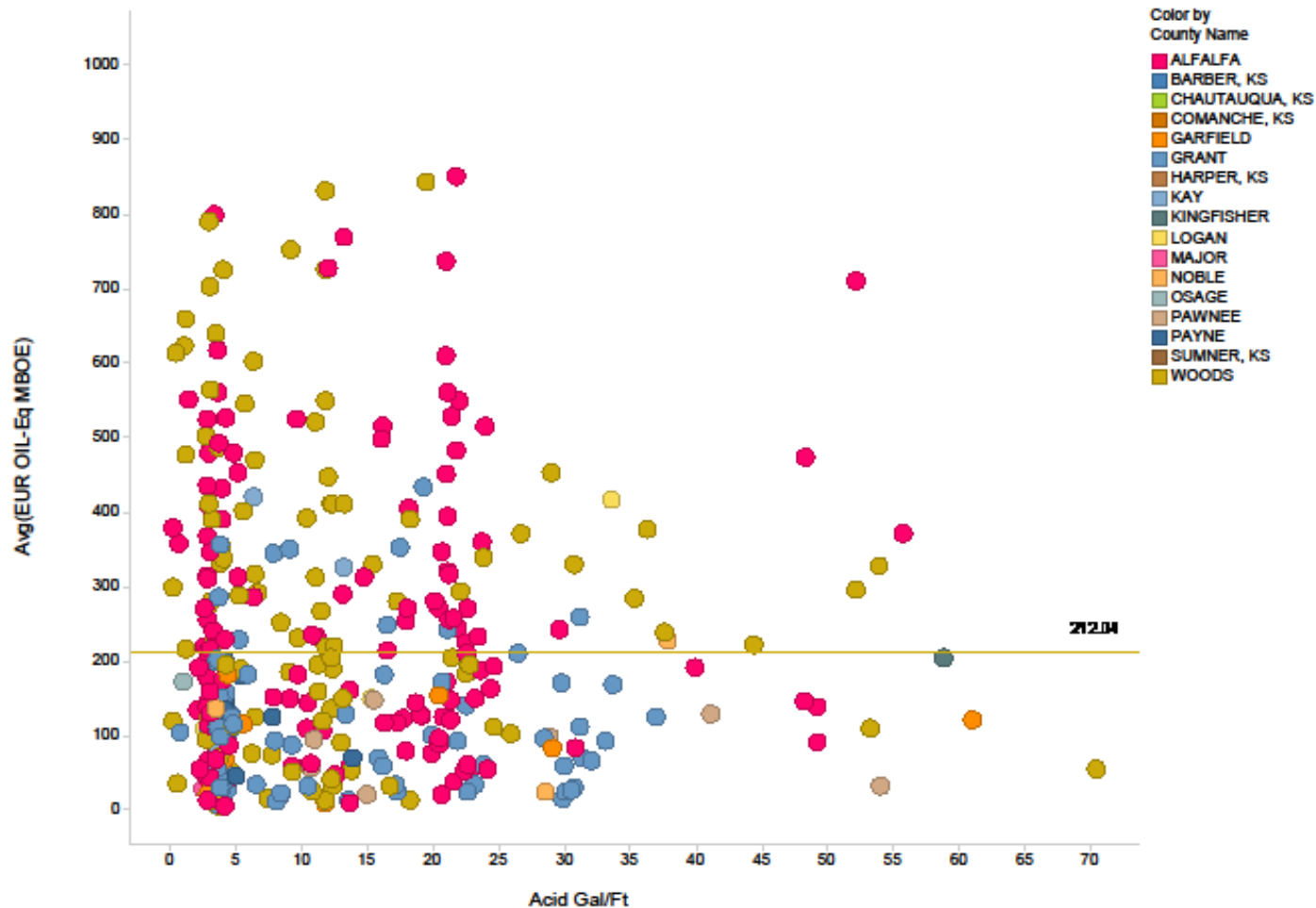
Proppant Volumes, # per Ft HZ Completed

MISSISSIPPI HZ - 615 WELLS MBOE EUR vs. PROPANT PER FT



Acid Fluid Volumes, Gal Acid per Ft HZ Completed

MISSISSIPPI HZ - 615 WELLS MBOE EUR vs. ACID PER FT

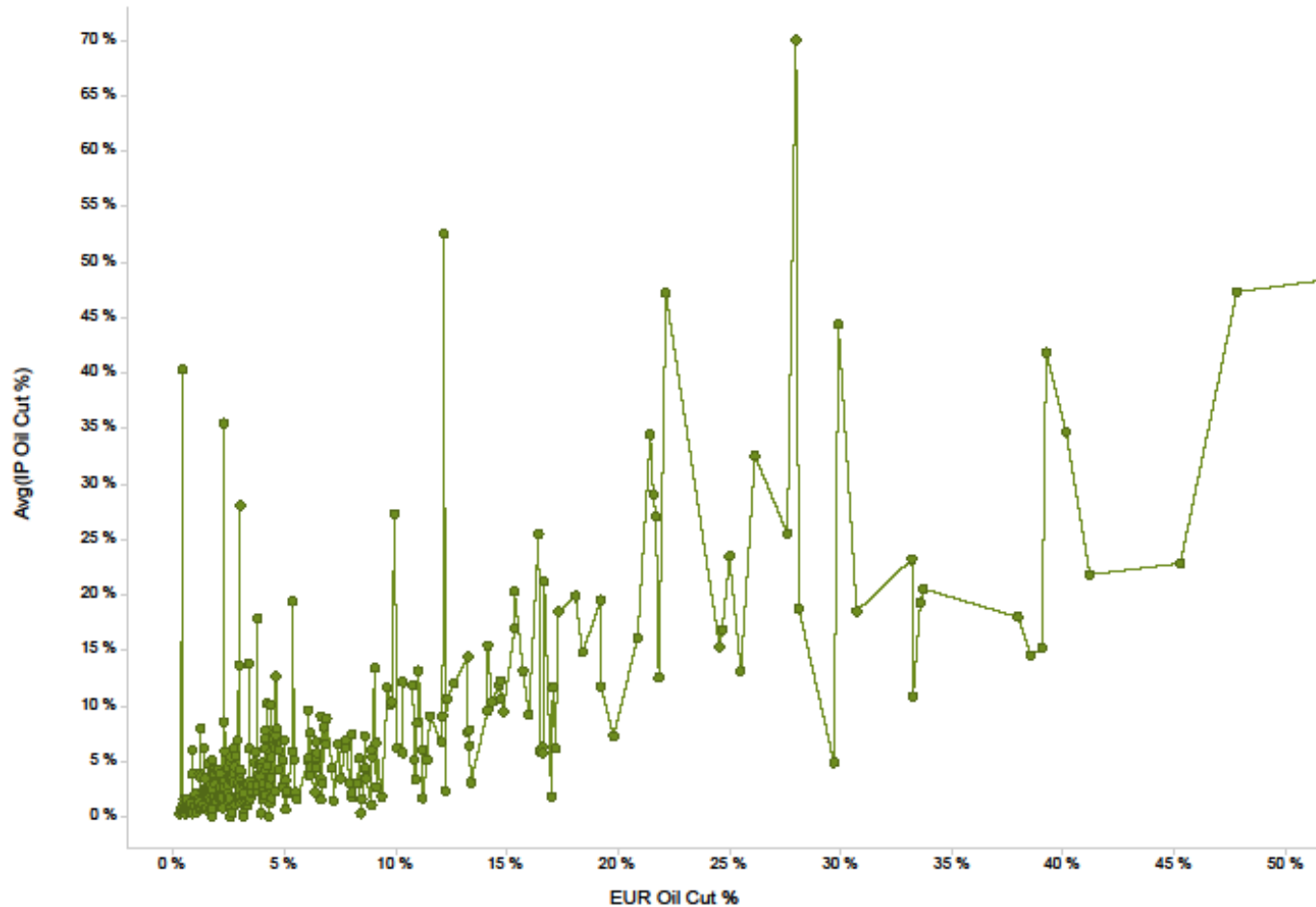


Production Characteristics Summary

- Multiple “Production Profiles ” have been observed.....
- 50 BOPD IP wells can make >300 MBO or <5 MBO, &
1000 BOPD IP wells can make <75 MBO or >300 MBO
- Depends on Lithology, producing methods, stimulation, area
- Initial Oil/Gas Declines Rates (Nominal) range from 40% to 99%
 - County averages range from 65 – 90%
- B factors range from .25 to 2, with most fitting 1.25 – 1.50
- Gas rates usually peak 3-6 mos after 1st prod (up to 1.5 years)
- Oil rates usually peak within 1st 30 days, but up to 12 months
- Water Production declines “similarly” to Oil Production on most wells, although contact with wet Chats can make it look like water drive

Oil Cuts – IP vs EUR's

499 Mississippi HZ - IP Oil Cut vs. EUR Oil Cut

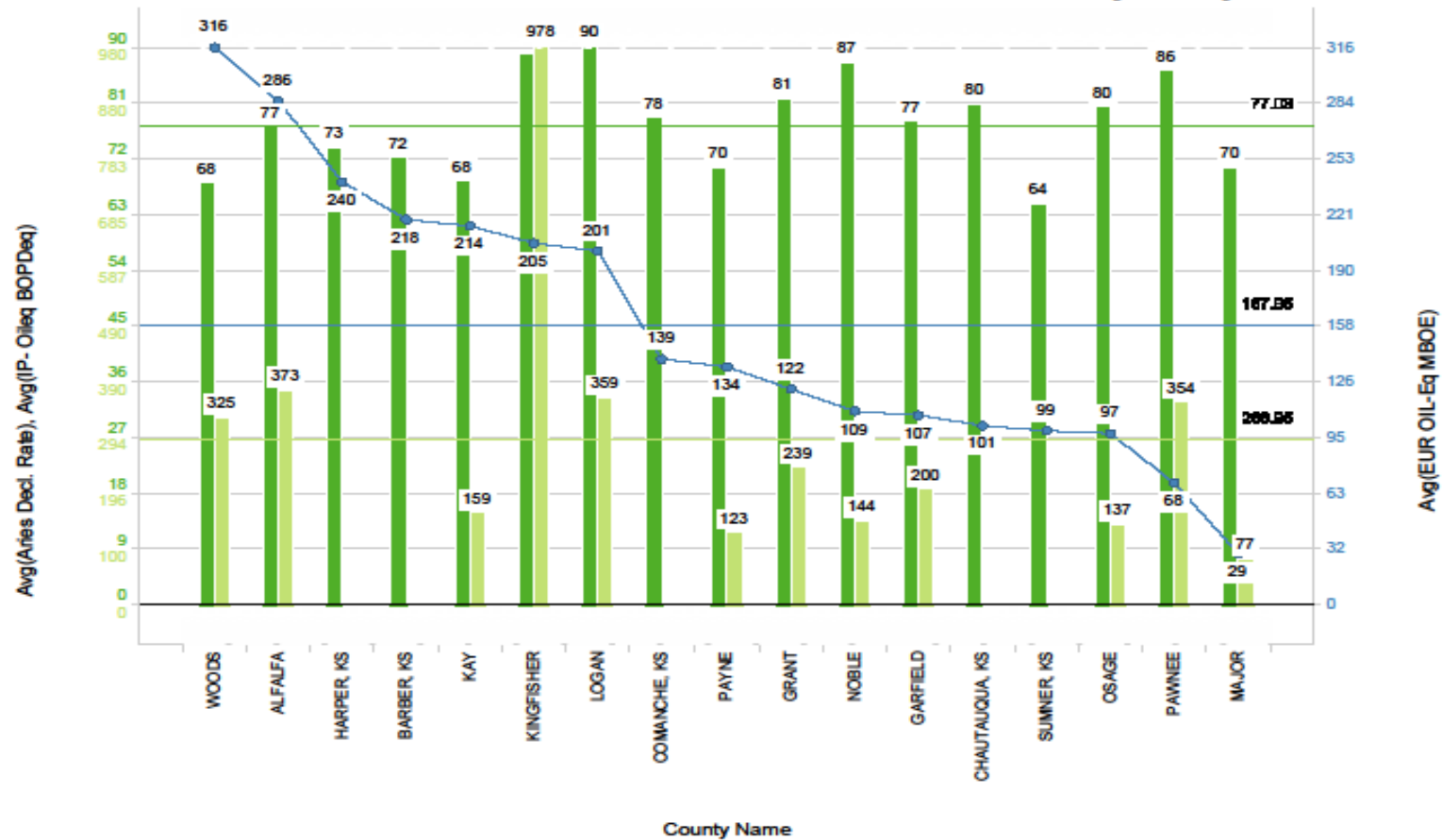


Oil Cuts Vary
from 0.1%
to 50%

Initial and Final
oil cuts
expected to
be similar in
most cases

Observed Average Initial Decline Rates by County

615 Miss HZ WELLS - Aries Decline Rate and BOED IP Rate VS. EUR MBOE by County



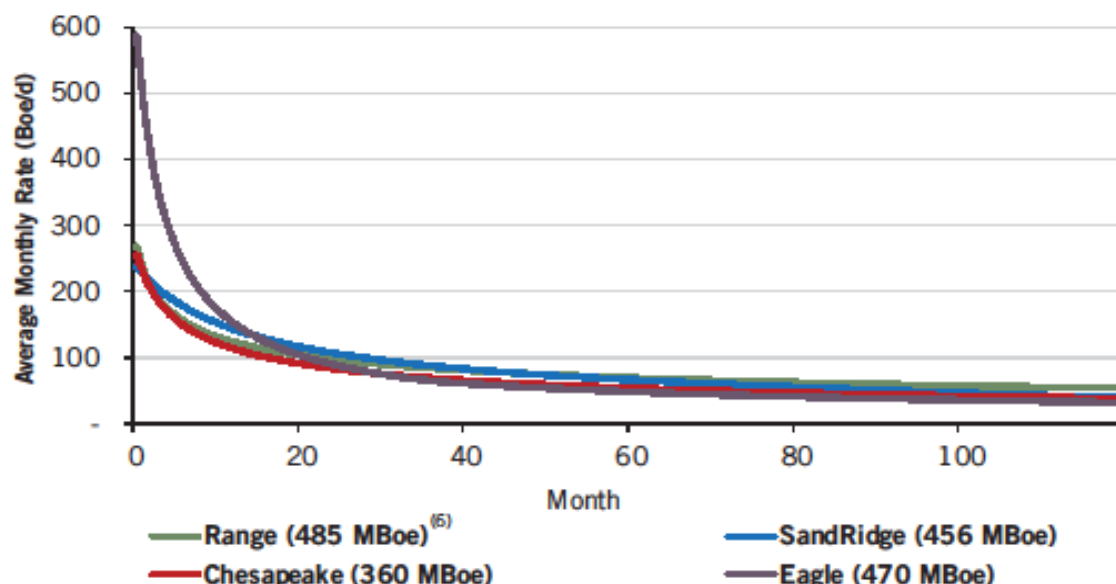
Type Curves Of Prominent Mississippian Players



Key Points

- Together Sandridge, Chesapeake, Eagle and Range Resources have drilled a majority of the Hz wells in the Mississippian
 - Type curves are based on some of the most mature Hz wells in the play
- Publically stated single well EURs range from 290 MBoe to 600 MBoe
- Current lateral lengths range from 2,200' to 4,000'
- Chesapeake, Sandridge and Eagle are located in the West part of the play and are approximately 50% liquids
- Range Resources
 - Located in the East part of the play and is 70% liquids⁽⁷⁾
 - Stated recovery factor from 4% to 9% of OOIP
 - Stated their Mississippian play economics rival those of the Marcellus wet gas area
- Halcon and Chaparral have recently publicly disclosed their Hz well EUR projections

Mississippian Comparative Type Curves⁽³⁾



Mississippian Single Well Summary^{(1),(2),(3),(4),(5)}

	Chaparral	CHK	Eagle	HK	RRC	SD	Lawco/Century
Lateral (ft)	Unknown	4,000'	3,500'	Unknown	2,197'	4,000'	3,000'
EUR (MBoe)	200 - 400	290 - 435	513	175	400 - 500	300 - 500	188
D&C Cost (\$MM)	2.5 - 4.0	3.7	3.5	2.5 - 3.5	3.1	3.2	1.7 - 1.9
LOE (\$/Boe)	Unknown	Unknown	2.06	Unknown	Unknown	9.61	13.09
Location (Area)	East	West	West	East	East	West	East

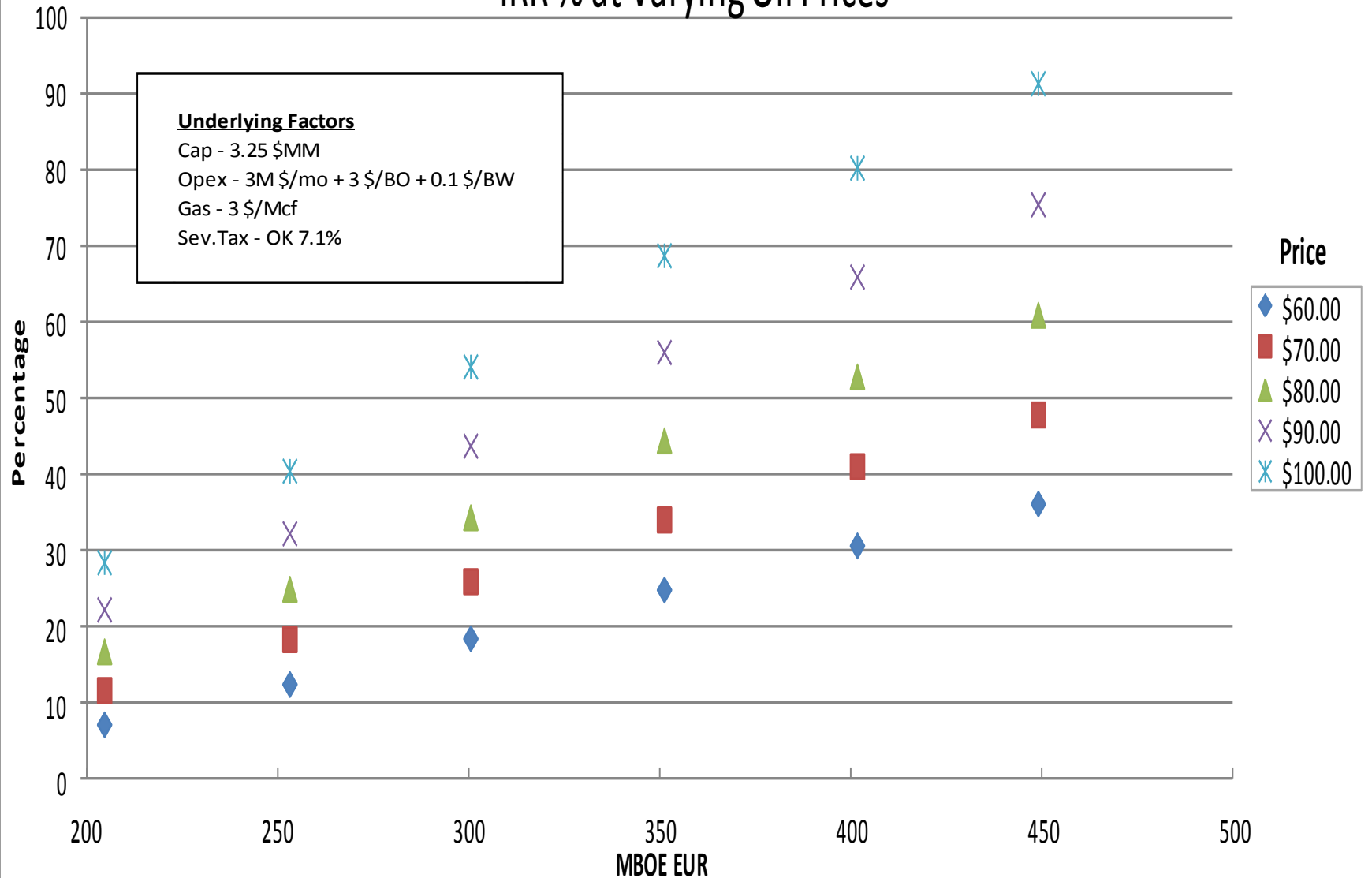
(1) Chaparral Energy Investor Presentation, February 2011
 (2) Eagle Energy Presentation
 (3) Halcon Resources Investor Presentation, April 2012
 (4) Range Resources Investor Presentation, June 2012
 (5) Sandridge Investor Presentation, June 2012
 (6) Range Resources Investor Presentation, August 2011
 (7) Assumes 500\$/bbl

Characteristics of Mississippian Play

- Significant Reserve Potential Throughout the Mississippian Reservoir in most all areas evaluated
- Shallow Unconventional Oil Reservoir – with areas of High GOR (Gas)
- Due to Reservoir Characteristics and Heterogeneity, The Mississippian Formation appears a perfect application for Horizontal Drilling
- Three to Five Horizontal Wells likely to be drilled per Section (640 acres). Potential exists for Additional Wells in some sections within Upper and Lower intervals within the Mississippian.
- Up-front costs are higher due to Analyses conducted on initial wells and drilling & installation of Salt Water Disposal Wells/Systems and Power. Infill well costs are expected to decrease appreciably
- Planning & Design can improve performance and economics
- Additional potential exists in the Serendipity of finding other productive formations

***“If I had \$3,000,000 I wouldn’t drill a Horizontal Mississippian Well,
But if I had \$30,000,000 I would drill 10 Wells” – J.P. Dick***

IRR % at Varying Oil Prices



Thank You

“An Expert is a man who has made all the mistakes which can be made in a narrow field” - Physicist Niels Bohr, Quoted in Wired



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