AUGUSTIN

EXPLORATION

Identifying and Evaluating Unconventional/Conventional Hybrid Basinal Sand/Detritus Benches to Extend Commercial Resource Plays Beyond the Mature Basin: A Case Study - *Southern Dawson County.*

Acknowledgements

1. **Augustin Land Partners**
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7. **Mark Sonnenfeld *et al***
8. **Jim Webb**
9. **Bruce Wilbanks**
10. **Dr. Harold Beaver**
11. **George Mitchell/Dan Steward**

Structure Map - Base Middle Spraberry Shale
(*Top Lower Spraberry*)

Historical Middle Spraberry Shale/Sand vertical producer

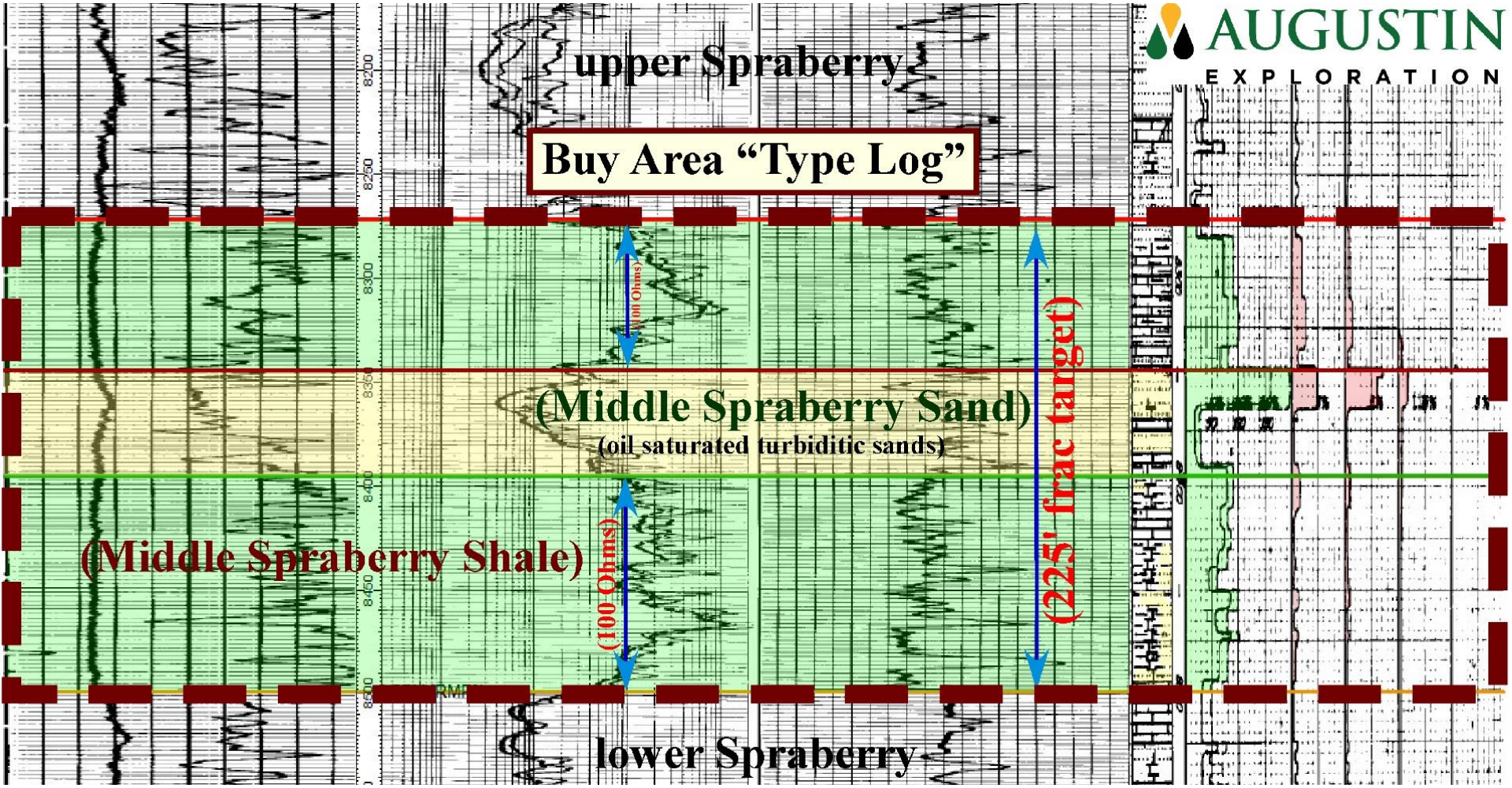
Notes:

(Middle Spraberry Sand/Shale)

Deposited on a Basinal pre-depositional "low"

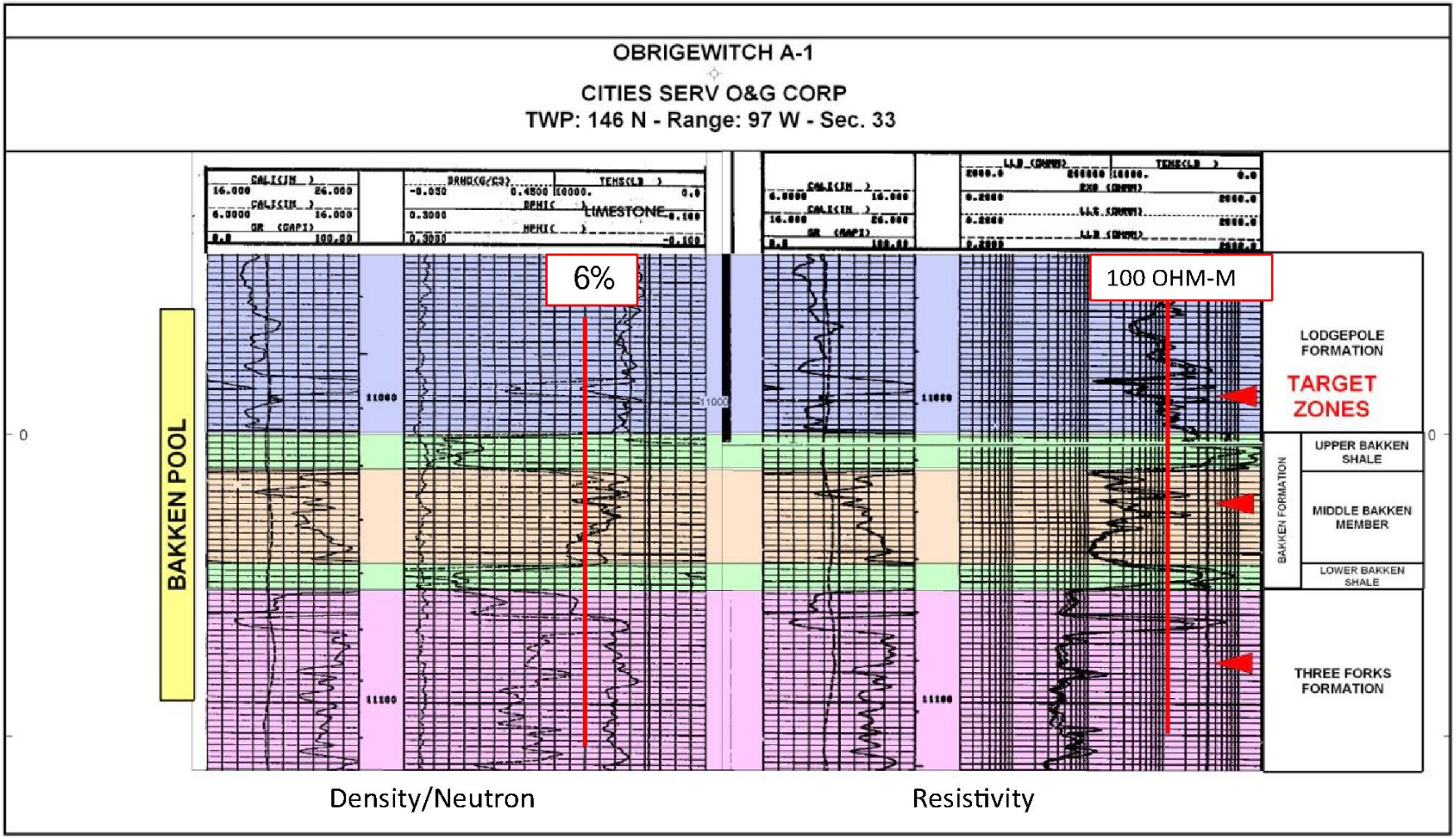
Surrounded by historical conventional production

New Commercial Horizontal Middle Spraberry Shale Production on the North, West, South, and Southeast.



North Midland Basin Middle Spraberry Shale/Sand – *"Midland Basin Bakken"*

(Hydrocarbon Saturated Basinal Clastics bounded by high Ohm Organic Rich Shales)



"Bakken Type Log"

(Hydrocarbon Saturated Basinal Clastic bounded by high Ohm Organic Rich Shales)

Continental RESOURCES

(South) A

42317365980000
ENERGY COMPANY
5
ELEV_KB : 2,865
ELEV_GR : 2,851
Twn-Rge-Sec : T2N B37 S7
Footage Calls : 1998 FSL 733 FEL
TD : 11,050

42317401330000
ENERGEN RES CORP
601H
ELEV_KB : 2,875
ELEV_GR : 2,853
Footage Calls : 4000 FSL 3130 FEL
TD : 16,528

42115331650000
ROFF OPERATING CO
BEAM
2
ELEV_KB : 2,924
ELEV_GR : 2,910
Footage Calls : 950 FSL 500 FEL
TD : 8,606

42115302190000
MIDWEST OIL
MEYERS
1
ELEV_KB : 2,948
ELEV_GR : 2,937
Twn-Rge-Sec : TP R36T S18
Footage Calls : 1320 FNL 1320 FEL
TD : 9,335

42115312190000
PRASAD HARI PROD CO
CROW
1
ELEV_KB : 2,958
ELEV_GR : 2,946
Twn-Rge-Sec : TP R36T S21
Footage Calls : 1980 FSL 660 FWL
TD : 8,300

A' North

Upper Spraberry

upper Middle Spraberry Shale

(oil saturated turbiditic sands)

Middle Spraberry Sand

Middle Spraberry Shale

(230' frac target)

Lower Spraberry

39° api gravity

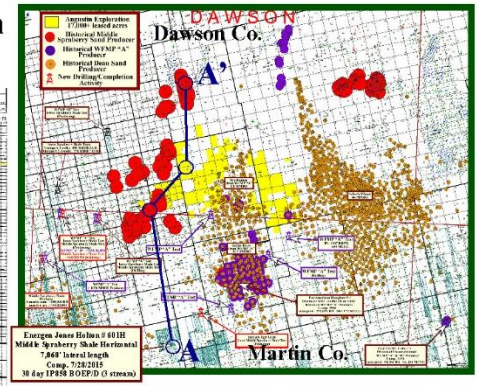
Energen Jones Holton # 601H
Middle Spraberry Shale Horizontal
7,068' lateral length
Comp. 7/28/2015
30 day IP 858 BOEP/D (3 stream)

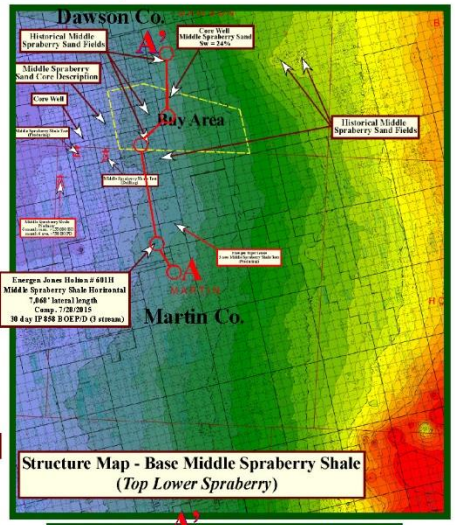
CUMOIL : 34,743 BBLS
CUMGAS : 62,494 MCF
COMP_DATE : 2/8/2012

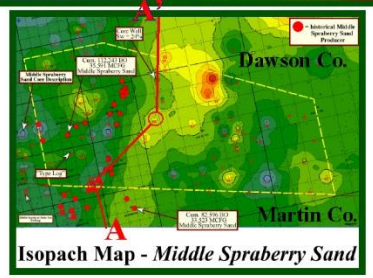
CUMOIL : 80,798 BBLS
CUMGAS : 180,181 MCF
COMP_DATE : 11/15/2006

COMP_DATE : 2/20/1972

CUMOIL : 121,513 BBLS
CUMGAS : 169,836 MCF
COMP_DATE : 7/3/1978







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South to North Stratigraphic Cross-Section
Middle Spraberry Shale
(Midland Basin "Bakken" Target)
Martin/Dawson Co., TX

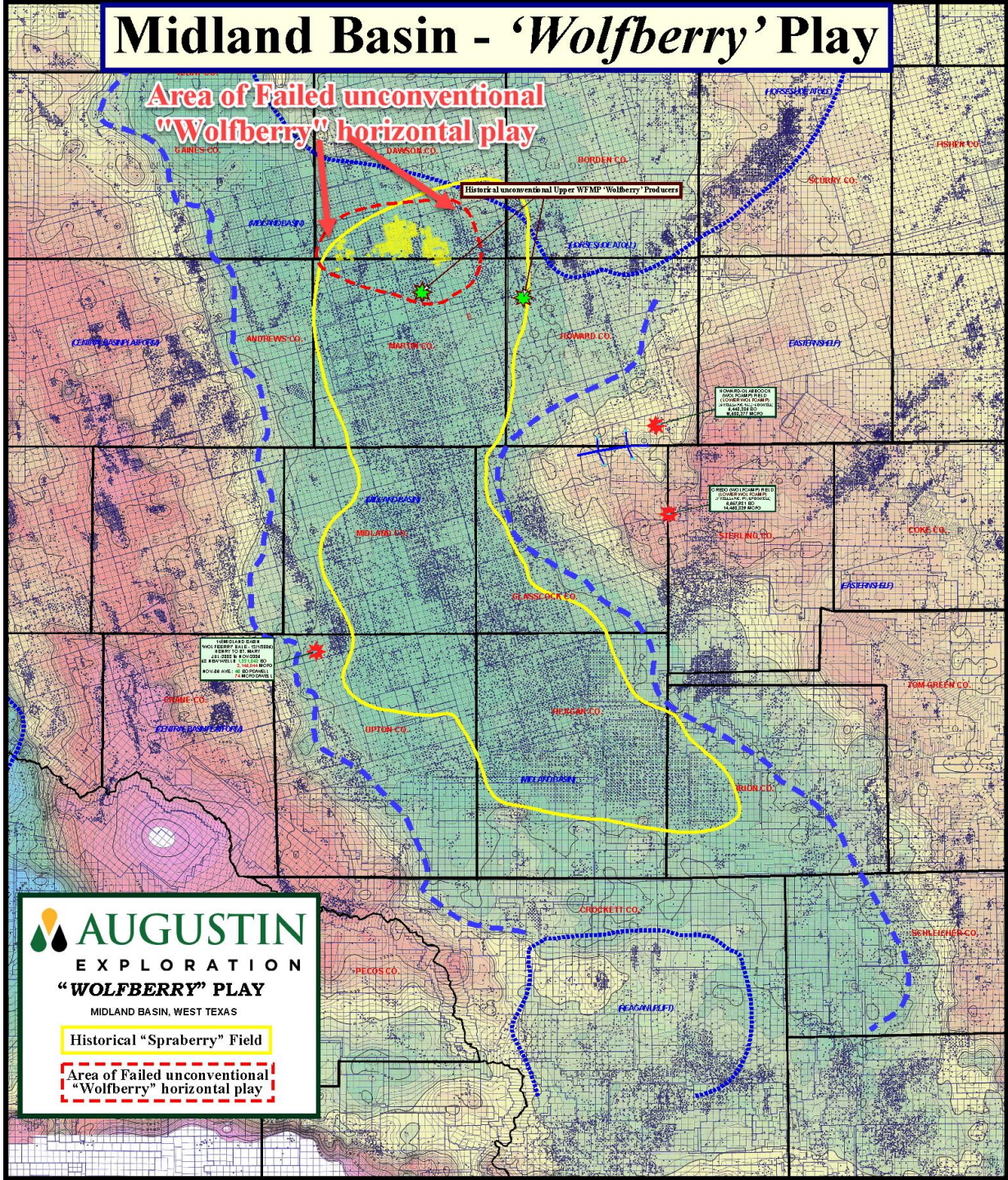
Midland Basin Resource Development Status – *November 2016*

The Commercial Boundaries for multiple Shale Benches continue to be tested and successfully expanded

Longer laterals (2+ miles) and Vintage 3-4 frac Designs continue to significantly Expand the Commercial Boundaries for multiple Horizontal Benches

Basinal Sands were the first Driver of the Delaware Basin Resource Development and the last Frontier of the Midland Basin Resource Development

The Benches that contain interbedded "Conventional Reservoir/Delivery Systems" to engage/produce the unconventional reservoir (*Conventional/Unconventional Hybrid Systems*) are the most prolific resource in the basin

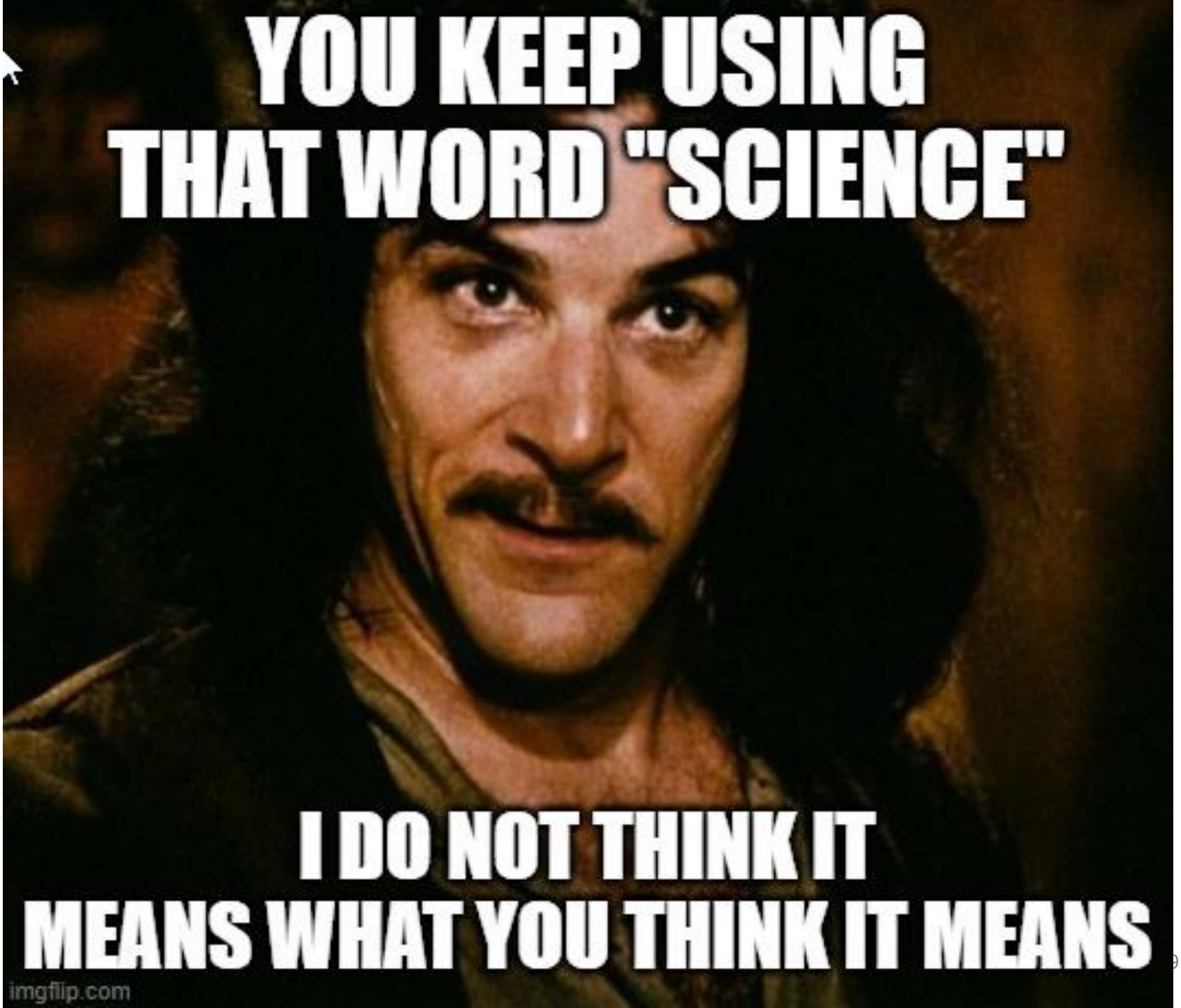


Industry's Response?

Entire region of north Midland Basin quickly transitions from *"Low Maturity"* to *"Immature"* as per the "whole rock TMax" therefore it is *NOT* a "resource play".

My Response: ***"Oh #$*&"***

This simple "Look-a-Like" Prospect Suddenly became a full blown "Science" project


YOU KEEP USING
THAT WORD "SCIENCE"
I DO NOT THINK IT
MEANS WHAT YOU THINK IT MEANS
imgflip.com

Science (from the Latin word scientia, **meaning** "knowledge")

:the intellectual and practical activity encompassing the systematic study of the structure and behavour of the physical and natural world through ***observation*** and ***experiment***

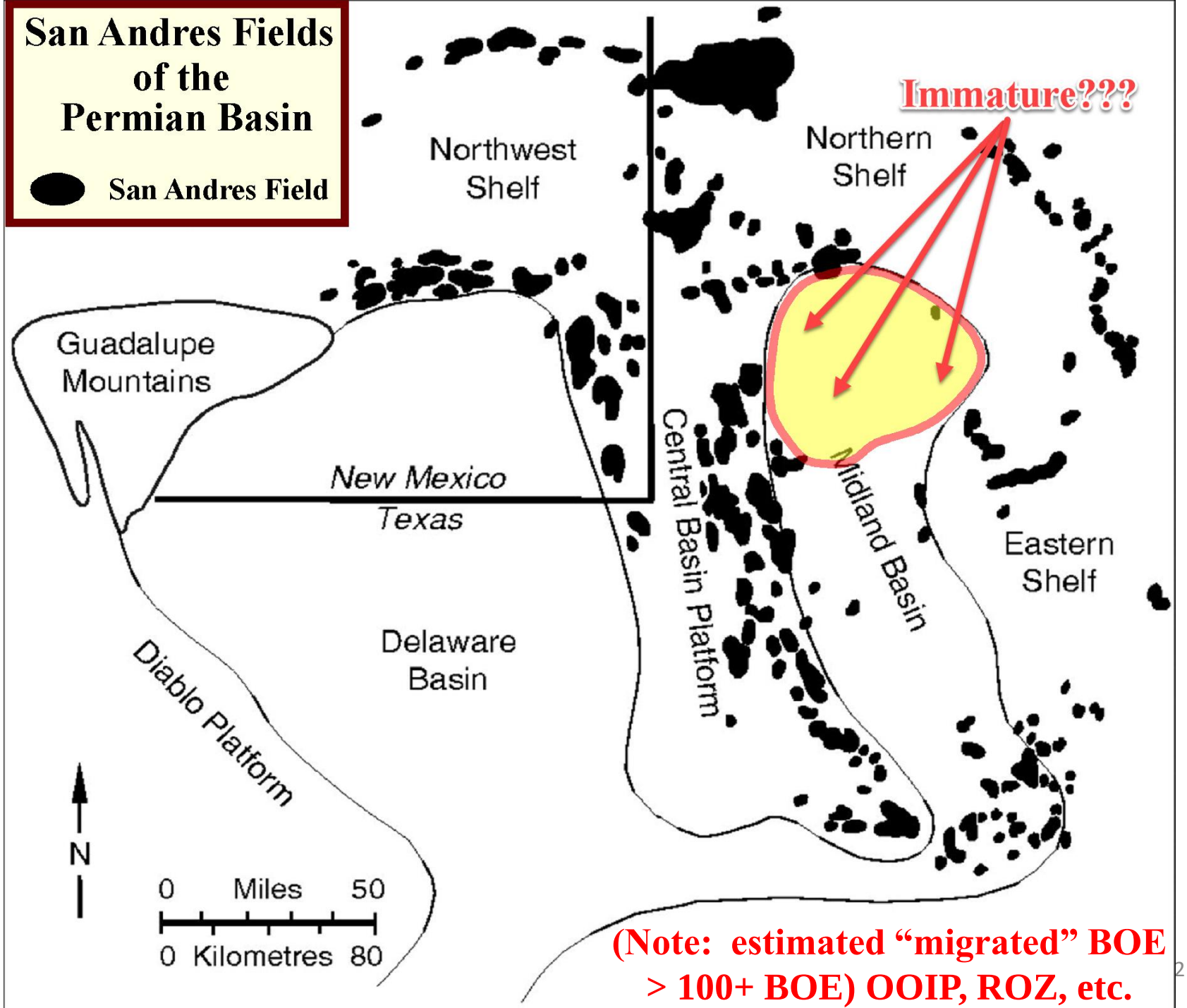
:systematic knowledge of the physical or material world gained through ***observation*** and ***experimentation***.

"In **Science**, Question ***EVERYTHING***!!!!" **– Dan Jarvie**

Observations:

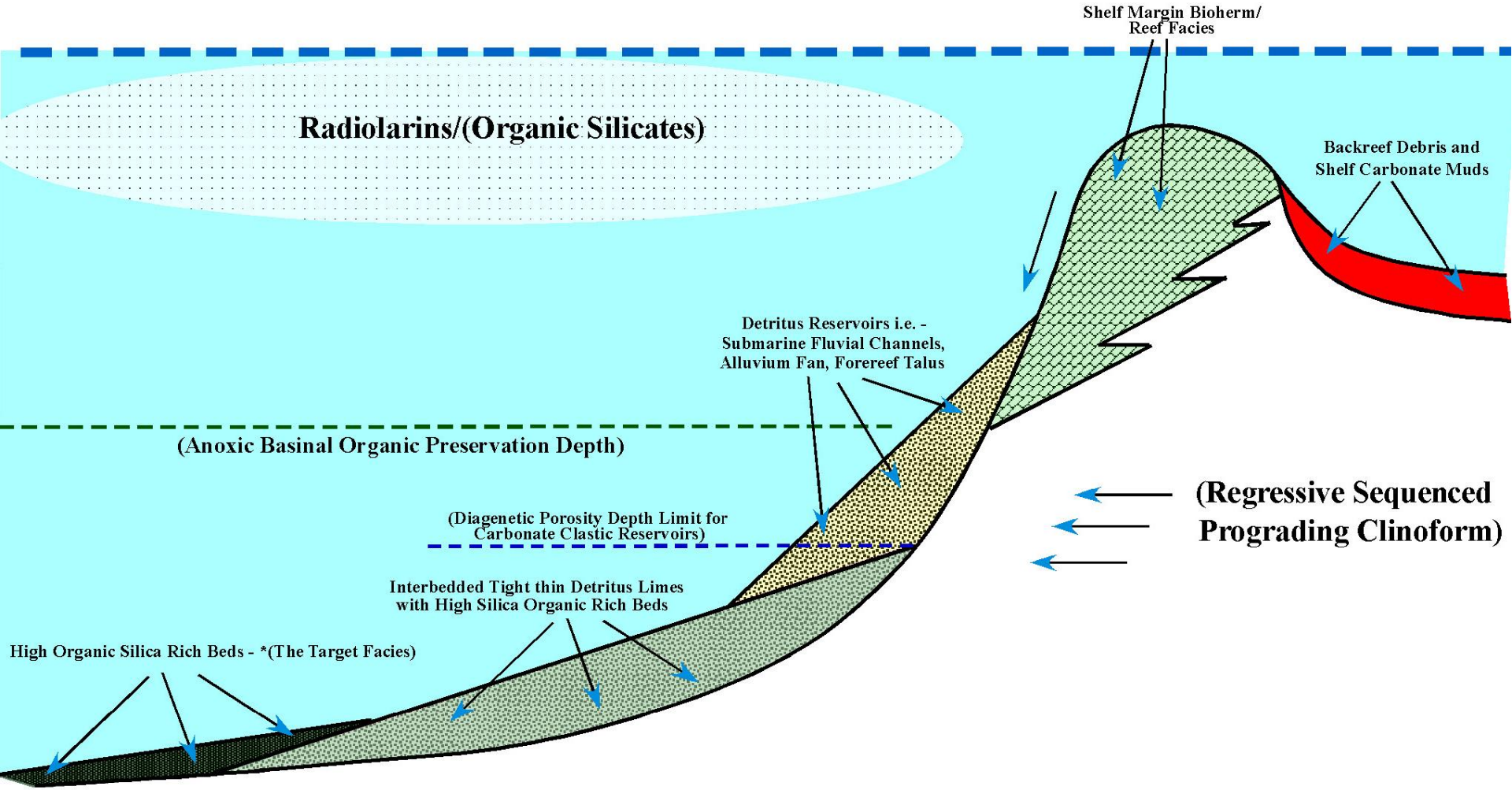
- **The basinal late Pennsylvanian through Permian Leonardian shales have to generate not only present day recoverable reserves in the unconventional and interbedded basinal conventional benches, but also supply through migration all surrounding shelf reservoirs with OOIP and ROZ. (*beginning 2019: 33 BBO and 118 TCFG produced in the Permian Basin*)**

- **"Low Maturity" and "Immature" Tmax unconventional reservoirs should produce low gravity crudes. The uneconomic unconventional shale benches tested in southern Dawson County still produced 37-39° gravity crudes.**


San Andres Fields of the Permian Basin
San Andres Field
Immature???
Northwest Shelf
Northern Shelf
Guadalupe Mountains
New Mexico
Texas
Central Basin Platform
Midland Basin
Eastern Shelf
Delaware Basin
Diablo Platform
N
0 Miles 50
0 Kilometres 80
(Note: estimated "migrated" BOE > 100+ BOE) OOIP, ROZ, etc.

Q. But what about carbonate "in-situ" hydrocarbon generation???

We have known for a long time and the past 24 years of commercial unconventional production supports that the vast majority (>99%) of hydrocarbon generation occurs below the "Anoxic Basinal Organic Preservation Depth". Exceptions would be rare catastrophic transgressive burial and subsidence of carbonate shelf muds.



"*Oversimplified*" Wolfcamp Strat Model

Organics deposited above the "Anoxic Basinal Organic Preservation Depth"

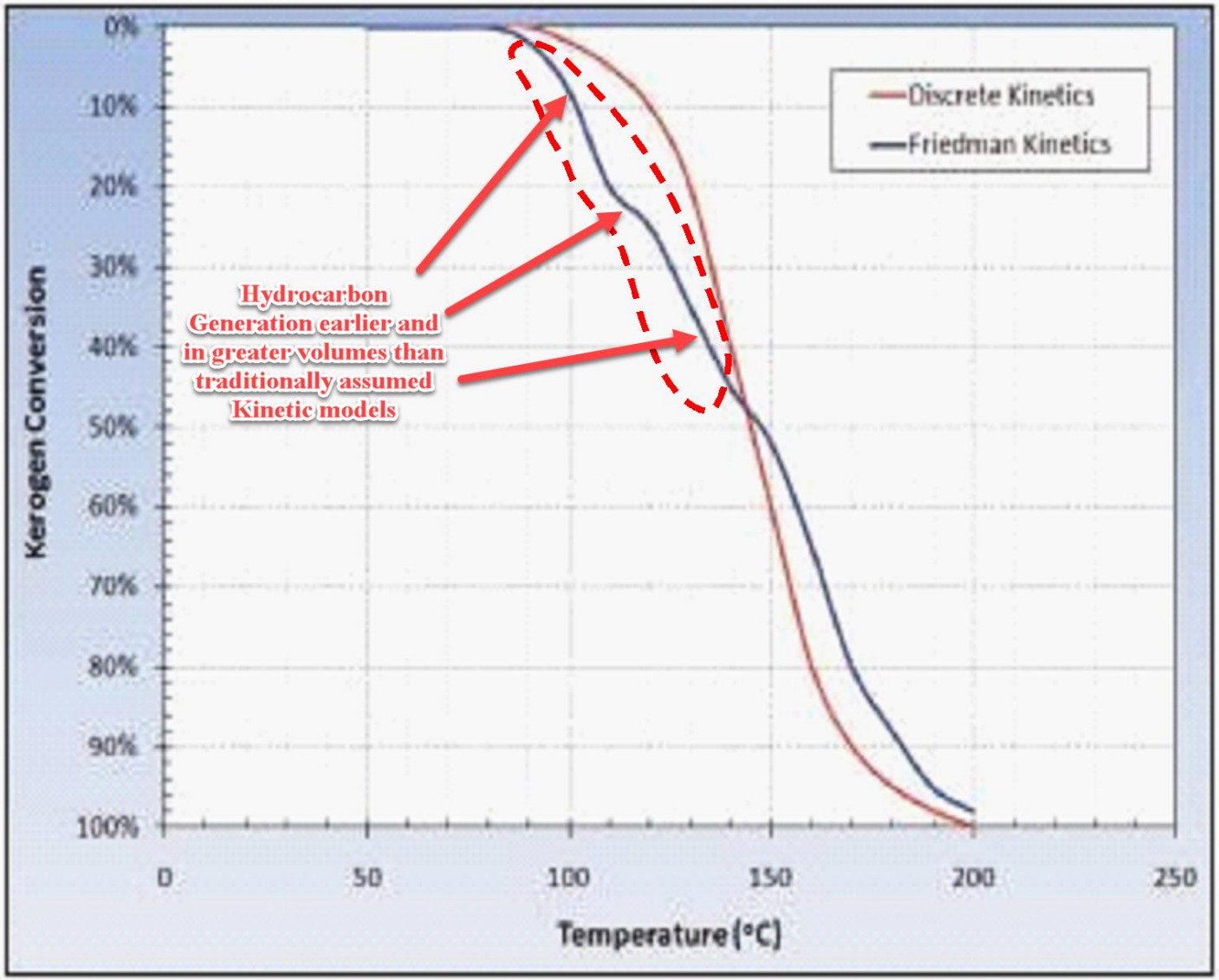
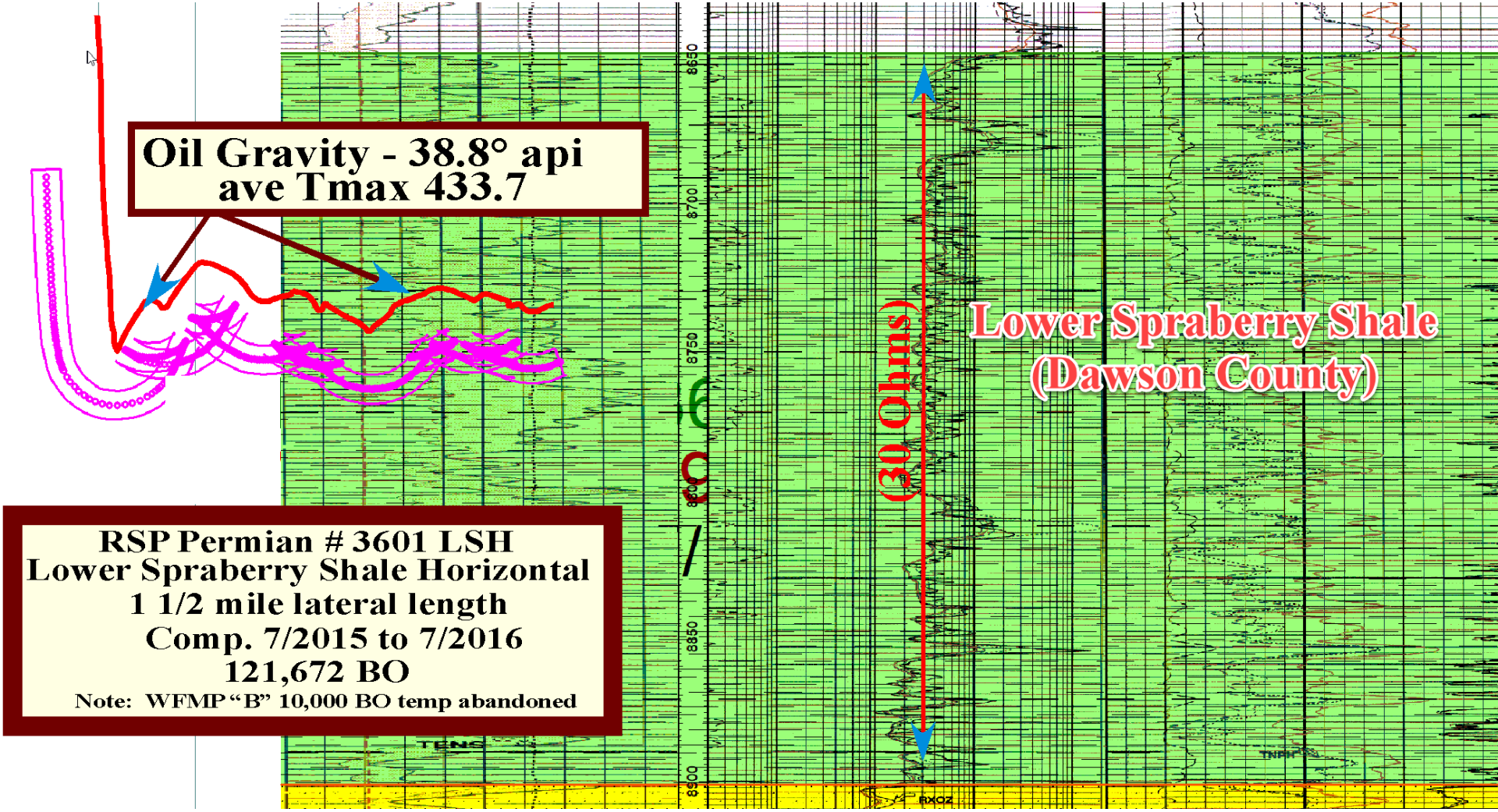


Figure 38. Comparison of discrete and Friedman kinetic parameters used to predict the temperature of conversion of Bakken Shale using an arbitrary and constant heating rate of 0.75°C/Ma. Discrete kinetic models use a single Arrhenius factor (probability factor) with a distribution of activation energies, whereas the Friedman model utilizes a different Arrhenius factor for all activation energies over each 10% of conversion from 0 to 100%. This affects both the earliest and latest computed generation temperatures and suggests earlier generation for the Bakken shale compared to the discrete model. Both mathematical models agree on peak or near 50% transformation ratio.

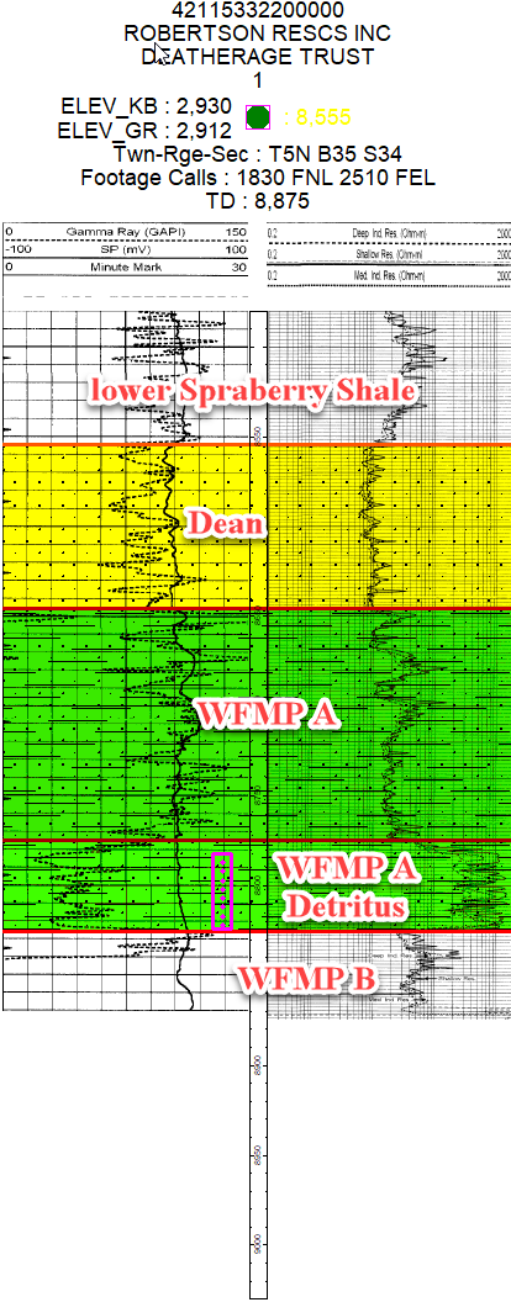
Friedman Kinetic model used in Bakken Shale Study supports earlier hydrocarbon generation in diagenesis

Note: Friedman Kinetics fits best with modern diagenetic models explaining production factors in unconventional source rock reservoirs – *i.e. unconventional source rock reservoirs produce by hydrocarbon expulsion across the microfracture face in response to a ΔP.*



Observations:

- 433 TMax is classified as "low maturity" yet produced oil of 38.8º api gravity. Q. How???
- RSP Permian landed properly and used a standard unconventional slick water frac which should not have had frac growth out of zone resulting in no contact with conventional sands.
- 120,000+ BO in 6 years is non-commercial. Commonly, commercial lower Spraberry Shale wells show ave. of 100+ ohms vs this well ave. of 30 ohms. Significant?

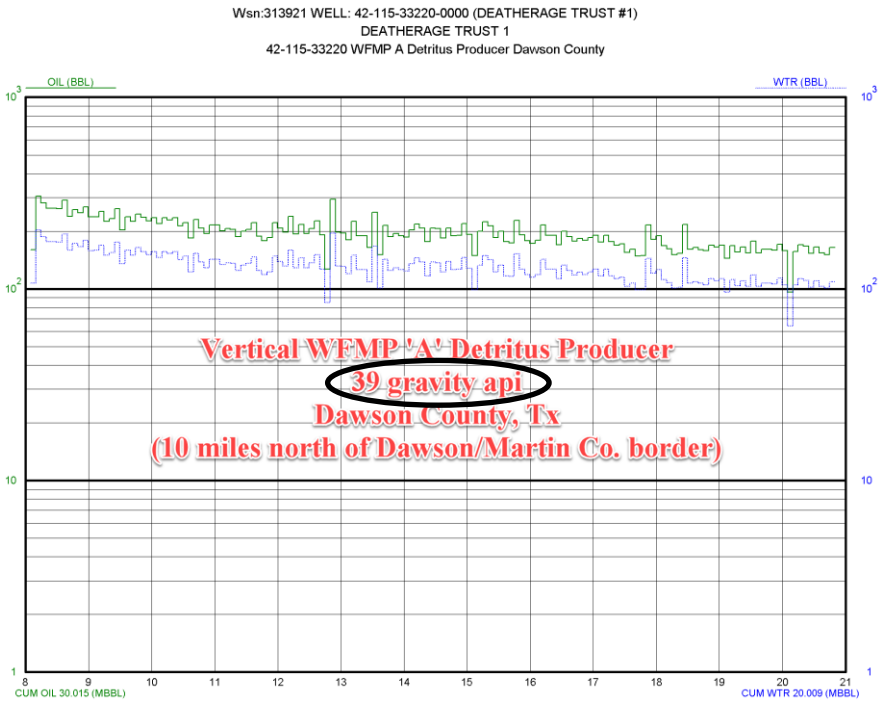


Observations:

- 39º gravity oil produced from 20 ohm interbedded organic WFMP A shales
- Very limited detritus porosity (i.e. given their thin size of < 6' and ratty GR they are at the depth margins of preservation of porosity)
- Frac with 80,000 #'s sand is large enough for vertical growth exposing the 20 ohm organic shales to production pathways
- Current EUR projections >50mbo greater than 40 acre drainage of possible lime reservoir capacity
- Some hydrocarbon dampening of SP seen throughout the WFMP A sequence

WFMP 'A' Detritus Production Liberty Field Dawson Co., Tx

(10 miles north of Martin/Dawson County Line)

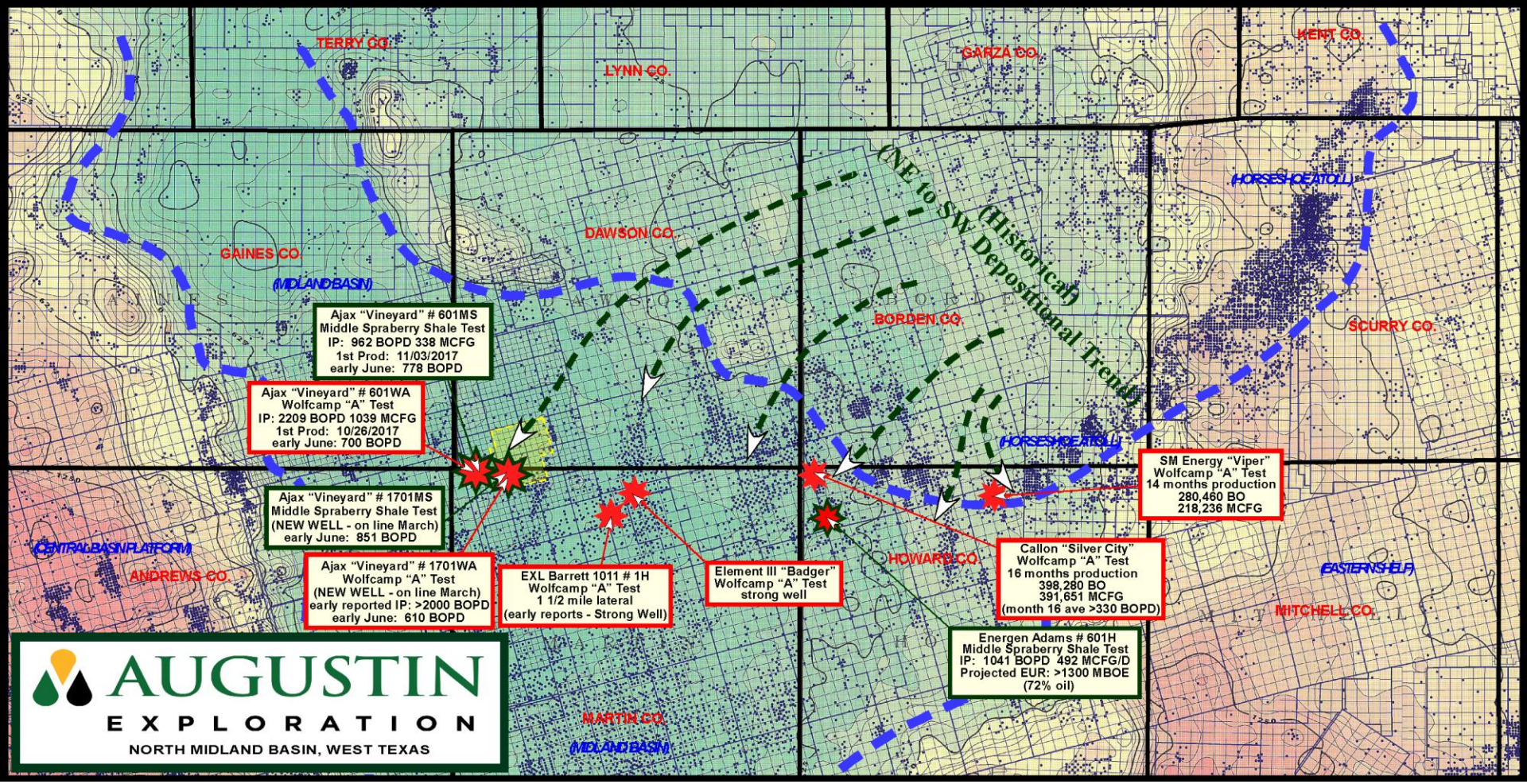


Q. Are these high gravity crudes produced from low TMax whole rock unconventional reservoirs in-situ?

Answer: No, Migration occurs within the source rock/unconventional reservoir. (See URTeC # 2461914 - Migration Happens: Geochemical Evidence for Movement of Hydrocarbons in Unconventional Petroleum Systems (*Sonnenfeld et al*)**)**

Q. If low TMax doesn't explain the non-commercial performance of the early Dawson County unconventional horizontal benches as per oil gravity, What Does???

A. The Rock Facies – *depositional geomorphology* - i.e. "old fashioned geology"

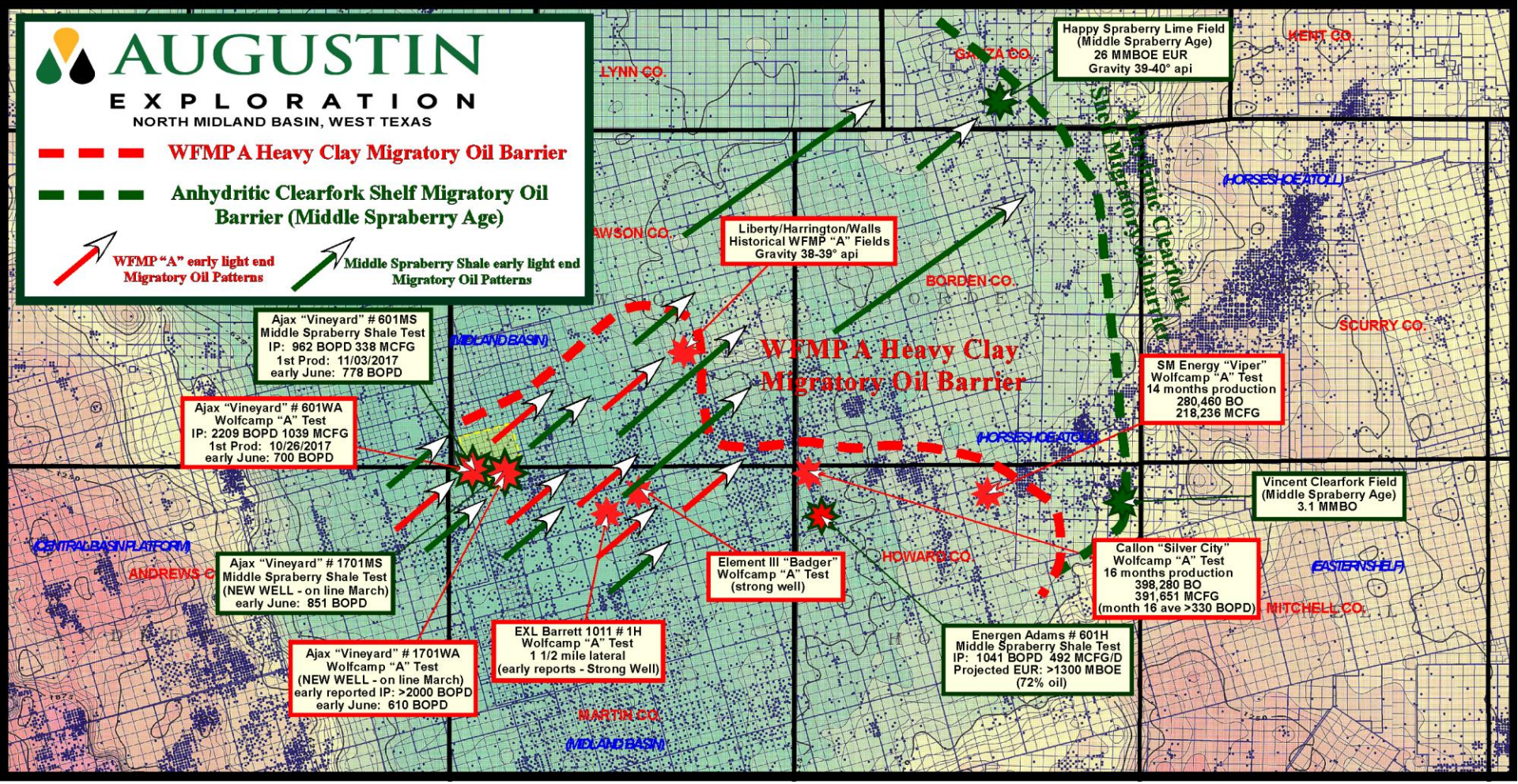


(3rd order residual map top of the Wolfcamp of the northern Midland Basin)

Note: modern day NE to SW detritus entrant across lows of the Wolfcampian/Pennsylvanian high stand Horseshoe Atoll.

Note: The Basinal Position of this region giving Radiolarins (- *dominant plankton of Permian age organics*) access to shelf nutrients across lows in the high stand Atoll explains why this northern region is one of the most "Organic Rich" parts of the Midland Basin

Note: Recent Wolfcamp "A" and Middle Spraberry Shale horizontal tests across the northern Midland Basin (***i.e. the two benches composed of interbedded conventional/unconventional "hybrid" systems***)



(3rd order residual map top of the Wolfcamp of the northern Midland Basin)

Note: Western basinal tilt/subsidence occurred during Wolfcampian/Leonardian time.

Note: Early light end hydrocarbon migration travels along brittle basinal micro-fracture network and interbedded conventional pathways from basinal temp gradient max (S/SW) to the NE trapped against heavy clay barriers and/or impermeable shelf facies in both the WFMP A and Middle Spraberry Shale.

Regional Geomorphology
North Central Midland Basin

Two Geomorphologic features dominate this Region: **1. Deposition** and **2. early Light End Hydrocarbon Migration**.

1. (**Deposition**) - Regional Geology comprised of basinal facies dominated by clastics from the modern day western entrant point across lows of the high stand Pennsylvanian/Wolfcampian Horseshoe Atoll. Modern day clastic source for the Midland Basin was North East (NE) to South West (SW) into the Basin – ***see Figure on Page 21***.

2. (**early light end Hydrocarbon Migration**) - Early Permian Wolfcampian/Leonardian western basinal tilt exaggerated depositional structure allowed early light end hydrocarbon migration travels along brittle basinal micro-fracture network and interbedded conventional pathways from basinal temp gradient max (S/SW) to the NE trapped against heavy clay barriers and/or impermeable shelf facies in both the WFMP A and Middle Spraberry Shale – ***See Figure on Page 22***.

Area Core Observations

- **Dominated by low Tmax pyrolysis trending lower SW to N-NE**
- **XRD minerology shows heavy clay % increasing on trend SW to N-NE**
- **High volumes of un-generated S2 as reflected in HI (Hydrocarbon Index) trend higher SW to N-NE in all Wolfcampian/Leonardian intervals**

Geologic Observations:

- **All conventional and unconventional production produces high gravity Crude generally 39°+api gravity crude - *Migrated oil in both unconventional and conventional reservoirs???***
- **Pyrite % is equivalent to NW Howard throughout Wolfcampian/Leonardian formations in this area (*measured by XRD minerology*). Basinal Sulfide In-Situ Precipitation (*Pyrite generation*) occurs under identical anoxic heat/temp/pressure conditions as hydrocarbon generation?????? (*i.e. basinal in-Situ pyrite is a Sedimentary Petrology marker for hydrocarbon generation*)**
- **Petrophysics, mud log gas and sample shows, suggest good "live oil" in our targeted zones. Solving for Archie, we find that the non-commercial unconventional zones (*WFMP "B", lower Spraberry Shale*) have a high calculated Sw as compared to our targeted intervals????**
- **Area operators have observed a slight but noticeable over-pressure to the WFMP A detritus target. *How would this occur in a low hydrocarbon generation environment????***

S Central Dawson *vs* NW Howard Core Mineralogy (XRD)

Core Location	Formation	Sample Depth (ft)	CLAYS				TOTALS		
			Chlorite	Smectite	Illite/Mica	Mx I/S*	Clays	Carb.	Silicates/etc.
SW Dawson	M Spra Shale	8656			13	5	**18**	43	39
SW Dawson	M Spra Shale	8707			25	10	**35**	20	45
S Central Dawson	M Spra Shale	8114	**1**		17	9	**27**	3	70
S Central Dawson	M Spra Shale	8216	**2**		28	8	**38**	1	61
S Central Dawson	M Spra Shale	8236	**1**		33	9	**43**	1	56
S Central Dawson	M Spra Shale	8260	**2**		27	7	**36**	1	63
S Central Dawson	M Spra Shale	8270	**1**		24	6	**31**	10	59
S Central Dawson	M Spra Shale	8296	**1**		9	4	**14**	26	60
S Central Dawson	WFMP "A"	9282	**1**		24	10	**35**	5	60
S Central Dawson	WFMP "A"	9315	**2**		25	13	**41**	5	54
S Central Dawson	WFMP "A"	9333	**2**		32	6	**40**	6	54
S Central Dawson	WFMP "A"	9347	**1**		34	12	**47**	2	51
S Central Dawson	WFMP "A"	9373	**1**		21	11	**33**	3	64
S Central Dawson	WFMP "A"	9391	**3**		25	6	**35**	1	64
S Central Dawson	WFMP "A"	9424	**3**		36	5	**44**	4	52
S Central Dawson	WFMP "A"	9461	**1**		28	13	**42**	8	50
S Central Dawson	WFMP "A"	9472	**2**		30	15	**47**	4	49

Core Location	Formation	Sample Depth (ft)	CLAYS				TOTALS		
			Chlorite	Smectite	Illite/Mica	Mx I/S*	Clays	Carb.	Silicates/etc.
NW Howard	L Spra Shale	7642	**5**		30	5	**40**	6	54
NW Howard	L Spra Shale	7767	**4**		28	4	**36**	7	57
NW Howard	WFMP "A"	8036	**2**		24	5	**31**	31	38
NW Howard	WFMP "A"	8057	**2**		18	5	**25**	17	58
NW Howard	WFMP "A"	8092			20	7	**27**	28	47
NW Howard	WFMP "A"	8100			12	4	**16**	60	34
NW Howard	WFMP "A"	8131			23	5	**28**	33	39
NW Howard	WFMP "A"	8173			25	6	**31**	5	64
NW Howard	WFMP "A"	8186	**2**		16	4	**22**	46	32

S Central Dawson Middle Spra. Clays = **22%** ave.
NW Howard lower Spraberry Clays = **38 %** ave.

S Central Dawson WFMP "A" Clays = **40 %** ave.
NW Howard WFMP "A" Clays = **26%** ave.

Conclusions: the Middle Spraberry Shale in Southern Dawson County is on the top end of "brittle" shales for commercial unconventional benches in the Midland Basin

The WFMP "A" is 'brittle' and will benefit significantly from 3rd generation frac designs. Focusing your landing target on the bottom 100'+ conventional/unconventional Shale/Detritus Hybrid will engage your best rock properties

S Dawson *vs* NW Howard Core TOC

Note: all samples are "Whole Rock" Tmax pyrolysis on sidewall cores

***lost S1 (*volatile hydrocarbons/gas and free oil*) median ≥ 35% (Jarvie) pending field handling conditions, rock brittleness, max ΔP exposure time, etc.**

Core location	Depth () Top	Formation	Leco TOC	RE S1	RE S2	RE S3	Tmax (°C)
SW Dawson	8656	M Spra Shale	2.64	1.86	16.65	0.08	434
SW Dawson	8707	M Spra Shale	4.17	3.14	25.93	0.89	434
S Central Dawson	8114	M Spra Shale	5.39	2.12	32.46	0.53	428
S Central Dawson	8216	M Spra Shale	4.95	1.52	30.80	0.51	429
S Central Dawson	8236	M Spra Shale	2.24	0.93	11.56	0.43	431
S Central Dawson	8260	M Spra Shale	5.35	2.44	32.28	0.59	428
S Central Dawson	8270	M Spra Shale	4.84	2.08	29.27	0.38	430
S Central Dawson	8296	M Spra Shale	2.91	1.14	18.41	0.43	431
S Central Dawson	9282	WFMP "A"	7.82	3.78	44.60	0.45	433
S Central Dawson	9315	WFMP "A"	10.68	3.62	57.89	0.52	431
S Central Dawson	9333	WFMP "A"	7.04	3.30	42.62	0.48	432
S Central Dawson	9347	WFMP "A"	4.35	1.71	27.22	0.38	433
S Central Dawson	9373	WFMP "A"	2.66	1.77	16.61	0.30	434
S Central Dawson	9391	WFMP "A"	3.88	1.85	21.98	0.40	435
S Central Dawson	9424	WFMP "A"	6.91	2.78	40.28	0.49	433
S Central Dawson	9461	WFMP "A"	4.14	2.10	25.18	0.43	434
S Central Dawson	9472	WFMP "A"	5.24	1.60	28.69	0.37	433
SW Dawson	9657	WFMP "A"	3.66	2.85	19.14	0.66	435
SW Dawson	9727	WFMP "A"	5.64	3.70	36.14	0.64	440
SW Dawson	9803	WFMP "A"	5.90	3.17	23.16	0.67	441

Core location	Depth () Top	Formation	Leco TOC	RE S1	RE S2	RE S3	Tmax (°C)
NW Howard	7642	L Spra Shale	2.24	1.73	7.50	0.62	441
NW Howard	7767	L Spra Shale	2.68	1.94	5.98	0.63	448
NW Howard	8036	WFMP "A"	3.08	1.86	9.07	0.75	445
NW Howard	8057	WFMP "A"	2.40	1.25	4.64	0.64	443
NW Howard	8092	WFMP "A"	3.48	3.13	11.93	0.59	447
NW Howard	8100	WFMP "A"	2.14	1.59	4.61	0.61	445
NW Howard	8131	WFMP "A"	2.49	1.89	7.42	0.73	445
NW Howard	8173	WFMP "A"	2.88	2.49	5.97	0.71	445
NW Howard	8186	WFMP "A"	2.59	2.12	5.44	0.73	450

NW Howard: 1 ½ mile laterals/*vintage 1 fracs*
Lower Spraberry Shale: **742** MBOE/EUR
WFMP "A": **853** MBOE/EUR

Southern Dawson M Spraberry ave S1 * : **1.9** mg HC/g rock

NW Howard L Spraberry ave S1 * : **1.83** mg HC/g Rock

Southern Dawson WCMP "A" ave S1 * : **2.68** mg HC/g rock

NW Howard WCMP "A" ave S1 * : **2.05** mg HC/g Rock

Notes: **S1** = volatile hydrocarbon content (i.e. free oil & gas) **S2** = remaining hydrocarbon generating potential – *hydrocarbons still in kerogen phase*
Tmax – maximum temp which hydrocarbon generation occurs in S2 during pyrolysis – measured in C*

Weatherford LABORATORIES

TOTAL ORGANIC CARBON, PROGRAMMED PYROLYSIS DATA

SCAL INC.

Well Name : McCarty 23 No.2	Operator : SDX Resources, Inc.	State : Texas	Project No. :
	API # :	County : Dawson	BH-66154 / BH-66154

Client ID	Depth () Top	Formation	Sample Type	Sample Prep	*	Leco TOC	RE S1	RE S2	RE S3	Tmax (°C)	**	Ro,%	HI	OI	S2/S3	S1/TOC *100	PI	Notes Checks	Notes Pyrogram	Lab ID
7	8249		Crushed Material	NOPR		8.87	4.24	67.68	1.35	425			763	15	50.1	48	0.06	TOC RE	n:lts2sh	3403108338
8	8281		Crushed Material	NOPR		4.71	2.34	37.63	0.70	428			799	15	53.8	50	0.06	TOC	n	3403108340
9	8295		Crushed Material	NOPR		8.34	4.42	65.11	0.71	425			780	9	91.7	53	0.06	TOC	n	3403108342

TABLE 1. Semi-quantitative X-ray Diffraction Analysis

Company : SDX Resources, Inc. Page: 1/1

Well Name: McCarty 23 #2 weight % 7/25/2013

Job #: 131363

		Q / feldsp.			carbonates								clay minerals						
sample #	depth in ft	quartz	plagioclase	K-feldspar	calcite	dolomite	ankerite	siderite	anhydrite	gypsum	zeolite	pyrite	apatite	illite + mica	I/S mixed-layer	smectite	attapulgite	kaolinite	chlorite	TOTAL *
7	*****	40	15		3	2						5		20	5	10				100
8	*****	40	15		5	2						3		20	5	10				100
9	*****	40	10		3	2						5		20	7	13				100

(?)

(YIKES!!!!)

DeRoen Mississipian Field – *east Central Dawson Co.*
WFMP 'A' sidewall cores

Observations:

- **Very low TMax but normal S1(*free oil*) in Pyrolysis**
- **Normal mature basinal pyrite percentage (?????)**
- **Very high heavy clay content (smectite) due to differential sorting dropping heavy clays nearer to source – *poor unconventional frac candidate.***

SW Dawson 5 miles north of Martin/Dawson Co. line

Client ID	Depth () Top	Formation	Sample Type	Sample Prep	*	Leco TOC	RE S1	RE S2	RE S3	Tmax (°C)	*	Ro,%	HI	OI	S2/S3	S1/TOC *100	PI	Notes Checks	Notes Pyrogram	Lab ID
30	9763		Powder Rock	NOPR		2.71	3.30	21.44	0.94	438		0.72	791	35	22.8	122	0.13		n:lts2sh	3402913569
37	9800.4		Powder Rock	NOPR		3.72	4.48	28.23	1.18	437		0.71	759	32	23.9	120	0.14		n:lts2sh	3402913571
39	9810.8	WFMP A detritus target	Powder Rock	NOPR		3.42	5.19	17.85	0.84	444		0.83	522	25	21.3	152	0.23		n:lts2sh	3402913573
	9815.7	WFMP A detritus target	Powder Rock	NOPR		4.44	5.96	24.47	0.95	443		0.81	551	21	25.8	134	0.20	TOC	n:lts2sh	3402913575
46	9843		Powder Rock	NOPR		3.07	3.99	18.52	1.19	436		0.69	604	39	15.6	130	0.18	RE	n:lts2sh	3402913577
47	9847.8		Powder Rock	NOPR		2.57	3.13	12.51	1.04	434		0.65	487	40	12.0	122	0.20		n:lts2sh	3402913579
48	9853		Powder Rock	NOPR		5.21	6.57	31.90	1.17	437		0.71	612	22	27.3	126	0.17	TOC	n:lts2sh	3402913581
50	9863.5		Powder Rock	NOPR		3.08	3.92	19.75	1.07	434		0.65	642	35	18.5	127	0.17		n:lts2sh	3402913583
51	9869.2		Powder Rock	NOPR		3.00	4.26	18.28	1.34	437		0.71	610	45	13.6	142	0.19	RE	n:lts2sh	3402913585

(?)

Observations:

- **WFMP 'A' detritus target thins to only 60'**
- **Mature oil window TMax pyrolysis in WFMP 'A' detritus target surrounded above and below by low maturity WFMP 'A' and WFMP 'B' samples**

Hypothesis:

Perhaps having readily accessible pathways to migration for generated S1 hydrocarbons (*interbedded thin fractured detritus limes*) allows the traditional maturity process to continue as the organics never hit sorb saturation????

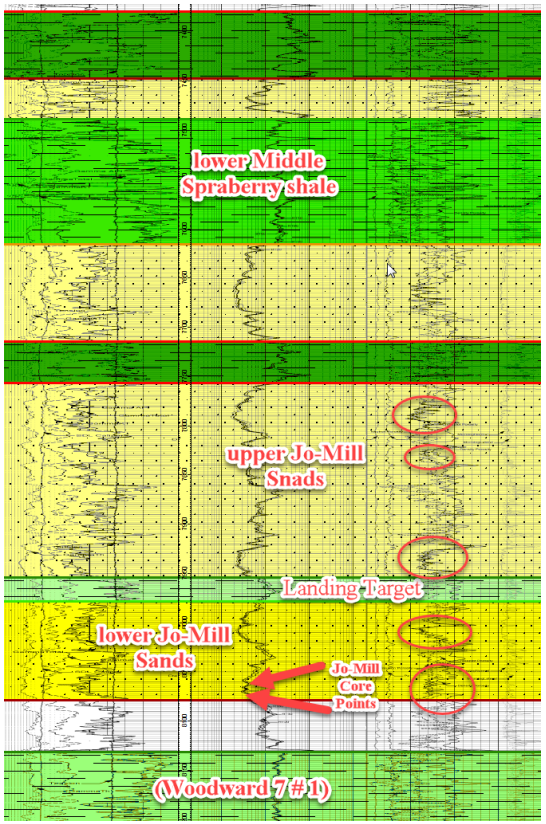
SCAL, Inc.
SPECIAL CORE ANALYSIS LABORATORIES

Drilled Sidewall Core Analysis Report

Company: [redacted]
File No.:
Well :
Location:

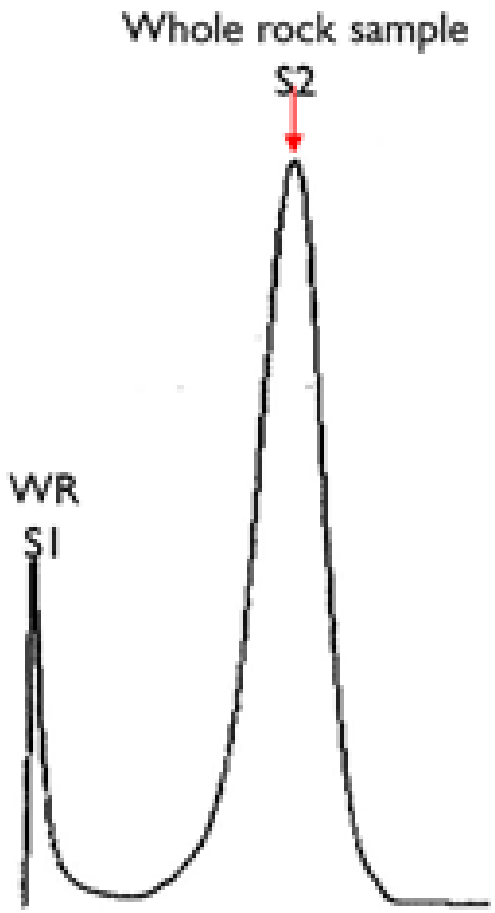
Field: Spraberry (Trend Area)
Formation:
County: Dawson County, Texas

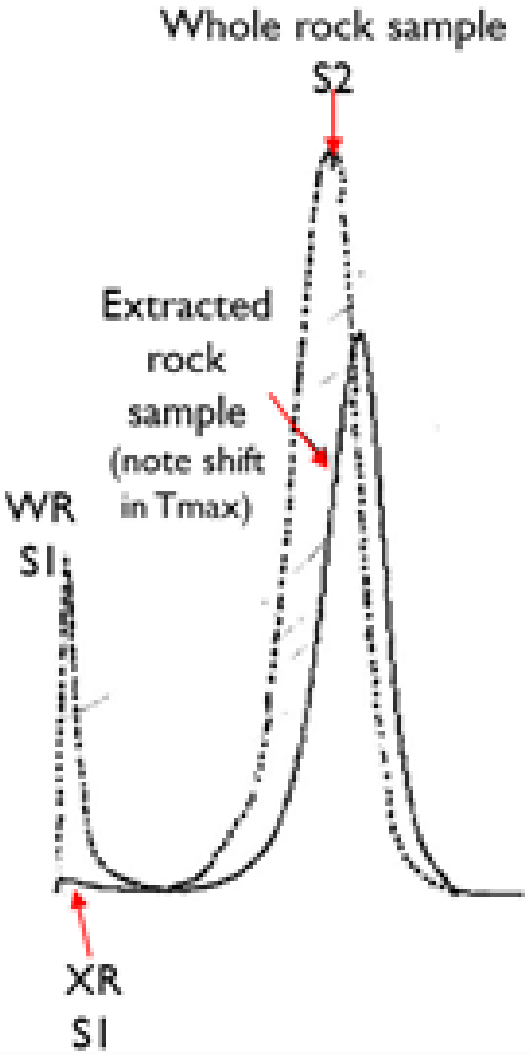
Sample Number	Depth	Air Permeability	Klinkenberg Permeability	Porosity	Grain Density	Sw	So	Gas Units	Fluorescence		Sample Description
	ft	mD	mD	%	g/cc	%	%		%	Description	
Confining Pressure 2,825psi											
1	8,064.0	6.44	5.88	15.09	2.70	29.4	19.2	487	100	Yl Grn	Ss:tn vfg wl srt rnd
2	8,070.0	0.5441	0.4456	14.01	2.66	26.3	19.4	454	100	Yl Grn	Ss:tn vfg wl srt rnd

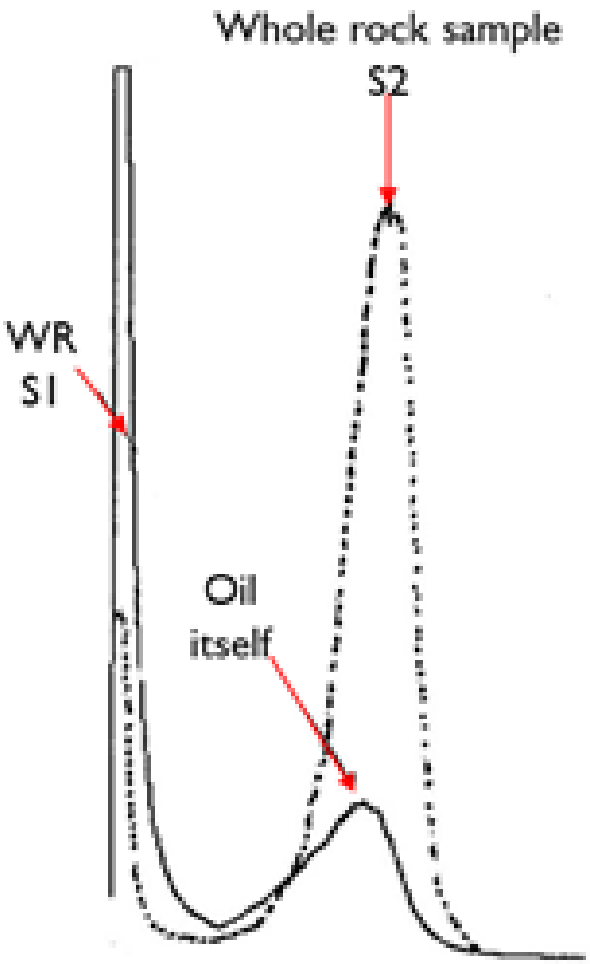


- **Consistent Saturations throughout upper and lower Jo-Mill Sands**
- **Interbedded organic shales for competent landing targets**
- **Note: Higher porosities (*closer to depositional source*) in Northern Midland Basin**

Pyrolysis Examples of effects on TMax of abundant S1 (free Oil) in "Whole Rock" vs "Extracted Rock" Samples - (*free oil removed*)





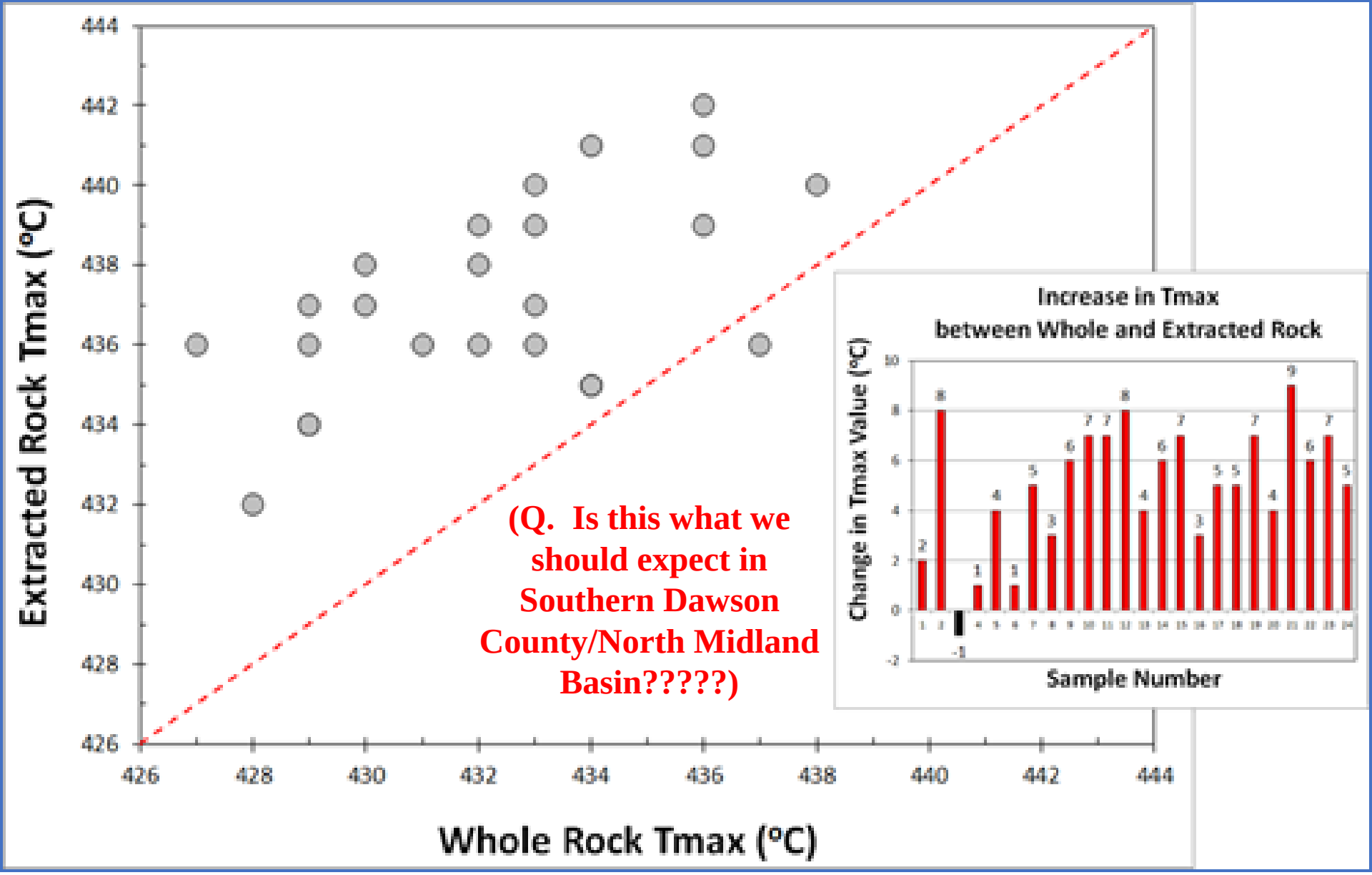


In the hydrocarbon generation process, the large molecule high polarity and low viscosity "bitumen" component – *basically resins and asphaltenes* – sorb hydrocarbons such as the early migrated light end oils until pressure saturates the sorbtive capacity. **When this occurs, light ends and hydrocarbon gases are released much more readily resulting in fractionation of the black oil.** This is actually positive as it cleans up the migrated oils. These adsorbed migrated oils bonded early in diagenesis in the S2 scew Whole Rock Tmax pyrolysis almost always to the negative also resulting in high HI (Hydrocarbon Index) readings - *Jarvie*.

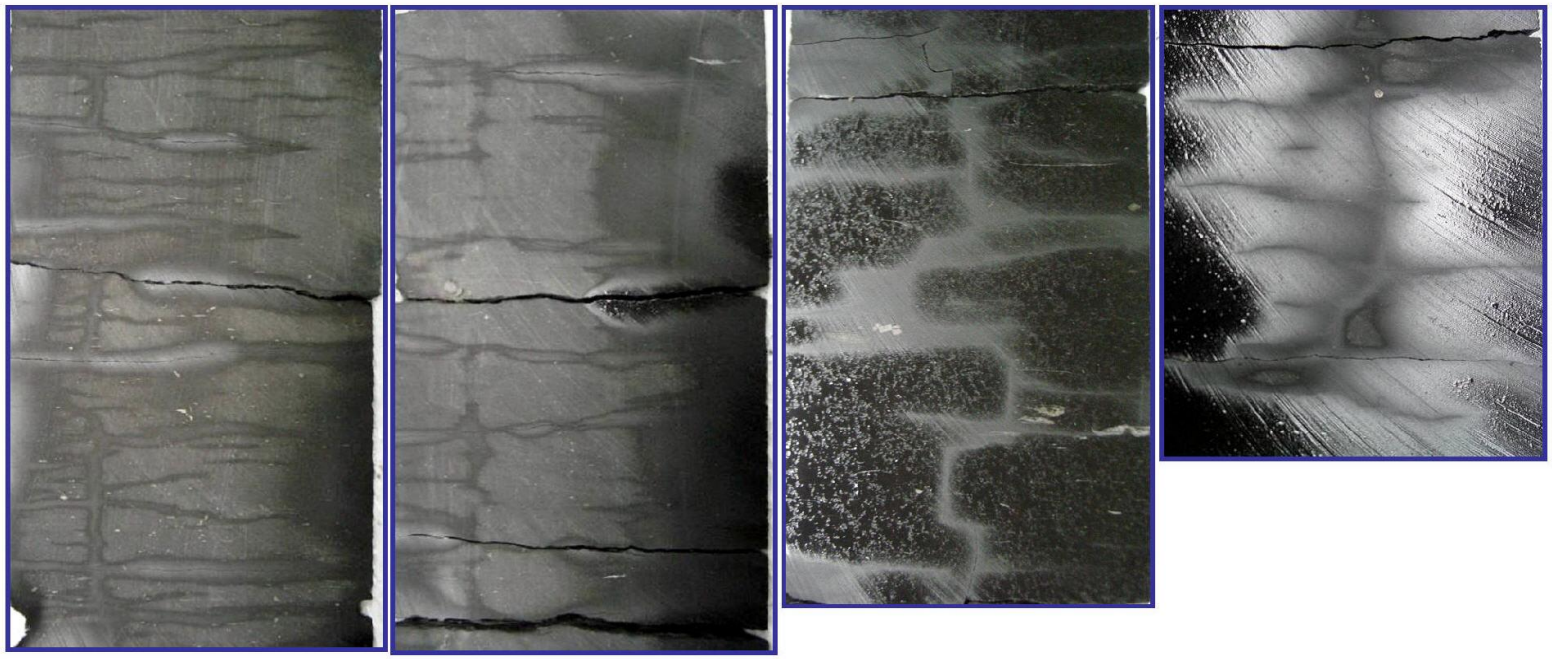
Q. So what accounts for the low TMax found throughout this area trending towards the modern day NE source points for the basin?

Hypothesis: In the hydrocarbon generation process, the large molecule high polarity and low viscosity "bitumen" component – *basically resins and asphaltenes* – sorb hydrocarbons such as the early migrated light end oils until pressure saturates the sorbtive capacity. **When this occurs, light ends and hydrocarbon gases are released much more readily resulting in fractionation of the black oil (*i.e. high gravity api crudes*).** This is actually positive as it cleans up the migrated oils. These adsorbed migrated oils bonded early in diagenesis in the S2 scew Whole Rock Tmax pyrolysis ***almost always to the negative*** also resulting in high HI (Hydrocarbon Index) readings - ***Jarvie*.**

Comments: "***that fits what we are seeing***"



Extracted Rock Tmax *vs* Whole Rock Tmax (Bakken - Parshall Field). Ave. increase of 6° C (Jarvie Bakken Study)

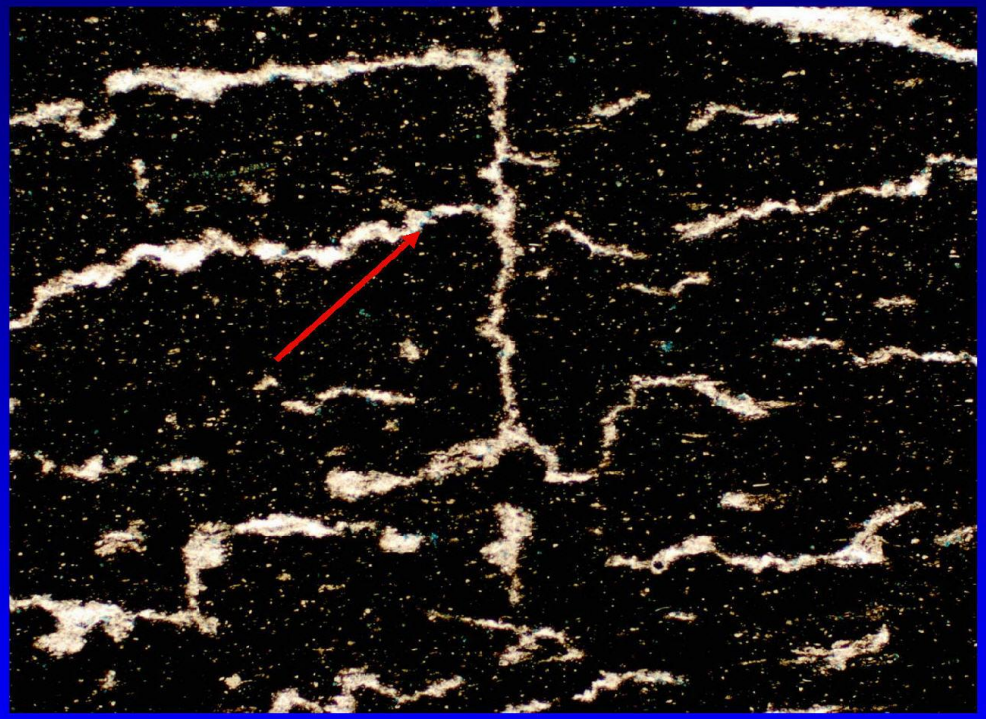


- Examples of horizontal partings connected by discontinuous vertical fractures to form a reticulate network emphasized during drying of slab after initial spraying with water
- These partings may or may not be open in subsurface (more likely in overpressured settings—no longer the case for Howard County, but perhaps the case at onset of generation), but certainly demonstrate planes of weakness for hydraulic stimulation to take advantage of with appropriate proppant program and with inhibition of proppant embedment

Cobra/(Manhattan) Guitar 1 # 3h - Cline Pay slabbed core photo

(Illustration of the "micro-fracture network present in brittle hydrocarbon saturated WFMP "D"/Cline pay even where no vertical and minimal horizontal fractures exist.)

Sample Depth 9049.5’ 40X



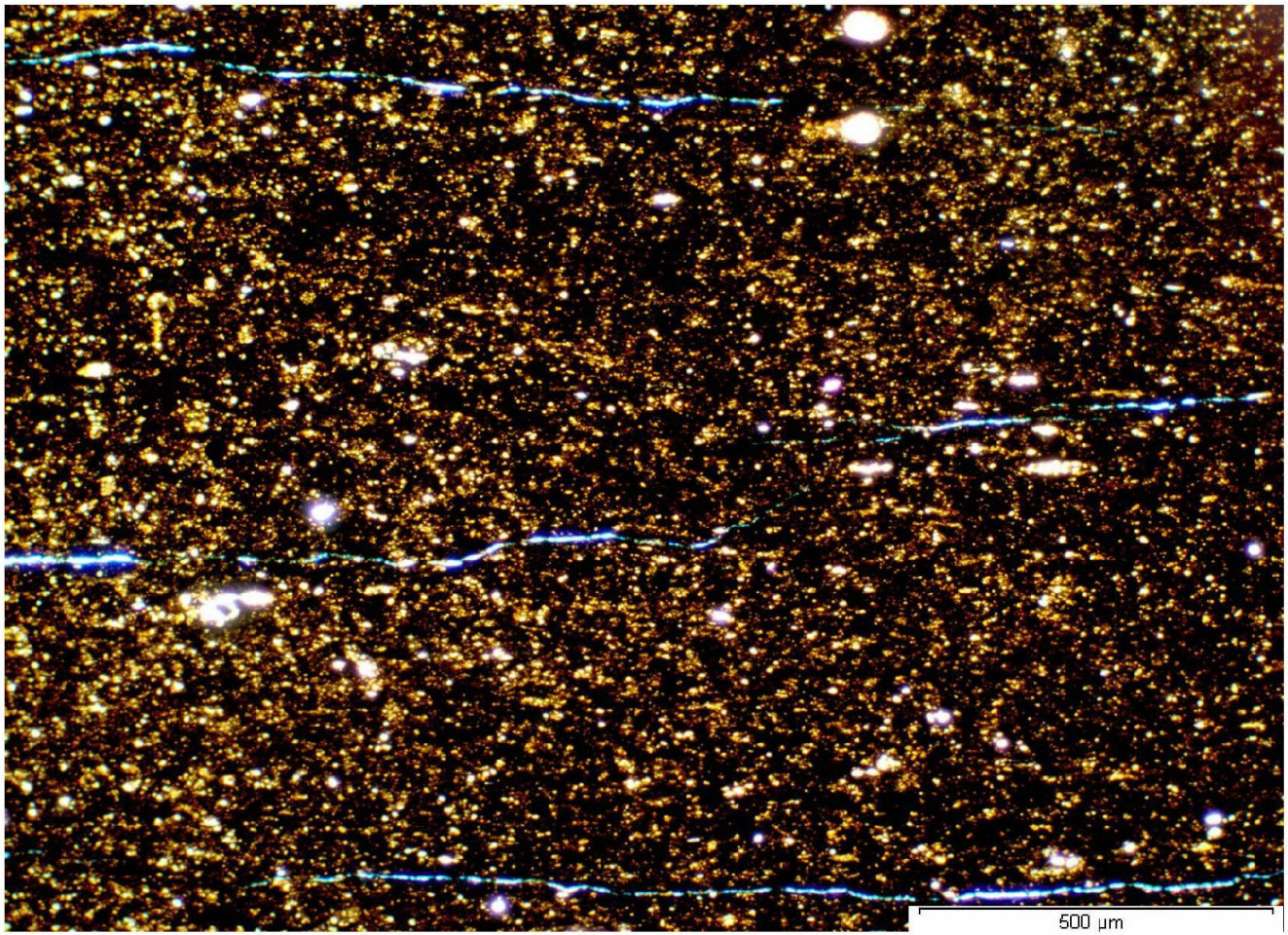
Vertically-linked horizontal natural microfractures in an organic-rich shale. Ptygmatic folding of the fractures indicates that fracturing occurred early in the burial history, *prior to significant* compaction—similar features observed in Bakken Shales (Sonnenfeld/Cantor). Rare microporosity is present within the microfracture network (arrow). Note rare open vugs and/or molds in the matrix.

Cobra/(Manhattan) Guitar 1 # 3h - Cline Pay thin section

(Thin Section revealing a more detailed look at the “micro-fracture network” present in brittle hydrocarbon saturated shales which provides pathways for unconventional fracs to engage the reservoir. Notable Quote: “*ptygmatic folding of the fractures indicates that fracturing occurred early in the burial history….*”)

Q. Why did fracturing occur early post deposition? A. Hydrocarbon generation occurs early (*Friedman Kinetics*).

• Multiple partings shown



Guitar 1-3 9088.9' 40X

Cobra/(Manhattan) Guitar 1 # 3h - Cline Pay thin section

(Thin Section illustrating partings present along weak bedding planes in a hydrocarbon saturated shale reservoir in the WFMP "D"/Cline)

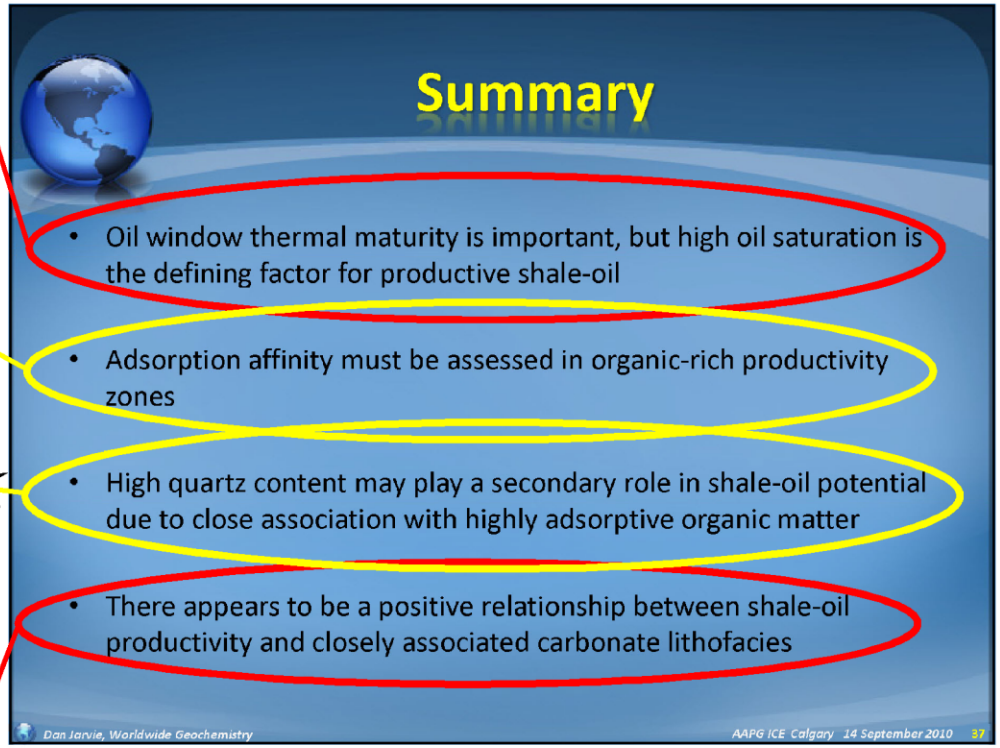
"Geo-Chem Conclusions"

Note: Not only captured S1 (volatile hydrocarbons/*free oil*) but also lost S1 during core acquisition due to evaporation of volitiles. S1 lost is 35% for 1 hr exposure of 38 gravity oil at 100° F - *i.e. Trip out time for sidewall cores*. Lost S1 can range from 10% to over 200%. Obviously, the more brittle the source rock the higher the S1-*lost* - *Jarvie*

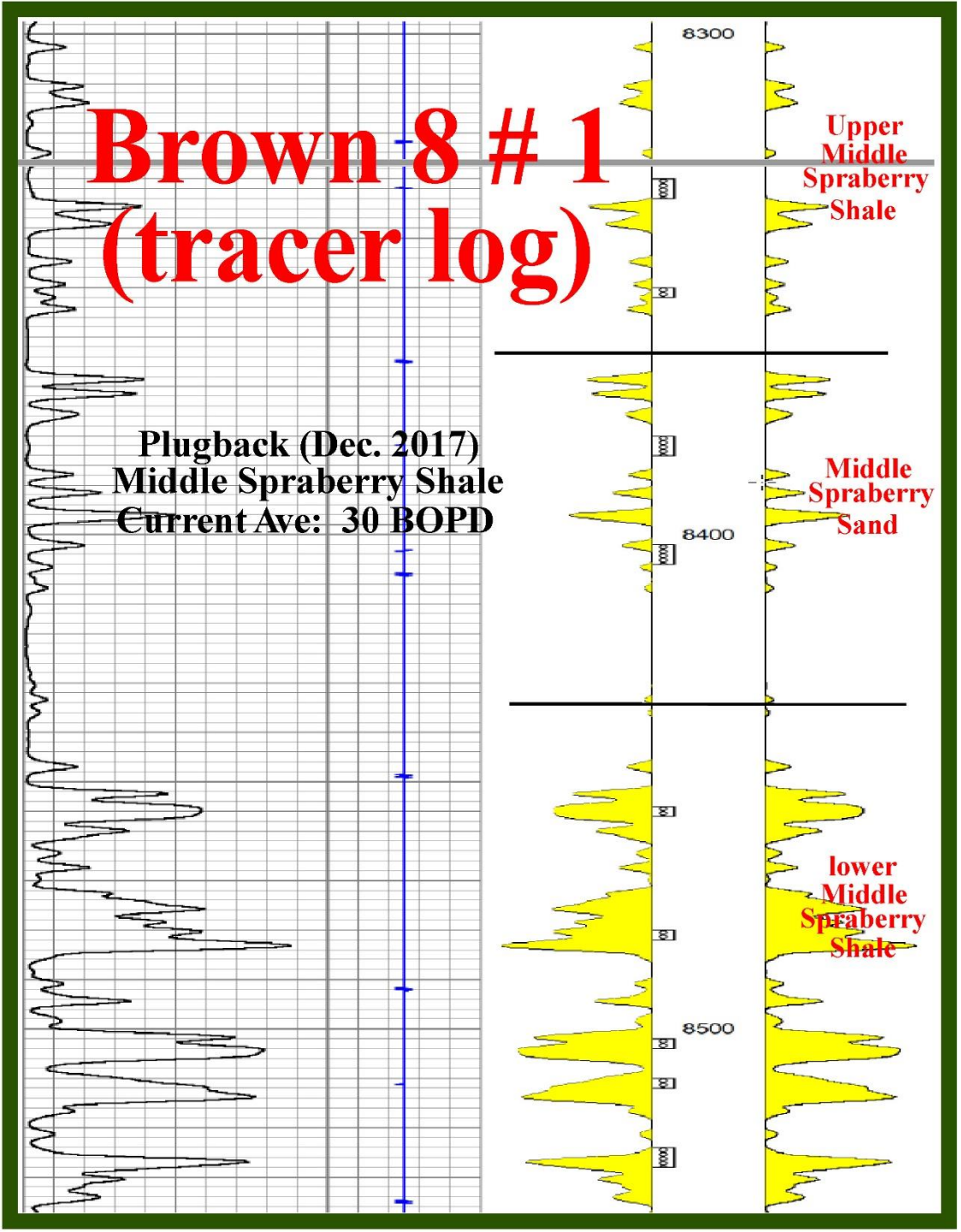
The first or very early light end migrated oils can be adsorbed with in-Situ S2 kerogens until saturation. These early 'adsorbed' migrated oils may be more readily produced when exposed to expulsion from maximum Delta Pressure when the exposure to the movement of the long chain hydrocarbon S1 overcomes the adsorptive bond on the S2 kerogens.

The primary organic content of the deep water facies for Permian Wolfcampian/Leonardian is siliceous shelled Radiolarins (- *i.e. plankton*). The WFMP B and lower Spraberry Shale facies is dominated by silicates and organic silicates. While most of the poor "commerciality" of the WFMP B and lower Spraberry Shale can be explained by the high heavy clay content found in the illite/smectite % of these formations, the adsorptive bond of the heavy silicate organics may also play a significant roll particularly in the long term production curve.

Note: The dominate facies of both the WFMP A and the Middle Spraberry Shale is carbonate heavy brittle shales interbedded with thin detritus micritic limes and basinal hydrocarbon saturated turbiditic sands - (*i.e. conventional/unconventional "hybrid" systems*).



Conclusions from: "*Unconventional Oil Petroleum Systems: Shales and Shale Hybrids*" - Dan Jarvie - 2011



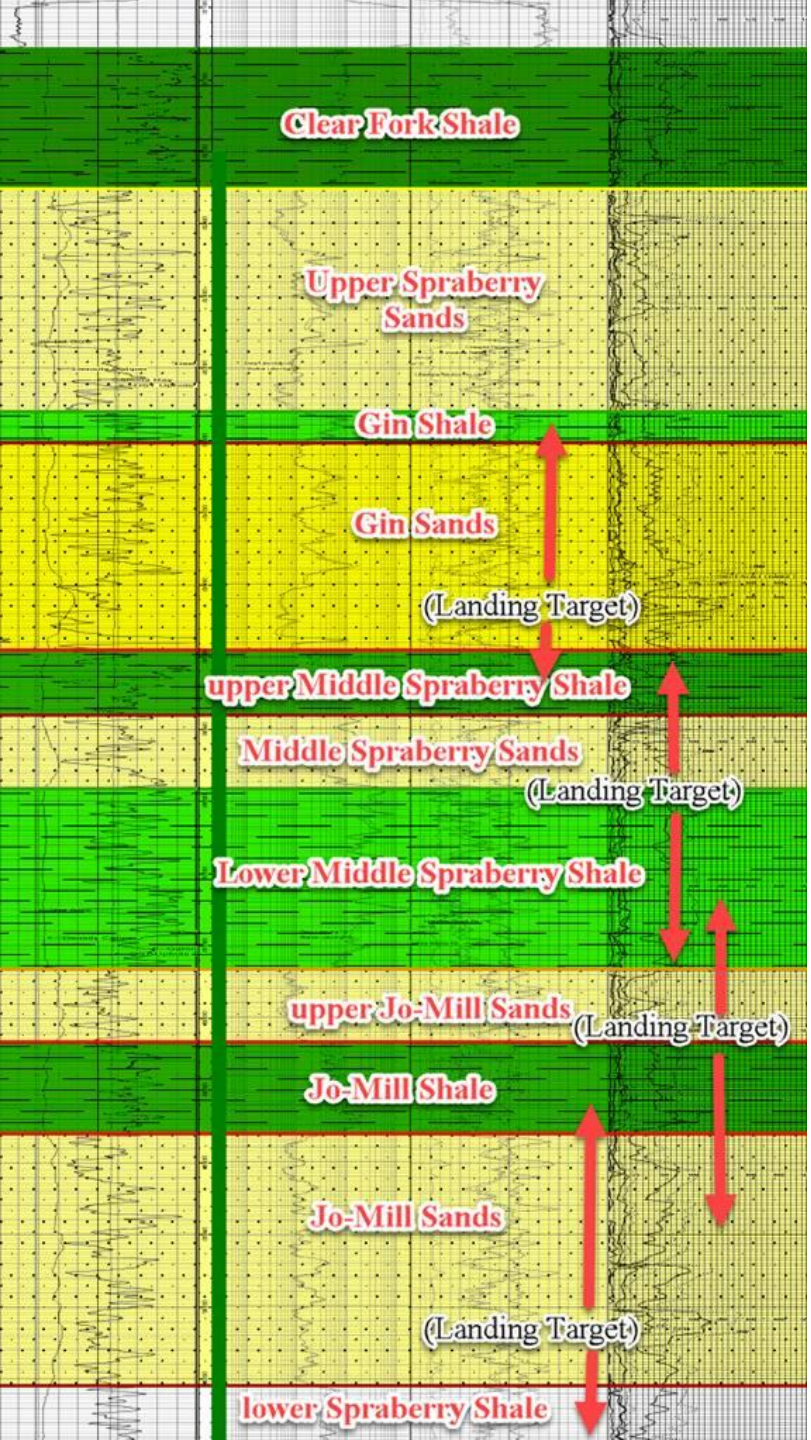
Observation and Notes:

1. The Middle Spraberry Shale shows limited growth in the Shales as expected that the "micro-fracture network" in the brittle hydrocarbon saturated shales would be the preferential frac path for an unconventional frac or hybrid frac (*i.e. slick water tailed in with linear gel pad????*).

2. The Middle Spraberry Sand shows limited growth most likely finding the basinal turbiditic sand reservoir paths.

3. The upper Middle Spraberry Shale growth is limited and looks limited on it's contribution.

4. The Energen landing target 40' to 60' below the base of the Middle Spraberry Sand is probably a good target for an effective frac in the lower Middle Spraberry Shale and Middle Spraberry Sand.



SW Dawson "Type Log"

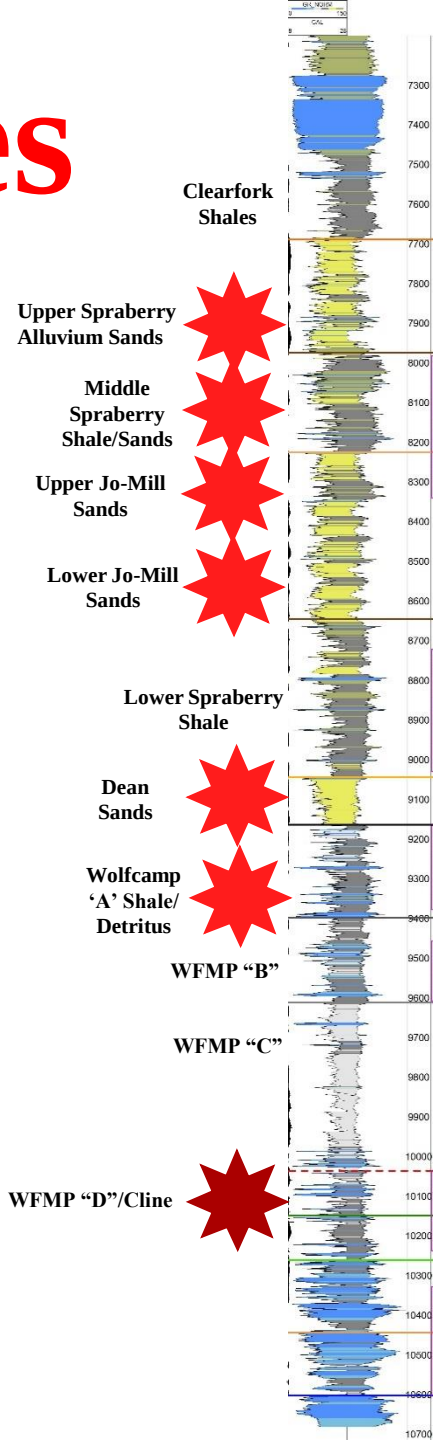
- **The Middle Spraberry package is still the obvious primary target due to the consistent sand thickness interbedded in the thickest brittle organic shale package**
- **Multiple "Bakken" targets emerge noting the glacioeustatic seas of the Permian Leonardian Spraberry deposition of multiple basinal sands interbedded with brittle organic shale packages. Most of these sands have associated regional historical production.**
- **While the Middle Spraberry shale has been cored extensively, few cores exist for the thinner Spraberry shale members. Knowing that the same source and clinoform cycles should result in similar facies confidence is high that additional benches will achieve similar results**
- **These targets are a perfect setup for multiple "wine rack" spacing and zipper fracs.**

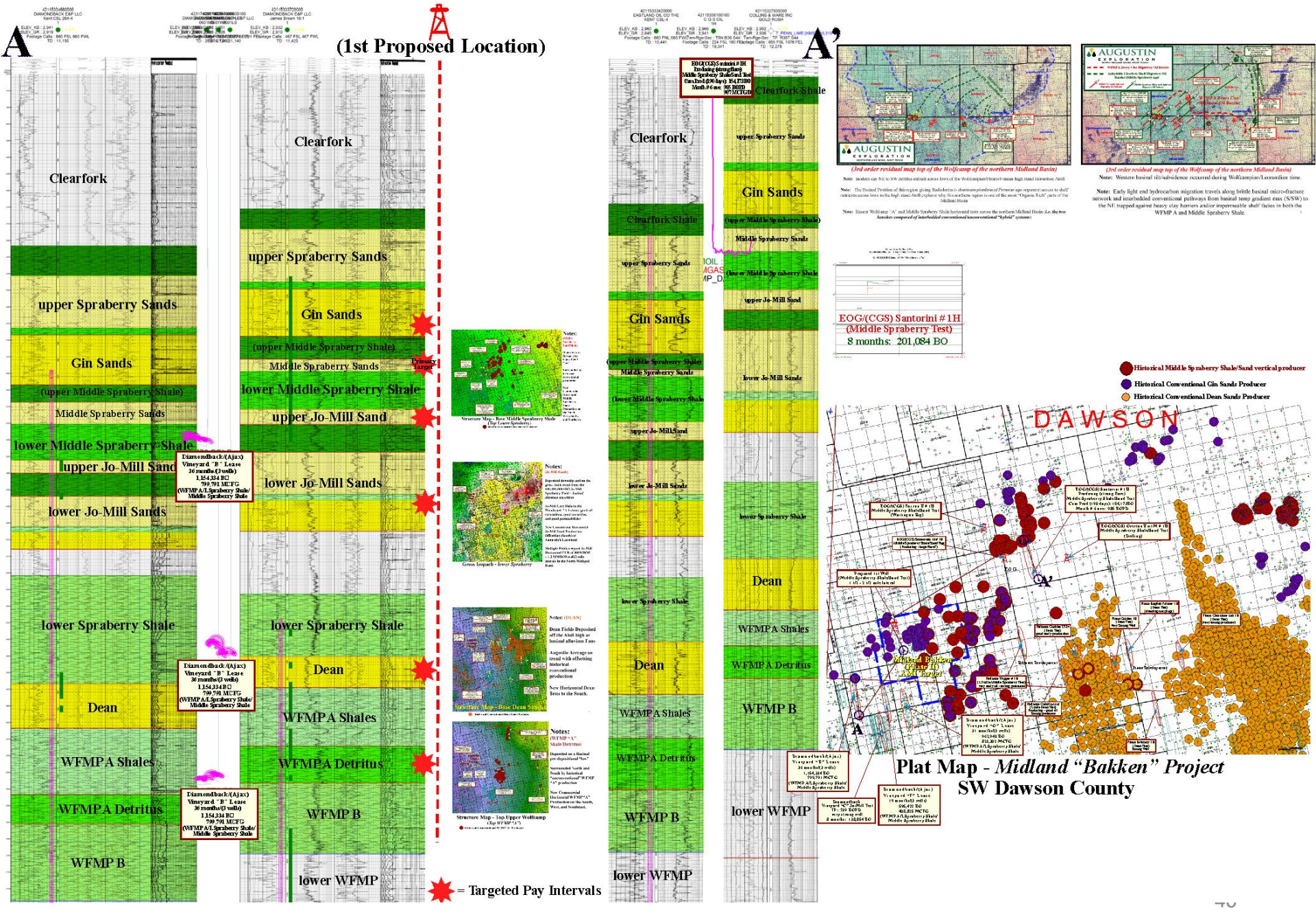
Six Targeted Benches

- upper Spraberry Shale/Sand *(Gin)*
- Middle Spraberry Shale/Sand
- upper Jo-Mill Sands *(lower Spraberry)*
- lower Jo-Mill Sands *(Lower Spraberry)*
- Dean Sands
- Wolfcamp “A” Shale/Detritus

Secondary Target

- Wolfcamp “D”/Cline



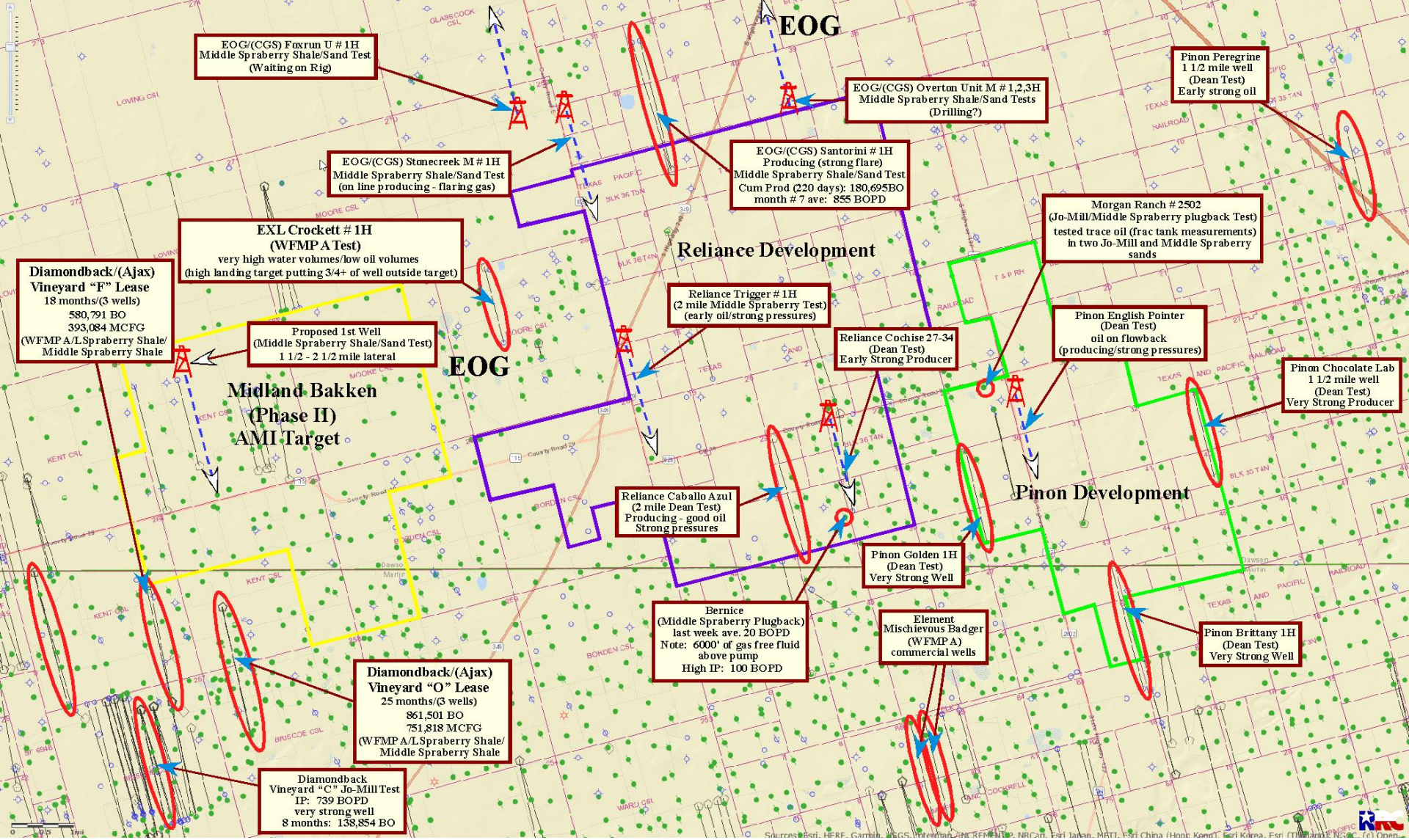

A
A'
(1st Proposed Location)
Clearfork
upper Spraberry Sands
Gin Sands
(upper Middle Spraberry Shale)
Middle Spraberry Sands
lower Middle Spraberry Shale
upper Jo-Mill Sand
lower Jo-Mill Sands
lower Spraberry Shale
Dean
WFMP A Shales
WFMP A Detritus
WFMP B
lower WFMP
Diamondback/(Ajax) Vineyard "B" Lease 36 months/(3 wells) 1,154,334 BO 799,791 MCFG (WFMP A/L Spraberry Shale/ Middle Spraberry Shale
Primary Target
= Targeted Pay Intervals
EOG/(CGS) Santorini # 1H (Middle Spraberry Test) 8 months: 201,084 BO
Historical Middle Spraberry Shale/Sand vertical producer
Historical Conventional Gin Sands Producer
Historical Conventional Dean Sands Producer
DAWSON
Midland "Bakken" Project
Plat Map - Midland "Bakken" Project
SW Dawson County

Q. So How is the "Midland Bakken" Project in Southern Dawson Co. going?

Great!!! Everyone is sleeping well.

Reliance/Pinon/(Midland Mafia): 2 years 7 horizontal wells (*1st commercial horizontals in Dawson County*) currently drilling well 8. One vertical Middle Spraberry Plugback test (very successful). 7 to 8 more horizontal wells planned for 2021 (various benches)

EOG/(CGS): drilled the Santorini # 1H Middle Spraberry horizontal 6 miles north of the Martin/Dawson County line. Appears to have a great confirmation well put on line in March. Currently drilling (full time rig??) with 9 permits filed.



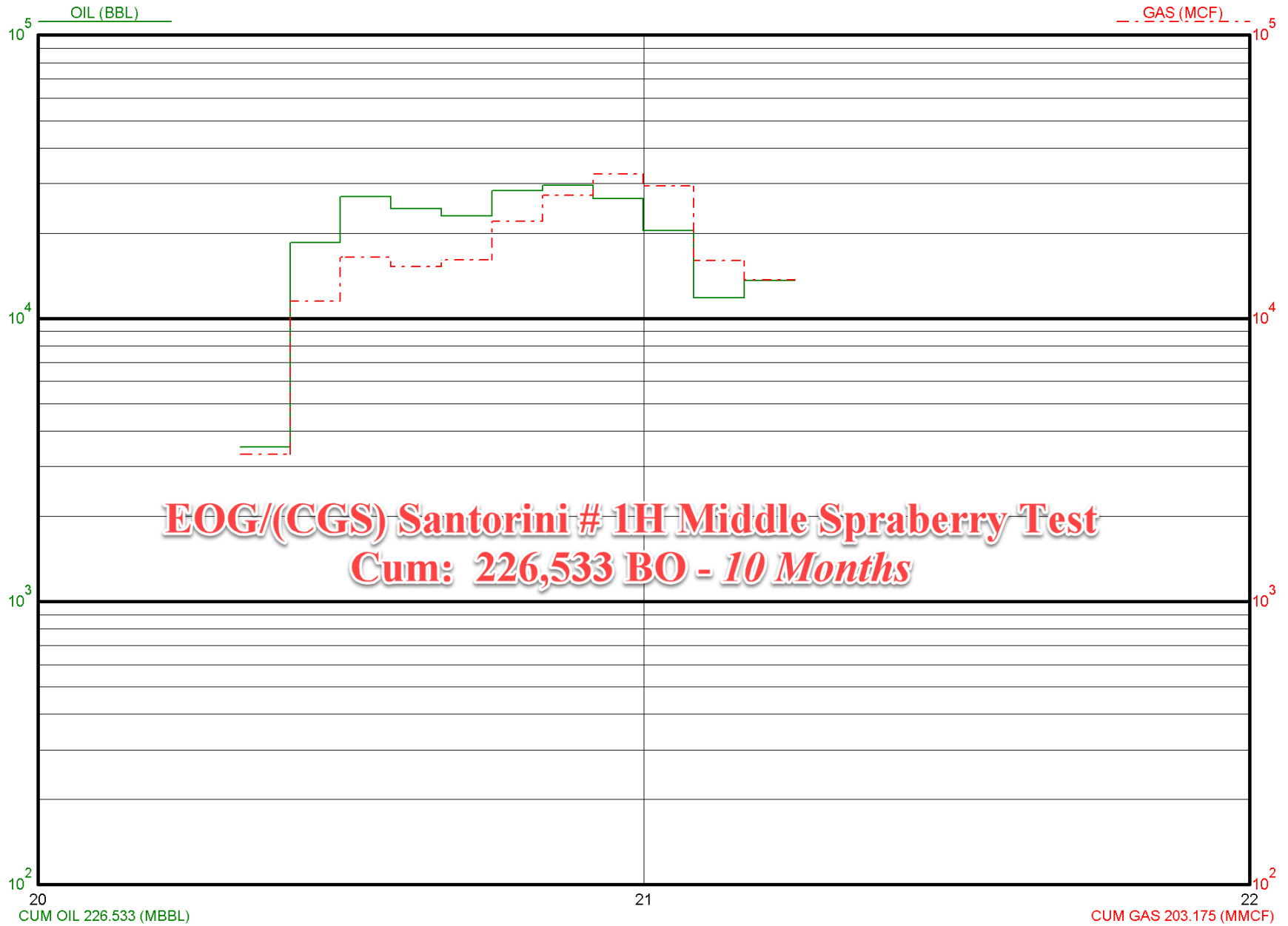
Activity plat map
Southern Dawson/Northern Martin Co.

Midland Basin 'Wolfberry' Play

Wsn:588950 WELL: 42-115-33810-0100 (42115338100100) [DEV]

1H

42-115-33810 EOG/(CGS) Santorini # 1H Middle Spraberry Test



Summary

Keep *pursuing* the "Science" until your hypothesis answers *all observations*