



Legacy Well Innovations & Opportunities

House Bill 1272

Testimonial Presentation of
Kyle Gardner

Senate Energy and Natural
Resources Committee

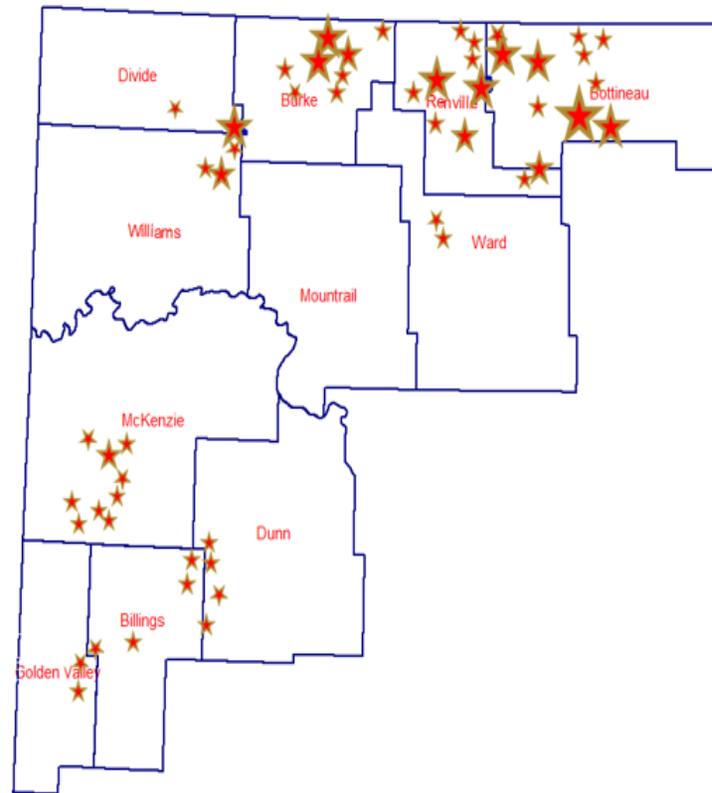
March 9, 2023

OPERATIONS

Cobra operates producing properties in Alabama, Arkansas, Louisiana, New Mexico, North Dakota, Michigan, Mississippi, Oklahoma, Texas, Utah and Wyoming .



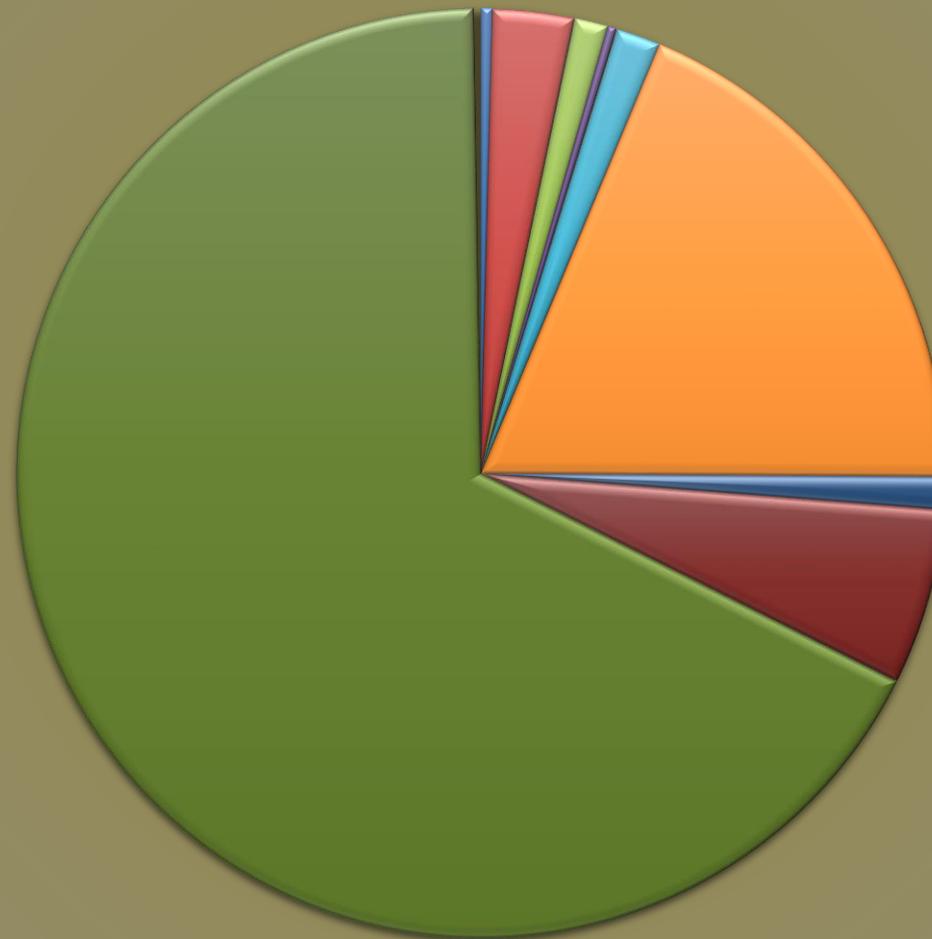
Cobra Oil & Gas Corporation





North Dakota Cumulative Oil Production By Formation

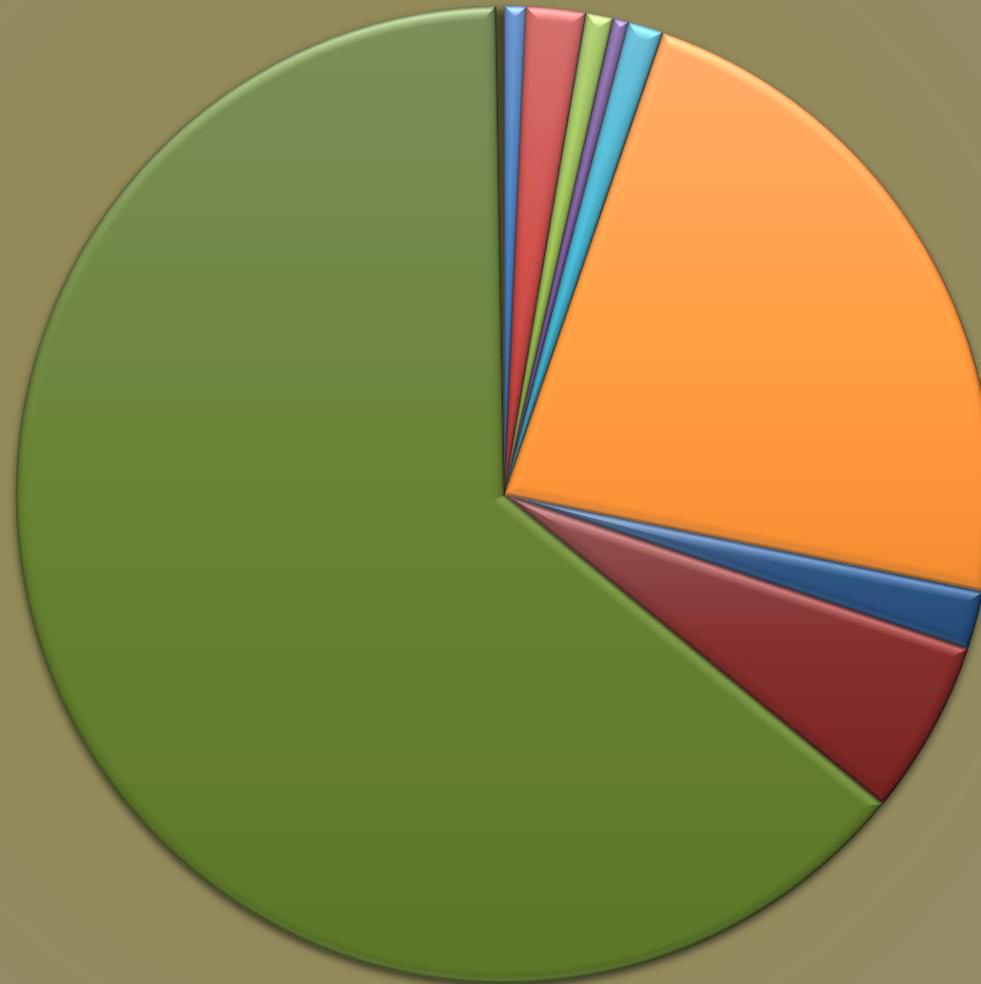
5,567,590,678
Barrels of Oil



- BIRDBEAR
- DEVONIAN-DUPEROW
- SILURIAN
- STONEWALL
- TYLER/HEATH
- MADISON GROUP
- SPEARFISH/MADISON
- RED RIVER GROUP
- BAKKEN/THREE FORKS
- DAWSON BAY
- WINNIPEGOSIS

North Dakota Total Well Count By Formation

25,146
Total Wells



■ BIRDBEAR

■ DEVONIAN-DUPEROW ■ SILURIAN

■ STONEWALL

■ TYLER/HEATH

■ MADISON GROUP

■ SPEARFISH/MADISON

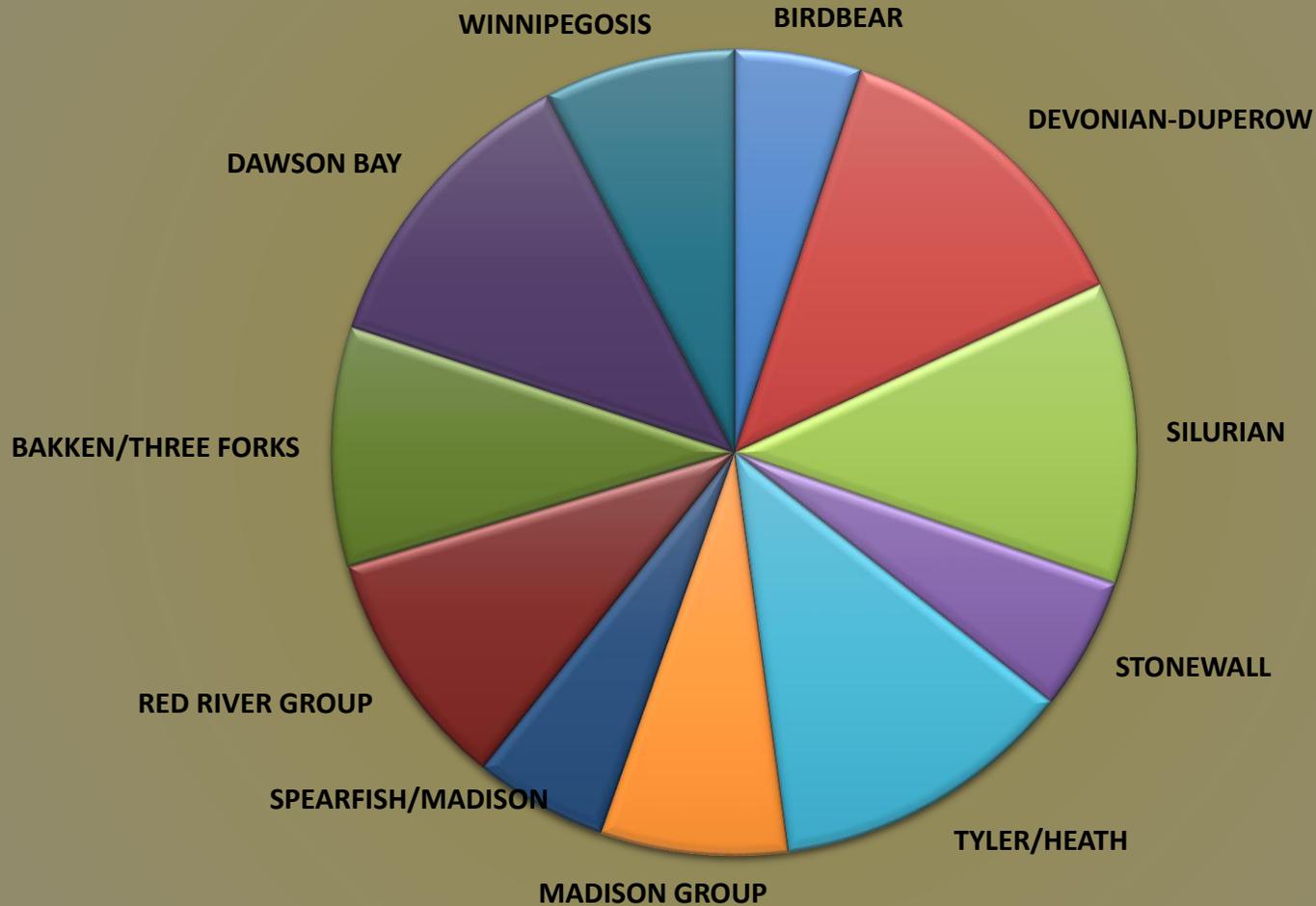
■ RED RIVER GROUP

■ BAKKEN/THREE FORKS ■ DAWSON BAY

■ WINNIPEGOSIS



North Dakota Cumulative BO/Well By Formation



- BIRDBEAR
- DEVONIAN-DUPEROW
- SILURIAN
- STONEWALL
- TYLER/HEATH
- MADISON GROUP
- SPEARFISH/MADISON
- RED RIVER GROUP
- BAKKEN/THREE FORKS
- DAWSON BAY
- WINNIPEGOSIS



Williston Basin Fun Facts

- According to NDGS production/well count data, all ND productive formations that have produced more than 1MM BO, average 221,411 BO/well.
- Bakken/Three Forks Cumulative Production/Total Well Count yields an average 233,910 BO/well.
- Bakken/Three Forks made 1,078,594 BOPD in September-2022.
- Bakken /Three Forks currently produce 96% daily production in ND.
- The Madison Formation links every Bakken well to a historically prolific conventional reservoir.

SO WHAT IS NEXT?



Madison Formation Fun Facts

- Conventional carbonate reservoir.
- Contains reservoir quality rock throughout the basin.
- Can source its own hydrocarbon.
- Has been identified as a Residual Oil Zone (ROZ) formation via academic research and empirical production data.

What is a Residual Oil Zone (ROZ)?

- A section within the stratigraphic column of a formation that exists below the “oil-water contact” of a reservoir which contains “immobile oil.”
- These sections of reservoirs have been naturally water flooded by 3 different criteria.
- In result, remnants of oil are stranded within sections of rock that the oil once migrated through.

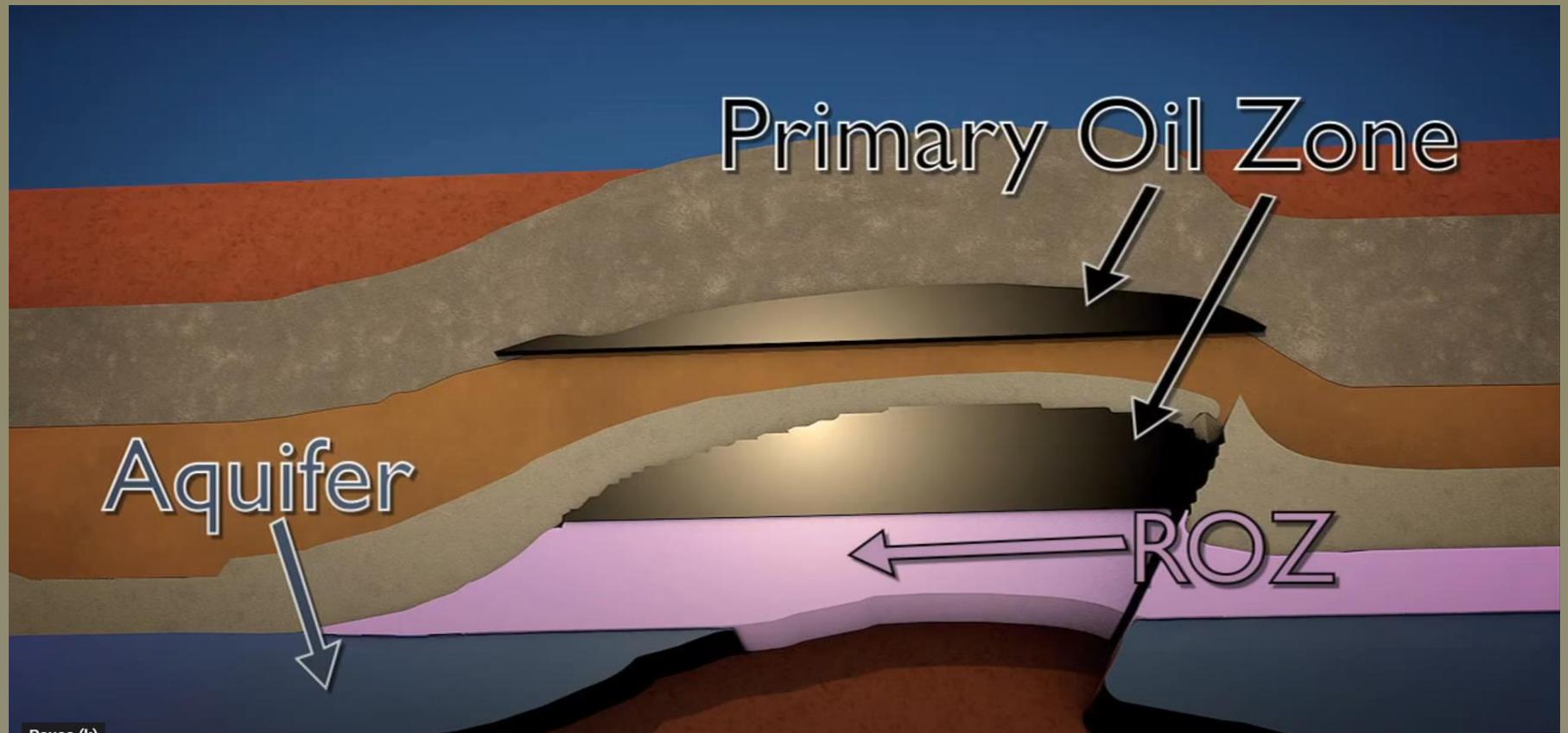
Types of ROZ

- **Type I** – Occurs when an existing hydrocarbon accumulation in a trap is subjected to a regional tilt (tectonically induced). Forcing oil to re-establish a new equilibrium.
- **TYPE II** – Occurs when a trap's seal is breached & allows for some or all of the hydrocarbon accumulation to vertically migrate from the trap, up the stratigraphic section.
- **TYPE III** – Similar to Type I but the static hydrocarbon accumulation undergoes a tilt due to ground water flows within the reservoirs.

Methods to Exploit the ROZ

- CO₂ Injection into the ROZ allows the CO₂ to become miscible within the oil droplets which in result lowers the oil interfacial surface tension, reduces viscosity and helps vacate the oil from the rock.
- Depressurizing the ROZ lowers the reservoir pressure within a radius around the wellbore to the bubble point pressure which allows the oil droplets to swell from gas expansion within the oil and helps vacate the oil from the rock.

Type II ROZ





RENVILLE COUNTY

FORMATION : MISSION CANYON
 DRLG. FLUID: SALT GEL NO OIL
 LOCATION :
 STATE : NORTH DAKOTA

DATE :
 FILE NO. :
 ANALYSTS :
 ELEVATION:

CONVENTIONAL CORE ANALYSIS

SAMP. NO.	DEPTH	PERM. TO HORZ.	AIR (MD) VERTICAL	POR. FLO.	FLUID SATS. OIL	WATER	GR. DNS.	DESCRIPTION
1	4572-73	0.92		13.5	12.9	30.0		LM FN XLN VUGGY CALC INF.
2	4573-74	64		18.5	15.2	23.2		LM FN XLN VUGGY CALC INF.
3	4574-75	7.2		12.0	17.6	35.2	CVF	LM FN XLN VUGGY CALC INF.
4	4575-76	104		18.5	16.6	35.2	CVF	LM FN XLN SCAT VUGS CALC INF.
5	4576-77	0.15		6.5	3.2	60.9		LM FN XLN SCAT VUGS CHKY
6	4577-78	42		12.8	10.9	34.2		LM FN XLN VUGS CALC XTAL
7	4578-79	1.1		7.4	7.1	31.0		LM FN XLN VUGS CALC XTAL
8	4579-80	0.39		20.7	23.7	23.7		LM OOL SCAT VUGS CALC INF.
9	4580-81	13		10.1	11.9	31.8		LM FN XLN VUGS CALC INF.
10	4581-82	3.8		10.2	8.8	29.2		LM FN XLN VUGS CALC INF.
11	4582-83	19		11.3	18.5	36.9	CVF	LM FN XLN VUGS CALC INF.
12	4583-84	33		11.9	14.8	28.0	CVF	LM FN XLN VUGS CALC INF.
13	4584-85	7.6		10.0	14.0	32.0	CVF	LM FN XLN SCAT VUGS CALC INF.
14	4585-86	36		11.1	14.3	28.6	CVF	LM FN XLN CALC INF.
15	4586-87	14		11.9	9.9	38.0		LM FN XLN VUGS CALC INF.
16	4587-88	13		23.4	14.8	33.6		LM FN XLN VUGS CALC INF.
17	4588-89	51		12.6	26.3	21.7		LM FN XLN VUGS CALC INF.
18	4589-90	7.8		18.1	23.4	23.4		LM FN XLN VUGS CALC INF.
19	4590-91	178		12.5	14.1	39.1		LM FN XLN VUGS CALC INF.
20	4591-92	13		14.4	18.5	27.8	CVF	LM FN XLN VUGS CALC INF.
21	4592-93	0.12		9.0	17.7	28.8	CVF	LM FN XLN VUGS CALC INF.
22	4593-94	0.16		7.7	12.1	40.3	CVF	LM FN XLN VUGS CALC INF.
23	4594-95	0.66		8.8	8.0	48.2		LM FN XLN VUGS CALC INF.
24	4595-96	66		3.0	3.6	50.3		LM FN XLN VUGS
25	4596-97	3.5		10.5	13.3	39.8		LM FN XLN CALC INF.

CVF CLOSED VERTICAL FRACTURE

These analyses, opinions or interpretations are based on observations and materials supplied by the client to whom, and for whose exclusive and confidential use, this report is made. The interpretations or opinions expressed represent the best judgment of Core Laboratories, Inc. (all errors and omissions excepted); but Core Laboratories, Inc. and its officers and employees, assume no responsibility and make no warranty or representation as to the accuracy of the data.

Type II ROZ

- Standard conventional approach “Pop the Top”
- Cobra Oil & Gas ROZ approach (full yellow section)
- Rock data, petrophysical data, mudlog data, & production data support a Type II ROZ.



Type II ROZ

[REDACTED]
 RENVILLE COUNTY
 FORMATION : MISSION CANYON
 ORLG. FLUID: SALT GEL NO OIL
 [REDACTED]
 STATE : NORTH DAKOTA
 DATE : [REDACTED]
 FILE NO. : [REDACTED]
 ANALYSTS : [REDACTED]
 ELEVATION: [REDACTED]

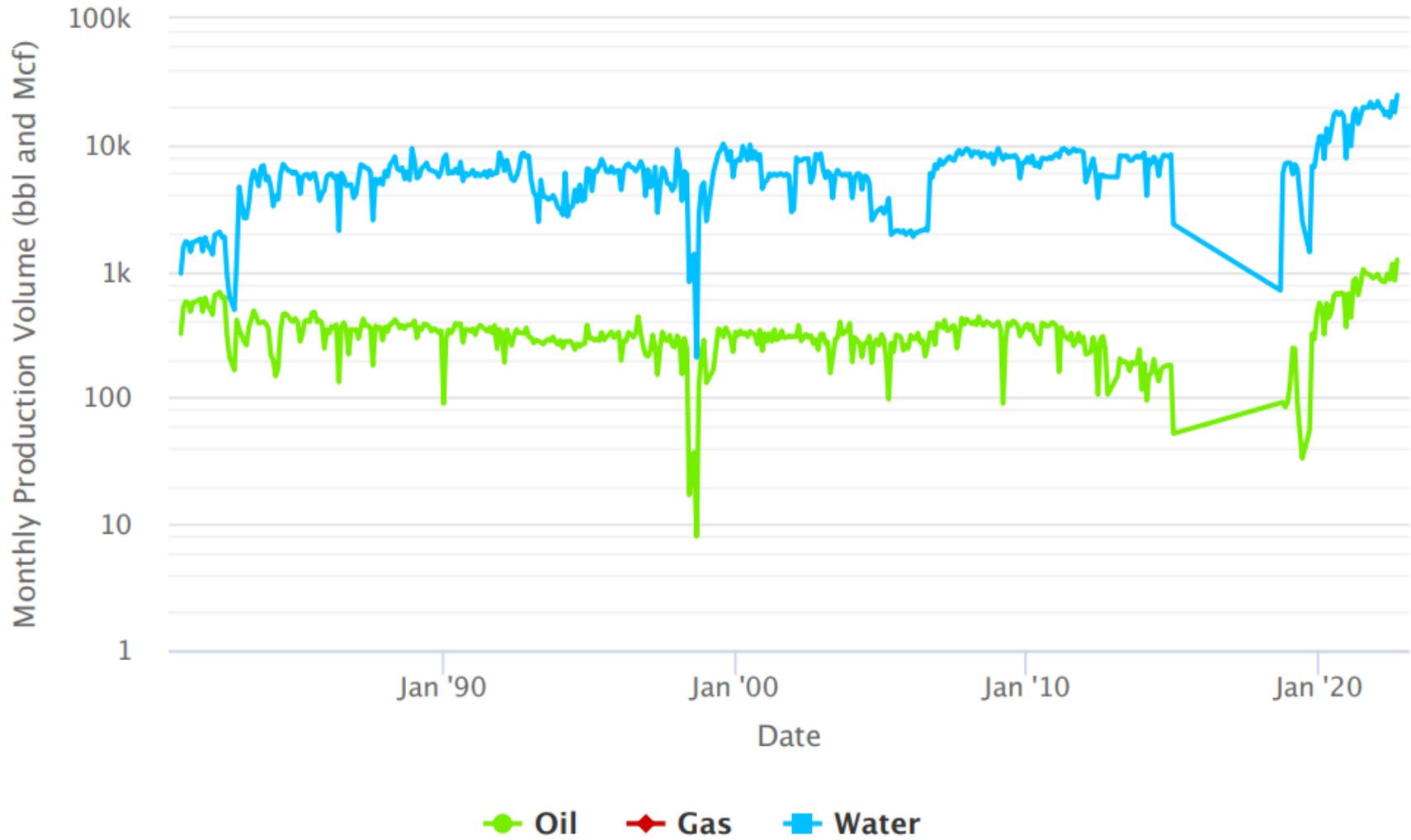
CONVENTIONAL CORE ANALYSIS

SAMP. NO.	DEPTH	PERM. TO HORZ.	AIR (MD) VERTICAL	POR. FLD.	FLUID SATS. OIL	WATER	GR. DNS.	DESCRIPTION
26	4597-98	20		14.3	8.0	29.5		LM FN XLN CALC INF.
27	4598-99	38		14.6	9.3	42.6		LM FN XLN CALC INF.
28	4599 -0	2.6		13.3	11.6	26.0		LM FN XLN VUGS CALC INF.
29	4600 -1	200		15.2	11.2	31.0	CVF	LM FN XLN SCAT VUGS CALC INF.
30	4601 -2	11		11.5	15.2	28.8	CVF	LM FN XLN SCAT VUGS CALC INF.
31	4602 -3	157		21.7	14.0	29.7	CVF	LM FN XLN OOL CALC INF.
32	4603 -4	250		18.3	17.2	27.4	CVF	LM FN XLN VUGS CALC INF.
33	4604 -5	31		17.9	12.8	28.8	CVF	LM FN XLN OOL CALC INF.
34	4605 -6	314		15.8	14.9	27.5	CVF	LM FN XLN OOL CALC INF.
35	4606 -7	61		18.1	15.5	35.2	CVF	LM FN XLN CALC INF.
36	4607 -8	93		15.2	17.4	32.4		LM FN XLN CALC INF.
	4608-4612							NO ANALYSIS LS
37	4612-13	24		10.6	13.1	26.1	CVF	LM FN XLN CALC INF.
38	4613-14	6.5		7.0	3.0	62.7	CVF	LM V/FN XLN CALC INF.
39	4614-15	113		9.1	2.3	51.9	CVF	LM V/FN XLN CALC INF.
40	4615-16	41		8.9	1.1	43.2	CVF	LM V/FN XLN CALC INF.
	4616-4623							NO ANALYSIS LS
41	4623-24	0.03		6.7	7.7	33.8	CVF	LM V/FN XLN CALC INF.
42	4624-25	2.8		10.9	16.3	29.0	CVF	LM V/FN XLN SUC CALC INF.

CVF CLOSED VERTICAL FRACTURE

- Standard conventional approach "Pop the Top"
- Cobra Oil & Gas ROZ approach (full yellow section)
- Rock data, petrophysical data, mudlog data, & production data support a Type II ROZ.

Monthly Production





Type II ROZ Results (Mission Canyon – Renville County, ND)

- After completing the full section of the productive Mission Canyon bed, oil cut increased with increased takeaway from increased reservoir deliverability.
- Cobra Oil & Gas deems this a method of reservoir depressurization.
- Like the San Andres ROZ plays of the Permian Basin, Cobra Oil & Gas believes the Mission Canyon ROZ potential could cover large areas of the Williston Basin.

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Type II/III ROZ

- Standard conventional approach “Pop the Top”
- Unconventional approach to Type II/III ROZ example.
- Rock data, petrophysical data & mudlog data support a Type III ROZ over a wide range of the Williston Basin.

Sample Number	Depth (feet)	Permeability	Porosity (%)	Saturation		Grain Density (gm/cc)	Lithology
		Horz (md)		Oil (%)	H2O (%)		
19	9186.0-87.0	7.0	14.0	24.2	26.0	2.79	Dol,mx1,sl/lm
20	9187.0-88.0	21	17.5	38.8	21.3	2.81	Dol,mx1,sl/lm
21	9188.0-89.0	9.6	14.8	36.3	22.4	2.82	Dol,mx1,sl/lm
22	9189.0-90.0	3.2	11.9	37.6	25.6	2.78	Dol,mx1,sl
23	9190.0-91.0	0.04	4.3	10.8	18.4	2.78	Dol,mx1,sl
24	9191.0-92.0	24	15.6	63.9	21.3	2.83	Dol,mx1
25	9192.0-93.0	11	14.4	30.2	17.0	2.84	Dol,mx1
26	9193.0-94.0	0.14	6.5	5.7	32.1	2.79	Ls,mx1,dol
27	9194.0-95.0	0.40	4.5	21.6	39.6	2.81	Ls,mx1,dol
28	9195.0-96.0	13	13.0	48.4	30.5	2.81	Dol,mx1
29	9196.0-97.0	33	18.6	41.8	24.1	2.83	Dol,mx1
30	9197.0-98.0	20	16.5	53.2	14.3	2.82	Dol,mx1
31	9198.0-99.0	5.1	13.2	35.8	19.4	2.81	Dol,mx1,sl/lm
32	9199.0-00.0	2.7	11.6	48.3	24.6	2.79	Dol,mx1,sl/lm
33	9200.0-01.0	4.8	13.0	18.0	9.0	2.76	Dol,mx1,sl/lm
	9201.0 - 9201.5						Not Suitable for Analysis
	9201.5 - 9202.0						Not Recovered
34	9202.0-03.0	2.9	13.8	45.2	39.1	2.85	Dol,f-mx1
35	9203.0-04.0	0.51	10.4	17.9	56.1	2.85	Dol,f-mx1
36	9204.0-05.0	7.5	16.3	34.6	32.6	2.84	Dol,f-mx1
37	9205.0-06.0	7.5	18.5	39.2	43.1	2.84	Dol,f-mx1
38	9206.0-07.0	0.22	16.1	5.2	71.1	2.85	Dol,f-mx1



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Sample Number	Depth (feet)	Permeability	Porosity	Saturation		Grain Density (gm/cc)	Lithology
		Horz (md)	(%)	Oil (%)	H2O (%)		
39	9207.0-08.0	18	15.5	9.4	56.3	2.83	Dol, f-axl
40	9208.0-09.0	0.58	12.9	25.3	40.8	2.84	Dol, f-axl
41	9209.0-10.0	0.44	10.0	19.0	47.1	2.83	Dol, f-axl
42	9210.0-11.0	1.4	13.3	40.6	28.5	2.82	Dol, f-axl
43	9211.0-12.0	0.14	8.4	11.5	56.2	2.82	Dol, f-axl, sl/lms
44	9212.0-13.0	0.01	4.0	9.2	45.9	2.79	Dol, f-axl, sl/lms
45	9213.0-14.0	0.04	8.5	9.9	46.2	2.84	Dol, vf-fxl
46	9214.0-15.0	0.22	11.6	8.3	53.9	2.83	Dol, vf-fxl
47	9215.0-16.0	0.05	8.7	11.7	59.6	2.83	Dol, vf-fxl
48	9216.0-17.0	0.03	7.4	12.2	52.2	2.83	Dol, vf-fxl
49	9217.0-18.0	0.02	6.8	6.2	40.1	2.83	Dol, vf-fxl
50	9218.0-19.0	0.03	9.2	18.0	51.0	2.82	Dol, vf-fxl
51	9219.0-20.0	0.01	9.0	10.2	56.2	2.83	Dol, vf-fxl

Type II/ III ROZ

- Standard conventional approach “Pop the Top”
- Unconventional approach to Type II/III ROZ example.
- Rock data, petrophysical data & mudlog data support a Type III ROZ over a wide range of the Williston Basin.



Type II/III ROZ Metrics (Mission Canyon Fryburg Bed – Renville County, ND)

- In a 1 mile radius from the referenced well \approx 2,600,000 BO & 30,000,000 BW have been produced from 5 wells completed from the interval highlighted in “pink.”
- The entire pore space capacity for 1 square mile of reservoir rock with the average quantities and height of the referenced core in the presentation is \approx 20,000,000 Bbls, if the rock were completely filled with water.
- It is only possible to recover more total liquid than the calculated storage capacity of this rock section by having an increased:
 - I. Average porosity
 - II. Vertical height
 - III. Drainage radius



Type II/III ROZ Outlook (Mission Canyon Fryburg Bed – Renville County, ND)

- Assuming adequate fluid handling and disposal/injection capacity, in order to produce the stranded oil in this ROZ, the entire interval should be completed and depressurized or injected with CO₂.
- Most of the Mission Canyon Fields are not defined by “dry holes” beyond the limits of productive reservoirs, but by the economic limit of commercial production at that point in time.
- Within the State of North Dakota, Mission Canyon Formation ROZ reserves could be comparable to the estimates of Bakken EOR reserves.

Brownfield ROZ vs. Greenfield ROZ

- **Brownfield ROZ** – exists when a section of the ROZ contains the overlying “Oil-Water Contact” and commercially produced by conventional means.
 - CO₂ can be injected into the Brownfield ROZ for EOR purposes.
- **Greenfield ROZ** – No overlying primary production exists. This section has been naturally waterflooded & commercial production from a conventional application is not feasible. The only portion of the ROZ present is below the “Oil-Water Contact.”
 - CO₂ can be sequestered into the Greenfield ROZ, which would yield barrels of oil from offset producers, unable to be recovered by other means.

Needs for Bakken EOR & Madison ROZ Potential

- Available & affordable CO₂.
- Available wells with mechanical integrity.
 - Wells of mechanical integrity within areas of Bakken EOR or Madison ROZ potential should be viewed as resources at a State level, not liabilities.
- Fluid handling systems.



References

1. Melzer, S., (2006) "Stranded Oil in the Residual Zone." U.S. Department of Energy Report, February.
2. Melzer, S., Trentham, R., (2016) "San Andres Formation Residual Oil Zones and Their Relationships to the Horizontal Carbonate Play On the Northern Shelf." Society of Independent Professional Earth Scientists, April.
3. Burton-Kelly, M., Dotzenrod, N., Feole, I., Peck, W., He, J., Butler, S., Kurz, M., Kurz, B., Smith, S., Gorecki, C., Energy & Environmental Research Center, (2018) "Identification of Residual Oil Zones in the Williston and Powder River Basins" U.S. Department of Energy, March.



Thank You!

I will gladly answer any questions for further discussion.