Maximizing Production from Residual Oil Zones in Western North Dakota

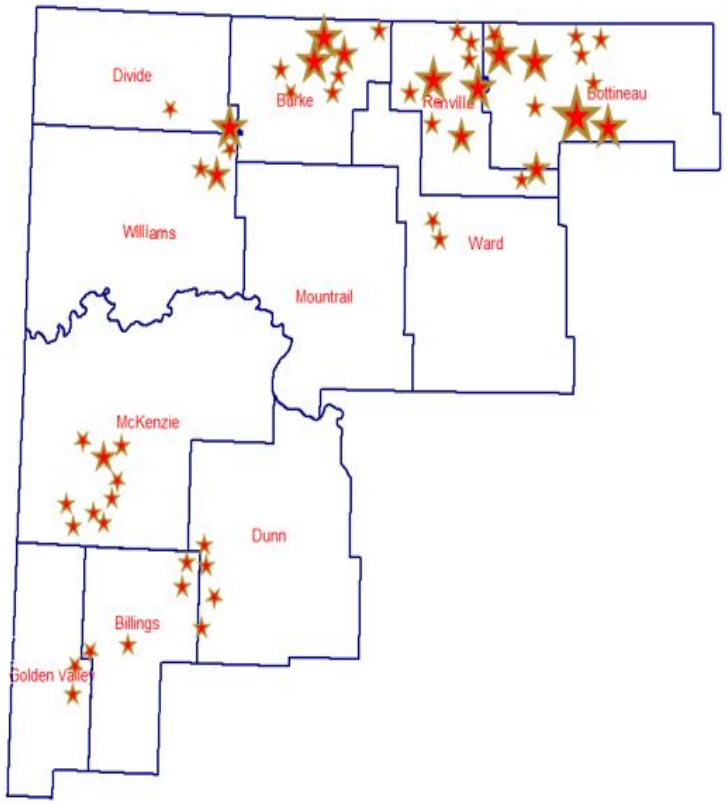
COBRA OIL & GAS CORPORATION

Testimonial Presentation of
Kyle Gardner

North Dakota Oil & Gas
Research Program

July 20, 2023

Cobra Oil & Gas Corporation



Madison Formation Fun Facts

- Conventional carbonate reservoir.
- Contains reservoir quality rock throughout the basin.
- Can source its own hydrocarbon.
- Has produced >1,000,000,000 BO.
- Has been identified as a Residual Oil Zone (ROZ) formation via academic research and empirical production data.
- Full Madison stratigraphic section has been penetrated in ALL Bakken/Three Forks wells.

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.

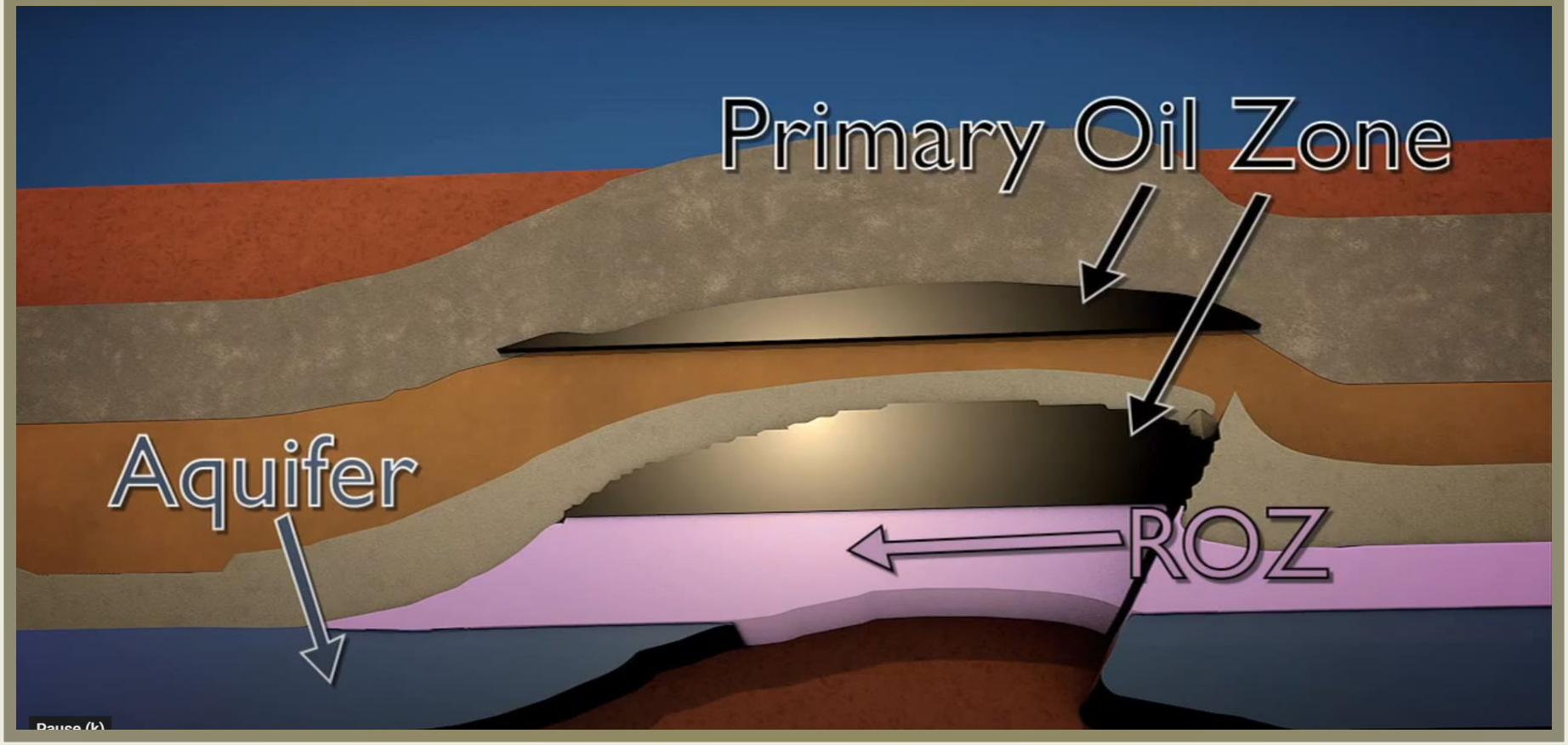
- **TYPE III** – Similar to Type I but the static hydrocarbon accumulation undergoes a tilt due to ground water flows within the reservoirs.

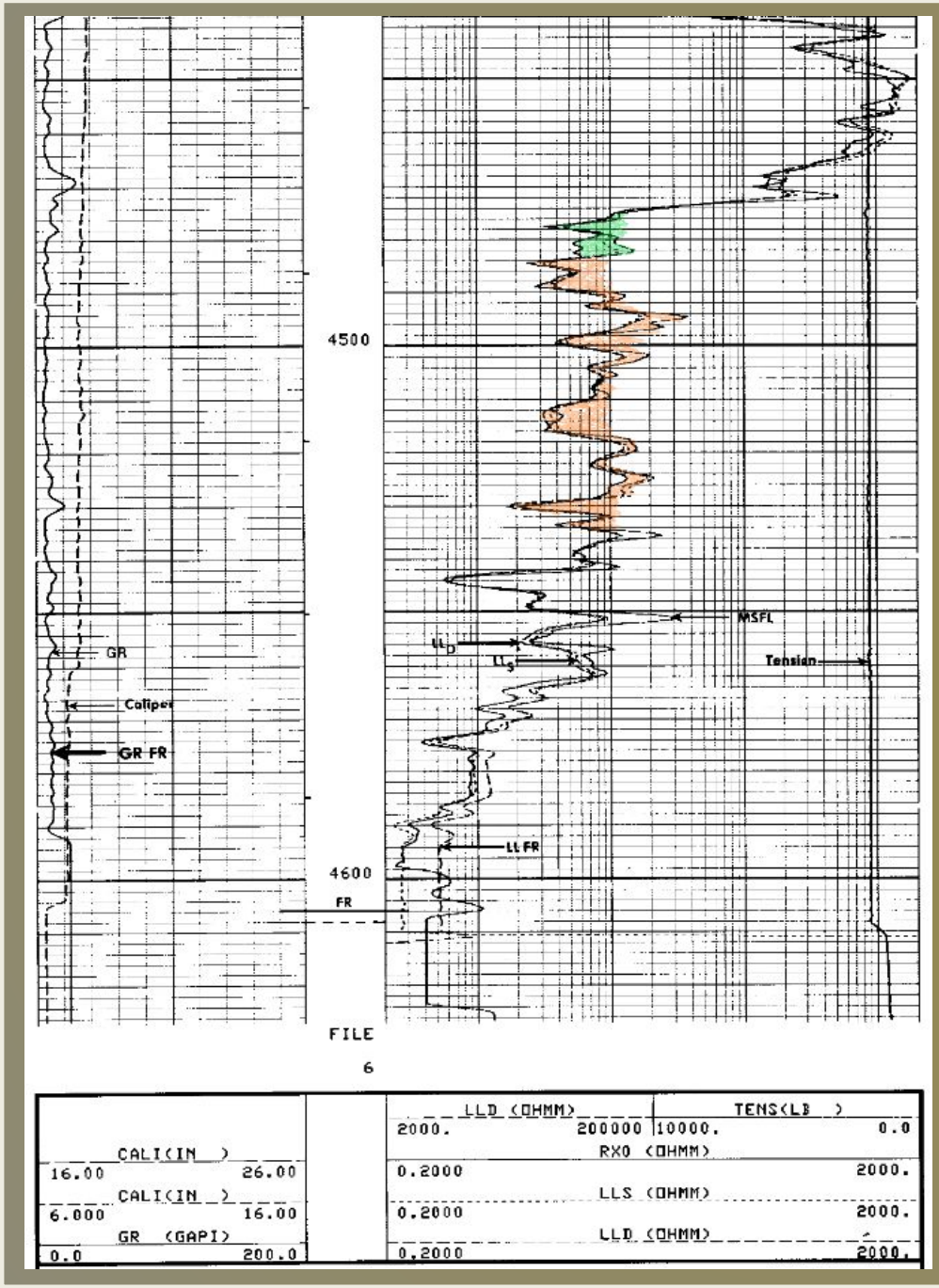
Methods to Exploit the ROZ

- CO_2 Injection into the ROZ allows the CO_2 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.

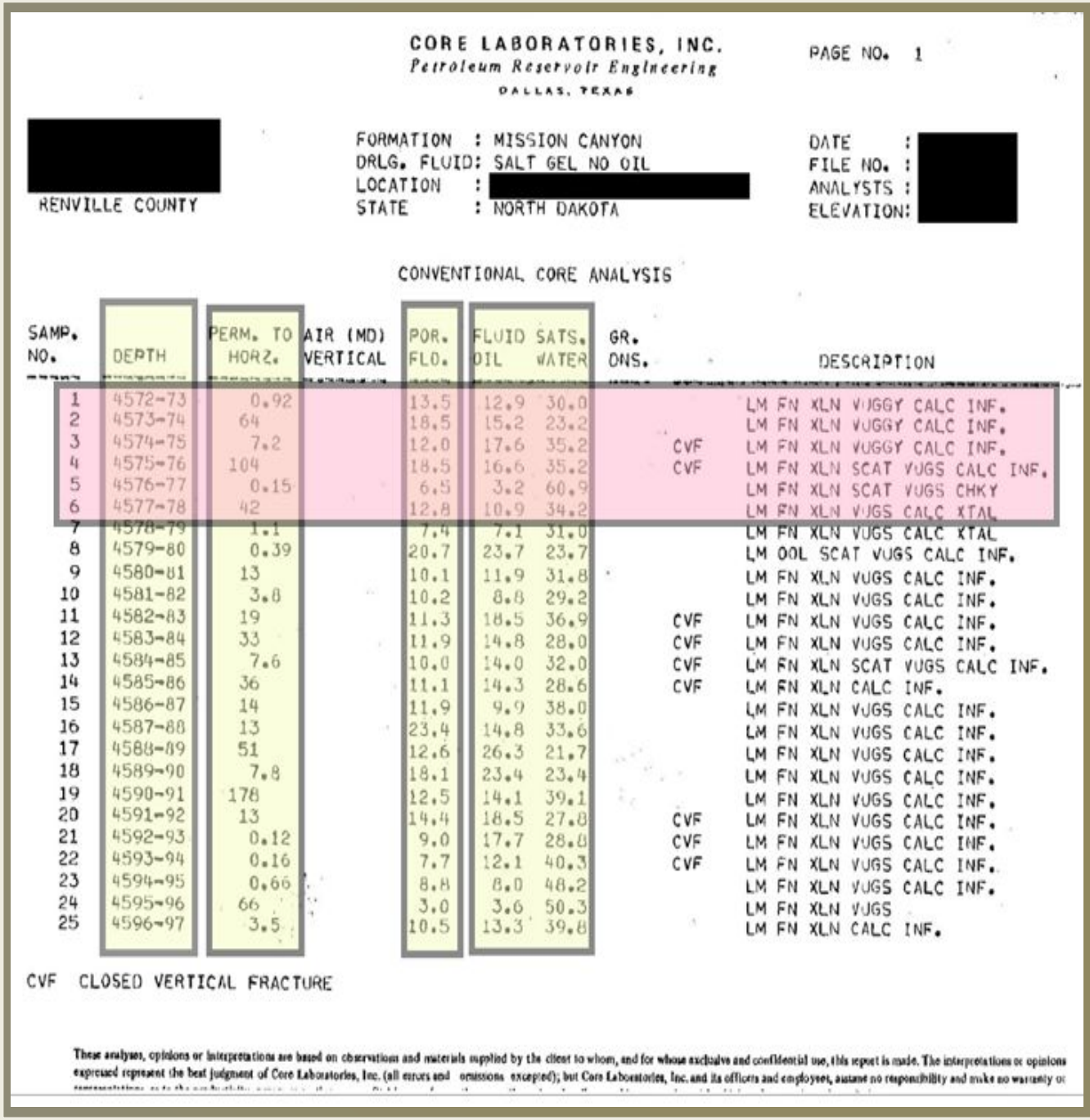
Type II ROZ





Type II ROZ

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



CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

PAGE NO. 1

[redacted]
RENVILLE COUNTY

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

DATE :
FILE NO. : [redacted]
ANALYSTS :
ELEVATION:

CONVENTIONAL CORE ANALYSIS

SAMP. NO.	DEPTH	PERM. TO AIR (MD) HOR2.	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.

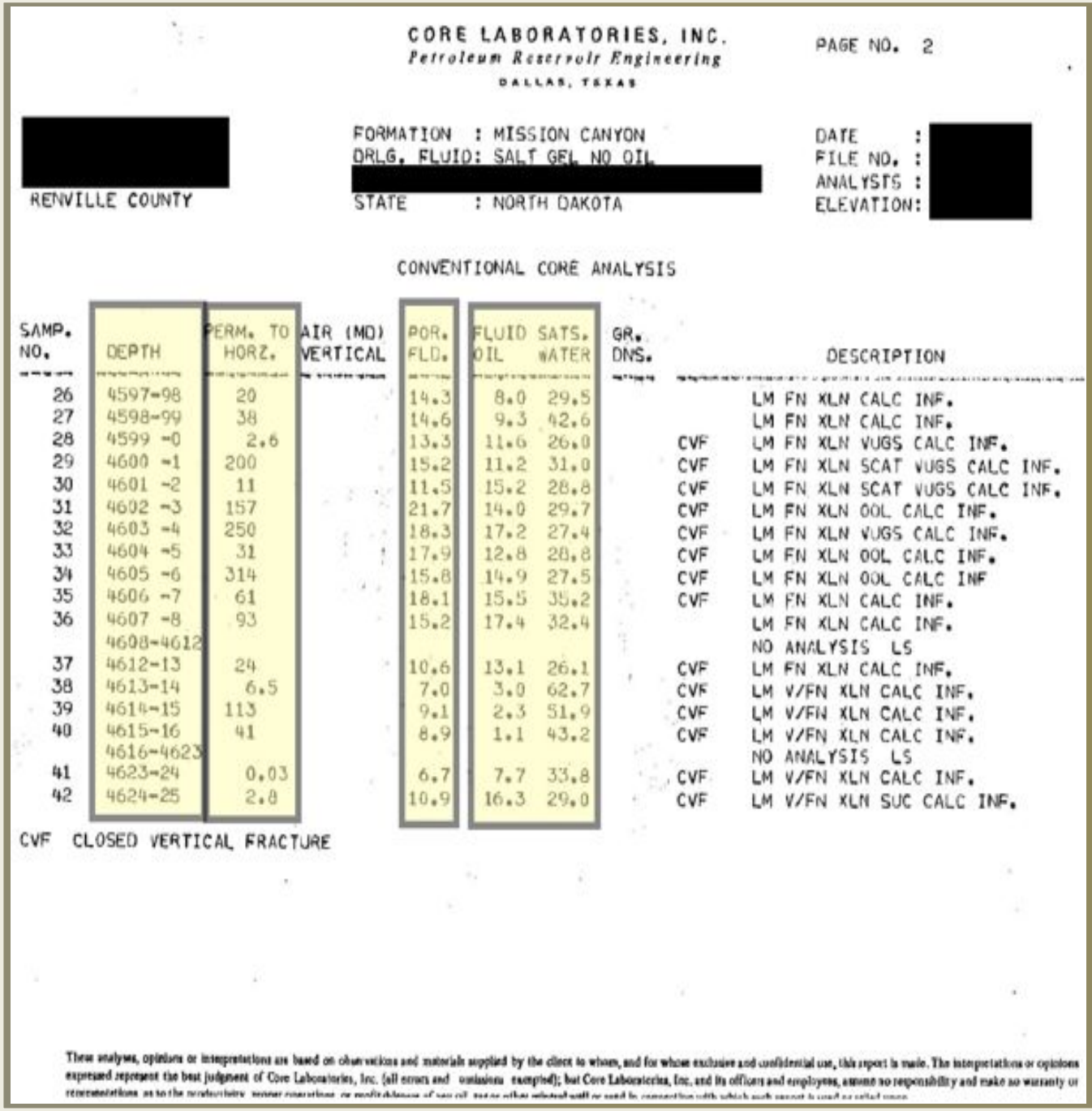
CVF CLOSED VERTICAL FRACTURE

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

COBRA OIL & GAS CORPORATION

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.



CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

PAGE NO. 2

[redacted]
RENVILLE COUNTY

FORMATION : MISSION CANYON
DRLG. FLUID: SALT GEL NO OIL
[redacted]
STATE : NORTH DAKOTA

DATE :
FILE NO. :
ANALYSTS :
ELEVATION: [redacted]

CONVENTIONAL CORE ANALYSIS

SAMP. NO.	DEPTH	PERM. TO AIR (MD) HORZ.	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	CVF	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

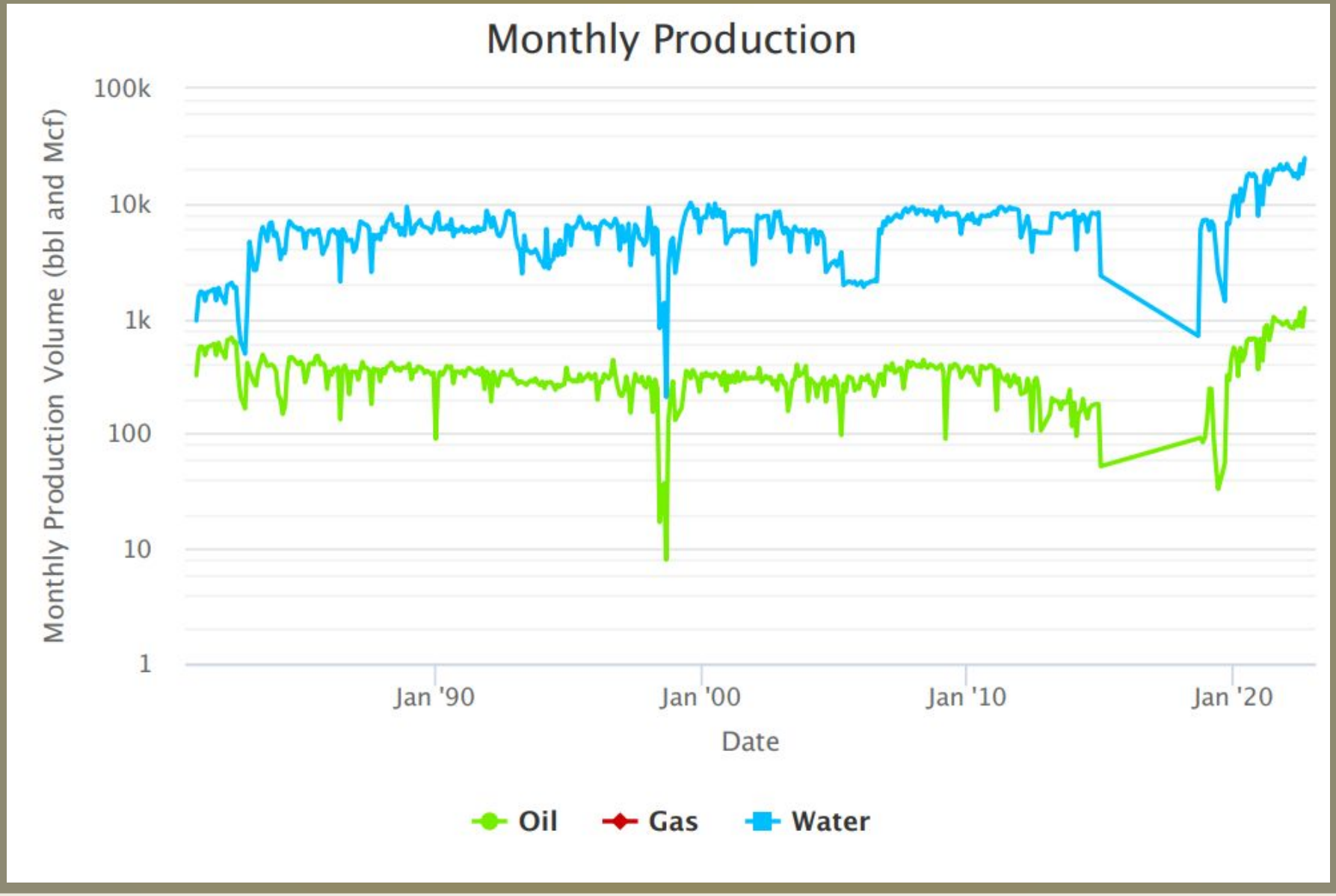
These analyses, opinions or interpretations are based on observations and materials supplied by the client to whom, and for whose exclusive and confidential use, this report is made. The interpretations or opinions expressed represent the best judgment of Core Laboratories, Inc. (all errors and omissions excepted); but Core Laboratories, Inc. and its officers and employees, assume no responsibility and make no warranty or representations as to the productivity, proper operations, or profitableness of any oil, gas or other mineral well or sand in connection with which such report is used or relied upon.

COBRA OIL & GAS CORPORATION

Type II ROZ

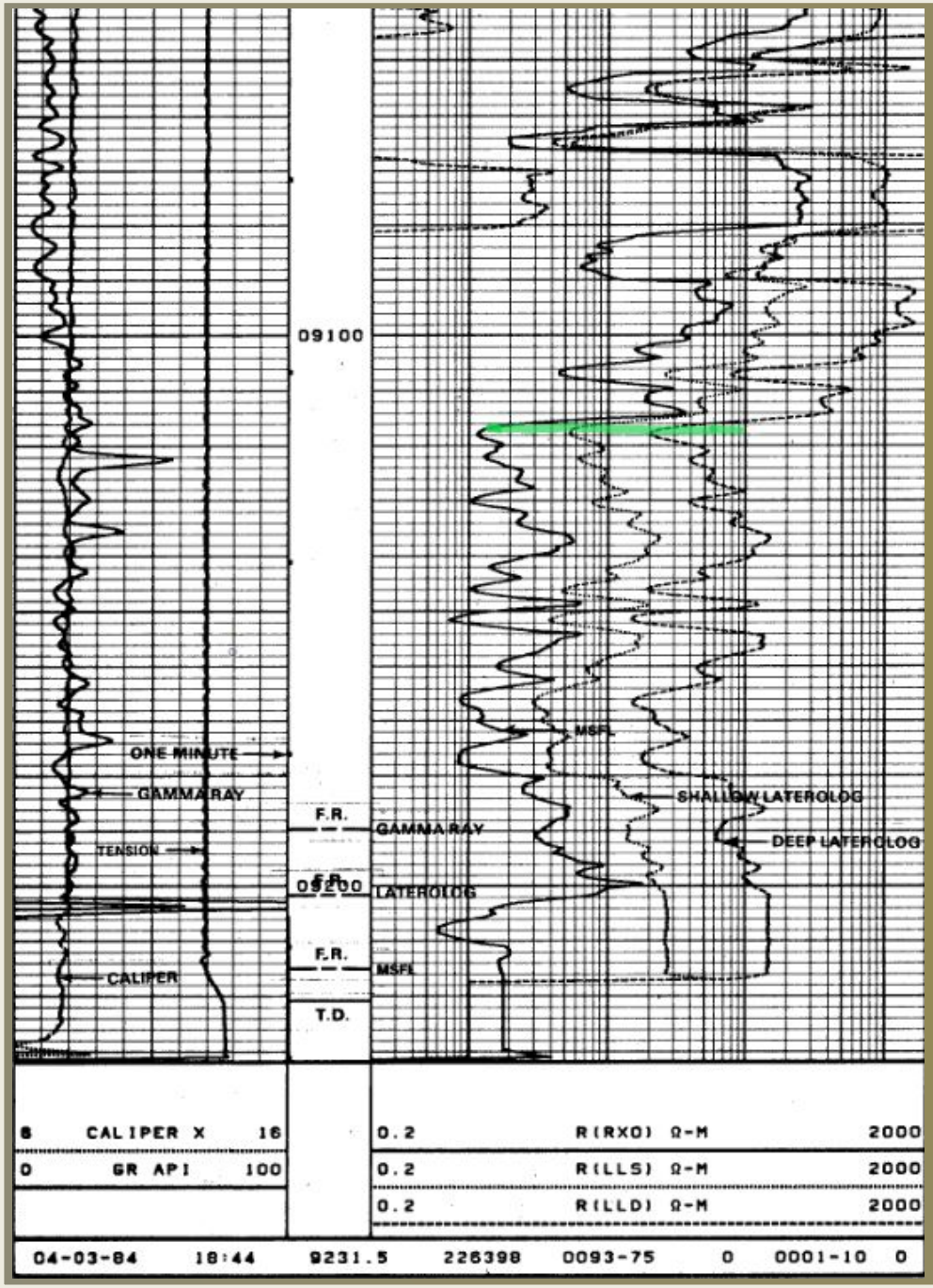
- Standard conventional approach “Pop the Top”
- Cobra Oil & Gas ROZ approach (full yellow section)
- Rock data, petrophysical data, mudlog data, & production data support a Type II ROZ.

COBRA
OIL & GAS CORPORATION



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

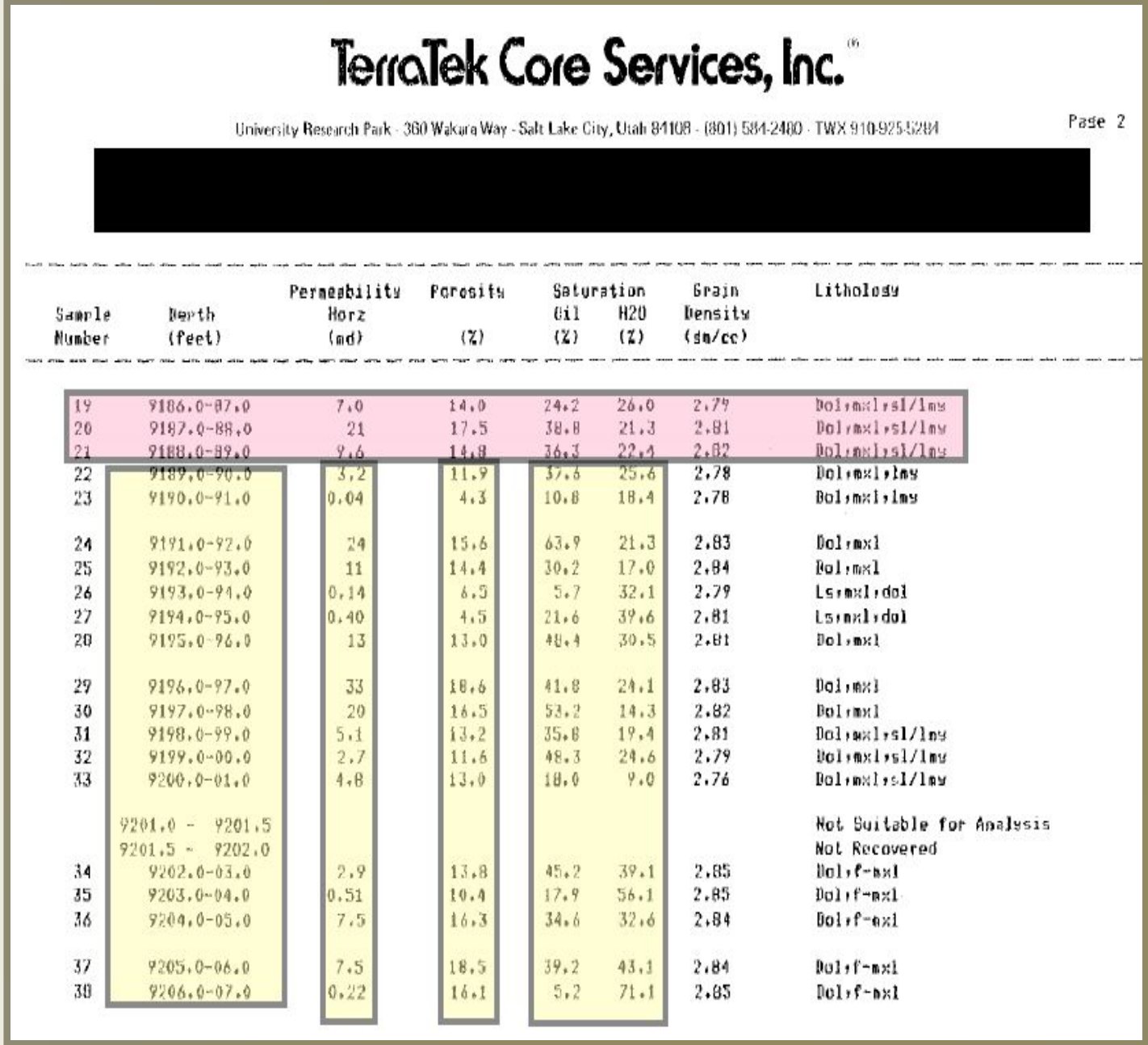
- After completing the full section of the productive Mission Canyon bed, oil cut increased with increased takeaway from increased reservoir deliverability.
- Cobra Oil & Gas deems this a method of reservoir depressurization.
- Like the San Andres ROZ plays of the Permian Basin, Cobra Oil & Gas believes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



COBRA OIL & GAS CORPORATION

Type III ROZ

- Standard conventional approach "Pop the Top"
- Unconventional approach to Type III ROZ example.
- Rock data, petrophysical data & mudlog data support a Type III ROZ over a wide range of the Williston Basin.
- Large section and high deliverability of fluid makes this ROZ formation more attractive for CO2 injection.



TerraTek Core Services, Inc.

University Research Park · 360 Wakara Way · Salt Lake City, Utah 84108 · (801) 584-2400 · TWX 910-925-5284

Page 2

[redacted]

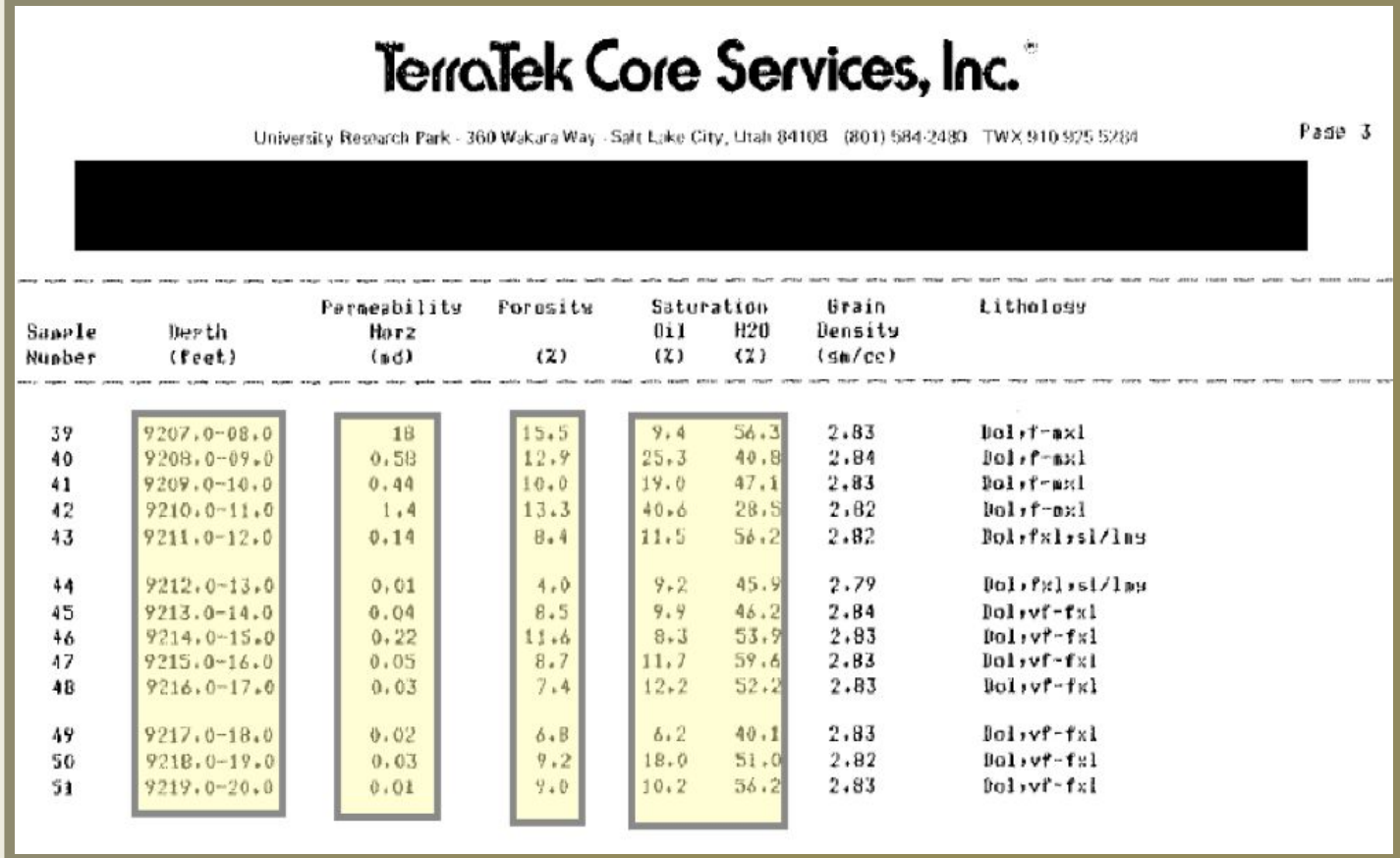
Sample Number	Depth (feet)	Permeability Horz (md)	Porosity (%)	Saturation Oil (%)	Saturation H2O (%)	Grain Density (gm/cc)	Lithology
19	9186.0-87.0	7.0	14.0	24.2	26.0	2.79	Dol;mxl;sl/lmy
20	9187.0-88.0	21	17.5	38.8	21.3	2.81	Dol;mxl;sl/lmy
21	9188.0-89.0	9.6	14.8	36.3	22.4	2.82	Dol;mxl;sl/lmy
22	9189.0-90.0	3.2	11.9	37.6	25.6	2.78	Dol;mxl;lmy
23	9190.0-91.0	0.04	4.3	10.8	18.4	2.78	Dol;mxl;lmy
24	9191.0-92.0	24	15.6	63.9	21.3	2.83	Dol;mxl
25	9192.0-93.0	11	14.4	30.2	17.0	2.84	Dol;mxl
26	9193.0-94.0	0.14	6.5	5.7	32.1	2.79	Ls;mxl;dol
27	9194.0-95.0	0.40	4.5	21.6	39.6	2.81	Ls;mxl;dol
28	9195.0-96.0	13	13.0	48.4	30.5	2.81	Dol;mxl
29	9196.0-97.0	33	18.6	41.8	24.1	2.83	Dol;mxl
30	9197.0-98.0	20	16.5	53.2	14.3	2.82	Dol;mxl
31	9198.0-99.0	5.1	13.2	35.8	19.4	2.81	Dol;mxl;sl/lmy
32	9199.0-00.0	2.7	11.6	48.3	24.6	2.79	Dol;mxl;sl/lmy
33	9200.0-01.0	4.8	13.0	18.0	9.0	2.76	Dol;mxl;sl/lmy
	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-mxl
35	9203.0-04.0	0.51	10.4	17.9	56.1	2.85	Dol;f-mxl
36	9204.0-05.0	7.5	16.3	34.6	32.6	2.84	Dol;f-mxl
37	9205.0-06.0	7.5	18.5	39.2	43.1	2.84	Dol;f-mxl
38	9206.0-07.0	0.22	16.1	5.2	71.1	2.85	Dol;f-mxl

COBRA OIL & GAS CORPORATION

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



TerraTek Core Services, Inc.

University Research Park · 360 Wakara Way · Salt Lake City, Utah 84108 (801) 584-2480 TWX 910 925 5288

Page 3

[redacted]

Sample Number	Depth (Feet)	Permeability Horz (md)	Porosity (%)	Saturation Oil (%)	Saturation H2O (%)	Grain Density (gm/cc)	Lithology
39	9207.0-08.0	18	15.5	9.4	56.3	2.83	Dol,f-mxl
40	9208.0-09.0	0.58	12.9	25.3	40.8	2.84	Dol,f-mxl
41	9209.0-10.0	0.44	10.0	19.0	47.1	2.83	Dol,f-mxl
42	9210.0-11.0	1.4	13.3	40.6	28.5	2.82	Dol,f-mxl
43	9211.0-12.0	0.14	8.4	11.5	56.2	2.82	Dol,fxl,sl/lms
44	9212.0-13.0	0.01	4.0	9.2	45.9	2.79	Dol,fxl,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	18.9	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

- 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.

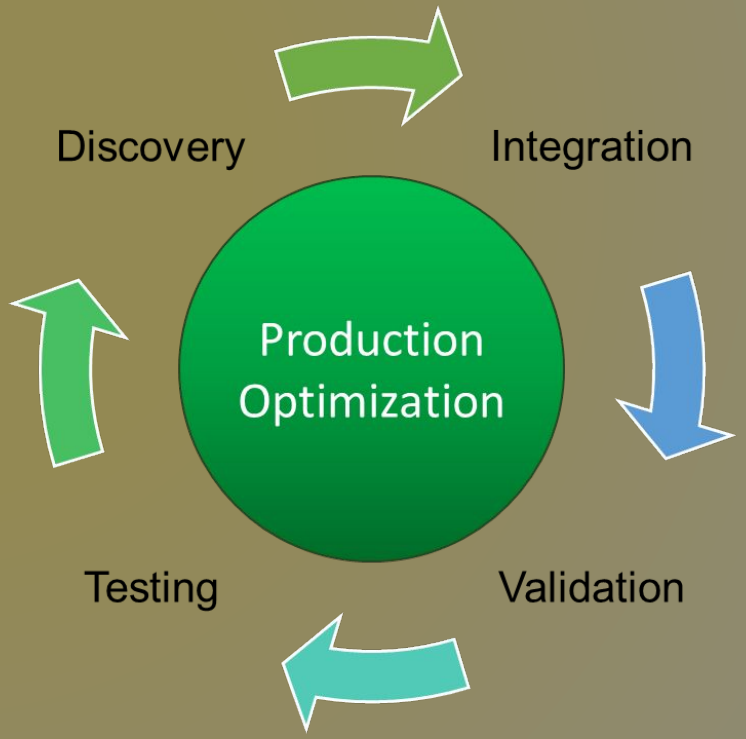
Type II/III ROZ Outlook (Mission Canyon Fryburg Bed – Billings County, ND)

- 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.

EERC Scope of Work

Investigate strategies to maximize oil recovery

- Data driven model investigation
- Production history and well test validation
- Digital hypothesis testing with partnered field testing and data collection
- Resulting in operational and completion strategies for optimization

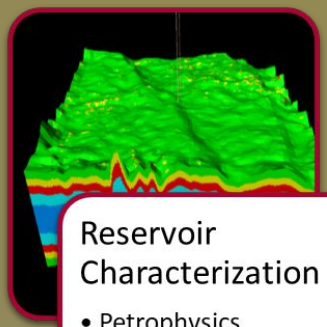


EERC Scope of Work

Methodology

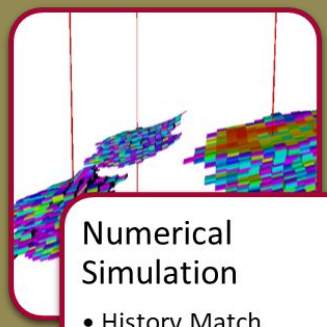
Data Assembly

- Core workshop
- Legacy data
- Find knowledge gaps



Reservoir Characterization

- Petrophysics
- Statistics
- Modeling
- Uncertainty Analysis



Numerical Simulation

- History Match
- Sensitivity Analysis
- Production Optimization

Field Testing

- Well, fluid, and core testing
- Recompletion
- Stimulation

EERC Scope of Work

- Data Assembly (Task 1)
  - Procure & audit legacy & proprietary data for analysis
  - Knowledge gap analysis
- Reservoir Characterization (Task 2)
  - Creation of simulation ready, data-driven models for hypothesis testing & subsurface prediction
  - Data collection recommendations
- Numerical Simulation (Task 3)
  - Validation of reservoir models, development strategy testing, & methods recommendation for field testing
  - Model based optimization strategy testing
- Project Management
  - Facilitation & coordination for project schedule & budget
  - Deliverable tracking & compliance

Cobra Scope of Work

- Data Collecting & Field Testing (Task 4)
  - Provide empirically derived database of engineering, geologic and field results from the project field
  - Plan & execute all field equipment upgrades & downhole operations
  - Provide company personnel for all surface and downhole operations
  - Provide safe & operatable usage of existing facilities and operated wells within the project field

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.