STATE OF NEW MEXICO
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION COMMISSION

APPLICATION OF GOODNIGHT MIDSTREAM PERMIAN LLC FOR APPROVAL OF A SALTWATER DISPOSAL WELL, LEA COUNTY, NEW MEXICO.

COMM. CASE NO. 24123
ORDER No. R-22869-A

APPLICATIONS OF GOODNIGHT MIDSTREAM PERMIAN LLC FOR APPROVAL OF SALTWATER DISPOSAL WELLS, LEA COUNTY, NEW MEXICO.

CASE NOS. 23614-23617

APPLICATION OF GOODNIGHT MIDSTREAM PERMIAN, LLC TO AMEND ORDER NO. R-22026/SWD-2403 TO INCREASE THE APPROVED INJECTION RATE IN ITS ANDRE DAWSON SWD #1, LEA COUNTY, NEW MEXICO.

DIV. CASE NO. 23775

APPLICATIONS OF EMPIRE NEW MEXICO LLC TO REVOKE INJECTION AUTHORITY, LEA COUNTY, NEW MEXICO.

CASE NOS. 24018-24020, 24025

Revised Self-Affirmed Statement of Galen Dillewyn
(Revised Exhibit F)
December 4, 2024

STATE OF NEW MEXICO
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT
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REVISED SELF-AFFIRMED STATEMENT OF GALEN DILLEWYN

My name is Galen Dillewyn. I have been recognized as an expert in subsurface characterization with over 20 years of detailed petrophysical (log) analysis and saturation profile modeling work. I was awarded a Bachelor of Science degree in Chemical Engineering from Texas Tech University in May 2000. Since July 2009, I have worked as an engineer for NUTECH Energy Alliance in Houston, Texas, supporting geological, petrophysical, completion engineering and optimization, and reservoir engineering services. This includes but is not limited to exploration of new fields and plays and development of existing fields.

In the present case, NUTECH analyzed the wireline logs on 10 wells. NUTECH was selected for this work from our technical approach to characterization and that we had previously done 8 wells in the field for XTO, the previous operator of the field. The only information provided by Empire Petroleum was the raw raster images of the data. NUTECH digitized the data for analysis.

The scope of analysis was to determine reservoir quality, porosity, permeability, and saturations. **Table F-1** shows the depths analyzed and the input curves used for each analysis. For the current wells analyzed, only open hole data, data which is obtained at the time of drilling, was used. No

REVISED EXHIBIT F

subsequent data was provided for analysis. In the case of Wells EMSU-142 and EMSU-614 a pulsed neutron tool was run before the analysis was completed and therefore the saturations take into account the more recent data. The pulsed neutron is a tool that can obtain data after the well has had pipe run on it and is cased off.

NUTECH utilizes an eight-step process for analysis as indicated in **Exhibit F-1**. This is known in the industry as our NULOOK analysis. The NULOOK process is designed to remove analyst bias from the analysis process and let the wireline data tell the story of the subsurface.

NUTECH utilized core data available in the area, including core results from the EMSU-679 and R.R. Bell #4 obtained by Chevron. See **Exhibit F-2**.

Step 1 is to validate the data. As with any data provided not all data is of the same quality. Some of the wireline tools are run over decades and the quality of the tools is different, some boreholes are more rugous than others providing issues for the tools that require borehole contact for proper measurement. Also, different tools by different vendors are slightly different and are subject to calibration. NUTECH utilizes downhole calibrations to verify correct tool measurement and consistent tool readings.

Step 2 calculates the volume of shale utilizing multiple indicators such as resistivity, gamma ray, spontaneous potential, and neutron-density difference.

Step 3 is where the irreducible water in the porosity is calculated.

Step 4 using the irreducible porosity from Step 3 the amount of clay can be determined.

Step 5 calculates the lithology in a volumetric basis. A variety of methods depending on the input data available are used. The primary method is the photoelectric effect (PE) curve. If mudlogs are available with descriptions that will also be utilized in a qualitative manner.

Step 6 is where the effective porosity is determined. This result is the same as core measured porosity. Once this is determined the water saturation is also calculated. A modified Simandoux equation is used for water saturation. See **Exhibit F-3**.

Step 7 has permeability calculated. In this instance a Timur Coates free fluid permeability equation is utilized. See **Exhibit F-4**.

Step 8 is the ranking of pay using predetermined thresholds. Every log analyzed has the flag cutoffs and any other parameters used in the analysis listed in the log header.

An example NULOOK interpretation is shown in **Exhibit F-5**. The various curves are described below.

Track 1 – Correlation: This is the original log data and includes SP, Gamma Ray, and Caliper. GR which wraps is shaded with consecutively darker shading with each wrap.

Track 2 – Reservoir Quality Flags:

- A yellow flag appears when the thresholds for Vclay, free fluid, and Kmin are met.
- A dark-cyan flag appears when the free water is less than the set threshold for free water production.
- A black flag appears when the volume of hydrocarbon exceeds a set percentage of effective porosity.
- A green flag appears when the permeability exceeds a Kfair threshold.
- A red flag appears when the permeability exceeds a Kgood threshold.

Note: The permeability threshold values are determined by area, based on client information and experience. A light-cyan flag appears on the right of the track when free water exceeds the set threshold. For intervals where Shale Vision processing is utilized, a purple flag is displayed.

Track 3 – Depth & Miscellaneous: Pay Rating the quality of a zone from 1 to 3. The flags in Track 2 determine the Risk Rating for the identified zones. Three flags are required for a # 3 rated zone. Four flags indicate a # 2 rating. Five flags indicate a # 1 rated zone. **Numbers rated 1 are always recommended for completion**. Zones rated 2 have lesser permeability and/or possible water production, and should be considered for completion. Zones rated 3 have low permeability and/or, are water producing, and are not usually recommended. An interval with fair permeability but low hydrocarbon volume is also rated 3. If perforations are available, they are displayed in this track. In addition, the SHALE FLAG (purple bar) is placed on this track indicating an unconventional zone with Shale Vision Analysis. Lastly, any completion information (such as PERF or DST) present is flagged accordingly.

Track 4 – Miscellaneous: Line Tension, Caliper Flag, TOC and CORTOC are presented in this track.

Track 5 – Lithology**:** PHIE, BVI, BVW as well as Volumetric Carbonate (Lime, Dolomite, Anhydrite), Quartz (Sand, Silica), Heavy (Unconventional), and Clay (Computed & Core Volumes)

Track 6 – Resistivity: Resistivity data provided by the customer (Shallow, Medium, Deep)

Track 7 – Porosity/PE: All porosity data (neutron, density, and sonic) provided by the customer. PE is presented in this track when available. If curves are normalized or edited they are present. Porosity may be presented on a Limestone Matrix or Sandstone Matrix dependent on formation type and preference.

Track 8 – Supplemental Data: MicroLog curves, density correction and Mud Log data when available.

Track 9 – NUSPEC™: This is a variable density display of the textural pore size distribution. The textural geometric mean (dashed curve) overlaid on the VDL is used in permeability calculation. This representation is similar to the bins produced in NMR log analysis.

Track 10 – Pore Size Distribution: The percentages of the various pores in the matrix are displayed. Clay content is brown, silt/small pores are tan, medium pores are yellow, and large pores are red. This representation is similar to the bins produced in NMR log analysis.

Track 11 – Volumetric Analysis: This track contains several curves:

- Water Saturation (Sw) is presented with a scale of 1 to -1, from left to right. With this representation for Sw, the left edge of the track corresponds to 100% water saturation and the center of the track corresponds to 0% water saturation.
- Effective porosity (PHIE) is presented as a red curve in decimal equivalent porosity units. It is scaled from 0.3 to 0 (or 0.6 to 0), and is presented across the full width of the track. Bulk Volume Water (BVW) is presented as a dark-cyan curve.
- Bulk Volume Irreducible (BVI) is the light-gray curve which is enhanced with dark-cyan shading. Free water is indicated with a light-cyan shading between BVW and BVI.
- The Free Fluid Volume is the difference between BVI and PHIE.
- The volume of hydrocarbons is indicated with black shading between PHIE and BVW.

Track 12 – Permeability: Permeability is presented in mili-Darcys with a color spectrum trending from blue to red as permeability increases. The scaling is determined from the values selected for risk ratings and depends on the basin/formation. For intervals where Shale Vision processing is utilized, the color spectrum is set to purple, indicating that SHALEPERM is being calculated in micro-Darcys.

Track 13 – "W" & In-Place: "W" is a varying textural parameter derived from irreducible water (BVI) and effective porosity (PHIE) that takes into account the "m" and "n" values in the saturation equation. ADSGAS (Adsorbed Gas), TOTGAS(Total gas) are presented in this track or Oil-In-Place based on hydrocarbon type or preference

Track 14 – Comments: Petrophysical Analyst comments on an identified zone.

Track 15 – Code: This coding provides a quick reference for the zone ratings. (See description for Track 2.) Intervals with Five flags have a code coloring of red intervals with Four flags have a code coloring of green, which intervals with Three flags have a code coloring of blue.

Track 16 – Fracture Track: Fracture Density Flags.

Track 17– Fracture Track: Gray flag to identify FIV zone and comments.

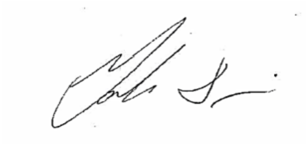
Track 18 – Fracture Track: Cumulative Fracture Height.

The two formations analyzed at Eunice Monument were the Grayburg and the San Andres. An example of the work is in **Exhibit F-6**. For EMSU-673. The Resistivity of the Water (RW) used was 0.4 ohm @ 75 degF. This was balanced in the reservoir above the Grayburg and in the evaporite sequence above that. The San Andres and Grayburg are primarily a dolomitic rock with some interspersed limestones. Both formations show evidence of hydrocarbon saturation. The work done on the 2 wells with pulsed neutron data shows that hydrocarbon sweep has occurred in areas where the waterflood is active but that the sweep has not been 100% effective with intervals of no sweep having occurred. The curves presented on each track are labeled on **Exhibit F-5** and described on pages 3 and 4. Of the 10 wells, 7 covered substantial portions of the San Andres interval and in each of the seven wells there is evidence of hydrocarbon saturation in the San Andres as shown in **Exhibit F-7**. In the Exhibit the water saturation reaches as low as 35% indicating a hydrocarbon saturation of 65%. The oil saturation varies from 65% down to 1% wherever porosity develops in the reservoir.

The San Andres formation generally is made up of three characteristics that are commonly broken into three parts. The upper portion of the reservoir is generally where the porosity develops and has been the conventional target of large fields such as Slaughter field in Cochran County, Texas and Wasson Field in Yoakum County, Texas. Below the porosity section is generally a zone of increasing water saturation that shows both moveable hydrocarbon and moveable water. Below this zone is the third zone known as the residual oil zone, or ROZ. This is an area with extremely high water saturation that some operators such as Steward Energy have been successful in producing hydrocarbon from.

The m and n values were adjusted for this updated analysis with additional discussion in Attachment 1 at the end of this document.

I understand this Self-Affirmed Statement will be used as written testimony in this case. I affirm that my testimony above is true and correct and is made under penalty of perjury under the laws of the State of New Mexico. My testimony is made as of the date next to my electronic signature below.



12/4/2024

____________________________ Date: ____________________________

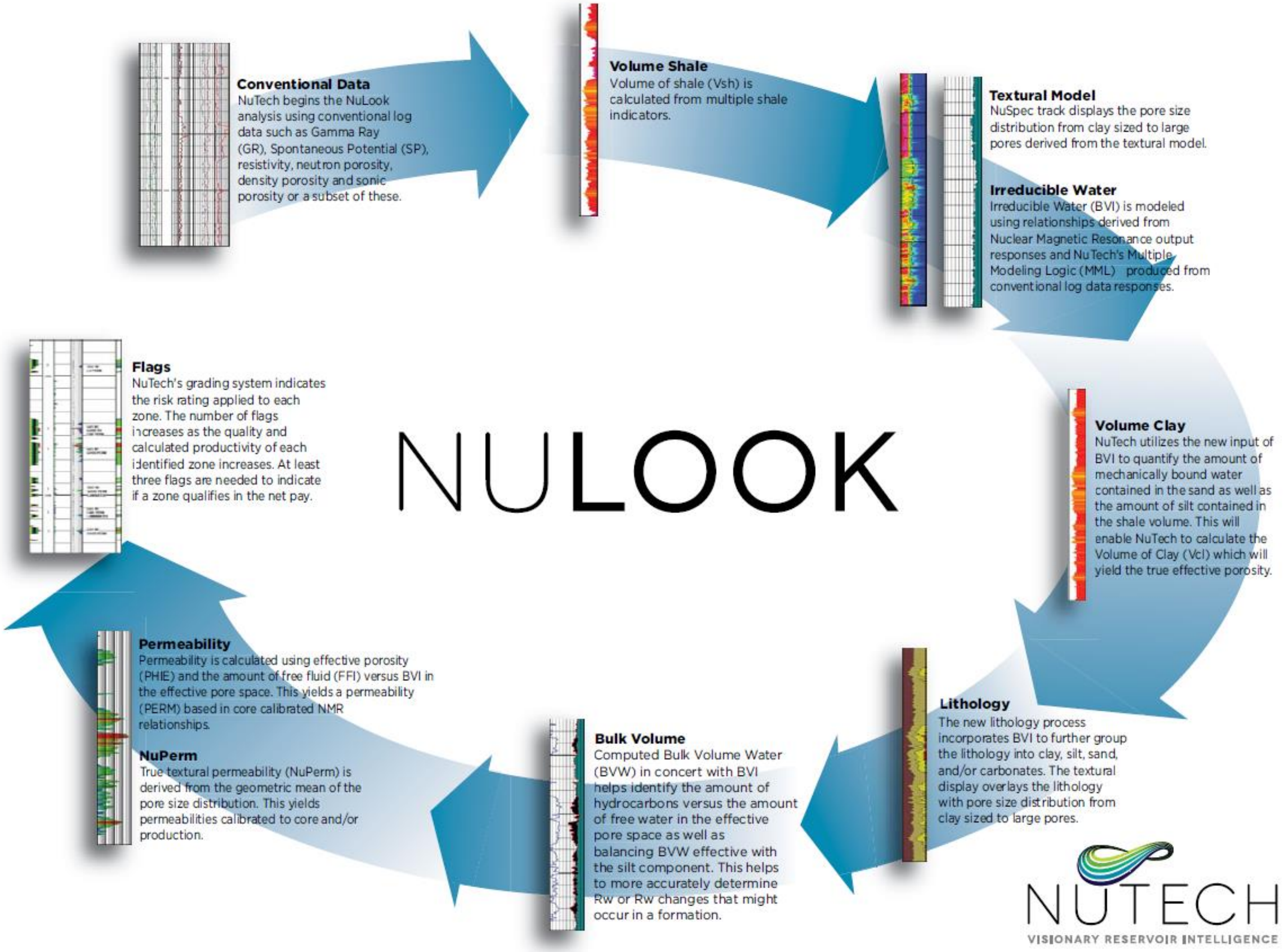
Galen Dillewyn
VP Business Development
NUTECH Energy Alliance

Table F-1

Wellname	API	Field	Top Depth	Bottom Depth	Input Curves
AGU #408	30025372860000	ARROWHEAD	3500.0	4537.0	CALI, DRHO, DTC, GR, PE, LLD, LLS, MSFL, RHOB, TENS
ESMU #713	30025373210000	EUNICE MONUMENT	3182.0	4182.0	CALI, DCAL, DRHO, GR, GRC, PE, LLD, LLS, RHOB, TENS
EMSU #673	30025373200000	EUNICE MONUMENT	3324.0	4324.0	CALI, DCAL, DRHO, GR, GRC, PE, LLD, LLS, MSFL, RHOB, TENS
EMSU #660	30025373190000	EUNICE MONUMENT	3386.0	4386.0	CALI, DCAL, DRHO, GR, GRC, PE, LLD, LLS, RHOB, TENS
EMSU #577	30025373180000	EUNICE MONUMENT	3210.0	4210.0	CALI, DCAL, DRHO, GR, GRC, PE, LLD, LLS, RHOB, TENS
EMSU #658	30025372800000	EUNICE MONUMENT	3315.0	4315.0	CALI, DRHO, GR, PE, LLD, LLS, RHOB, TENS
RYNO SWD #1	30025439010000	JESS BURNER	3685.0	5847.0	DEPT, GR, CALI, MSFL, LLS, LLD, DT, PE, DRHO, DPHI, NPHI, DEPTH, CALI, DRHO, DT, GR, NPHI, PE, DPHI, LLD, LLS, MSFL
EMSU #746	30025373560000	EUNICE MONUMENT SOUTH	3630.0	5368.0	DEPT, PE, GRD, NPOR_LS, CALD, DCOR, RHOB, TENS, LLD, LLS, MGUARD, DEPTH, CALD, DCOR, GRD, LLD, LLS, MGUARD, NPOR_LS, PE, RHOB, TENS
EMSU #628	30025372790000	EUNICE MONUMNET; GRAYBURG-ANDRES	3635.0	4546.0	DEPT, PE, GRD, CALD, DCOR, NPOR_LS, RHOB, TENS, MGUARD, LLS, LLD, DEPTH, CALD, GRD, LLD, LLS, MGUARD, NPOR_LS, RHOB, PE, TENS, DCOR
RYNO SWD #1	30025439010000	JESS BURNER	3685.0	5847.0	DEPT, GR, CALI, MSFL, LLS, LLD, DT, PE, DRHO, DPHI, NPHI, DEPTH, CALI, DRHO, DT, GR, NPHI, PE, DPHI, LLD, LLS, MSFL
EMSU #746	30025373560000	EUNICE MONUMENT SOUTH	3630.0	5368.0	DEPT, PE, GRD, NPOR_LS, CALD, DCOR, RHOB, TENS, LLD, LLS, MGUARD, DEPTH, CALD, DCOR, GRD, LLD, LLS, MGUARD, NPOR_LS, PE, RHOB, TENS
EMSU #628	30025372790000	EUNICE MONUMNET; GRAYBURG-ANDRES	3635.0	4546.0	DEPT, PE, GRD, CALD, DCOR, NPOR_LS, RHOB, TENS, MGUARD, LLS, LLD, DEPTH, CALD, GRD, LLD, LLS, MGUARD, NPOR_LS, RHOB, PE, TENS, DCOR
Eunice Monument South Unit 614	30025354530000	EUNICE MONUMENT; GRAYBURG-SAN ANDRES	2980.0	3992.0	DEPT, BSAL, CCLD, CIRF, CIRF_FIL, CIRN, CIRN_FIL, CRFI, CRNI, DCAL, ED, FBAC, GR, GTEM, INFD, IRAT, IRAT_FIL, MWFD, ND, RSCF_RST, RSCN_RST, SBNA_FIL, SFFD, SFND, SIGM, STIT, TENS, TPHI, TSCF, TSCN, WINR_RST, WTEP, WPRE, DEPTH, DPHZ, DT, HCAL, HDRA, HLLD, HLLS, RXOZ, TNPH
Eunice Monument South Unit 142	30025044280001	Eunice Monument; Grayburg-San Andres	2900.0	4040.0	DEPT, CCLC, INFD_FIL, BSAL, SIBF, RSCF, MARC, RSCN, CIRN_FIL, SIGM, TSCN_FIL, CIRF_FIL, TSCF_FIL, IRAT_FIL, TENS, TPHI, GR, WINR, CCLD, WPRE, WTEP

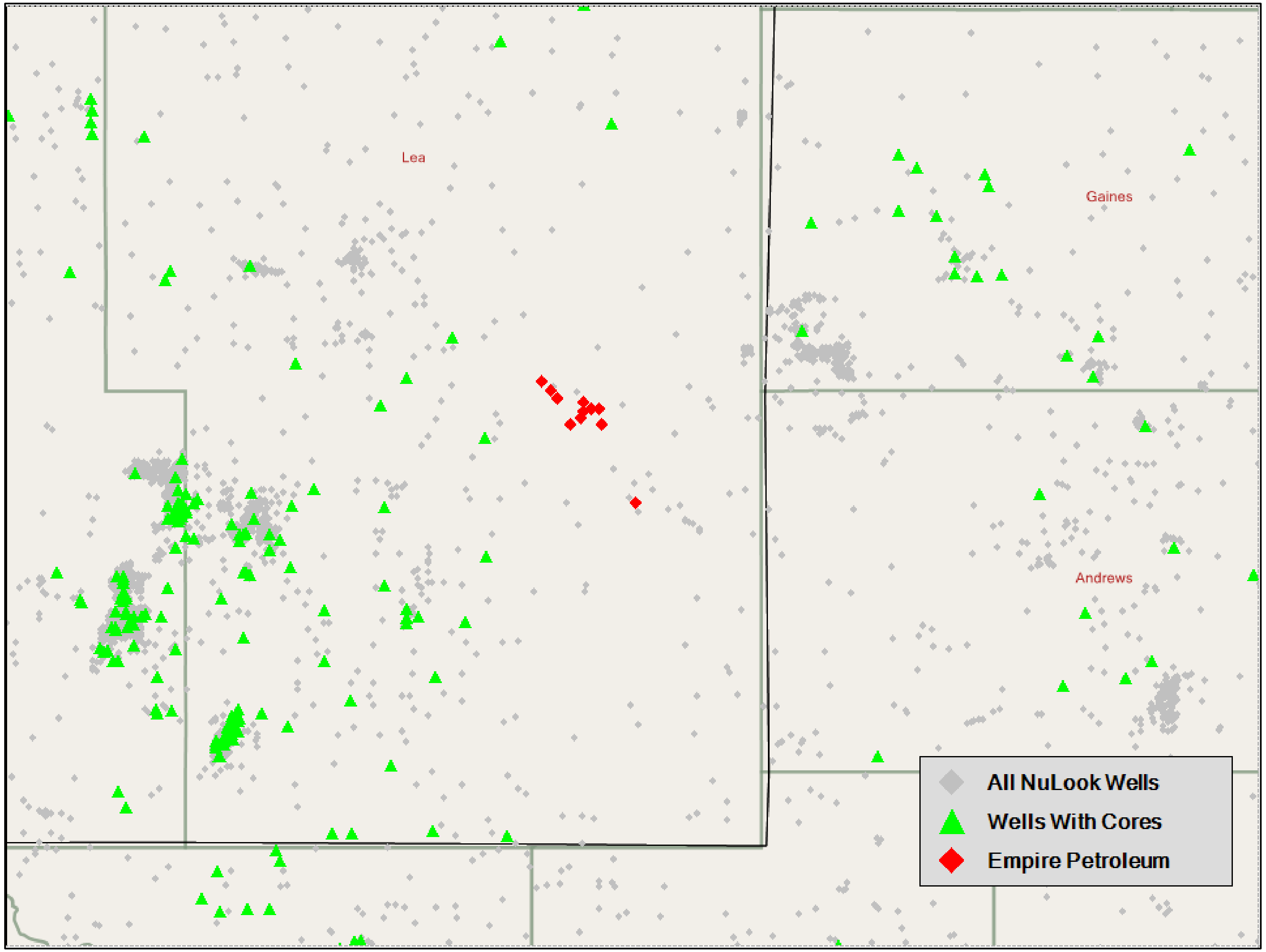
Input data for analysis

Exhibit F-1



NULOOK Process

Exhibit F-2



NUTECH wells analyzed, wells with core, and location of Empire Petroleum's analyzed wells

Exhibit F-3

$$SW \cong \left\{ \left(\frac{a.Rw}{\phi^m} \right) \left(\frac{1}{Rt} - \frac{Vsh}{Rsh} \cdot SW_{\text{guess}} \right) \right\}^{(1/n)}$$

Modified Simandoux equation

Exhibit F-4

$$K = \left(\frac{C \; x \; \phi^{2W}}{W^4 x \left(R_w / R_{tirr} \right)} \right)^2$$

Timur Coates Free Fluid Permeability Equation

Exhibit F-5

NULOOK™ WITH SHALE VISION TRACK DESCRIPTIONS

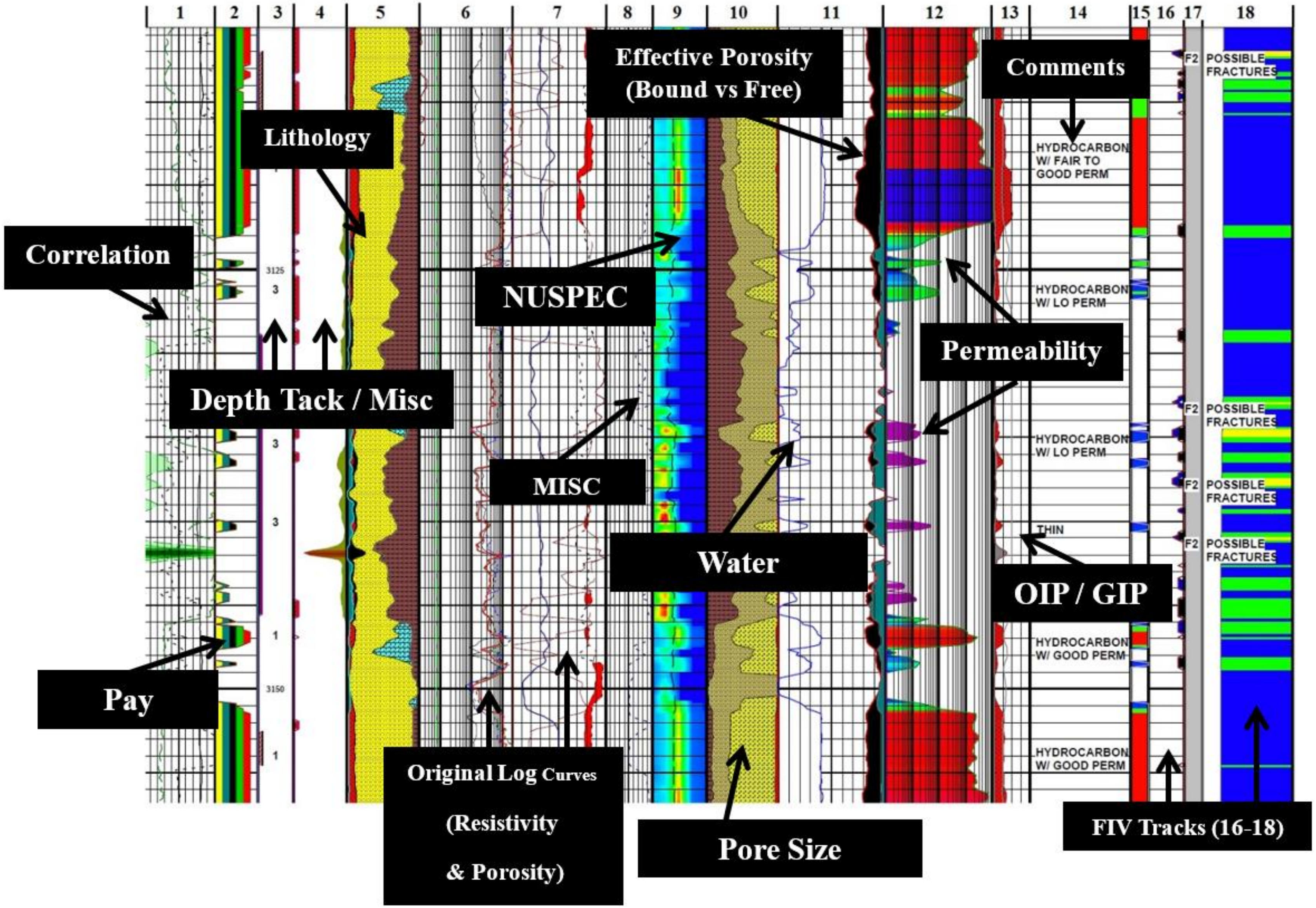
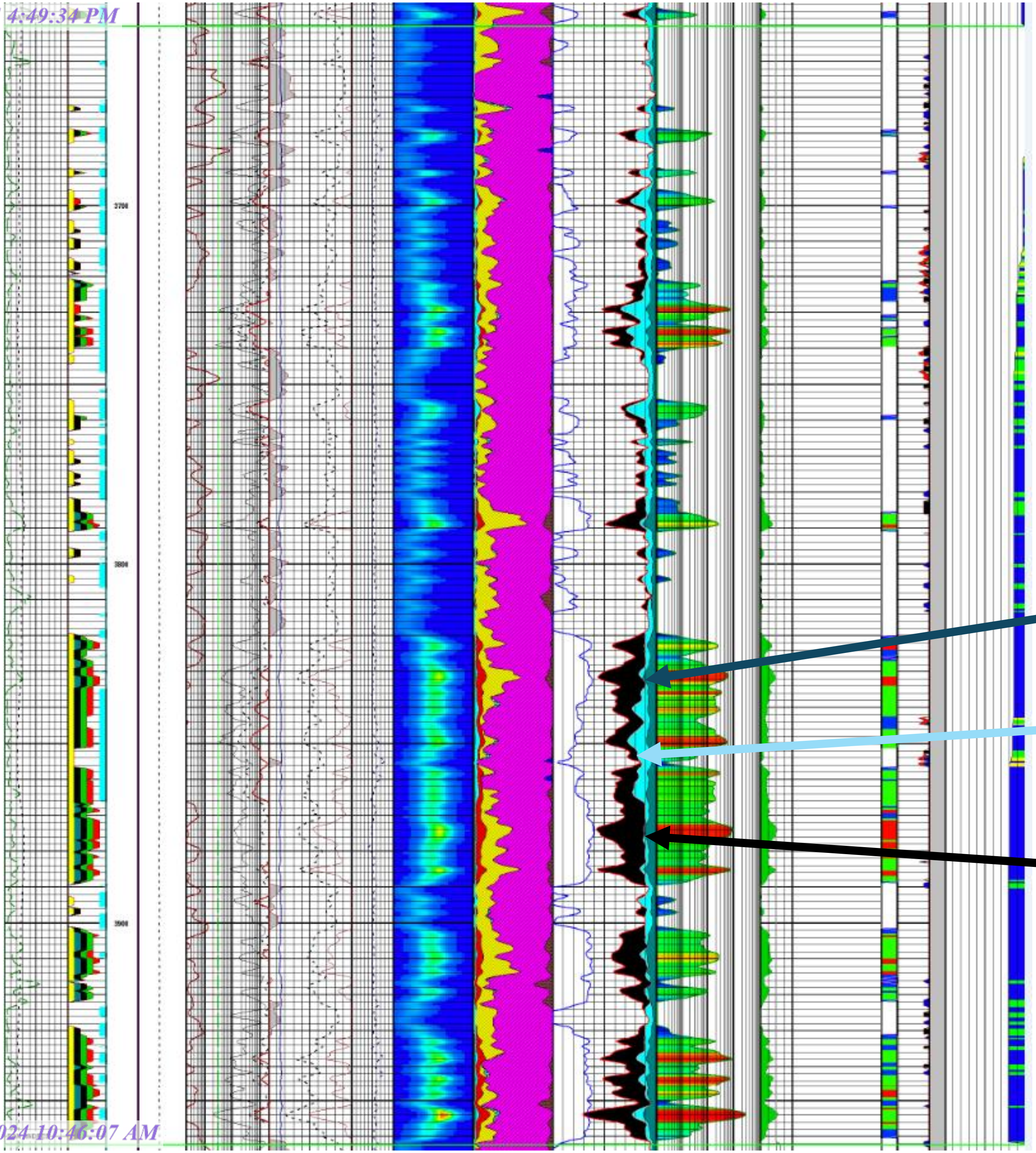


Exhibit F-6



EMSU-673 Grayburg Section

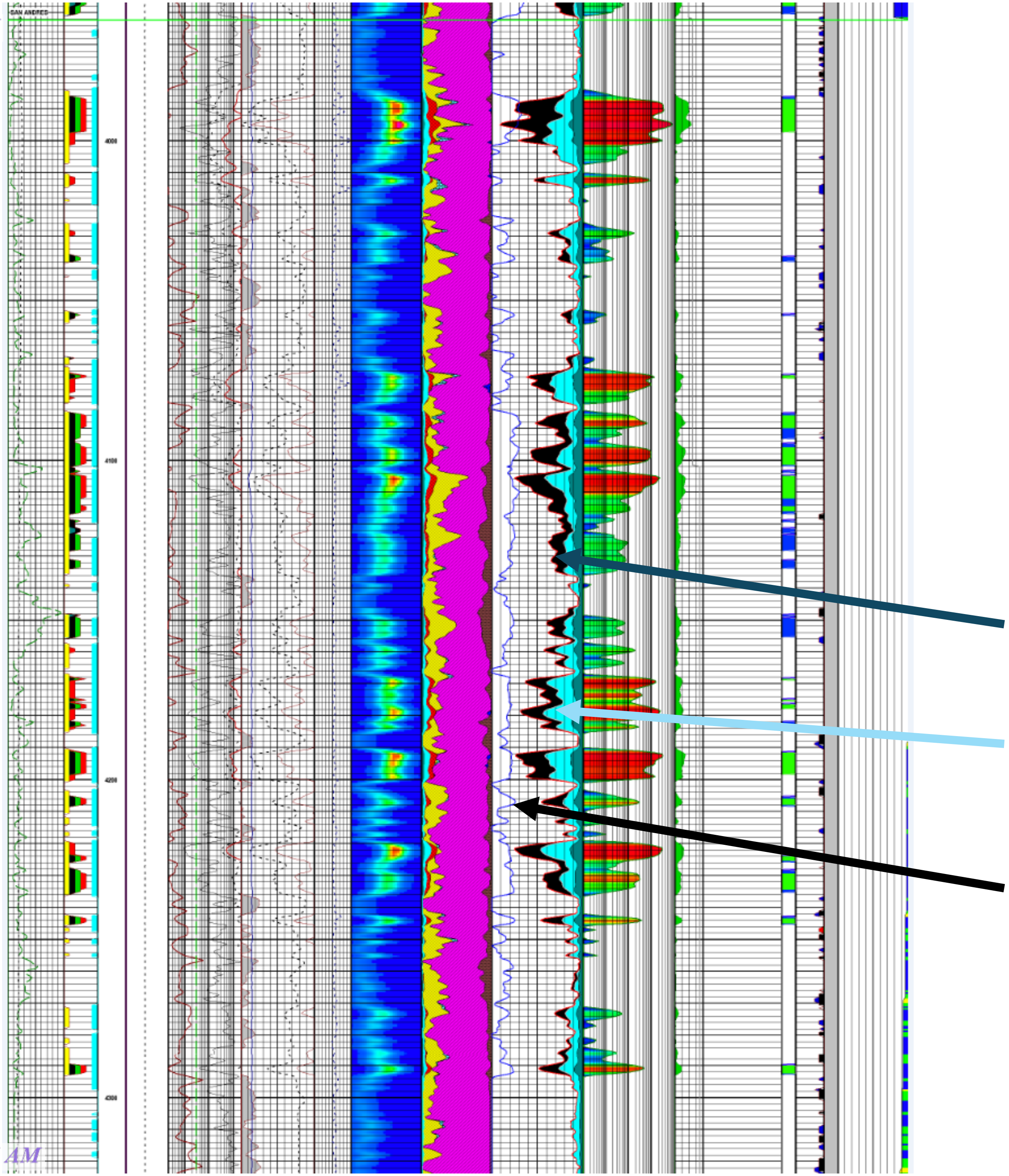
Bound Water

Moveable Water

Oil

Exhibit F-7

EMSU-673 San Andres Section



WATER SATURATION PARAMETER SCENARIOS IN LEA COUNTY

FOR EMPIRE

Prepared for

NUTECH ENERGY ALLIANCE

NUTECH
VISIONARY RESERVOIR INTELLIGENCE

SEPTEMBER 2024

Table of Contents

1. Scope of the Project

The scope of this project is to take m and n values in the study “A Four-County Appraisal of the San Andres ROZ Fairway of the Permian Basin”, apply them to EMSU #679 well (API 3002531009) and provide commentary on implication of the values.

2. Introduction

Water saturation is a portion of the poro rock reservoir volume that is filled with water, and it is generally assumed that the poro volume not filled with water is occupied with hydrocarbon. Determining water saturation was one of the multiple rock properties delivered by Nutech's Nulook to Empire to provide with the best petrophysical solution of the San Andres and Grayburg formations in EMSU #679 well in Lea County. In addition, Nutech also ran 4 more scenarios using 4 sets of m and n to see how they impacted in water saturation estimation. These 4 sets of m and n values were chosen because the study divided Gaines County into 5 partitions (figure 1 taken from study), so the derived water saturation can be tested in different geological characteristics. Although the subject well is not in Gaines County, petrophysical properties are similar in the neighbor Lea County.

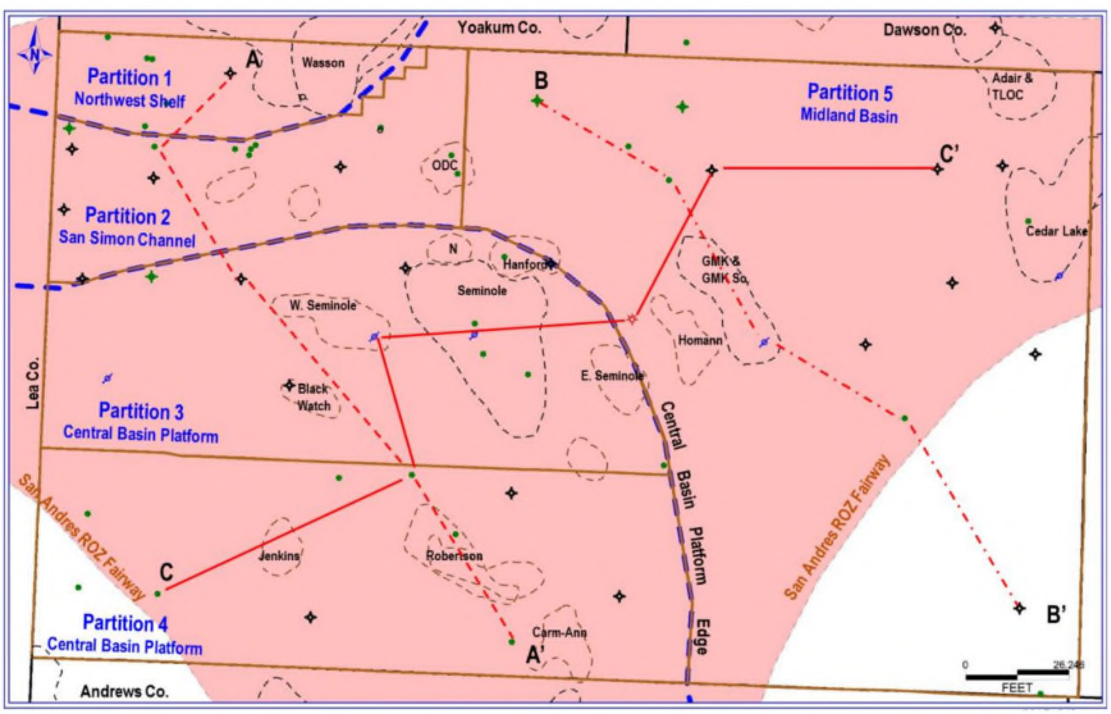


Figure 1 Gaines County: geologic partitions, major oil fields and study well locations

3. The Water Saturation Equation

This section contains topics related to the water saturation established by Archie in 1942.

Archie's Equation and Its Parameters:

- Archie's Equation: The Archie equation relates water saturation to resistivity measurements and rock properties. It's a fundamental tool in the oil and gas industry for assessing reservoir quality.
- Parameters: Saturation Exponent (n): This exponent characterizes the relationship between resistivity and water saturation. It typically varies between 1.8 and 4.0, but a common value is 2.0. Higher n values indicate that water saturation changes more significantly with resistivity variations. Cementation Exponent (m): The m exponent reflects the connectivity of pore spaces within the rock. It's influenced by factors like lithology, pore geometry, and wettability. Generally, m values range from 1.2 to 2.0.

Factors Affecting m and n Values:

- Lithology and Rock Type: Different rock types (e.g., sandstone, limestone, shale) exhibit varying pore structures. Sandstones tend to have higher m values due to well-connected pores, while carbonates (like limestone) may have lower m values because of more complex pore networks.
- Porosity and Pore Geometry: Higher porosity often corresponds to higher m values. Rocks with well-connected, large pores (high porosity) allow better fluid movement, affecting the resistivity response. Irregular pore shapes or tortuous pathways (related to tortuosity factor a) impact both m and n.

- Wettability: Wettability refers to how easily a rock's surface attracts or repels fluids. Water-wet rocks (where water adheres to the surface) tend to have higher m values. Oil-wet rocks (where oil adheres) can lead to lower m values, affecting the resistivity response.
- Formation Water Salinity: The salinity of formation water (reservoir water) influences Archie's parameters. Higher salinity tends to increase m values.
- Permeability and Fluid Distribution: Permeability affects the connectivity of pore spaces. Rocks with high permeability may have different m and n values compared to low-permeability rocks. Fluid distribution (oil, water, gas) within the reservoir also plays a role.

Measurement Techniques:

- Conventional Technique: The classic method involves analyzing well logs and core data. However, it assumes homogeneity and may not be accurate for heterogeneous reservoirs.
- Core Archie Parameter Estimation (CAPE): A more robust approach that considers core measurements and accounts for heterogeneity.
- Three-Dimensional Regression Technique (3D): A method proposed to reduce error percentages in water saturation calculations by directly measuring resistivity in core samples1.

Water Saturation parameters used in the "A Four-County Appraisal of the San Andres ROZ Fairway of the Permian Basin" study.

This study addressed the San Andres Residual Oil Zone (ROZ) "fairway" within the Permian Basin comprising Gaines, Yoakum, Terry and Dawson counties. For the assessment, it was reported the use of m and n values coming from core data. The study also used m and n values per partition within each county based of geological settings. The report assessed the following:

- What is the size and distribution of the in-place San Andres ROZ fairway oil resource favorable for CO_2-enhanced oil recovery (EOR)
- How much of this in-place San Andres ROZ fairway oil resource can be mobilized and technically produced using CO_2 EOR.
- How much CO_2 can be stored by developing the San Andres ROZ fairway resource in this four-county area.
- What portion of the San Andres ROZ fairway resource can be economically developed while providing by-product storage of CO_2.

4. Water Saturation Scenarios

For the water saturation scenarios, all petrophysical parameters remain constant except m and n for EMSU #679 well. M and n values use for analysis were taken as they are from each partition in the study.

Original Analysis

To estimate water saturation, Nutech assumed a=1, m =2, n=2, Rw=0.4 OHMM at 75 F (from produced water) and porosity from multi-mineral model (table 1). Core porosity (CORPOR) versus derived porosity (PHIE) in the volumetric track (figure 2) seemed in good agreement which implies strong correlation for the assumed fluid and rock mineral properties. On the other hand, core permeability to estimated permeability looked scatered due to possible fractured reservoir. The derived water saturation had a good agreement with core water saturation in the lower Grayburg formation with averaged 30% water saturation. However, computed water saturation appeared from 10% to 15% higher from top of San Andres to 4302' probably due to deeper water based mud invasion in the coring process. Although GR, resistiviy, density and neutron, PE, DRHO and Caliper logs do not show any change in mineral and fluid distribution through Grayburg and San Andres formation, core water resistivity from 4302 to bottom depth had averaged values of 90% which is a significant diference compared to derived water saturation of around 60%. Here is a summary of properties given by the original analysis:

Zone	Summaries										
DEPTH FT	GROSSFT	PAYFT	RANK	CLAY DEC	PHIE DEC	SW DEC	NUPERM MD	HydPorFT POR-FT	NUPERMFT MD-FT	TOC %	OIP MMBO/sec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ZONE 1	1248	31	2.8	0.053	0.022	0.928	0.121	4.364	150.853	0.000	16.668
PENROSE	159	28	2.6	0.057	0.055	0.783	0.303	2.56	48.256	0.000	9.777
GRAYBURG	388	324	1.9	0.014	0.089	0.354	1.389	23.742	538.967	0.000	90.677
SAN ANDRES	214	158	2.3	0.028	0.081	0.421	0.960	10.9	205.394	0.000	41.63
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
	TOT	TOT	AVGX	AVGX	AVGX	AVGX	AVGX	CUM	CUM	AVGX	CUM

Table 1 Summary of rock properties and OIP for EMSU #679 well

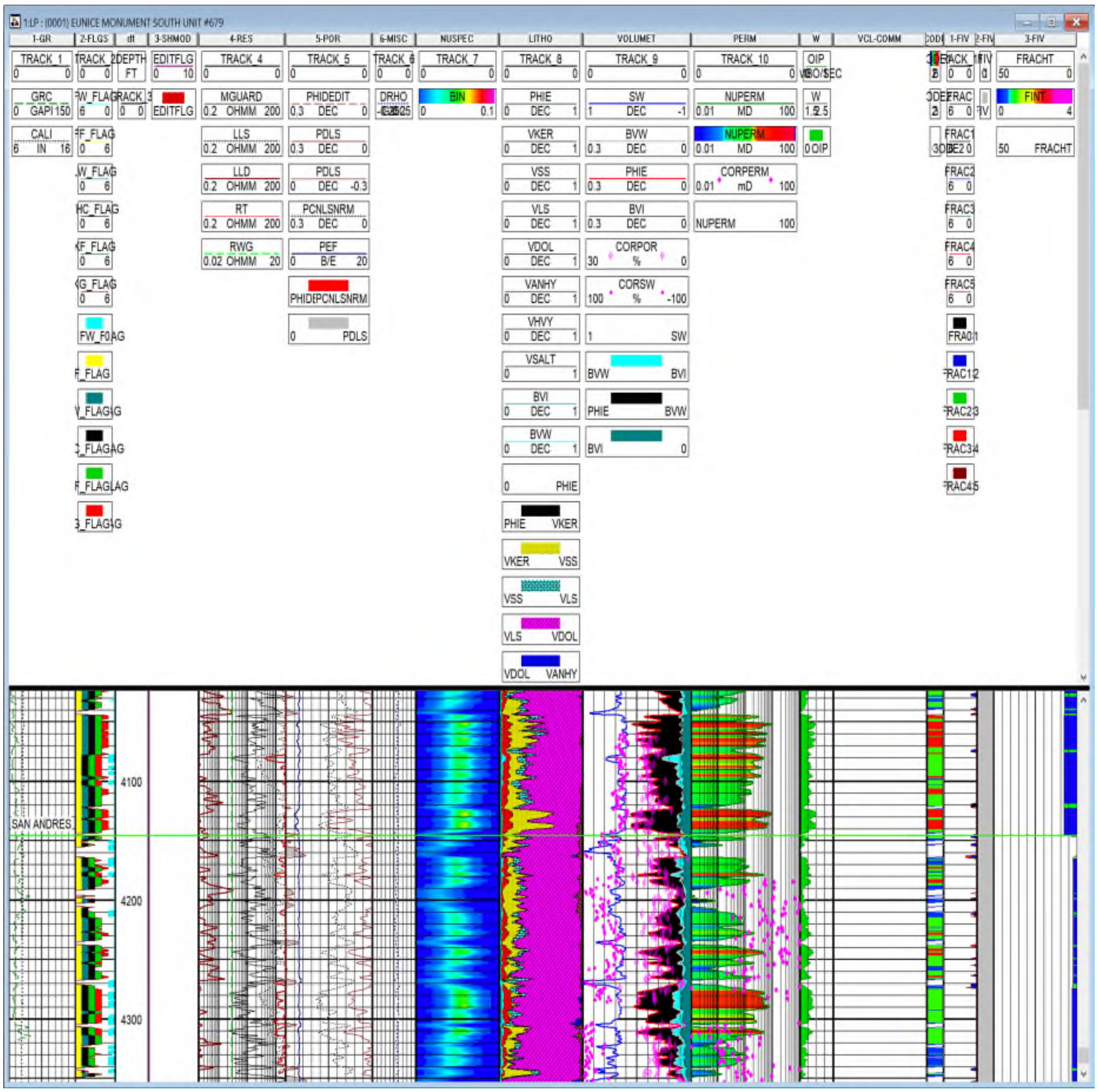


Figure 2 Original petrophysical analysis for EMSU #679 well

Partition 1 and 5

Partition area 1 and 5 in the study had the same m and n values, so only one realization was necessary. Values of m=2.3, n=2.3 were run showing some good match between core water saturation and calculated water saturation from the top of San Andres to 4302'. However, agreement between these two parameters were off above and below this zone (Figure 3). Above this zone core water saturation was 20% in average higher than derived water saturation while in the section below, the deference was 20% lower. This is not a likely scenario due to little physical support for the fluid distribution mismatch.

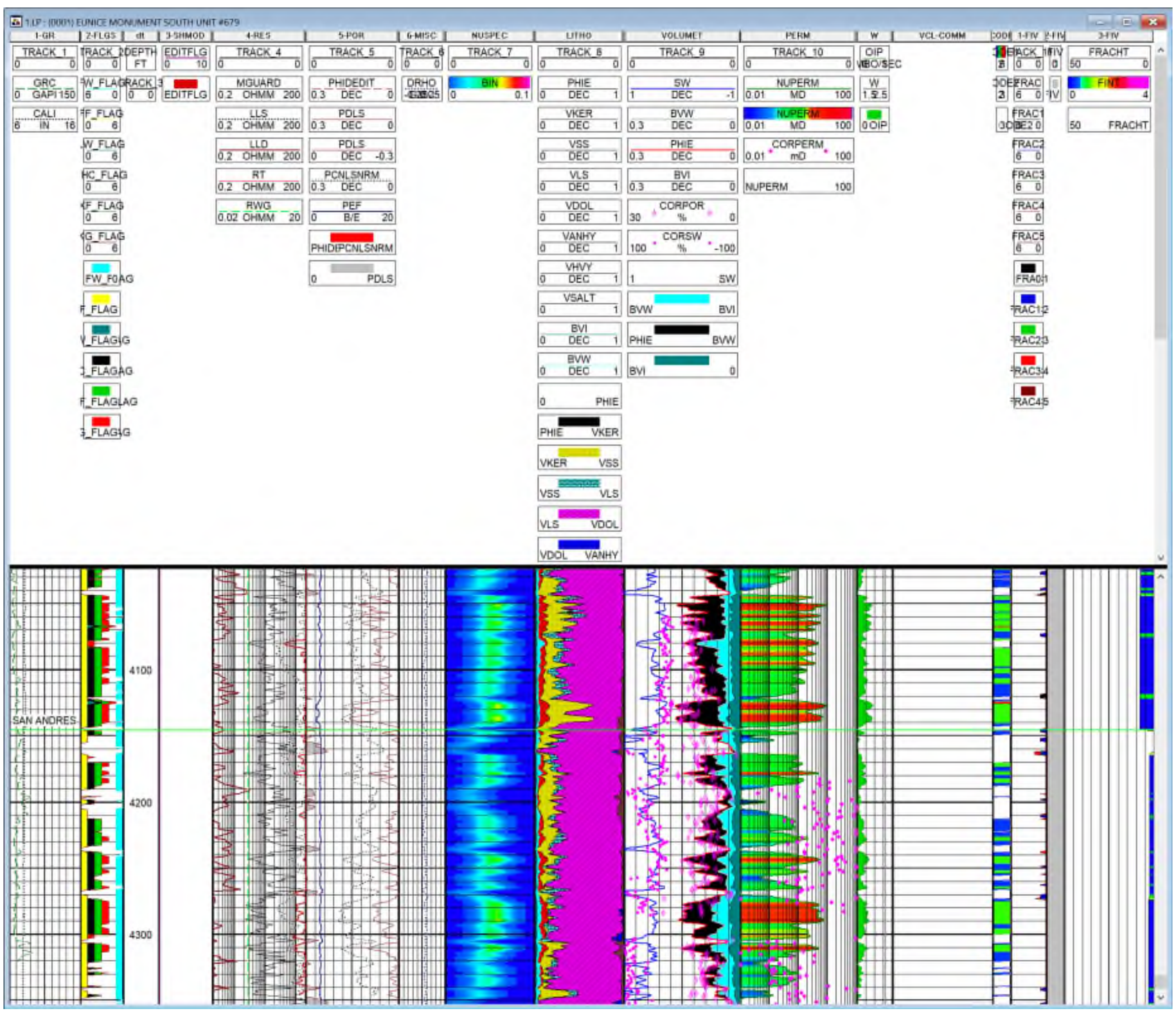


Figure 3 Petrophysical analysis using m=2.3 and n=2.3

Partition 2

ROZ assessment for partition 2 (San Simon Channel) located in the northeast of the county used m=2.3, and n=3.0. In this case, the lower San Andres core water saturation appeared about 15% higher than the computed water saturation (figure 4) which makes it a bit closer than the other 2 scenarios. However, core water saturation versus derived water saturation is about 35% difference toward the top making it physically more difficult to explain in a water-based mud system.

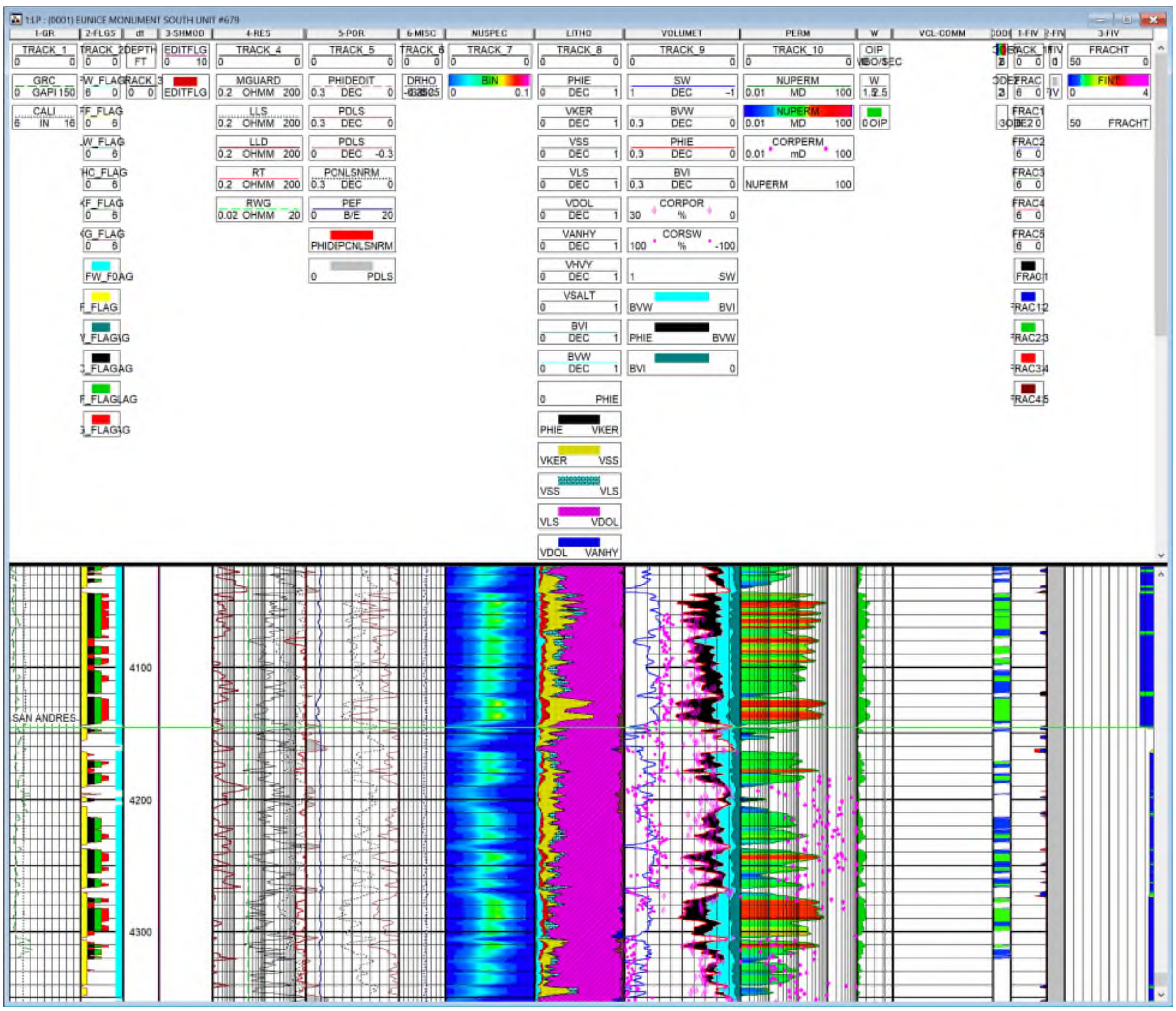


Figure 4 Petrophysical analysis using m=2.3 and n=3.0

Partition 3 and 4

Partitions 3 and 4 are grouped for analysis because they used same m=2.3 and n=3.4. These two partitions are in the central basin platform of Gaines County. The n parameter for the scenario is much higher than the partition 2 which make calculated water saturation much higher than before (figure 5). This makes core water saturation and computed water saturation to agree in the lower San Andres from 4302 to bottom. The disparity between these two parameters is more evident toward the top with 40% in average.

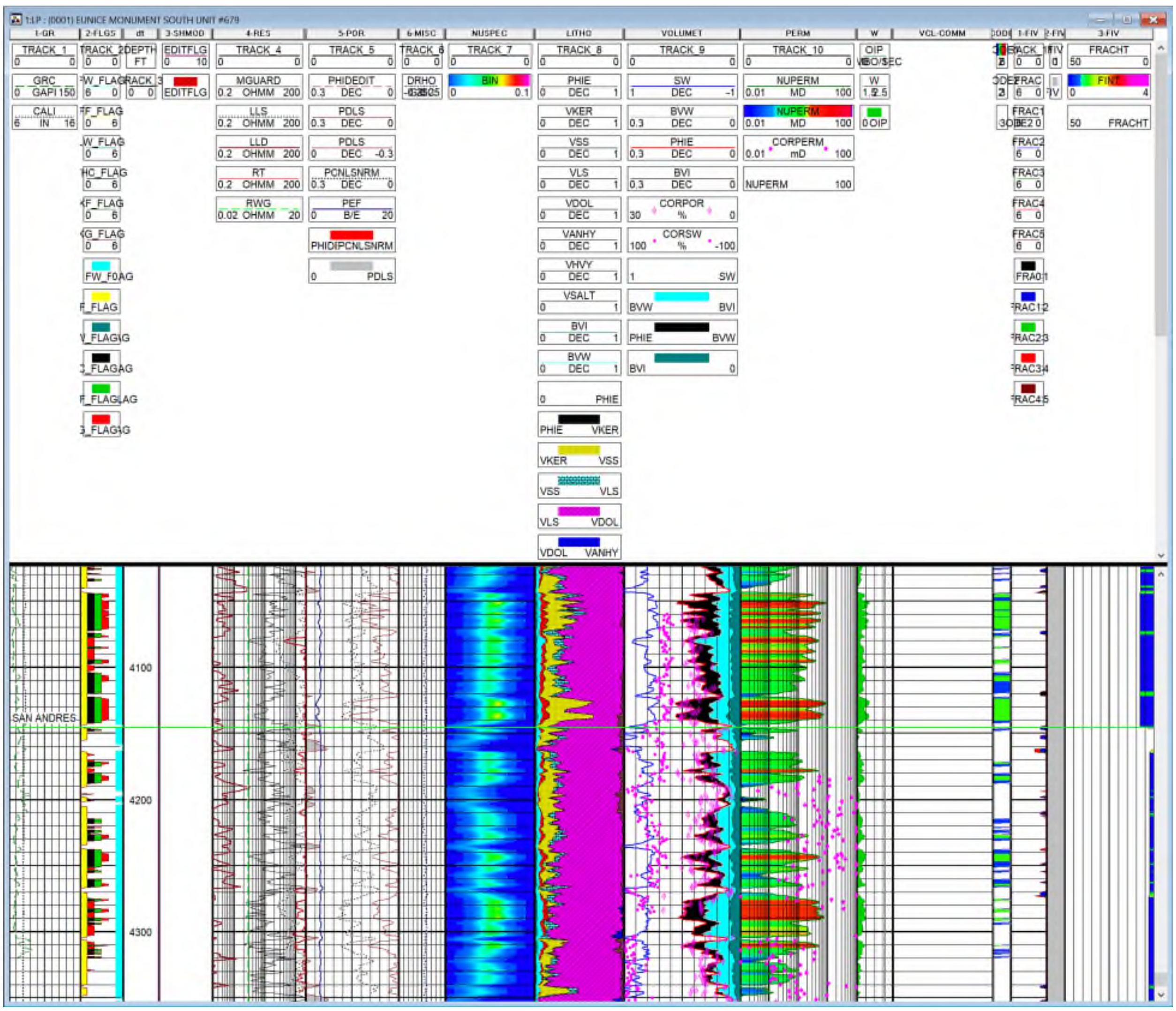


Figure 5 Petrophysical analysis using m=2.3 and n=3.4

Scenario 5 What it takes to match CORSW

To make core water saturation and derived water saturation in agreement a variable m and n must be used which is an unlikely scenario because there is no change in logs character through Grayburg and San Andres formations. However, m and n were varied from top to bottom to find the best match to core water saturation (figure 6). Values for m and n were 2 and 2 respectively from TOP to 4158, m=2.15 and n=3 from 4158 to 4303 and m=2.4 and n=3.4 from 4303' to well bottom. Volumetrics shows (table 2) that there is reduction of 35% of OIP compared to original analysis in the San Andres while there is no change in OIP in the Grayburg.

Zone	Summaries										
DEPTH FT	GROSSFT	PAYFT	RANK	CLAY DEC	PHIE DEC	SW DEC	NUPERM MD	HydPorFT POR-FT	NUPERMFT MD-FT	TOC %	OIP MMBO/sec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ZONE 1	1248	31	2.8	0.053	0.022	0.928	0.121	4.364	150.853	0.000	16.668
PENROSE	159	28	2.6	0.057	0.055	0.783	0.303	2.56	48.256	0.000	9.777
GRAYBURG	388	324	1.9	0.014	0.089	0.354	1.389	23.742	538.967	0.000	90.677
SAN ANDRES	214	94	2.5	0.028	0.081	0.640	0.958	7.041	204.906	0.000	26.891
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	TOT	TOT	AVGX	AVGX	AVGX	AVGX	AVGX	CUM	CUM	AVGX	CUM

Table 2 Summary of rock properties and OIP for EMSU #679 well using variable m and n.

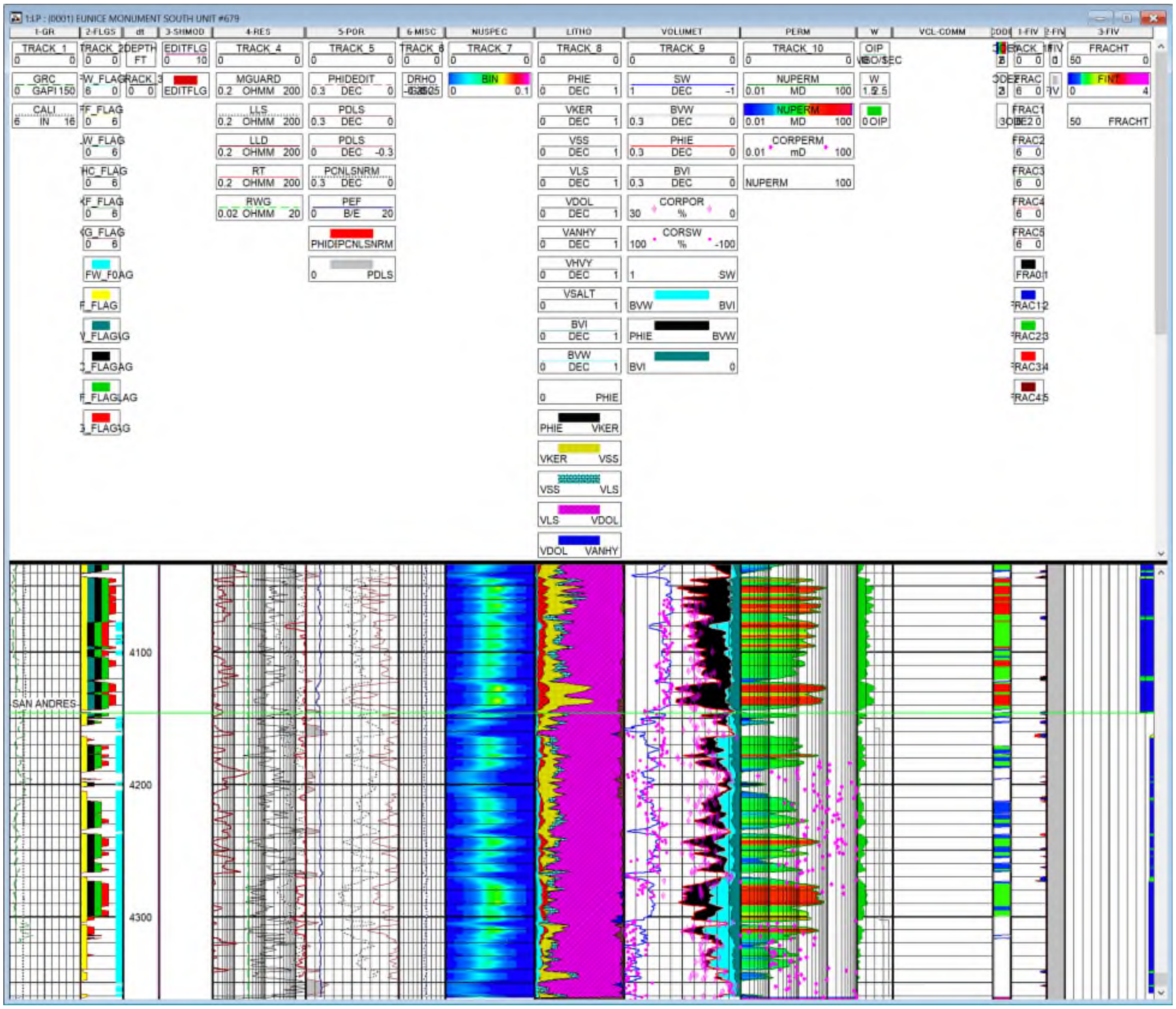

Figure 6 Petrophysical analysis using variable m and n