

# **Characterization of an Unconventional Resource, Uteland Butte Member, Lower Green River Formation, Uinta Basin, Utah**

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## **Abstract**

Horizontal oil production in Utah's Uinta Basin has grown dramatically over the past decade with development activity primarily focused in the prolific Uteland Butte play. The Uteland Butte member (UB) is an informal member of the Eocene Green River Formation. The UB primarily consists of organic shales, limestones, and dolostones deposited in Lake Uinta during a freshwater period immediately following the Paleocene/Eocene Thermal Maximum. Estimated Ultimate Recoveries from UB wells range from 50,000 to 1,500,000 barrels of oil. Previous outcrop and subsurface studies have observed discrete depositional belts and associated subplays within the UB, based on the relative percentages of carbonate content and intragranular vs. organic-matter (OM)-hosted porosity. The dramatic variation in well EURs is partially attributable to the variation of multiple geologic factors associated with these depositionally-driven subplays, including depositional facies, source rock quality, maturity, pore pressure, and fluid mobility. The Uteland Butte Organic subplay (UBO) is the northernmost productive subplay and is characterized by the presence of highly-overpressured, organic-rich lacustrine source rocks and secondary carbonate beds. This study presents the results of an integrated petrophysical, core, and geochemical analysis to characterize the UBO. Sedimentological and stratigraphic description of core confirmed the presence of prolific source rocks within the UBO along with significant carbonate and dolostone content. Subsequent laboratory analyses verified the presence of significant volumes of mobile hydrocarbon stored in OM-hosted porosity within mature Type-I kerogen. Wireline logs were calibrated to core analyses and utilized to evaluate depositional facies throughout the UBO and further delineate the extents of organic porosity within the UB. These findings were immediately utilized to refine lateral placement in existing development benches and were also paramount in the decision to test and develop additional resource within the Uinta Basin.

Keywords – Uinta Basin, Green River Formation, Uteland Butte, unconventional, lacustrine

Theme – Hydrocarbons in the Rockies, Uinta/Piceance

### **References:**

- Brinkerhoff, R., and Millard, M., 2019, Using pore system characterization to subdivide the burgeoning Uteland Butte Play, Green River Formation, Uinta Basin, Utah, AAPG Rocky Mountain Section Meeting, 2019
- Chidsey, T.C., 2010, Major Oil Plays in Utah and Vicinity, Utah Geological Survey – Survey Notes, Vol. 42, Number 1
- Logan, S.K., Sarg, J.F., and Vanden Berg, M.D., 2016, Lithofacies, deposition, early diagenesis, and porosity of the Uteland Butte member, Green River Formation, eastern Uinta Basin, Utah, and Colorado: Utah Geological Survey Open File Report 652
- Rueda Chapparro, F., Machel, H.G., and Vanden Berg, M.D., 2019, Dolomitization in the Uteland Butte Member of the Eocene Green River Formation, Uinta Basin, Utah: Utah Geological Survey Open-File Report 700,
- Vanden Berg, M.D., Wood, R.E., Carney, S.M., and Morgan, C.D., 2014, Geological characterization of the Uteland Butte member of the Eocene Green River Formation – an emerging unconventional carbonate tight oil play in the Uinta Basin, Utah [abs.]: AAPG Eastern Section Annual Meeting, Pittsburgh, Pennsylvania, September 6 – 10

# **Characterization of an Unconventional Resource**

## **Uteland Butte member**

## **Lower Green River Formation**

## **Uinta Basin, Utah**

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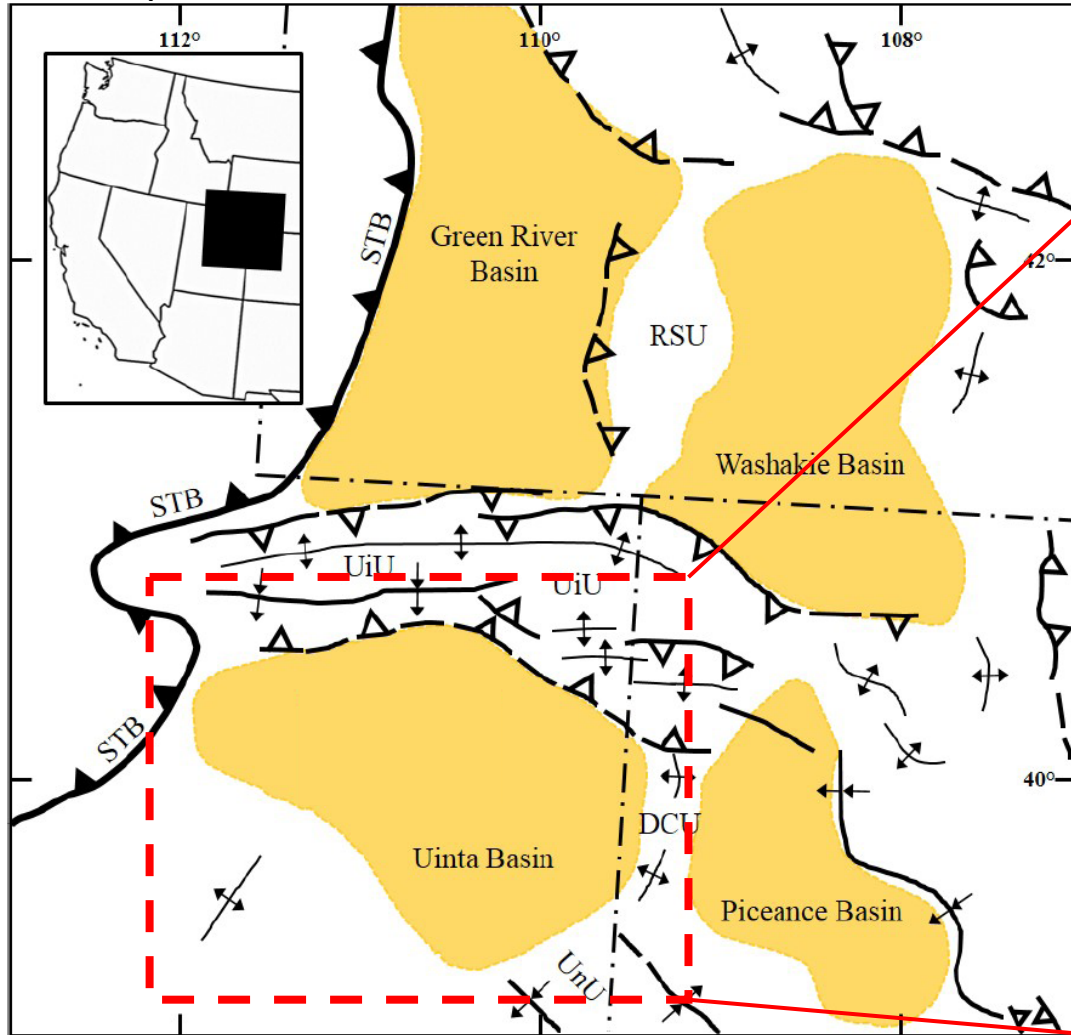
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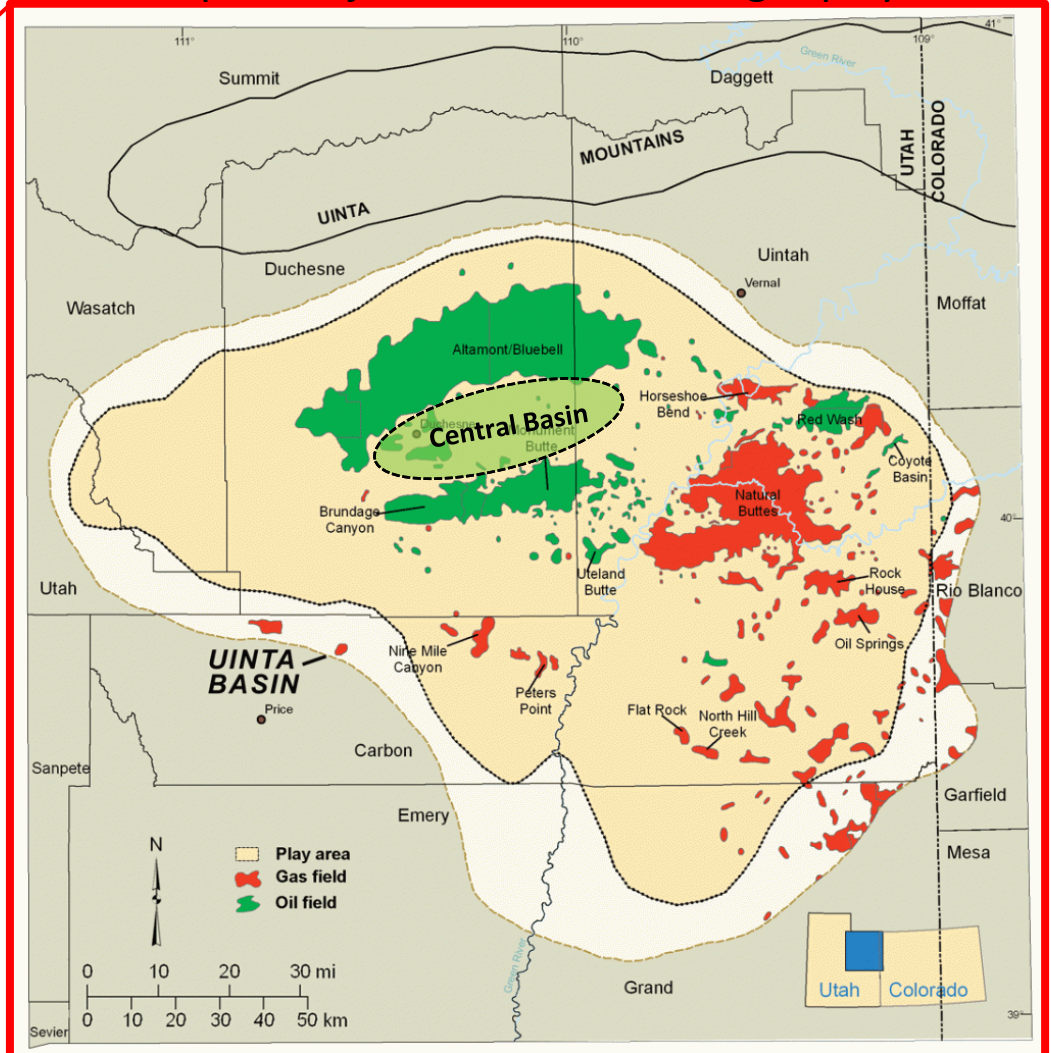
# Uinta Basin Locator Slide

Map of western U.S. Laramide lacustrine basins



Modified from Rueda Chaparro 2019

Map of major Uinta Basin oil & gas plays

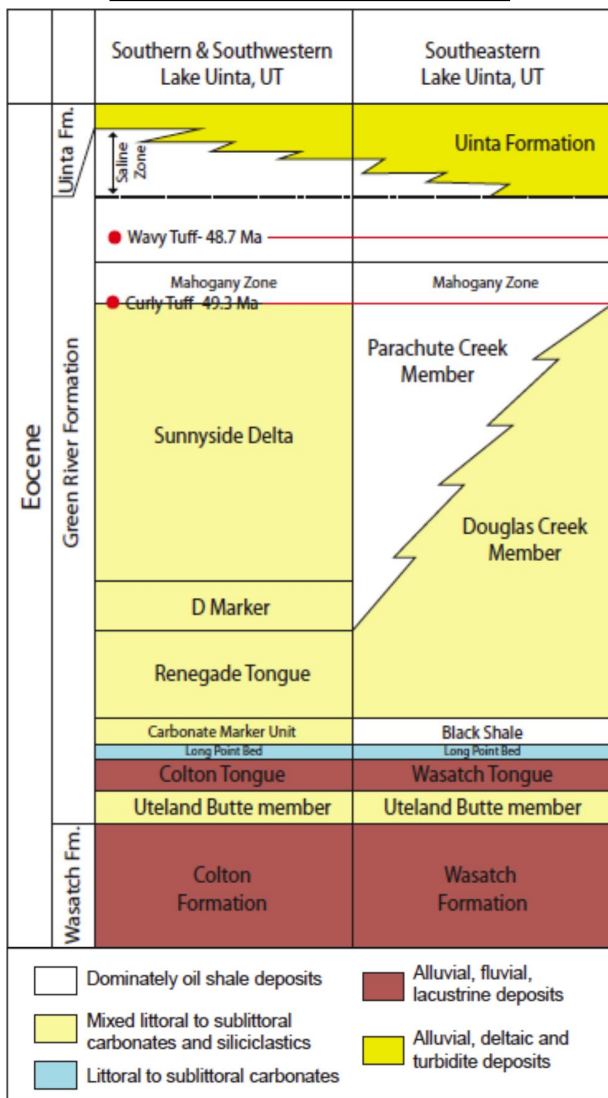


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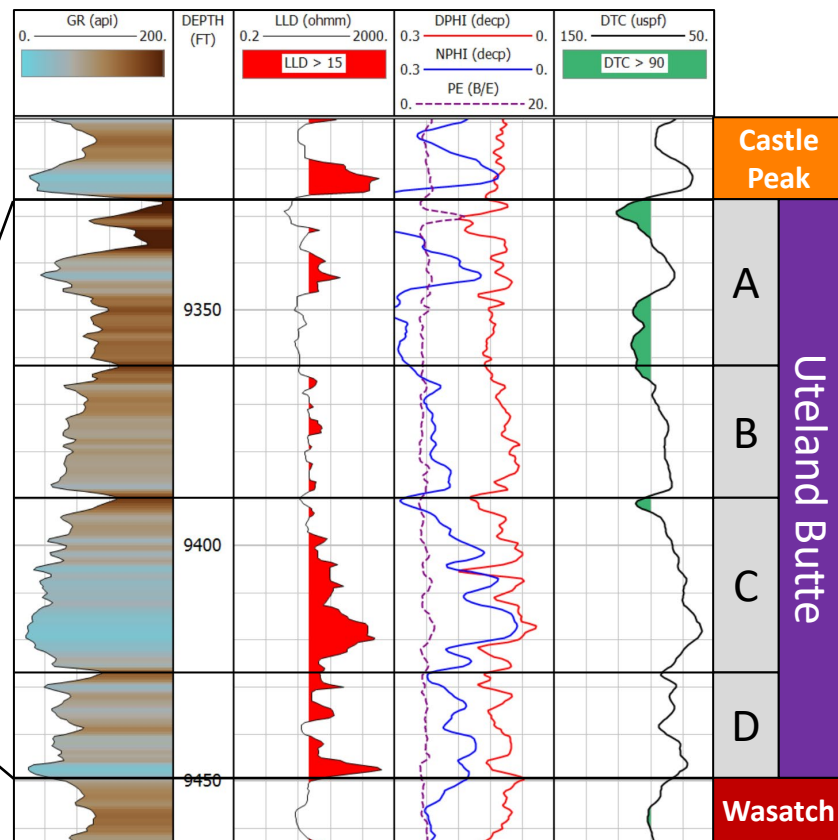
# Geologic Setting

## General Stratigraphy

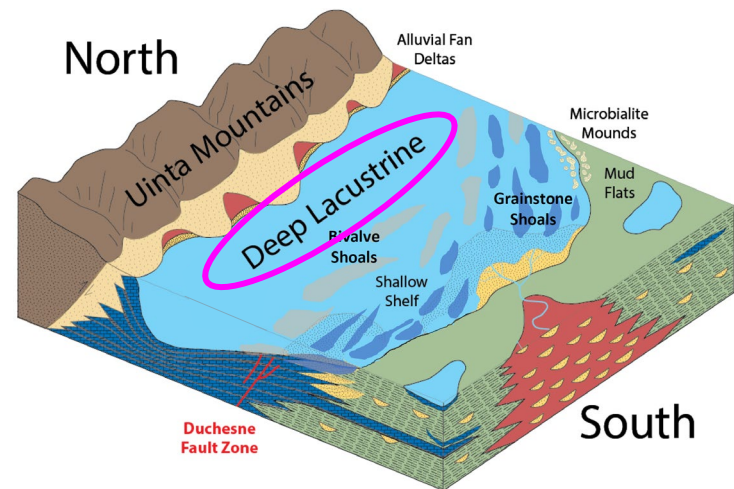


Modified from Logan et al, 2016

## ★ XCL Pilot Hole Log



## Uteland Butte Depositional Model



Modified from Brinkerhoff & Millard, 2019

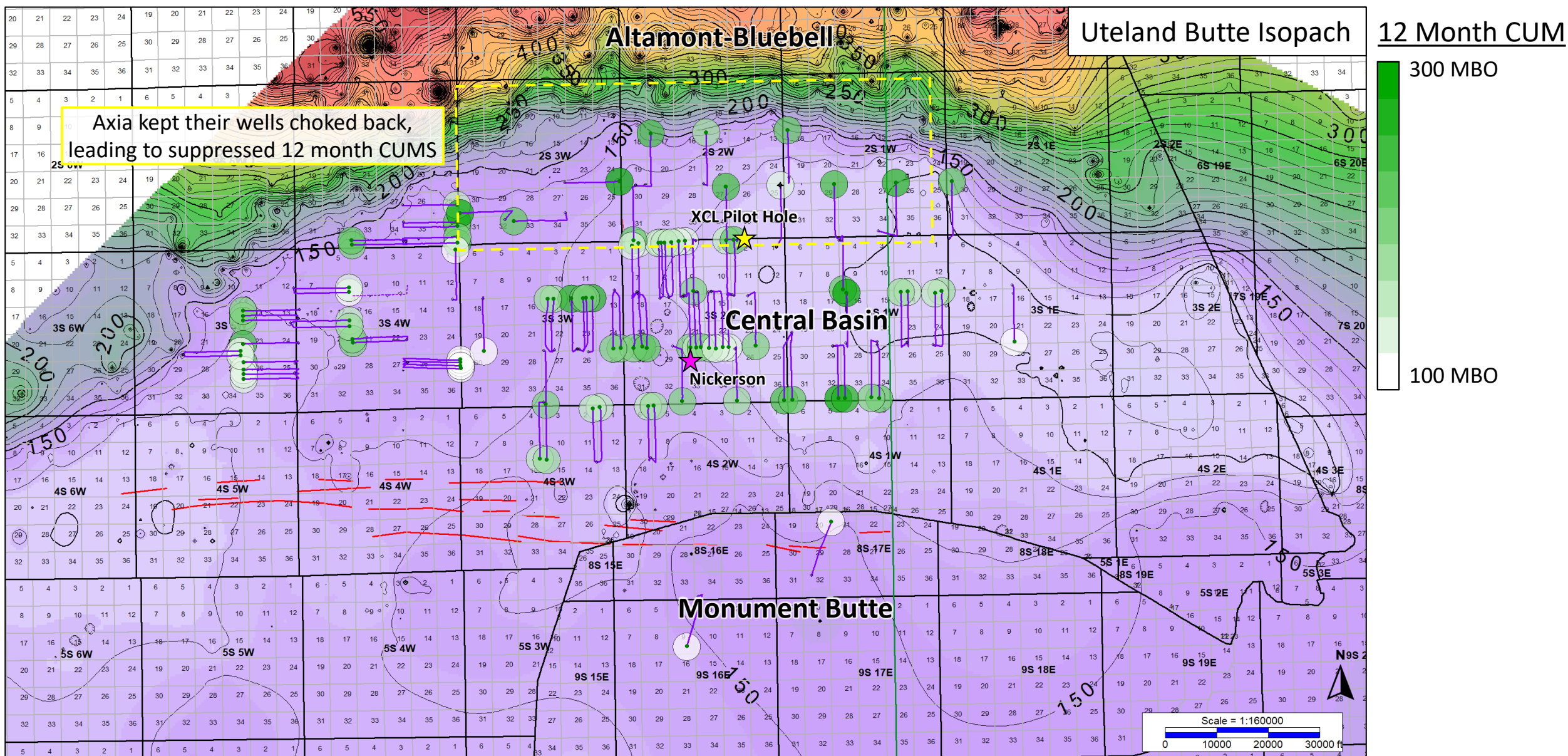
## Uteland Butte Deep Lacustrine Play

- Dominantly Type 1 kerogen
- Overpressured: 0.7 – 0.8 psi/ft
- GOR: 800 – 1000 scf/bbl
- API Gravity: 40 – 42
- Yellow Wax
- EUR: 800 – 1200 MBO
- Requires large fracs



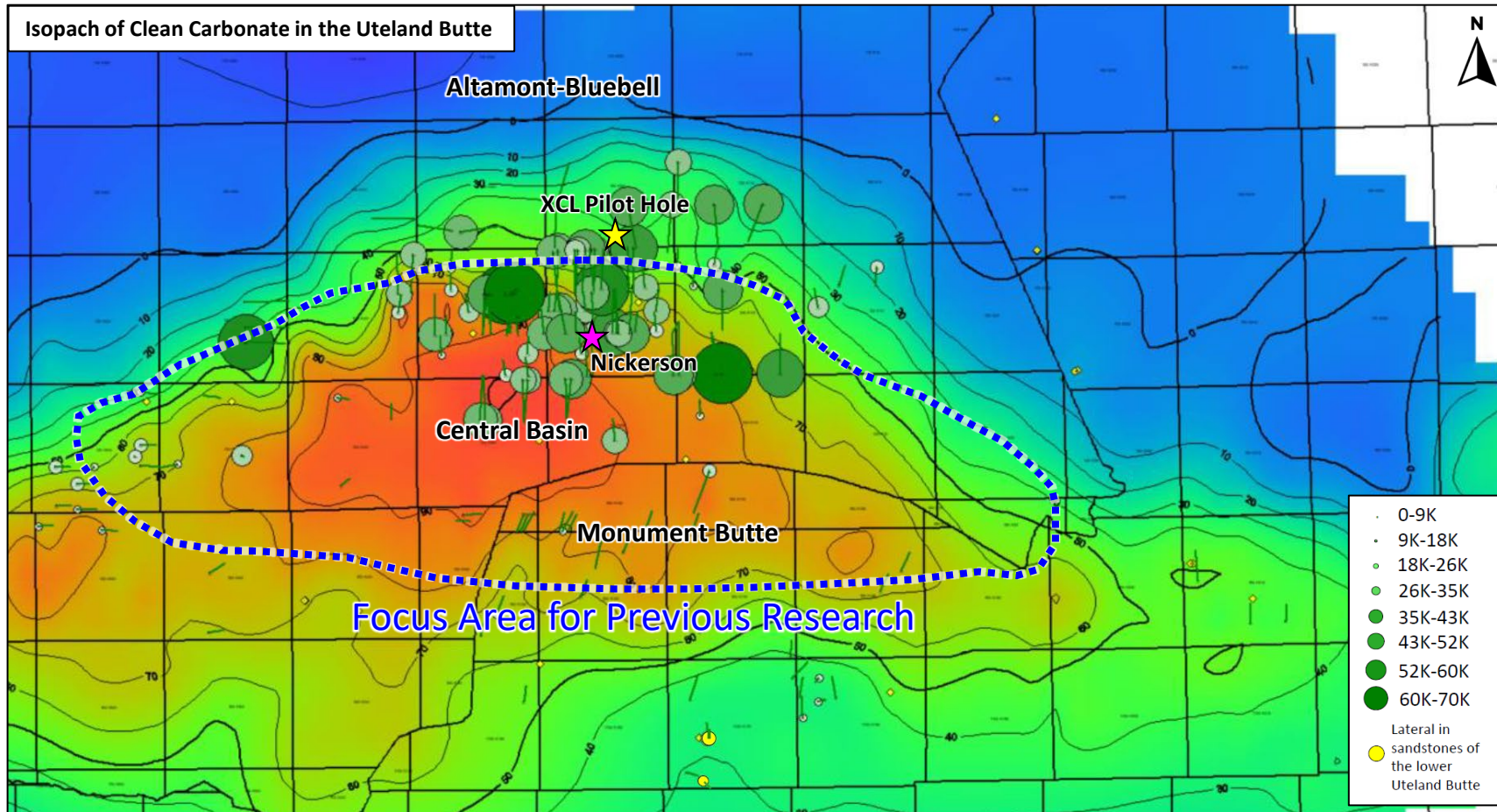
# Uteland Butte Production

10,000' Laterals with 12 Months of Production





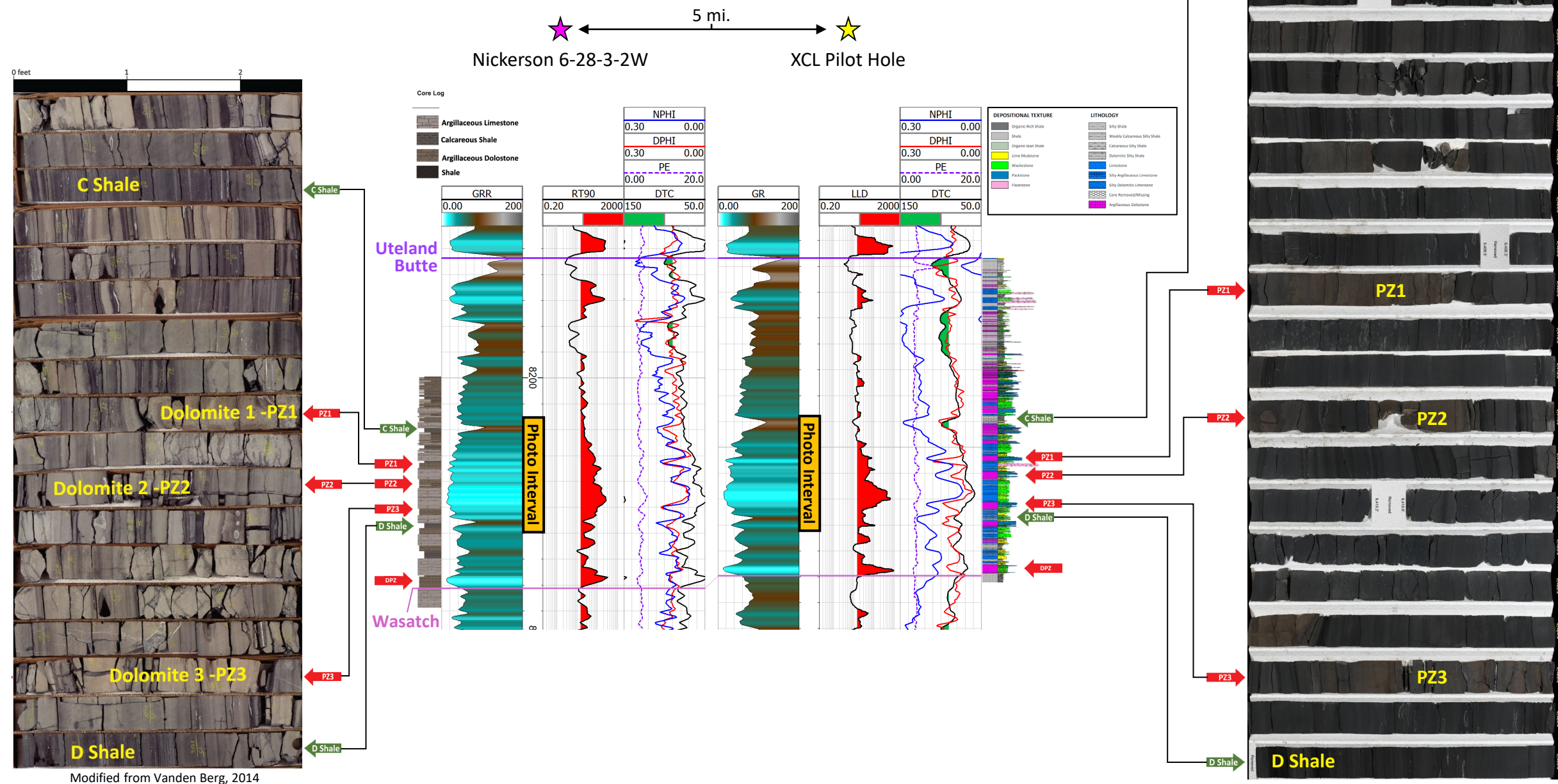
# Previous Research & Publications



Modified from Brinkerhoff & Millard, 2019

- Previous research and literature has focused on more proximal depositional areas
- Driven by availability of core and outcrop
- Early drilling and coring programs concentrated on carbonate-rich areas
- XCL drilled a pilot hole and collected >1,000' of core in April 2020 to characterize the organic-rich portion of the play

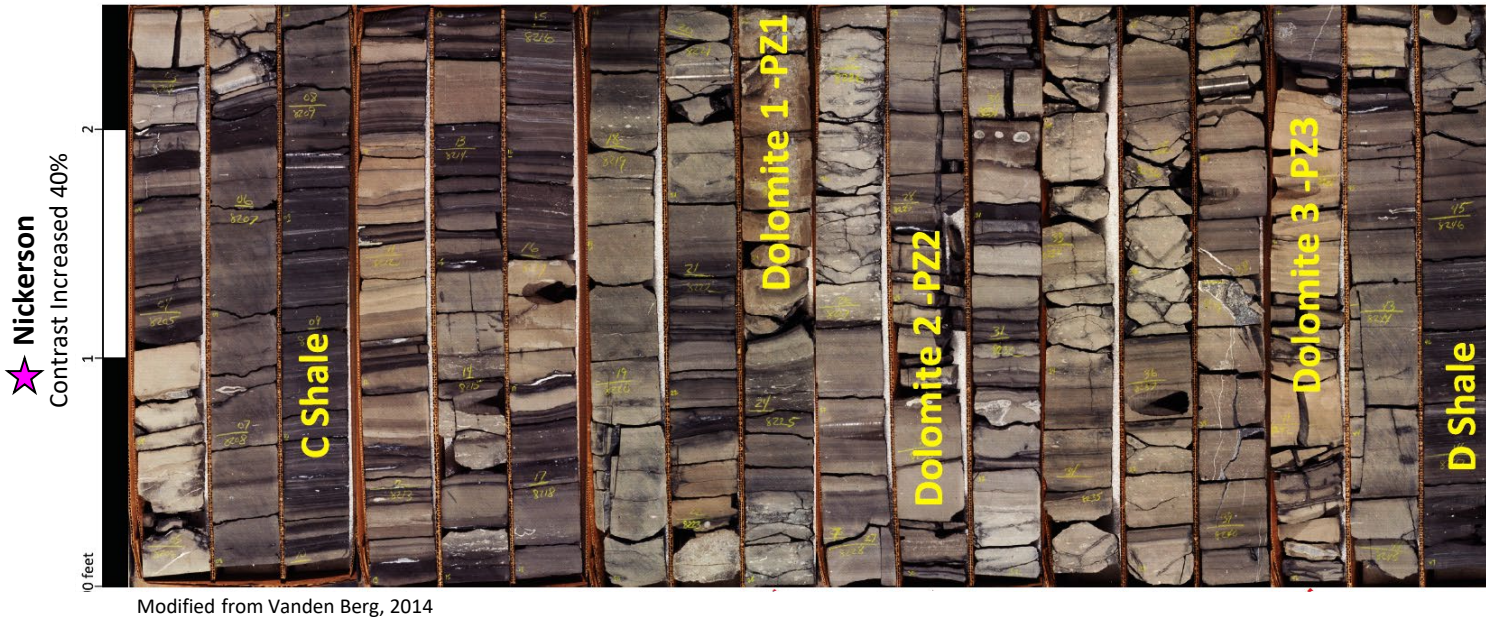
# Comparison to Carbonate-Rich Play





# Comparison to Carbonate-Rich Play

Contrast-Enhanced Core Photos



Characteristic	Nickerson	XCL PH
PZ Thickness	1 – 2.5'	1 – 2.5'
Non-PZ Dolomite	Common	Rare
Color	Lt to dk gray, Lt brown	Dk gray to black, dk brown
Fossils	Uncommon large bivalves, turritella	Common to abundant bivalves, turritella
Depositional Environment	Littoral to sublittoral w/ profundal shales	Sublittoral to profundal

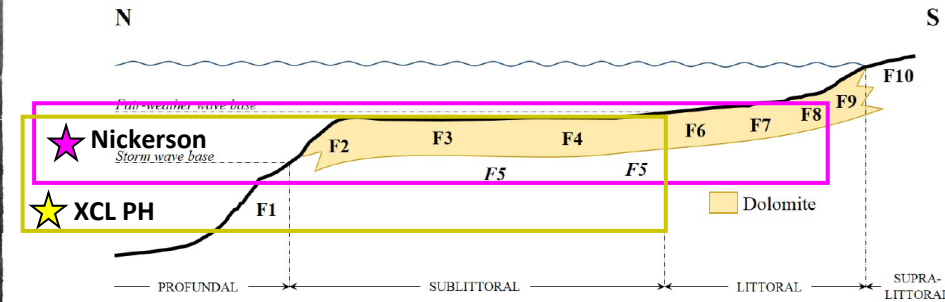
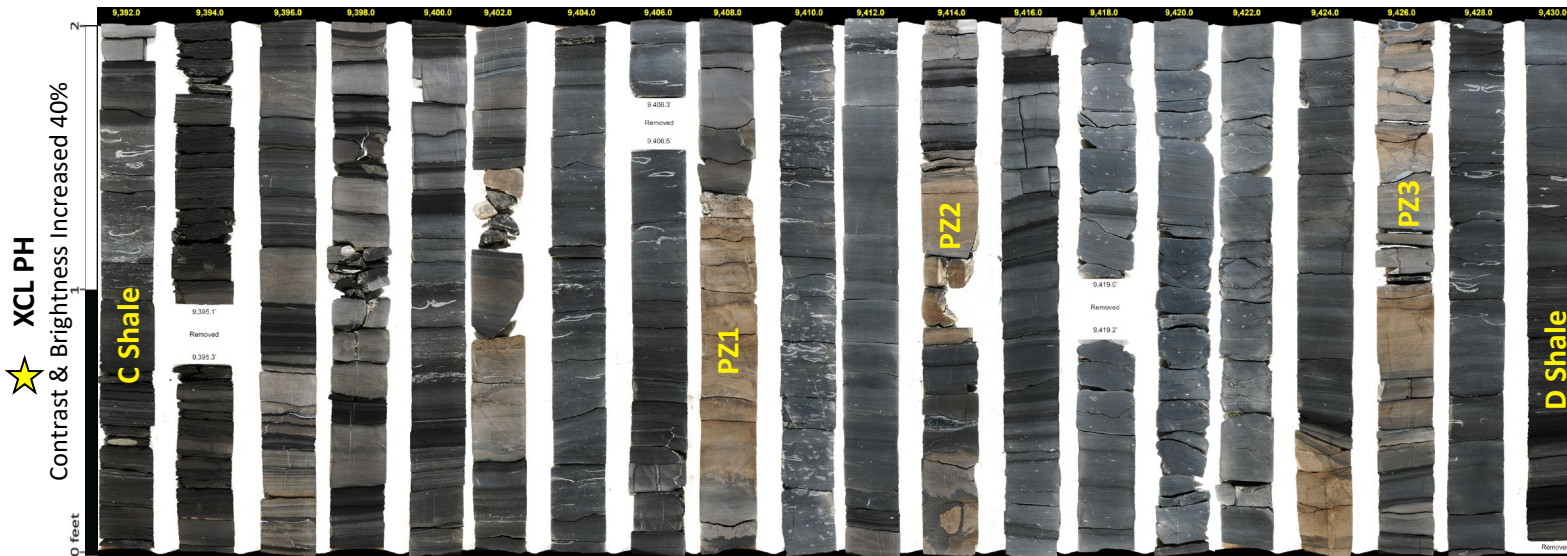
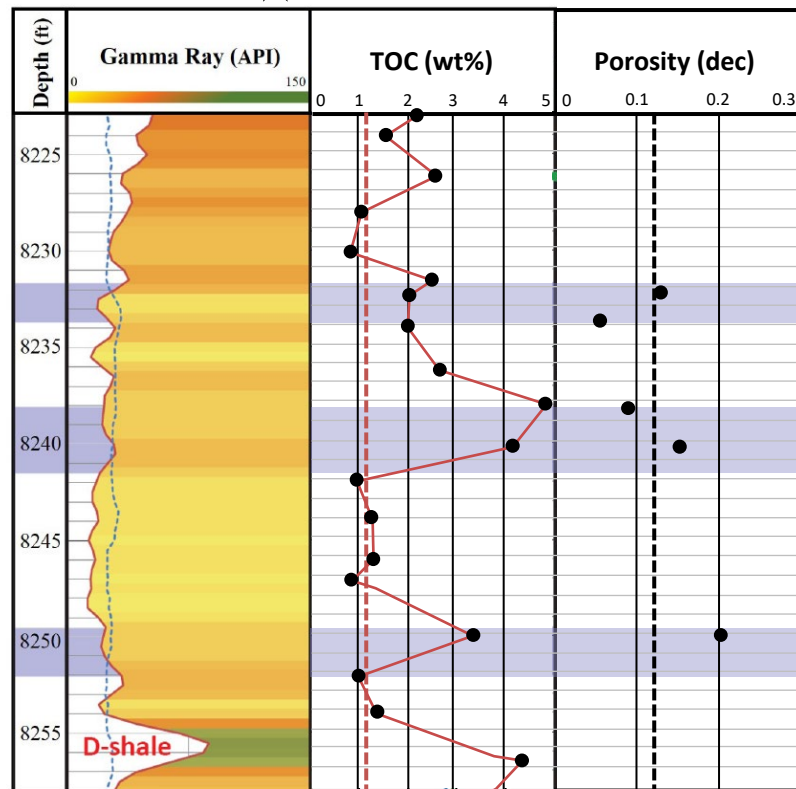


Figure 4.16. Schematic representation of facies distribution and dolomitization. F5 was not dolomitized.

Modified from Rueda Chaparro 2019

# Comparison to Carbonate-Rich Play

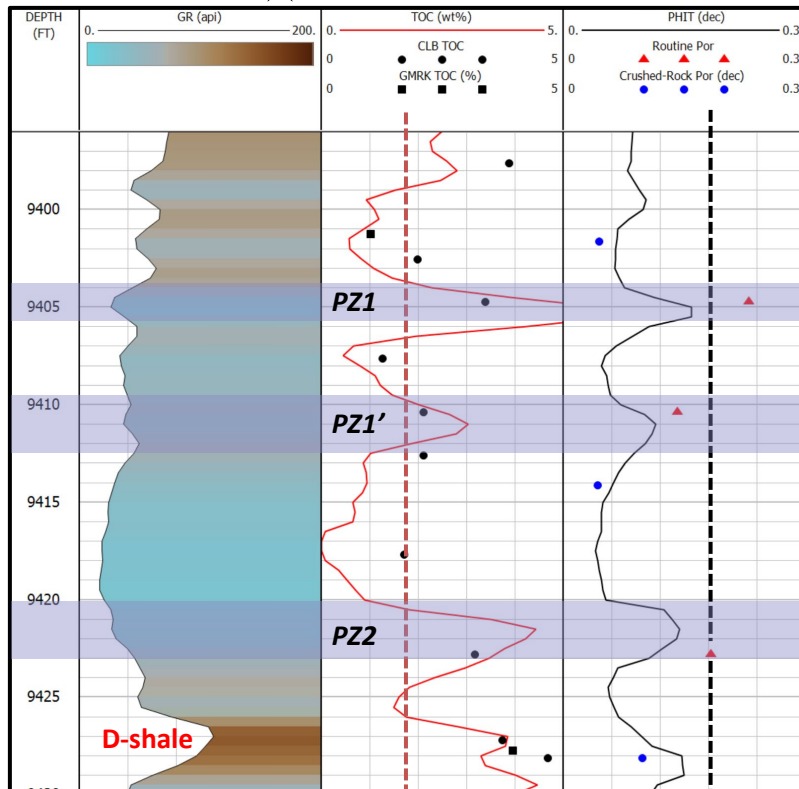
★ Nickerson 6-28-3-2W



Modified from Rueda Chaparro et al 2019

Avg. Core Limestone TOC = 1.1% Avg. Core Dolo  $\Phi$  = 0.12

★ XCL Pilot Hole



Avg. Core Limestone TOC = 1.8% Avg. Core Dolo  $\Phi$  = 0.18

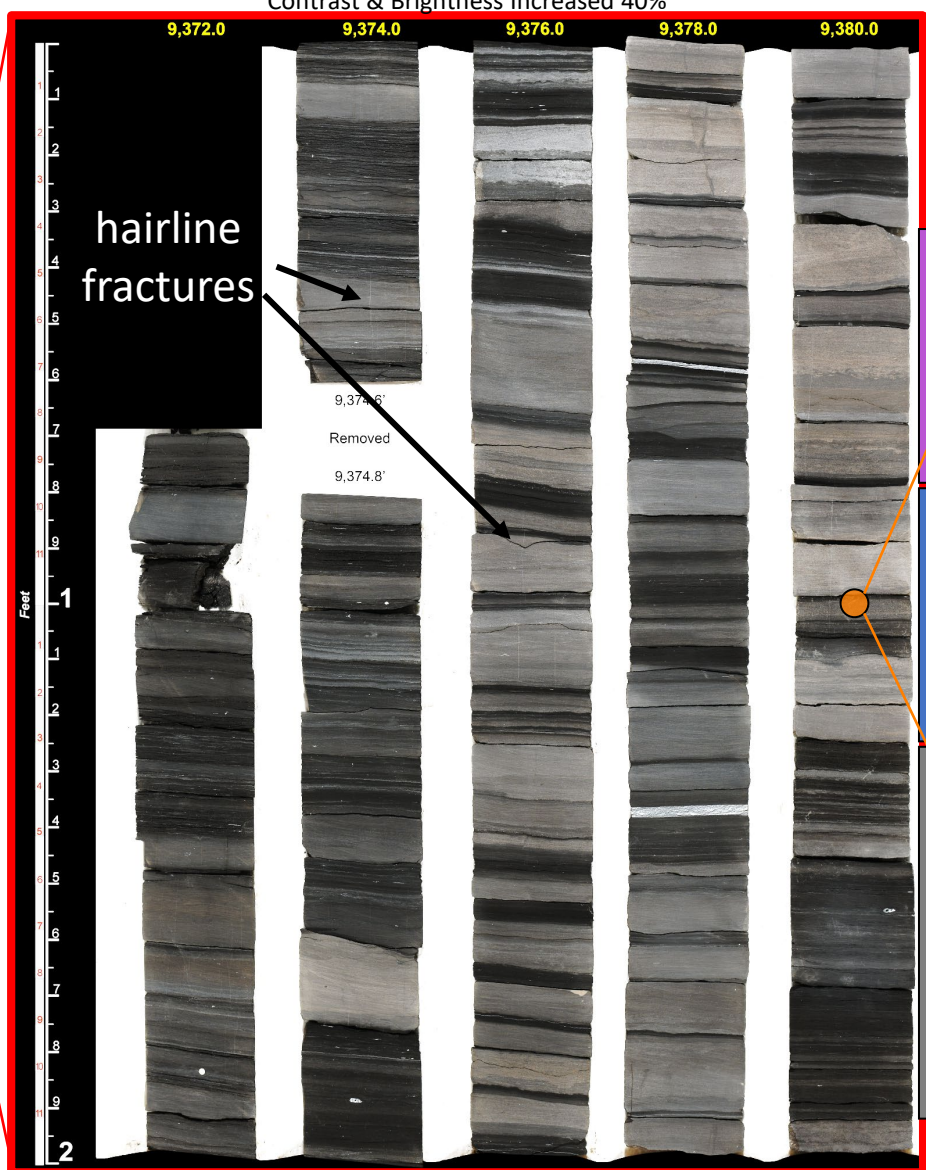
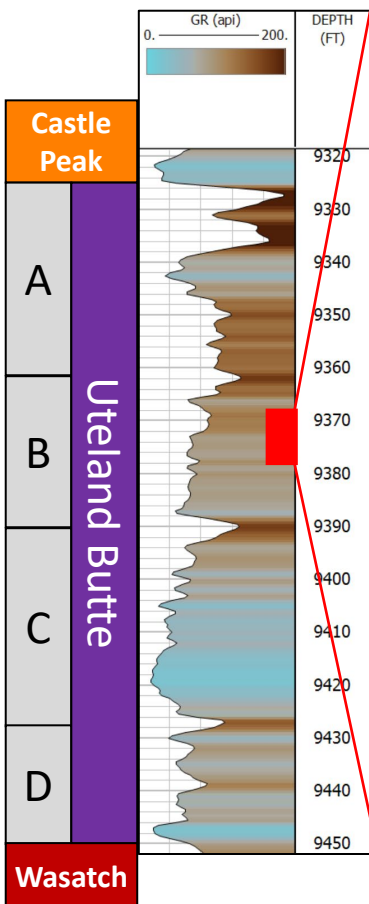
- XCL PH contains higher TOC in the Uteland Butte C limestones
- Dolomites are similar thickness in both wells
- Dolomite  $\Phi$  is equivalent or better in the Bobby PH
- These characteristics both point to better production potential in the organic-rich play



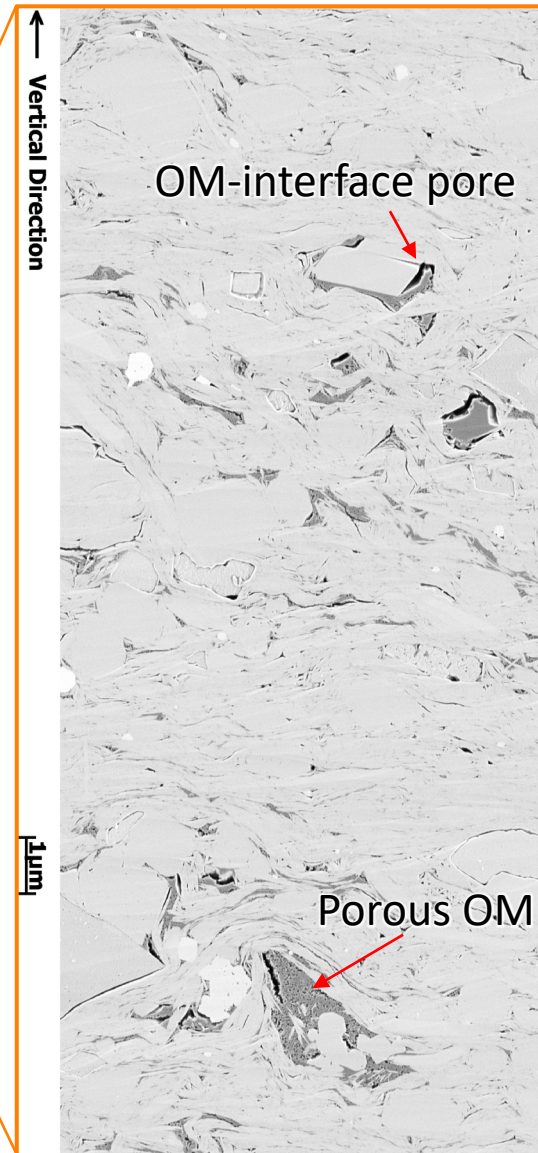
# Uteland Butte A & B Cyclicality

★ Bobby PH

Contrast & Brightness Increased 40%

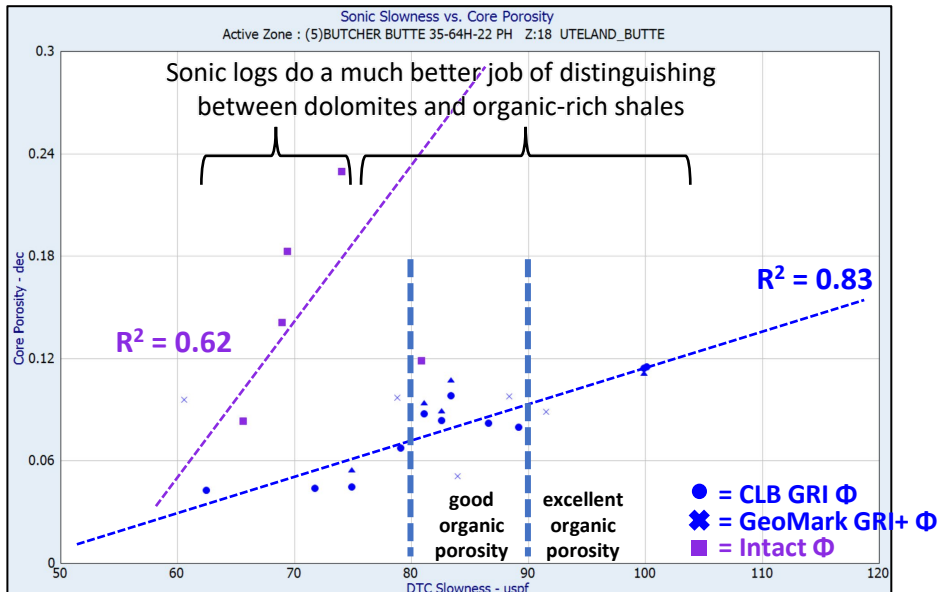
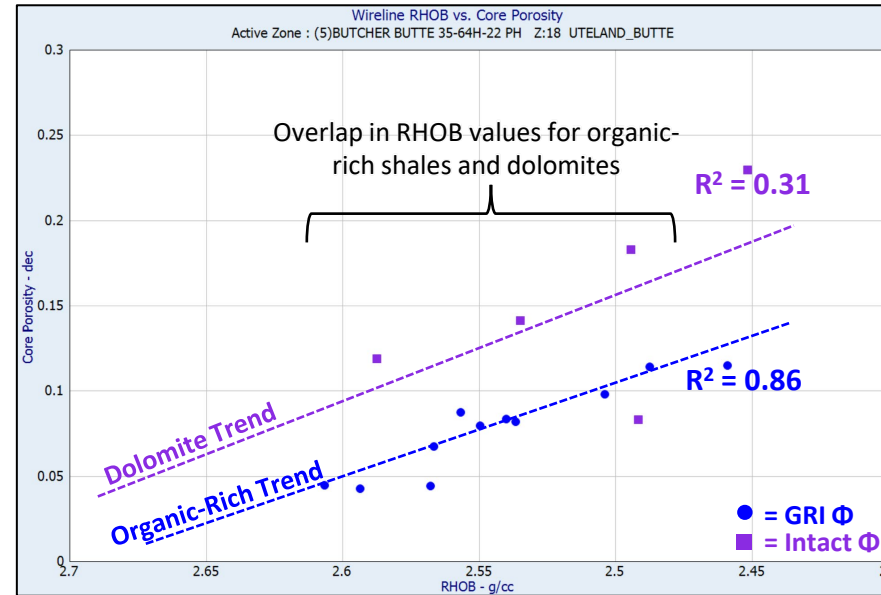
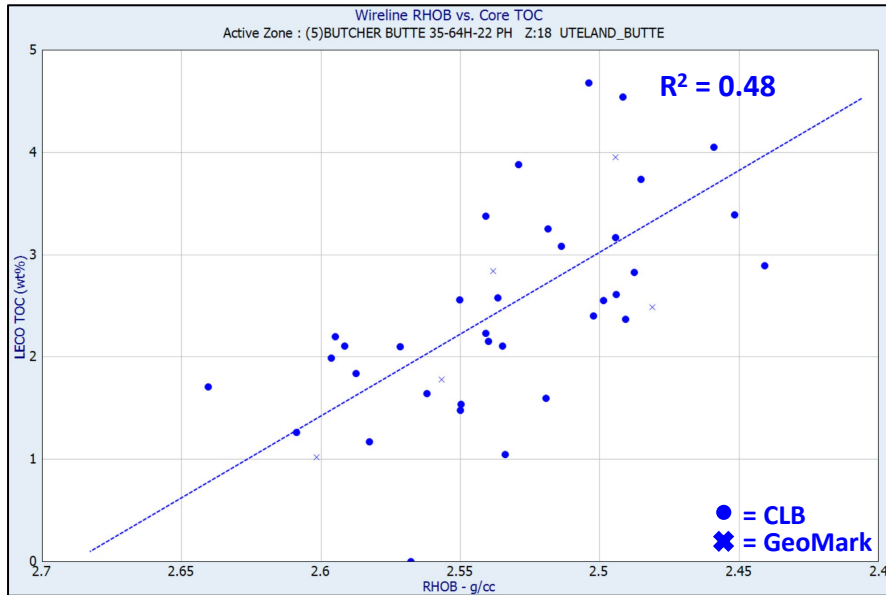


dolomite  
limestone  
OM-rich shale



- UB-A & B intervals are composed of repeating cycles of organic-rich shale overlain by marly limestone with dolomitization increasing towards the top of the cycle
- Organoporosity is characterized by a combination of mineral-interface pores, commonly near recrystallized dolomite, and spongy porous organic matter

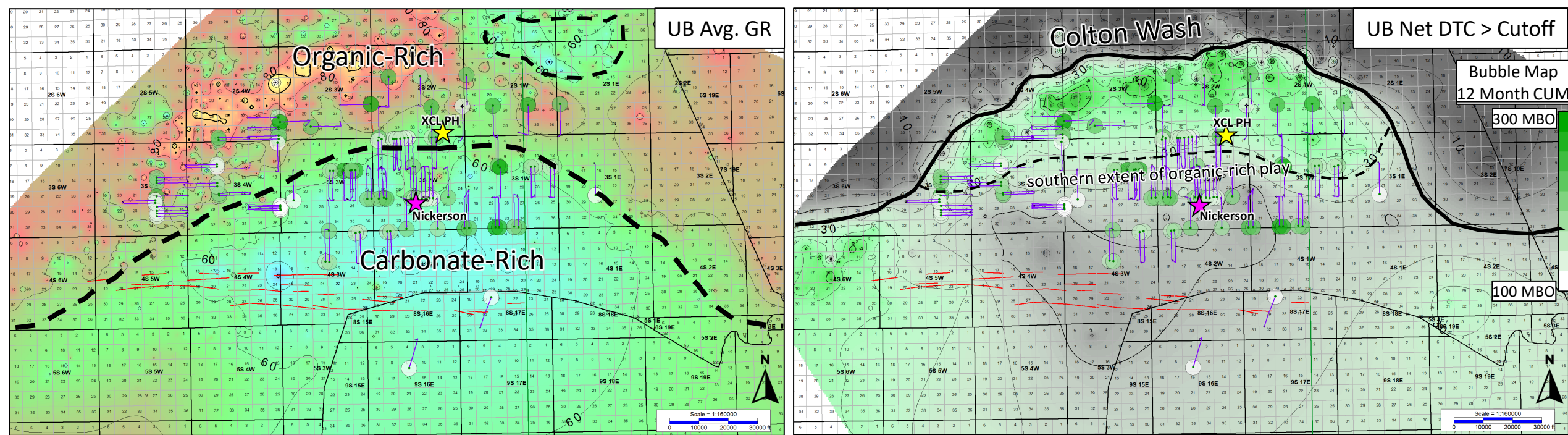
# Core & Log Data Relationships



- A good correlation exists between wireline RHOB and core TOC
- Wireline RHOB is influenced by both dolomite porosity and organic-associated porosity
- However, elevated sonic slowness is strongly associated with organic-associated porosity, making it an excellent proxy

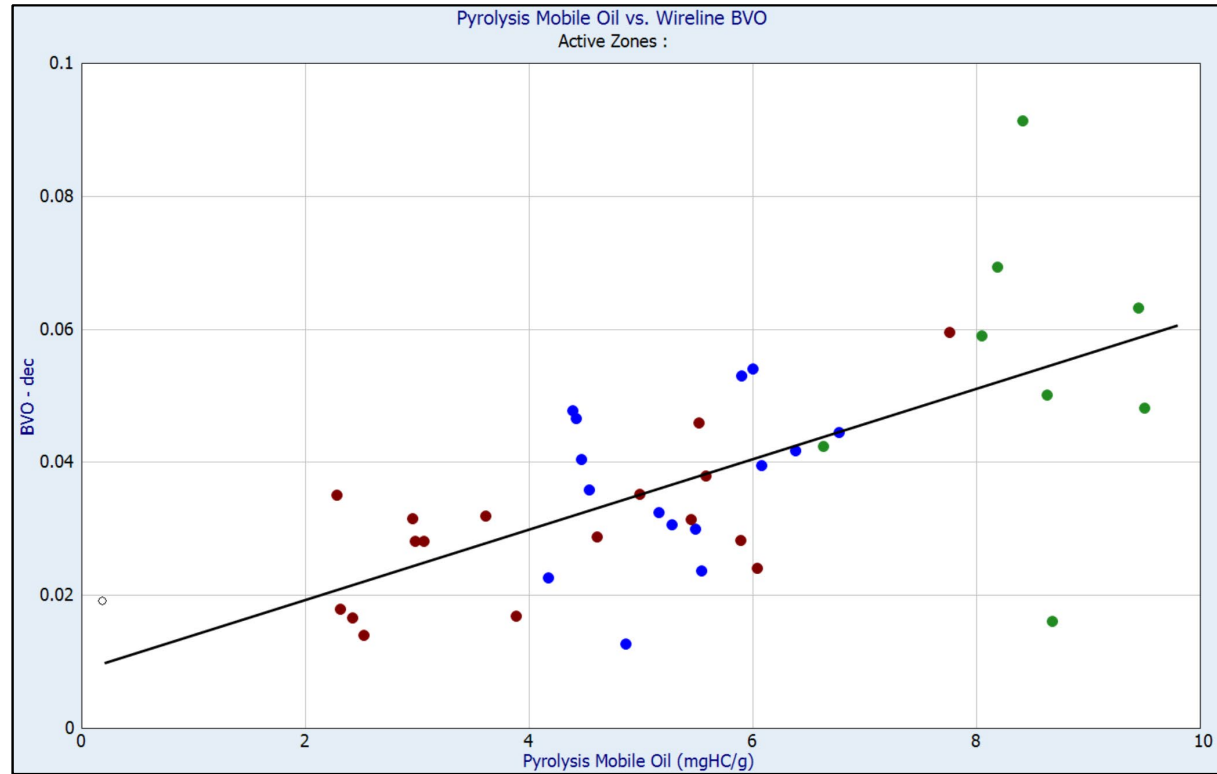


# Mapping the Organic-Rich Uteland Butte Play



- Average GR may be used to map the extent of the organic-rich play but does a poor job of clearly delineating the northern limits
- RHOB logs can be heavily affected by washouts/hole conditions
- Sonic logs provide reliable, clear limits on the extent of this play
- Carbonate-rich play to the south is productive, whereas the Colton Wash has yet to be drilled

# Organic-Rich Upside Formations



- = Uteland Butte
- = Upside Formation A
- = Upside Formation B

- Pilot hole logs were calibrated using pyrolysis from cuttings
- This method identified 2 prospective organic-rich formations with a similar trend to the Uteland Butte of pyrolysis mobile oil vs. wireline BVO
- Exploratory wells were drilled to exploit these formations with very positive initial flowback results

# Conclusions

- The organic-rich Uteland Butte play of the Central Basin is a world-class resource play characterized by TOC-hosted porosity combined with intragranular porosity hosted by pervasive dolomites
- This system contains relatively higher amounts of generative organic matter than the carbonate-rich play to the south while retaining excellent carbonate reservoir properties
- Sonic logs provide the best tool for mapping the extents of the organic-rich play
- Methods used to describe Uteland Butte have led to promising tests in 2 other organic-rich formations on XCL's acreage

# Acknowledgments



**HALLIBURTON**



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# References

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