

Devonian Carbonate Reservoirs, Western Canada, the Gift That Keeps on Giving, a Small E&P Company's Perspective*

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Abstract

Devonian carbonate reservoirs in Alberta have produced 4.5 billion barrels of oil and 31 TCF of natural gas over the past 90 years. Production from these carbonate reservoirs, largely since the late 1940's, accounts for 30 percent of all the production to date in Western Canada. This talk discusses, from a personal experience level, the role of the small exploration and production company in the exploration and development of these prolific reservoirs.

Until the early 1990's these Devonian reservoirs were developed mainly by large multinational companies. Over the past 15 to 20 years a decrease in Canadian exploration budgets has resulted in a shift of expertise and exploration activity to the smaller, more entrepreneurial companies. We discuss this shift and illustrate four specific examples from the authors' personal experiences.

Two examples are from the Leduc Formation: 1) The Wild River "Pinnacle Reef" trend comprised of small (60 to 200 acres) limestone reservoirs that are deep (4500 meters), sweet and overpressured, and 2) The Gregg Lake Lower Leduc Reef margin that contains over 100 BCF of natural gas at 5100 meters.

Overlying the Leduc is the Nisku Formation which is comprised of dolomitized patch reefs, shoals and bank-margin buildups. The Wild River Nisku discovery is one of the larger pools discovered in this trend with reserves of 67 BCF of natural gas.

Overlying the Nisku is the Upper Devonian Wabamun Formation which is a regional, shallow-water carbonate ramp deposit. The Berland River gas pool (110 BCF) is an excellent example of fault-controlled dolomitization resulting in a high deliverability gas reservoir.



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**"Devonian Carbonate Reservoirs, Western Canada
The Gift That Keeps on Giving, A Small E&P
Company's Perspective"**

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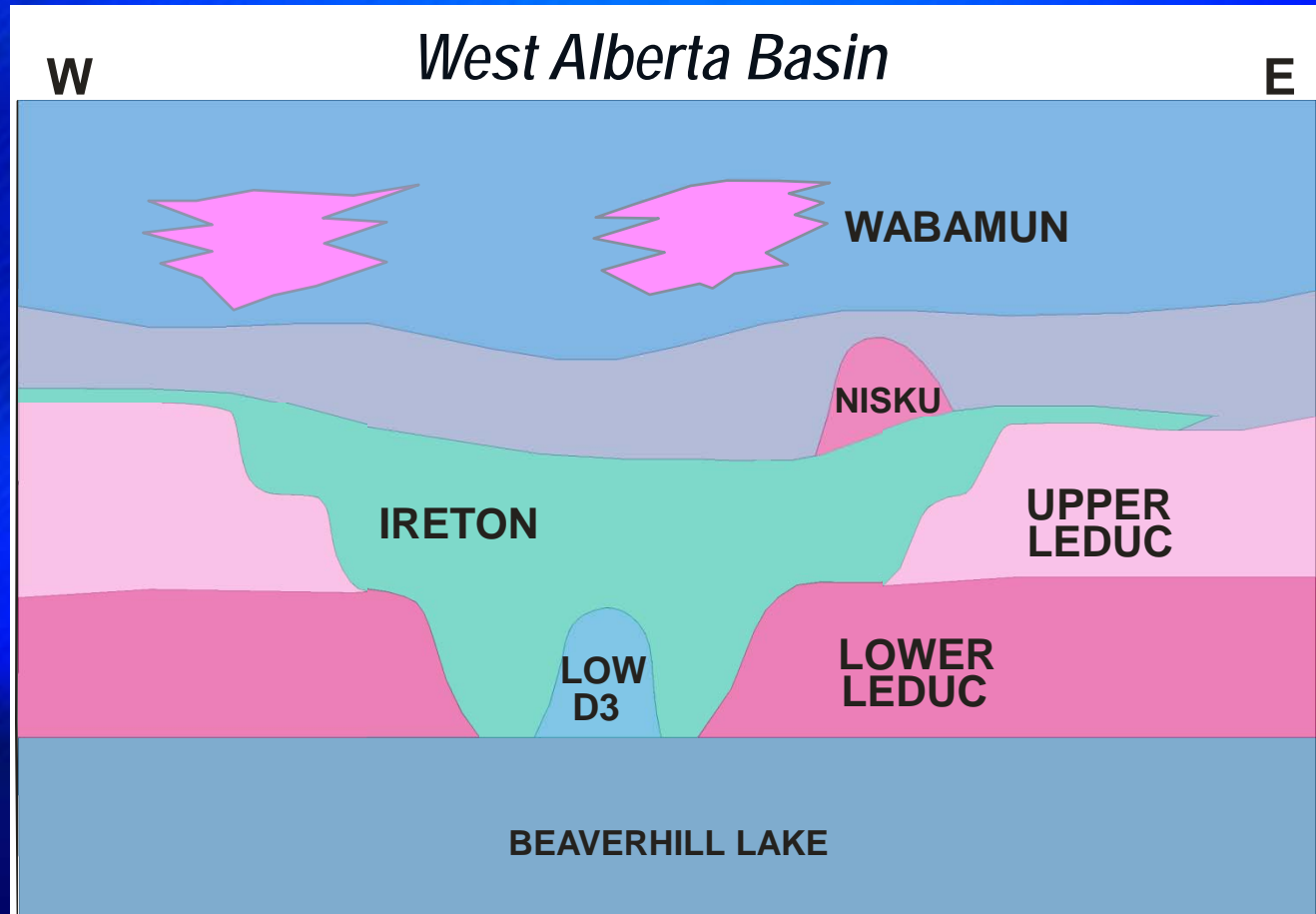
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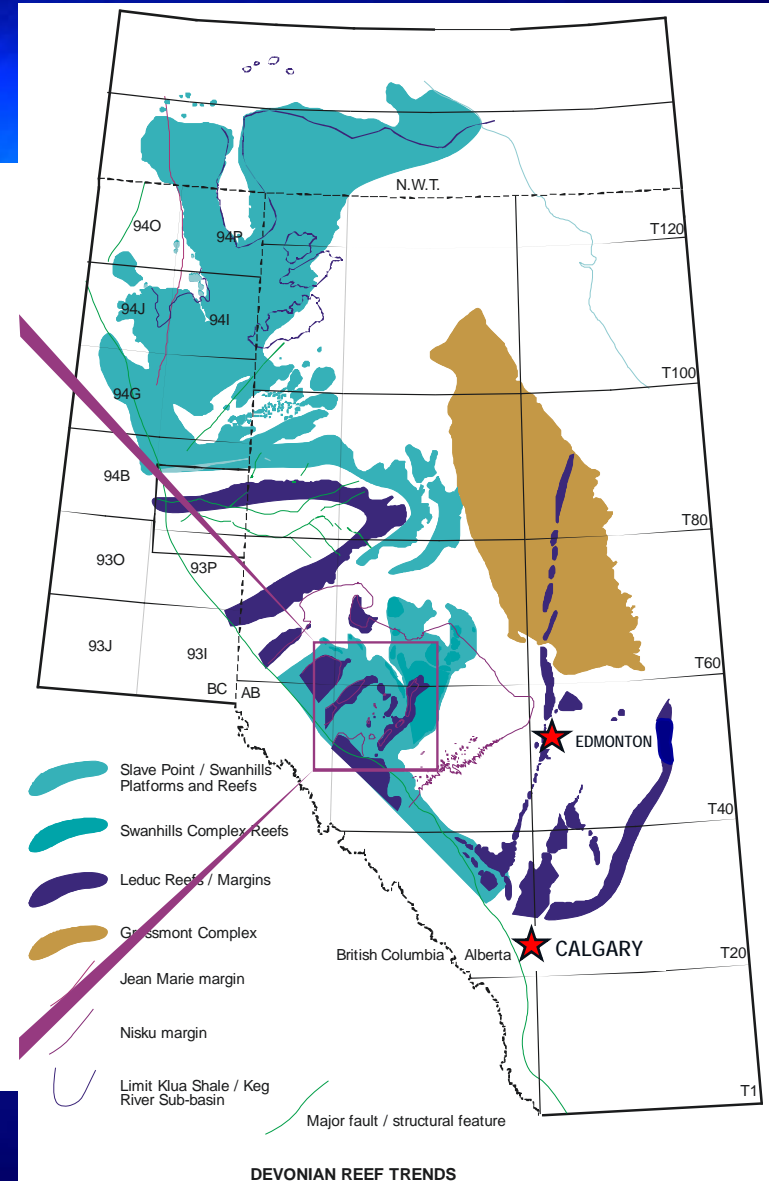
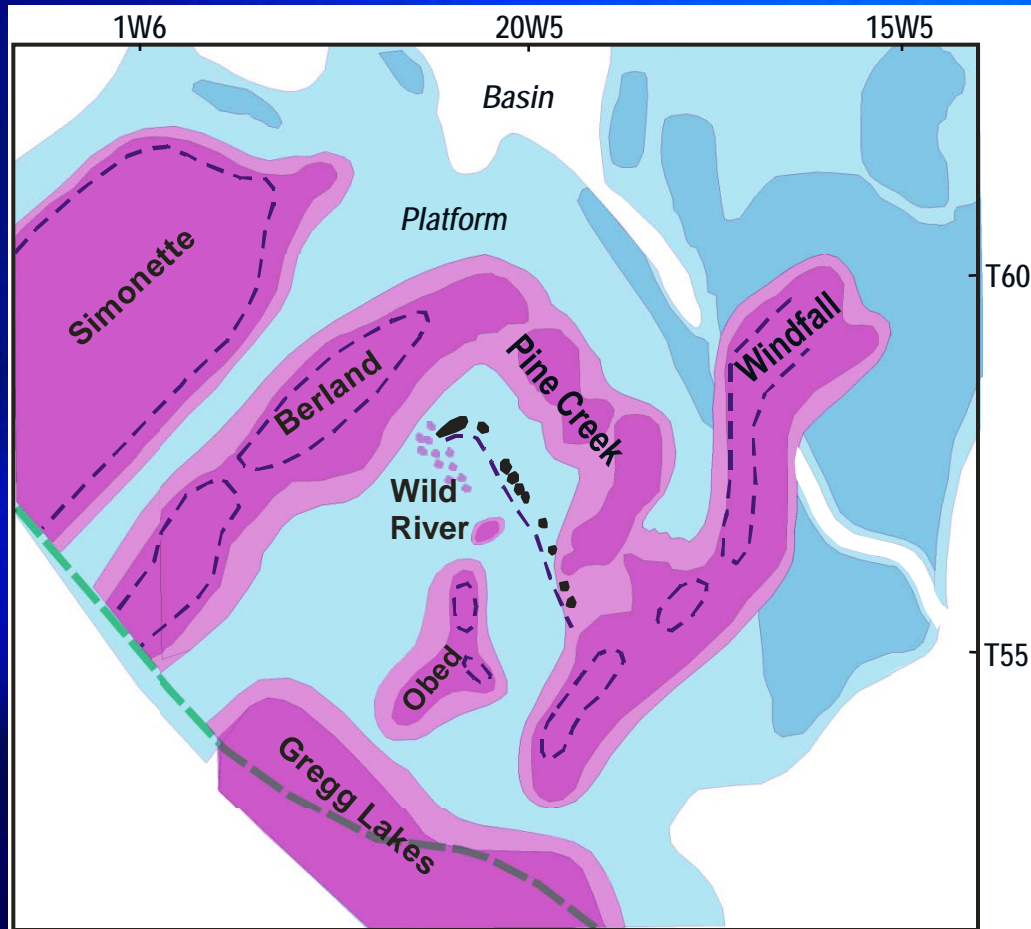
Introduction

- Over the past 15-20 years small entrepreneurial E&P companies have made significant discoveries.
- Will discuss the authors' personal experience with four "play types" since 1991.
 - *Wild River Leduc "Over pressured Pinnacle Reefs"*
 - *Gregg Lakes Lower Leduc Reef Margin*
 - *Wild River Nisku Patch Reefs and Shoals*
 - *Berland River Dolomitized Wabamun Carbonate Ramp*

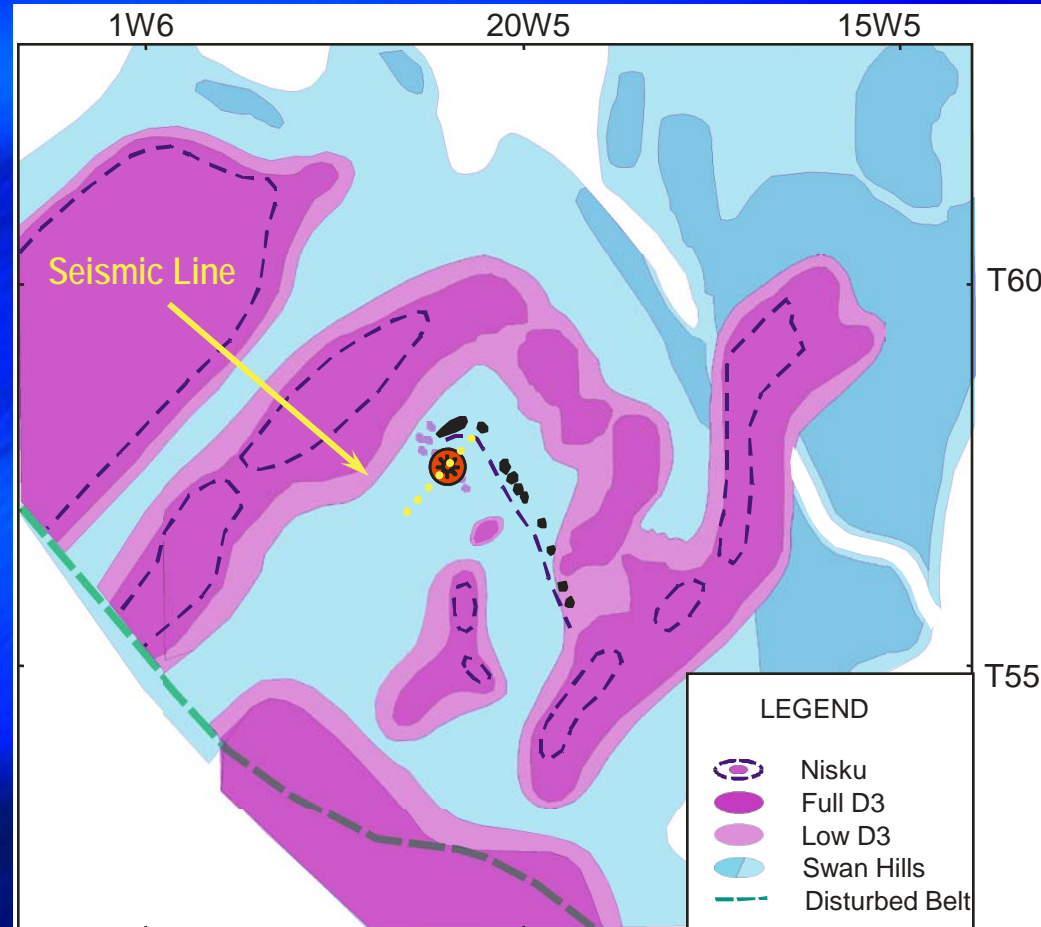
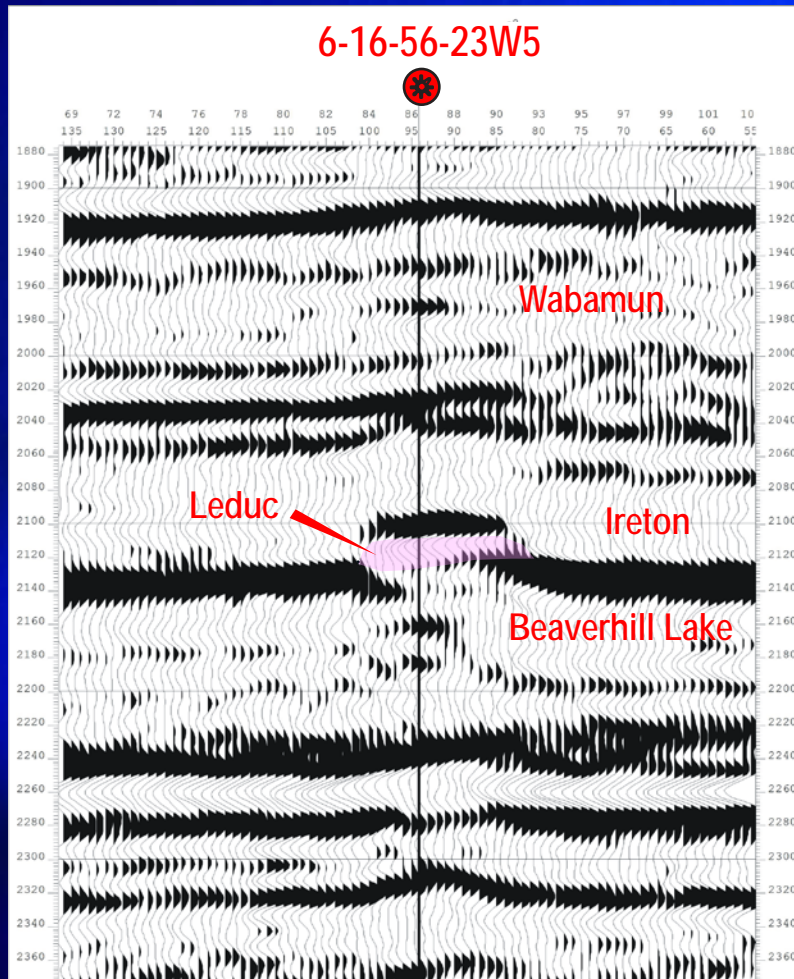
Generalized Regional Stratigraphy



Regional Setting



Wild River Leduc "Pinnacles"



Wild River Leduc “Pinnacles”

CHARACTERISTICS:

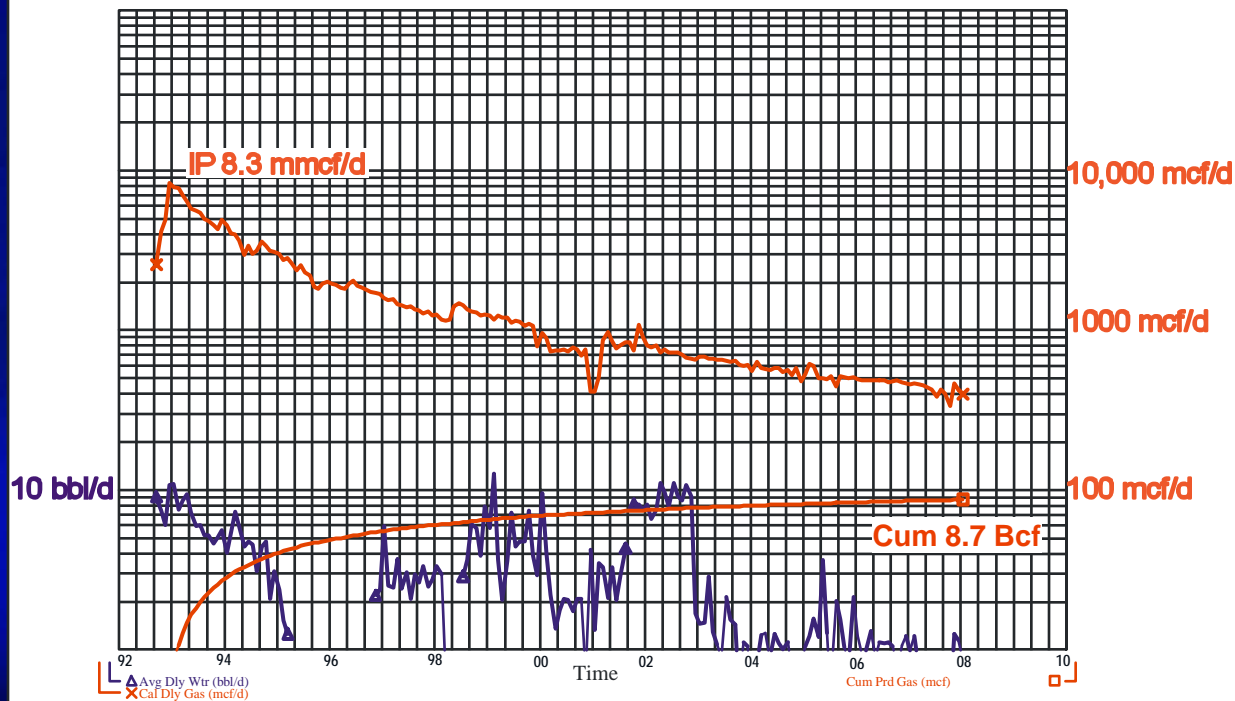
- 13,500 feet (4,115 meters) & over pressured @ 12,000 Psi (83 Mpa)
- 60 to 200 acres in size
- Gas saturated (Dry, sweet gas)
- Typical Lower/Middle Leduc facies (“Cairn”)

RESERVOIR:

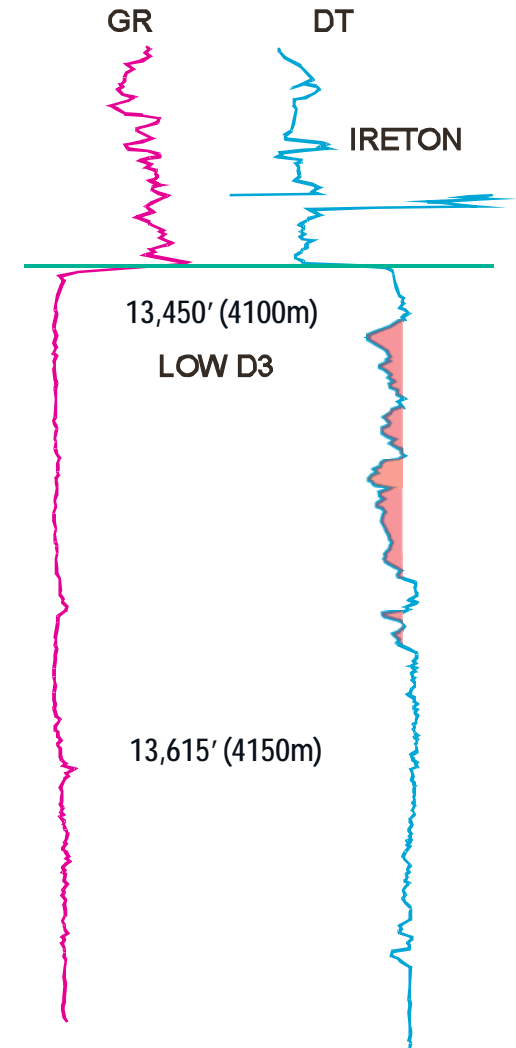
- Limestone reservoir with 3%-7% porosity & low Kh
- 310 feet (95 meters) thick
- 8-12 BCF in place per reef
- 11 reefs discovered to date in Wild River sub-basin.

Wild River Leduc "Pinnacles"

6-16-56-23W5



6-16-56-23W5



Wild River Leduc "Pinnacles"



15-19-56-23W5 – 13,370' (4075m)

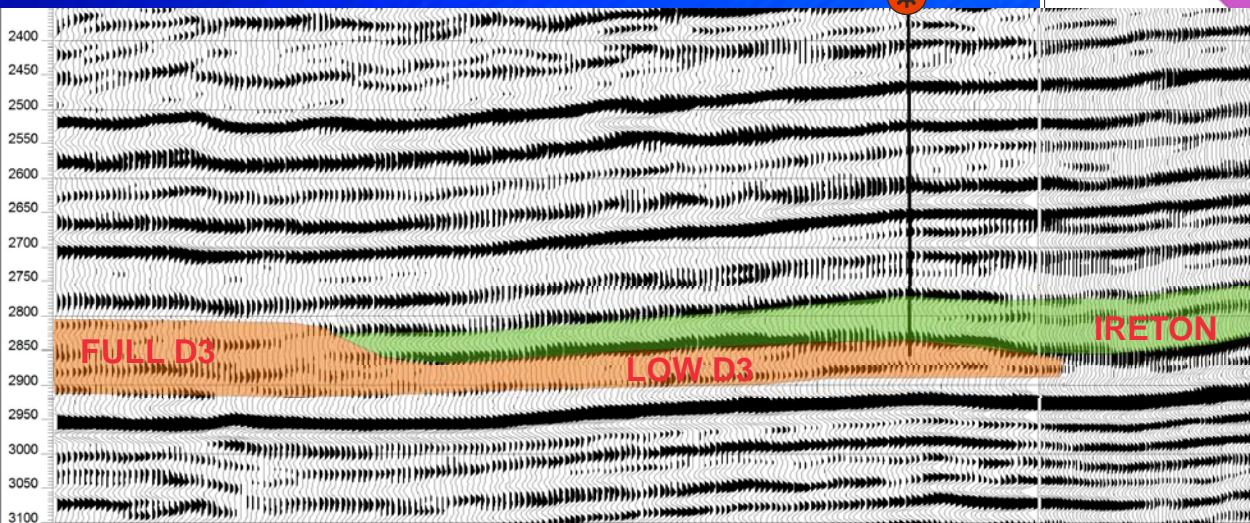
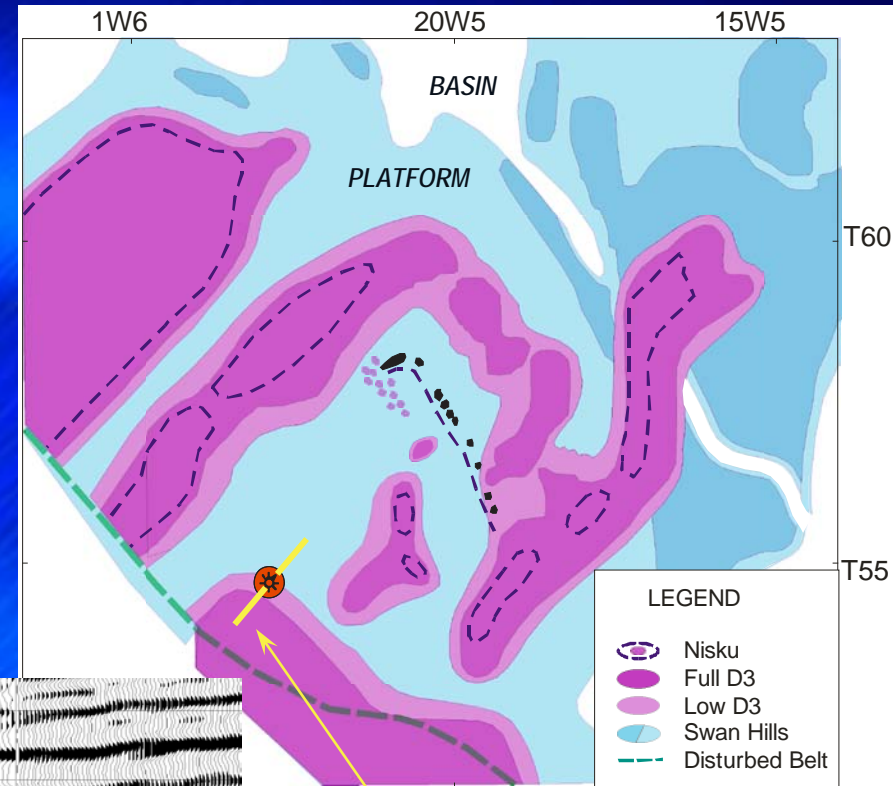


15-19-56-23W5 – 13,385' (4080m)

Gregg Lake Low Leduc Margin

Buildup at Platform Margin

7-7-53-26W5



Seismic Line

Gregg Lake Low Leduc Margin

CHARACTERISTICS:

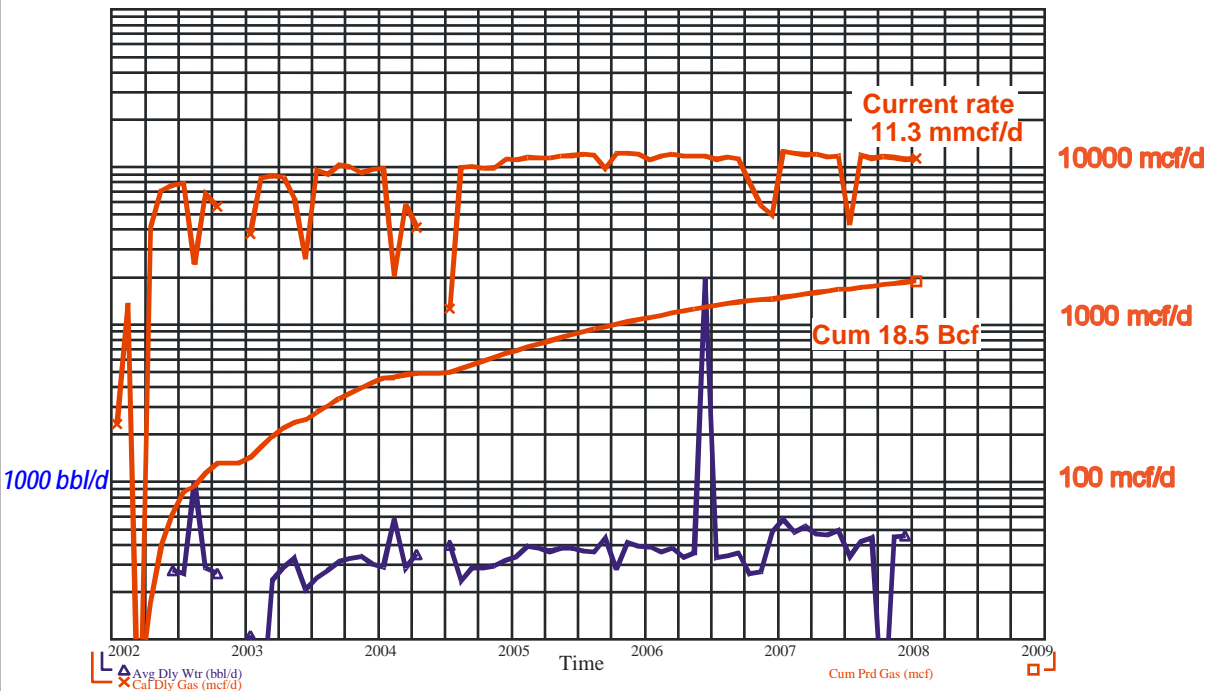
- Deep 17,000 feet (5,180 meters) & normal pressure (7,000 psi)
- Areally extensive (3,500 acres)
- Sour gas (23% H₂S) and “inactive” bottom water

RESERVOIR:

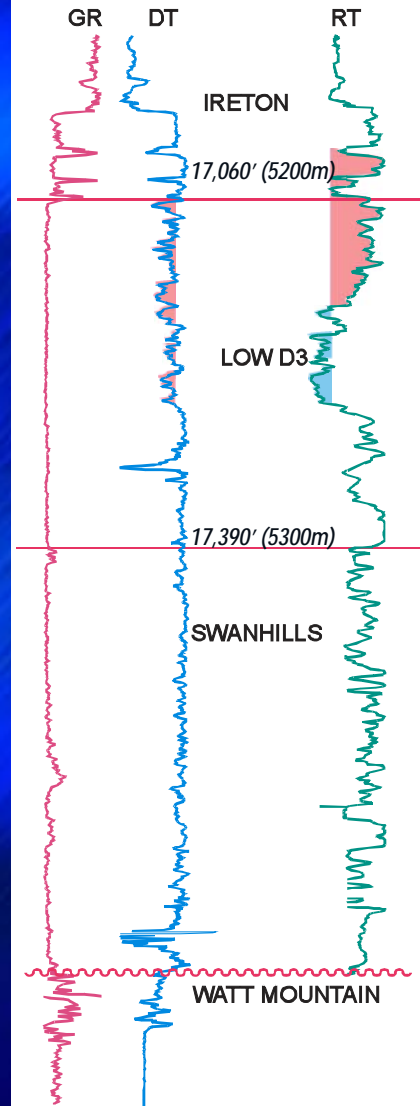
- Dolostone reservoir with 3% to 12% porosity, moderate to low Kh
- 100 – 130 feet (30 - 40 meters) of gas pay
- 150 BCF in place

Gregg Lake Low Leduc Margin

7-7-53-26W5



7-7-53-26W5



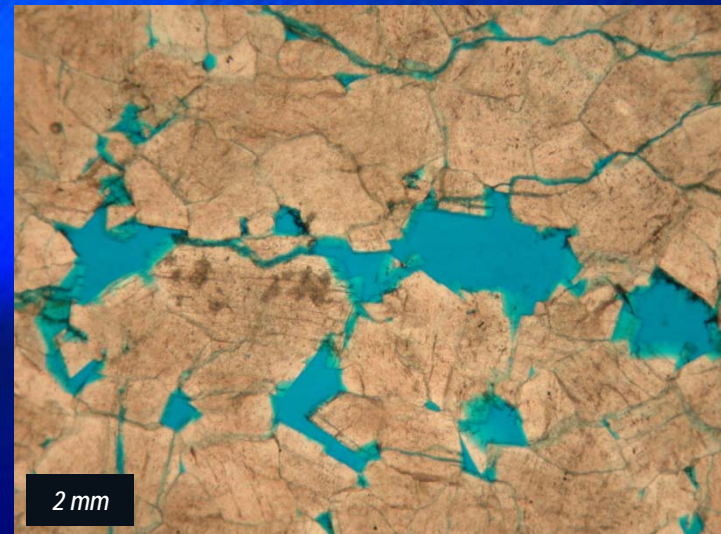
Gregg Lake Low Leduc Margin



7-7-53-26W5 – 17,170' (5233m)



7-7-53-26W5 – 17,190' (5240m)



7-7-53-26W5 – 17,170' (5233m)

Wild River Nisku Reefs

PATCH REEFS AND SHOALS

8-14-57-23W5

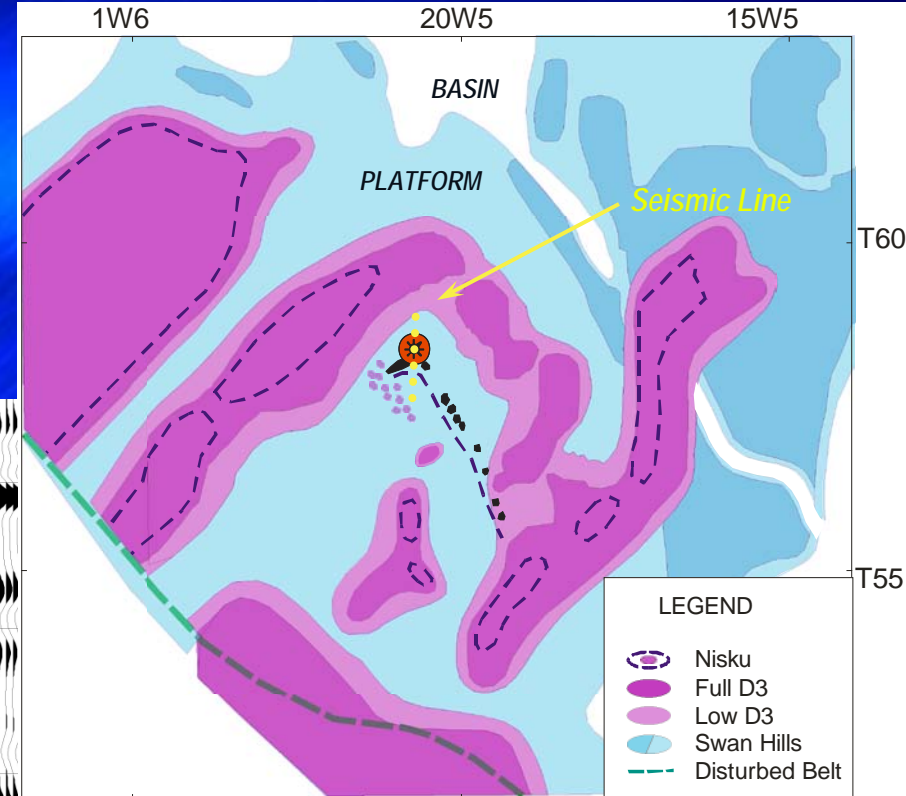


WABAMUN

D2 REEF

IRETON

BHLK



Wild River Nisku Reefs

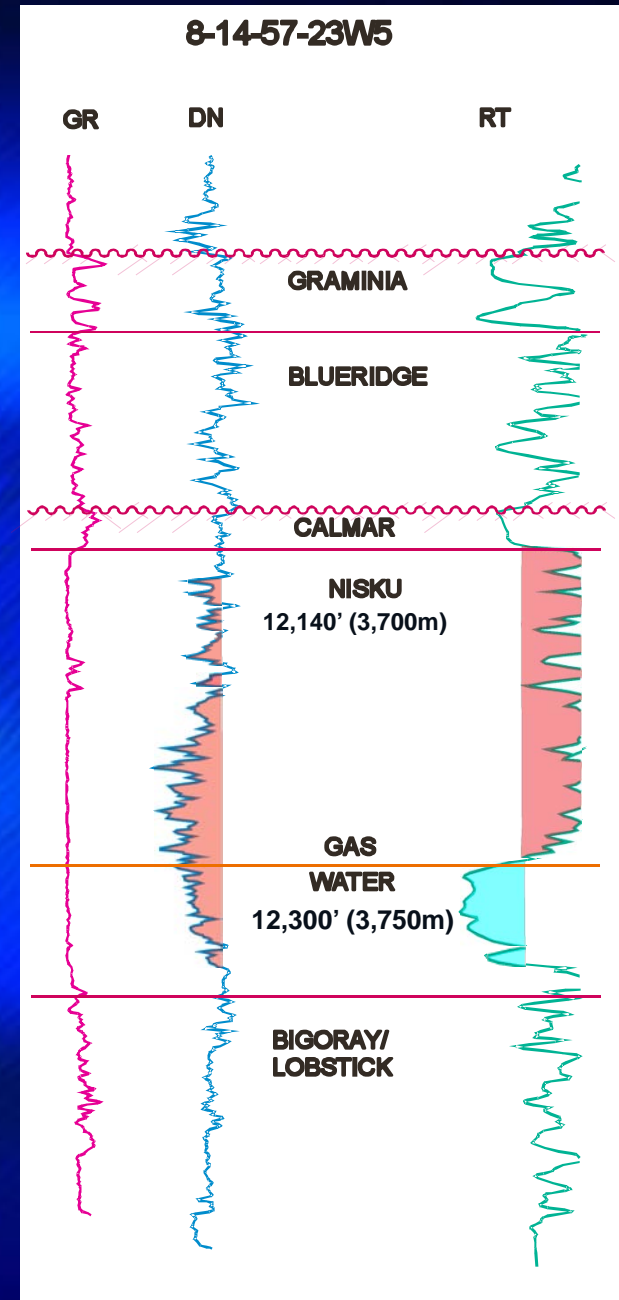
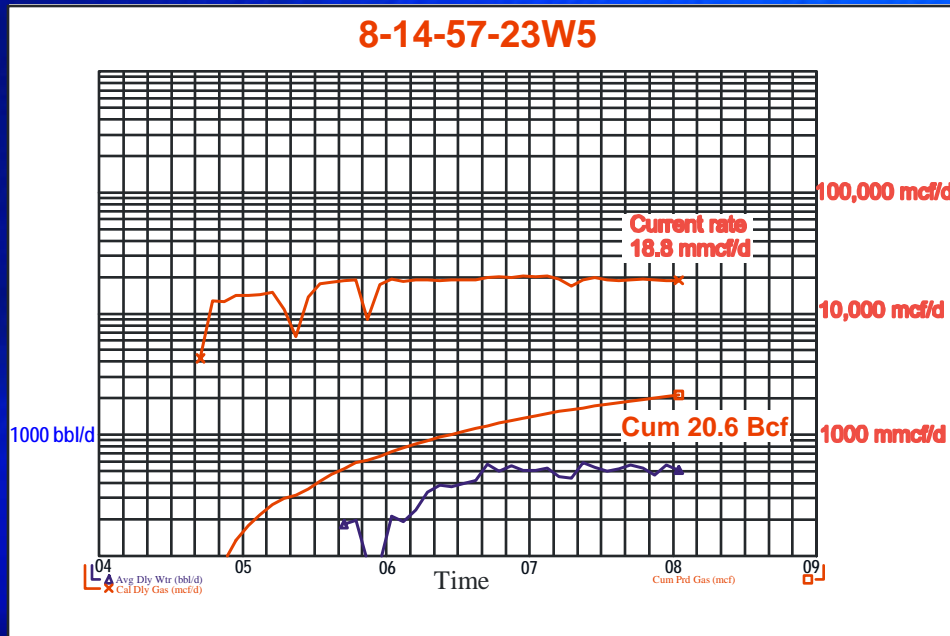
CHARACTERISTICS:

- 12,140 feet (3,700 meters) depth
- “Patch” reef and shoals
- Range in size from 100 to 1,200 acres
- Sour gas (12% to 28% H₂S) and “inactive” bottom water

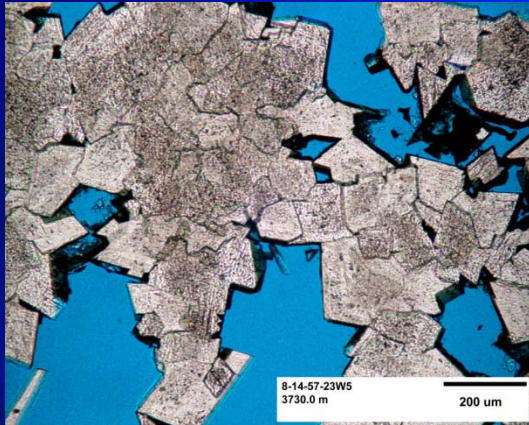
RESERVOIR:

- Dolostone reservoir up to 20% porosity, excellent Kh
- 80 – 245 feet (24 - 75 meters) of gas pay
- Best reef Nisku E Pool (Fairborne discovery) has 77 BCF of gas-in-place

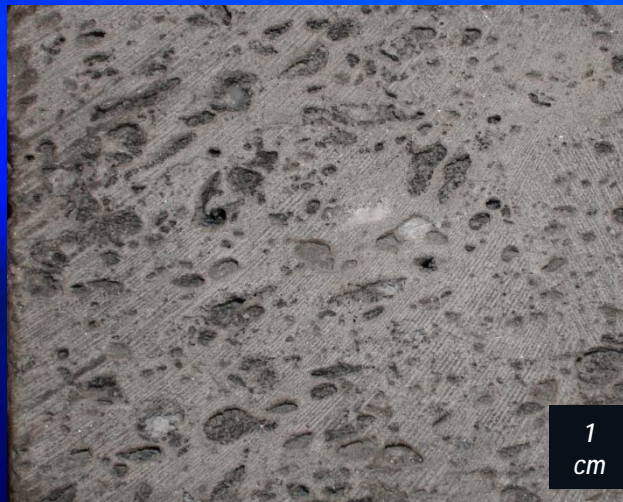
Wild River Nisku Reefs



8-14-57-23W5 Cecilia Nisku E



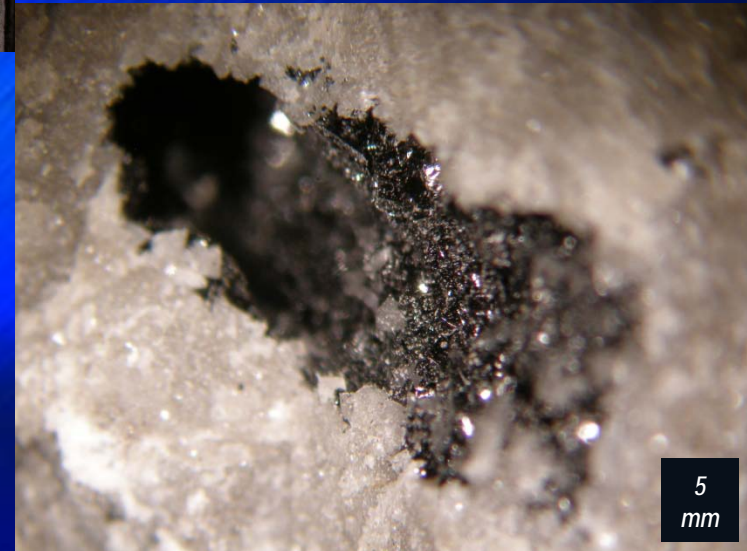
2-2-57-22W5 Cecilia Nisku A Pool



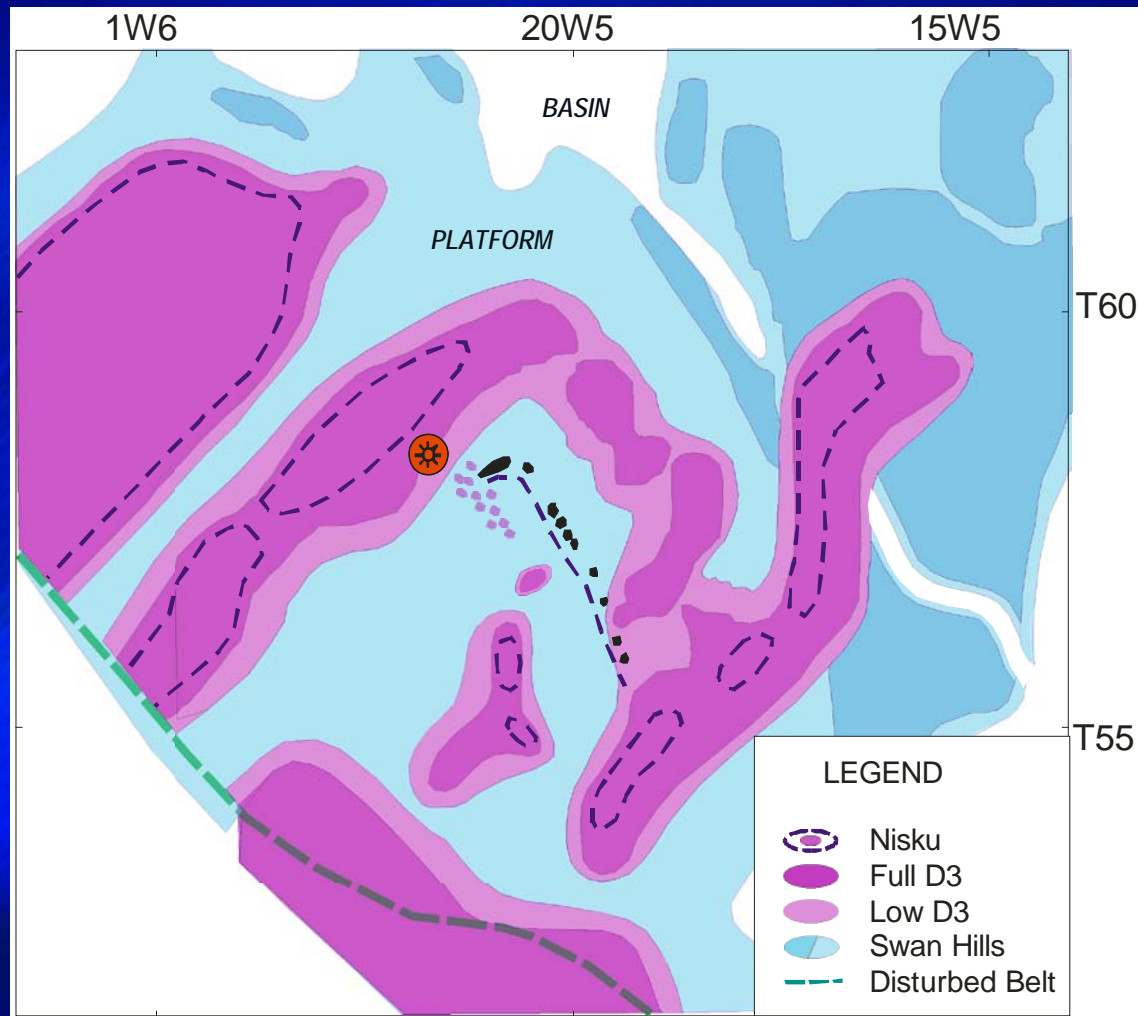
Wild River Nisku



2-2-57-22W5 Cecilia Nisku A Pool



Wabamun - Berland River



Wabamun - Berland River

CHARACTERISTICS:

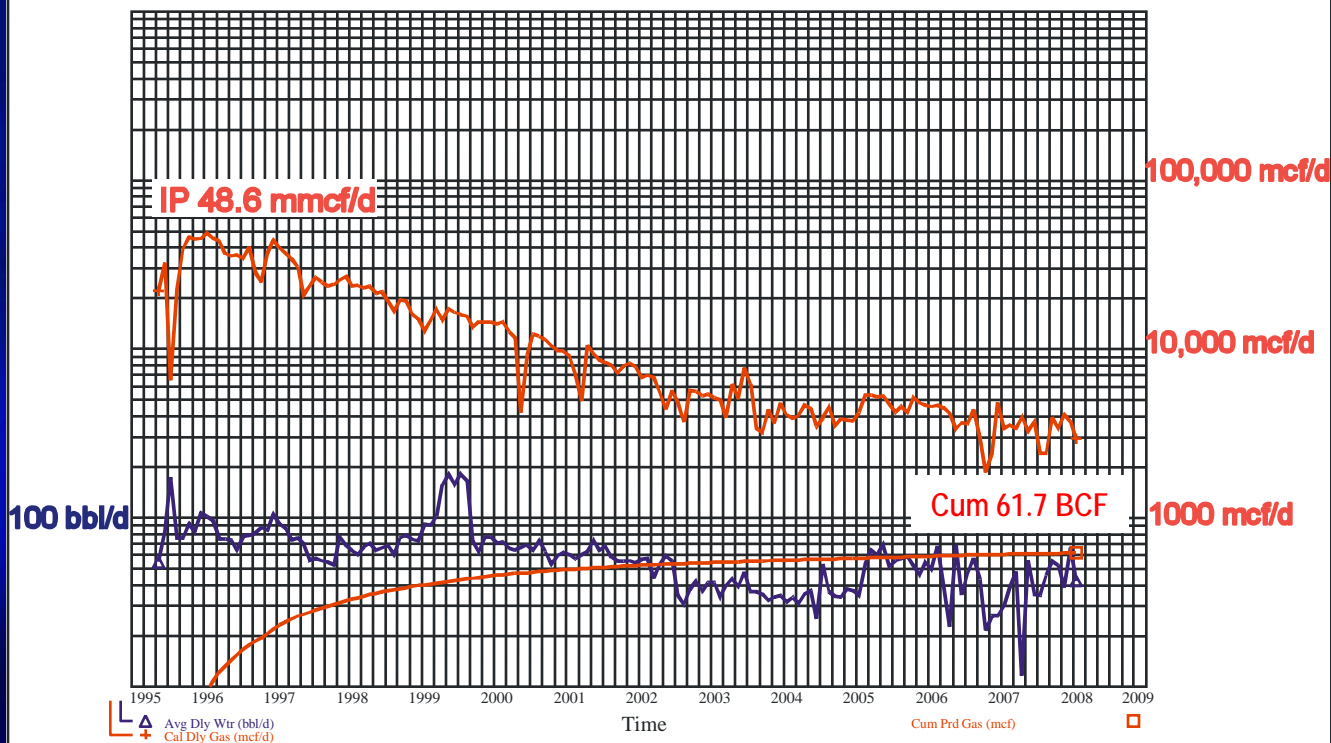
- 12,140 feet (3700 meters) depth
- Normal faults
- 2,700 acres in size
- Sour gas (17% H₂S) and “inactive” bottom water

RESERVOIR:

- Dolostone reservoir up to 20% porosity, excellent Kh
- 130 feet (40 meters) of gas pay
- 115 BCF of gas-in-place
- Cumulative Production 62 BCF

Wabamun – Berland River

7-5-59-24W5



7-5-59-24W5

GR

DT

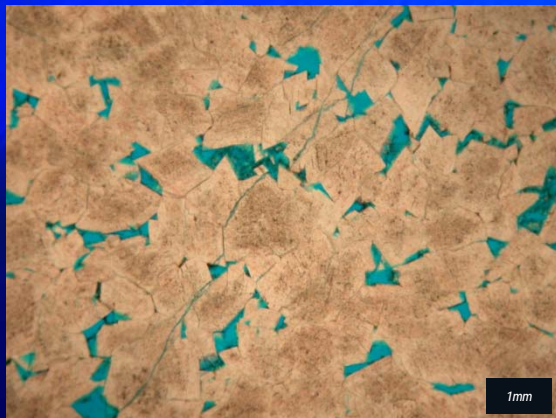
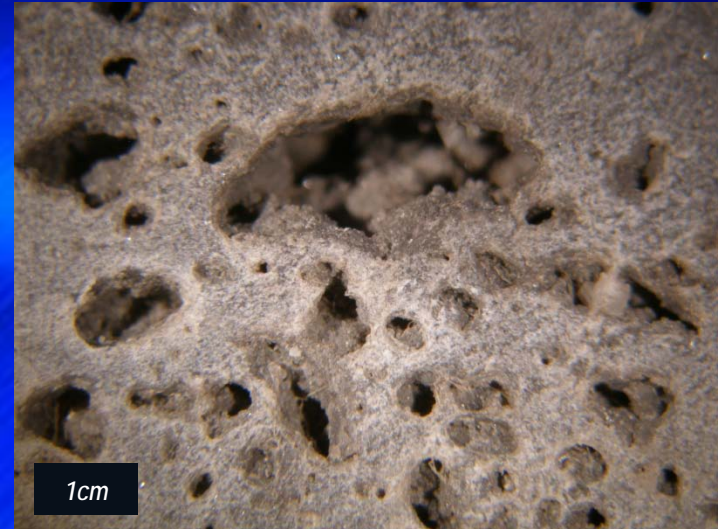
EXSHAW

WABAMUN

11,810' (3600m)

12,140' (3700m)

Wabamun – Berland River



7-5-59-24W5 – 11,883'(3622m)

"Why Were These Reservoir Opportunities Initially Overlooked?"

- Incorrect geophysical and petrophysical interpretation – *Gregg Lakes Leduc*
- "The Reservoir is too tight and limited" – *Wild River Leduc*
- "I cannot map these reservoirs with seismic" / "I guarantee it will be wet" – *Wabamun at Berland River and Wild River Nisku.*
- Remote areas, little infrastructure – *all of these prospects*
- "Gas prices are low and will never recover" – *all of these prospects*

Summary

- The four discoveries described are all different play types.
- Conventional wisdom said they were unlikely to exist.
- **Keys to these successes:**
 - Knowledge of regional depositional and diagenetic systems
 - Quality seismic data
 - “ENTREPRENURIAL COURAGE” and luck