



North American Shale Gas Overview

Northeast Energy & Commerce Association - NECA

September 22, 2009 - Gerhard Pflug

Forward Looking Information *

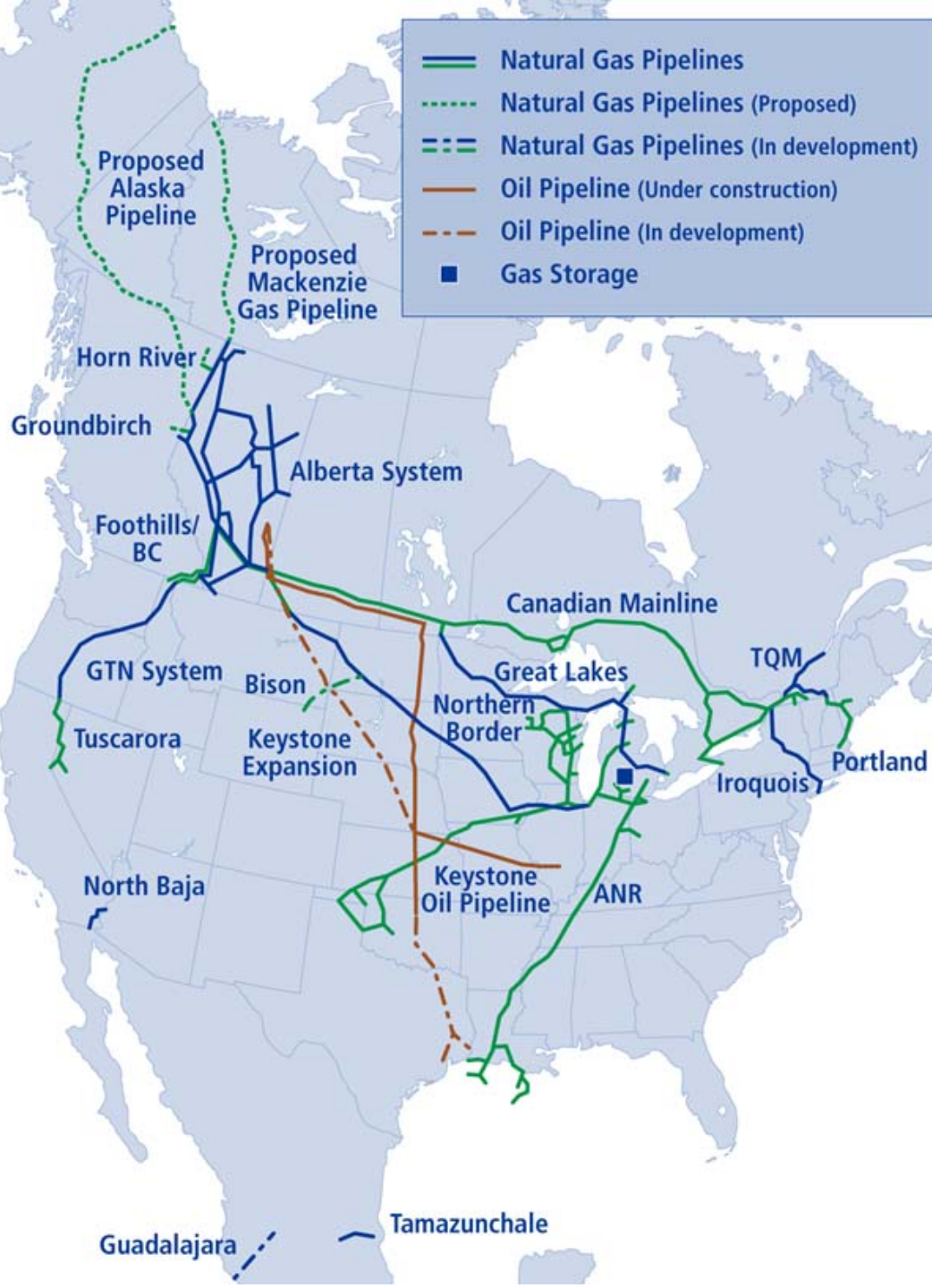


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Agenda

- Introductory Remarks
- Shale Gas “101”
- WCSB - Horn River and Montney
- U.S. Lower 48 Overview
- Marcellus Shale

Pipeline Assets



- 59,000 km (36,500 mi) of wholly owned natural gas pipeline
- Interests in an additional 7,800 km (4,800 mi) of natural gas pipeline
- 250 Bcf of regulated natural gas storage capacity
- Unparalleled connections from traditional and emerging basins to growing markets
- Average daily volume of approximately 15 Bcf
- Keystone oil pipeline 1.1 million Bbl/d

<http://www.transcanada.com>

Shale gas changes everything...

*“The successful commercial production of natural gas from shales, which comprise approximately 50 % of the sedimentary rock record, is nothing short of **revolutionary** and the most exciting technical achievement of petroleum engineering and the geosciences in the last 60 years, inevitably leading to major **structural** changes in the natural gas industry”*

George P. Mitchell:

entrepreneur, oilman & philanthropist

As founder of Mitchell Energy,
George Mitchell is the undisputed
father of the North American shale
gas revolution; he embodies the best
traditions of American ingenuity,
determination and value creation.*

*Through experimentation and
perseverance, it took him only 18
years to turn the Barnett Shale play
into an “overnight” success and in
so doing create a new industry!*

** Sold to Devon Energy for \$3.5 Billion in 2001*



Shale gas is making headlines...

U.S. Gas Fields Go From Bust To Boom!

A massive natural-gas discovery here in northern Louisiana heralds a big shift in the nation's energy landscape. After an era of declining production, the U.S. is now swimming in natural gas.

- *Wall Street Journal*

The Haynesville Times

November 12, 2008

Petrohawk Posts FIVE Haynesville IPs Over 15 Mmcfe/d!

Company Increases Risked Haynesville Shale Potential to 11.9 Tcfe

Reuters Sept. 10, 2009

Encana's Horn River Shale Gas Find
Among North Americas Biggest

THE AMERICAN OIL & GAS
REPORTER
MAY 2009

The "Better Business" Publication Serving the Exploration / Drilling / Production Industry

Marcellus Shale Play's
Vast Resource Potential
Creating Stir In Appalachia

The Burgess Shale* made headlines 100 years ago!



* Cambrian Age - 505 MYA

Mount Stephen: Burgess Shale – Yoho National Park

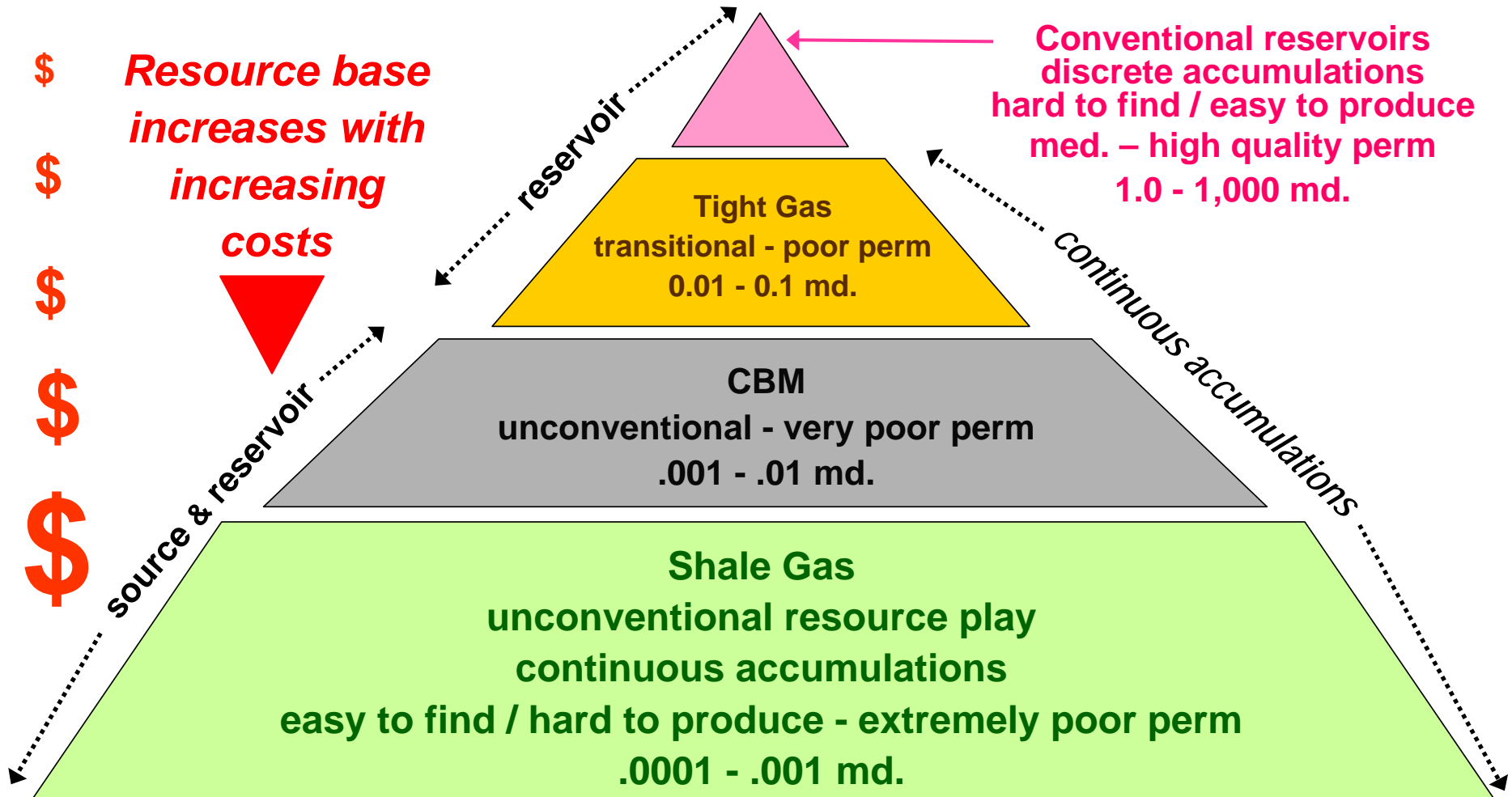


Charles Doolittle Walcott, former head of the Smithsonian Institute and the U.S.G.S. changed our understanding of the natural world.

Dismantling the gas resource pyramid...

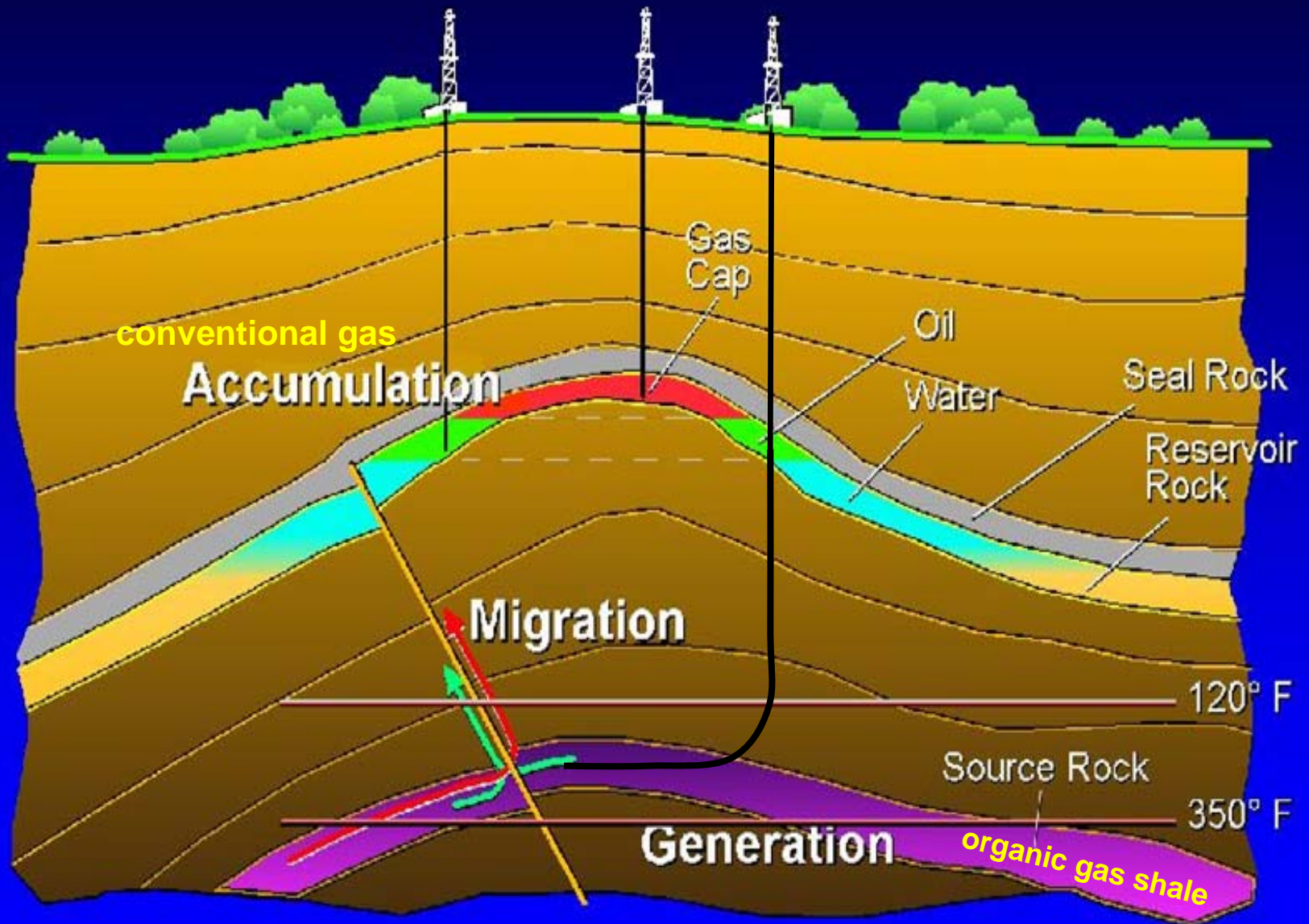


The Gas Resource Pyramid



Commercial success in shale gas is achieved through a “manufacturing” approach, utilizing economies of scale & the application of leading edge drilling & completion technology

Shale plays produce gas from the HC "source" rock



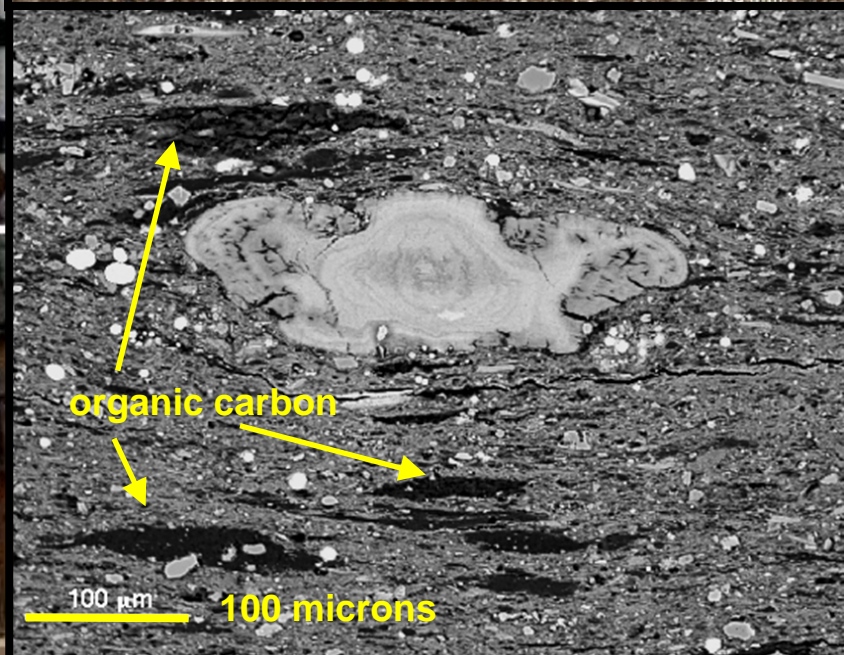
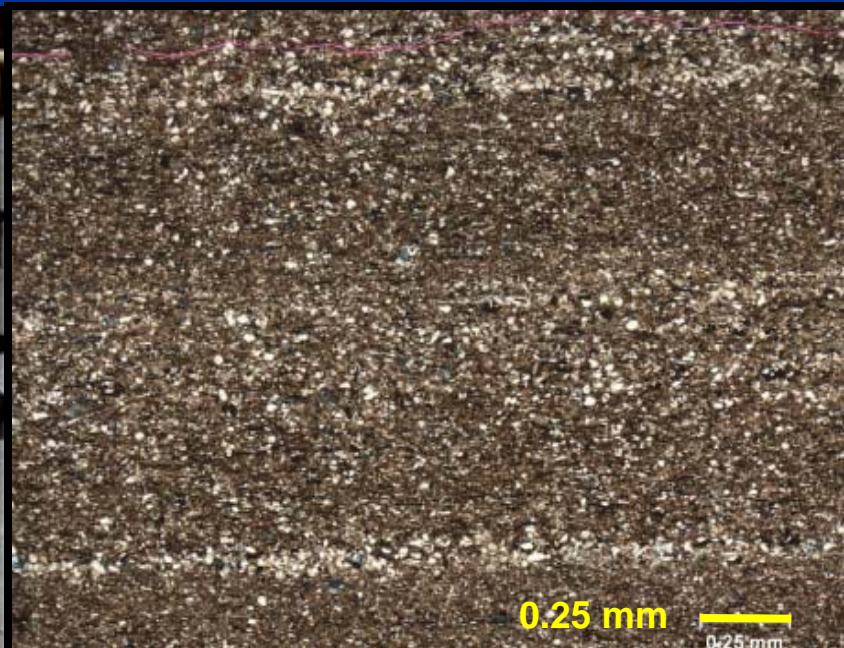
What is a gas shale anyway?

- **Extremely** fine grained marine sediments
- Have both **organic** (carbon) & **inorganic** (clay) component
- **Ultra low** porosity & permeability
- Shale is both HC **source rock** (NG “kitchen”) & **reservoir**
- Gas shales can be **thermogenic** (deep, heat & pressure)
- Gas shales can be **biogenic** (shallow, microbial by-product)
- Typically has **vast** amounts of **gas in place** (resource)
- Gas storage: both as **free** gas & **sorbed** gas
- Gas flow: **diffusion** (matrix) & **Darcy** flow (fractures)
- Production requires **high density** fracture network
- Carbonate (limestone) environment - “**pure**” shales
- Clastic (sandstone) environment – “**mixed**” shale assemblages
- Shale plays like other “**resource**” plays are easy to find but technically challenging & expensive to produce

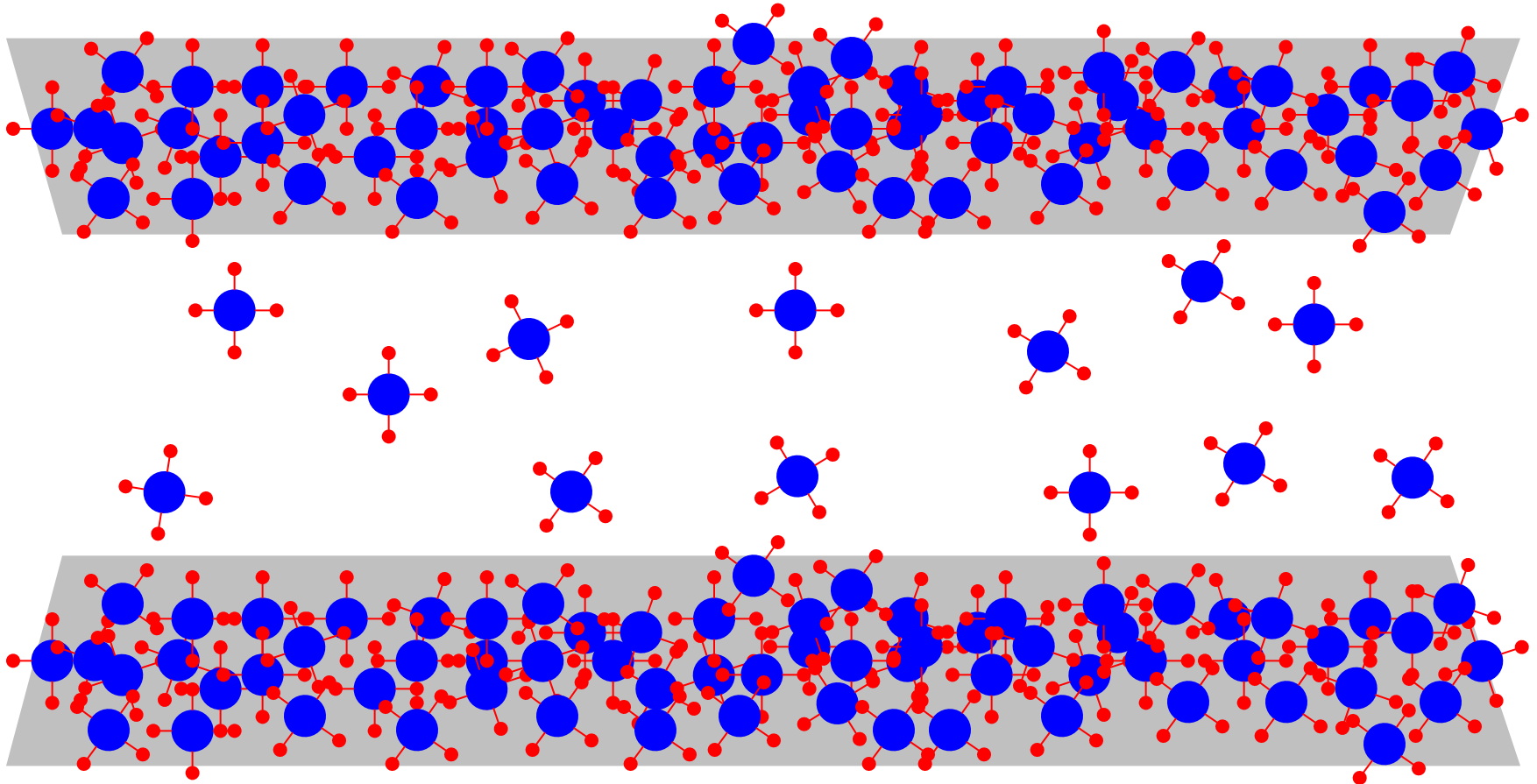


Organic Shales in Outcrop

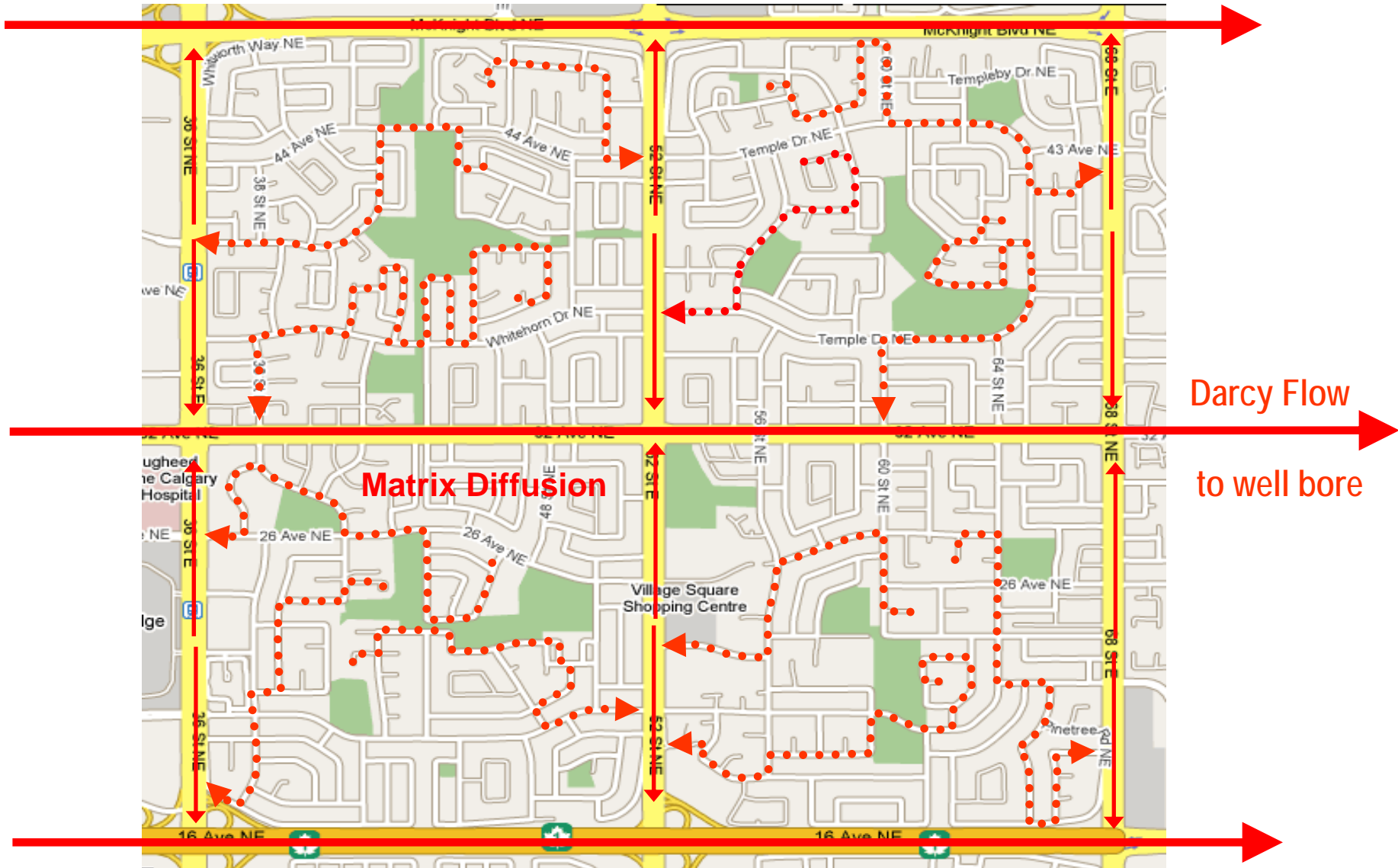
Black organic shales in core, under microscope & SEM



Shale Gas Storage: "Sorbed" vs. "Free" gas



Shale Gas Flow: Matrix "diffusion" vs. "Darcy" flow

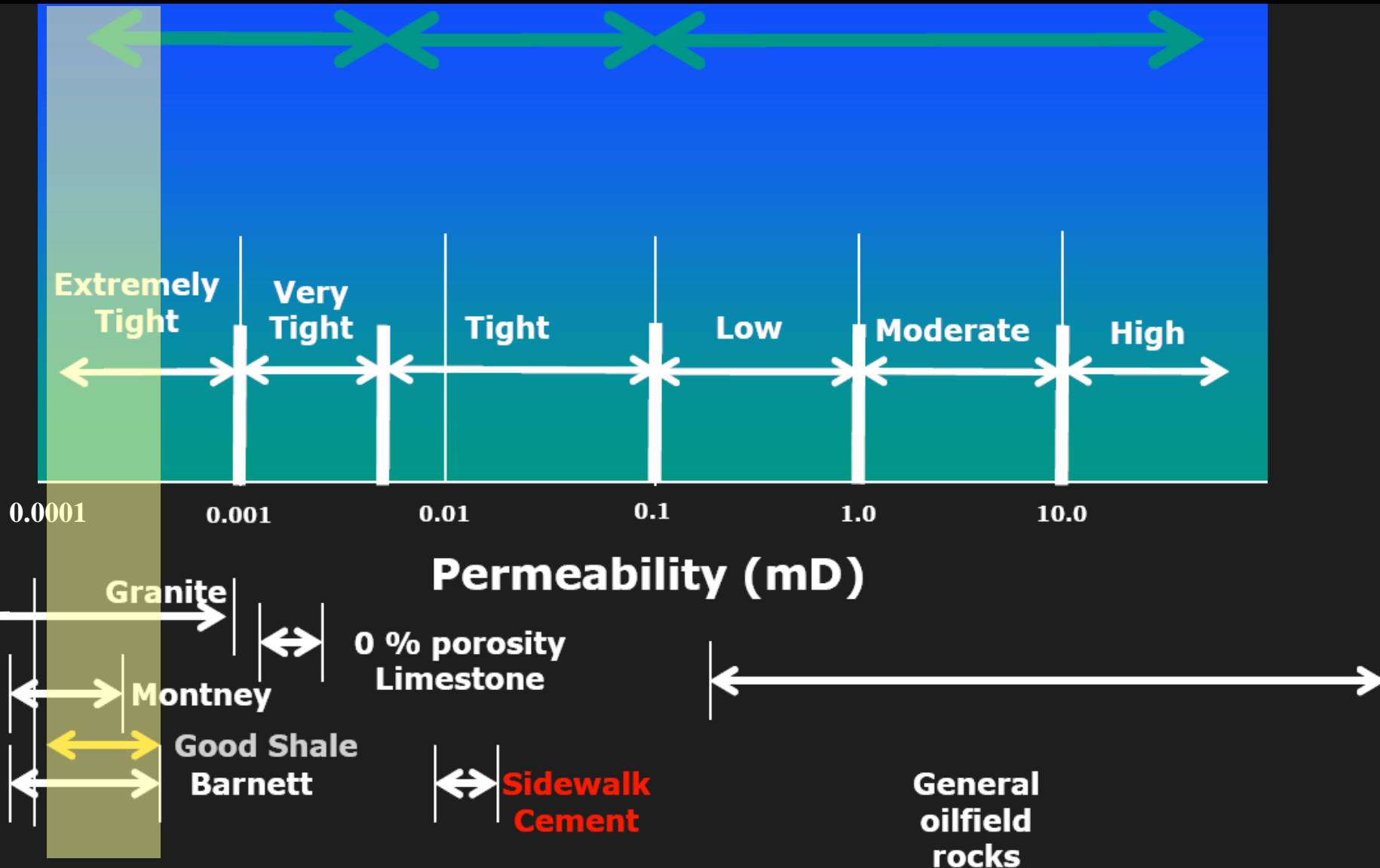


Permeability Comparisons

Shale Gas

Tight Gas

Conventional Gas



0.0001

0.001

0.01

0.1

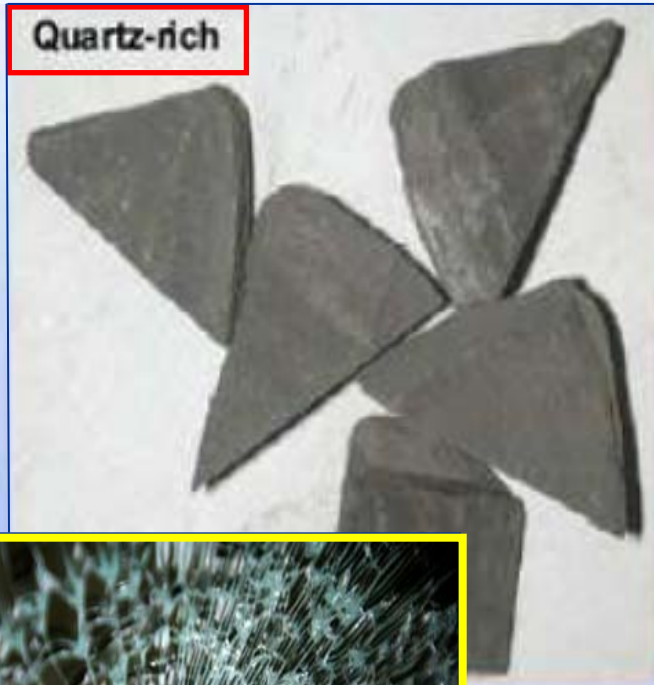
1.0

10.0

Permeability (mD)

Creating Permeability

Brittle: good

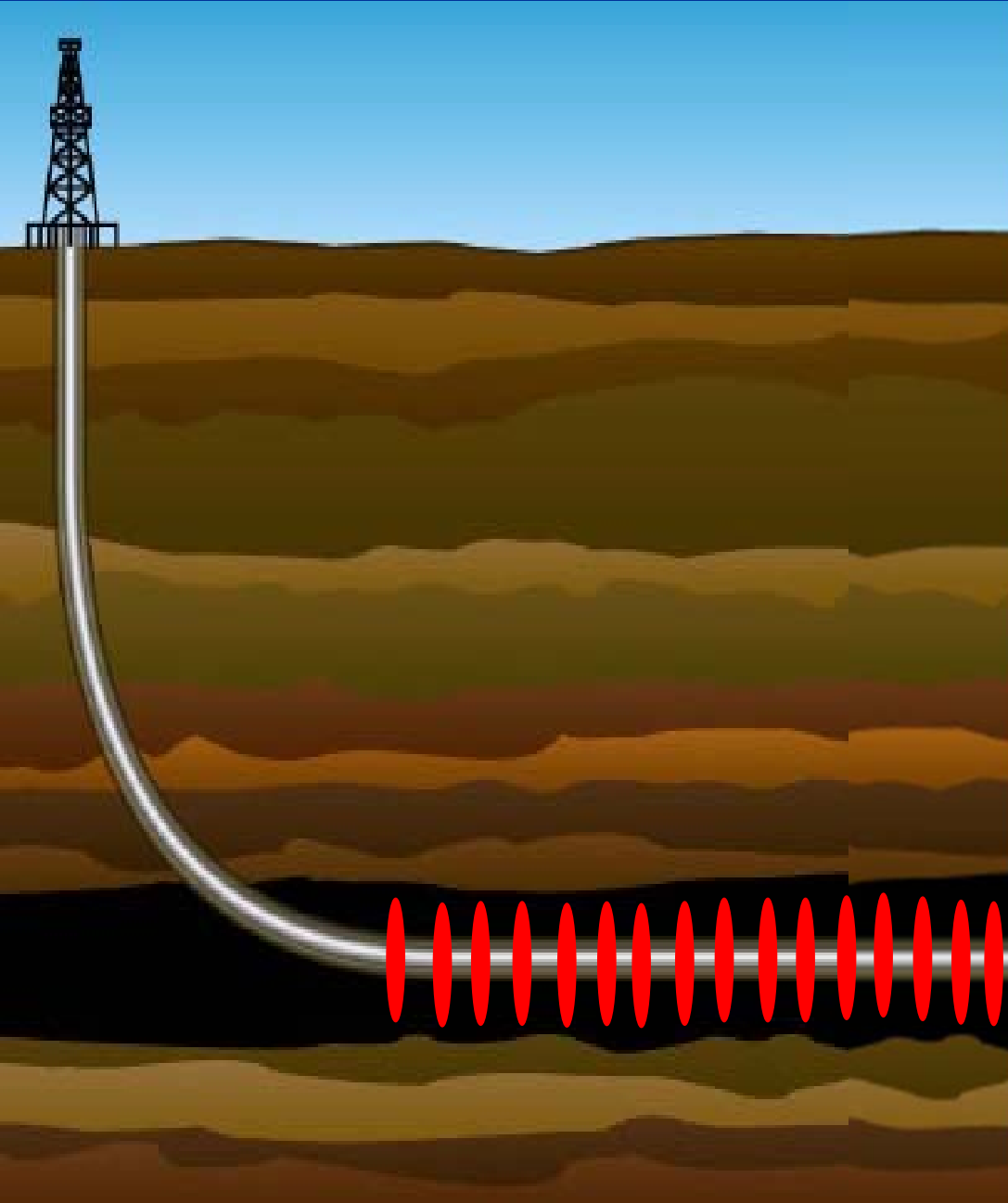


Ductile: bad

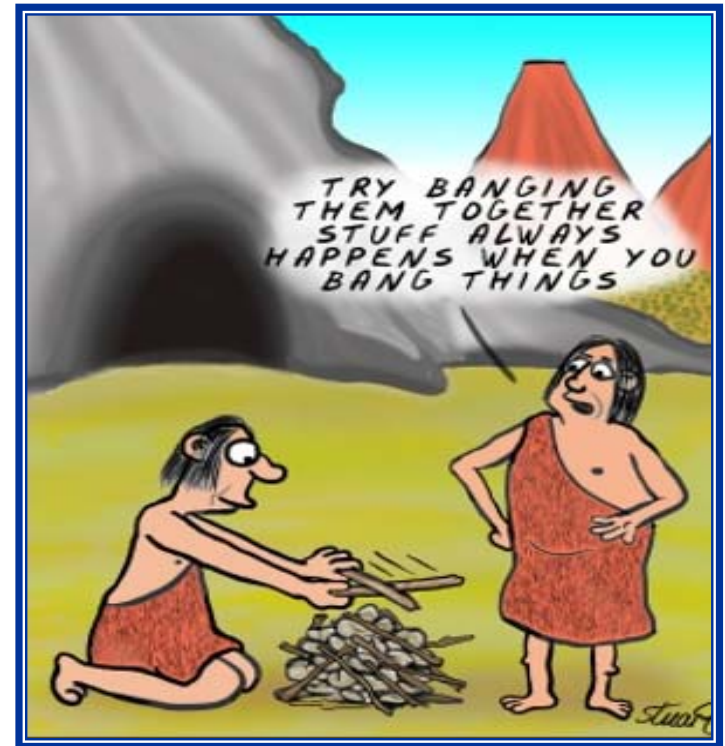


after Bustin & Ross

Drilling & Completions Breakthrough



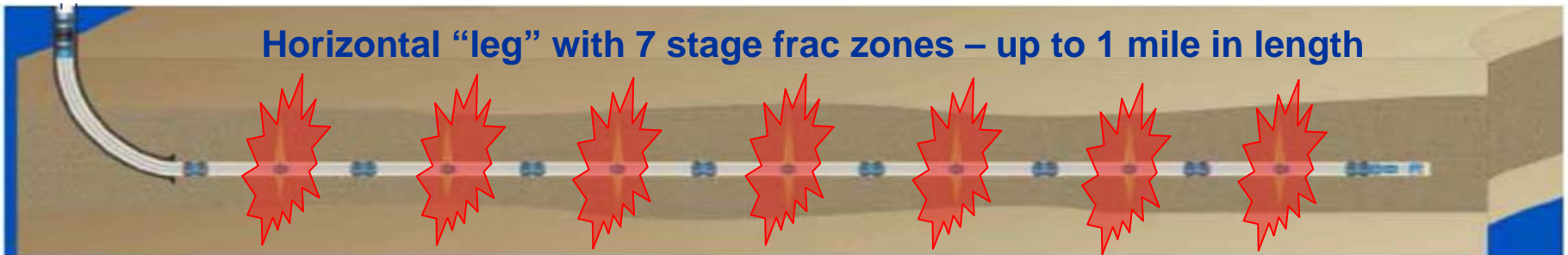
Horizontal drilling with laterals exceeding a mile in length in combinations with massive multi-stage hydraulic fracing (20 stages) has revolutionized the gas industry.



Horizontal Drilling & Multi-Stage “Slickwater” Fraccing

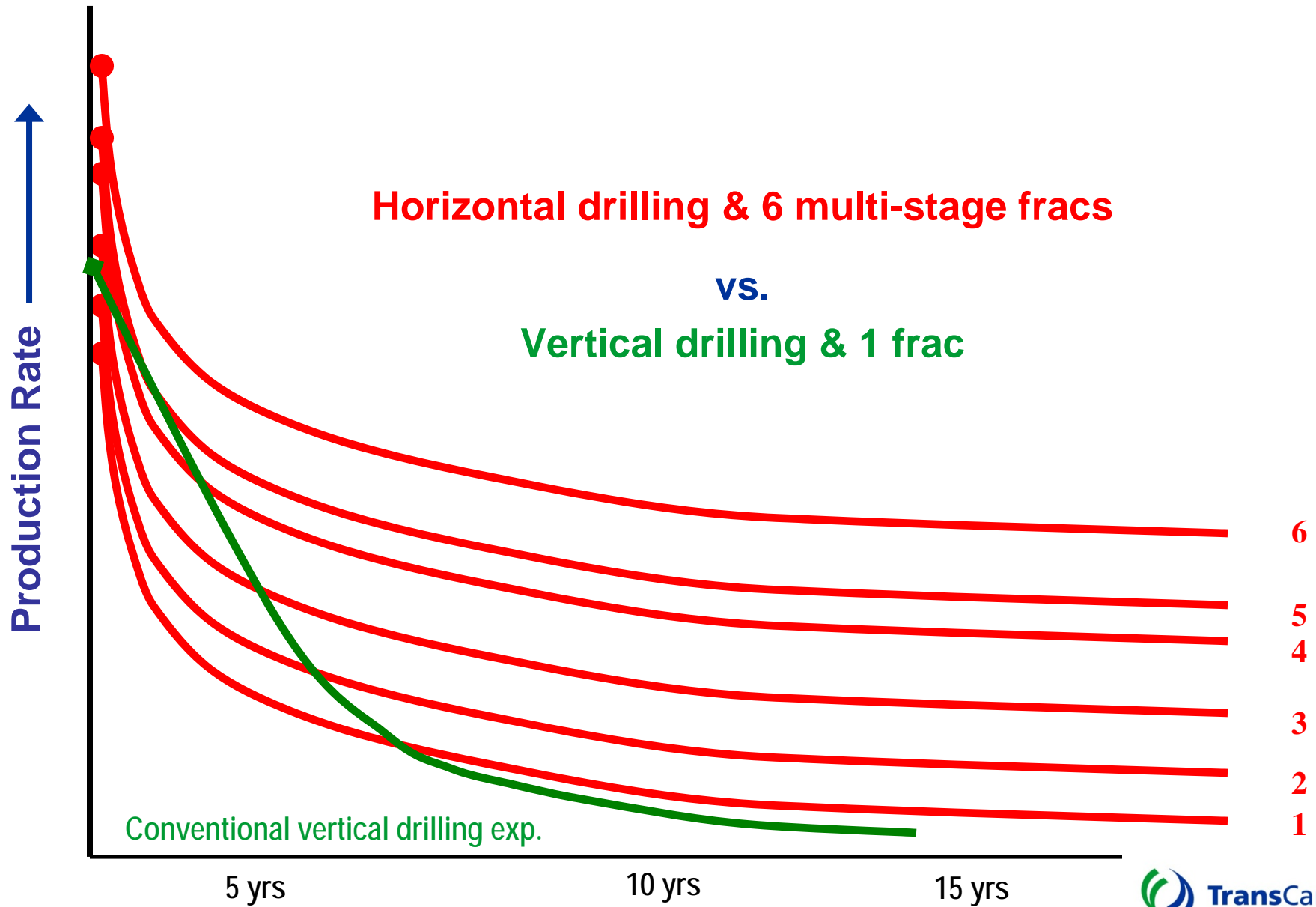


Horizontal “leg” with 7 stage frac zones – up to 1 mile in length



Requires 4 - 8 million gals. of water & 2,000 – 3,000 tonnes of sand

Production Decline: exponential vs. hyperbolic

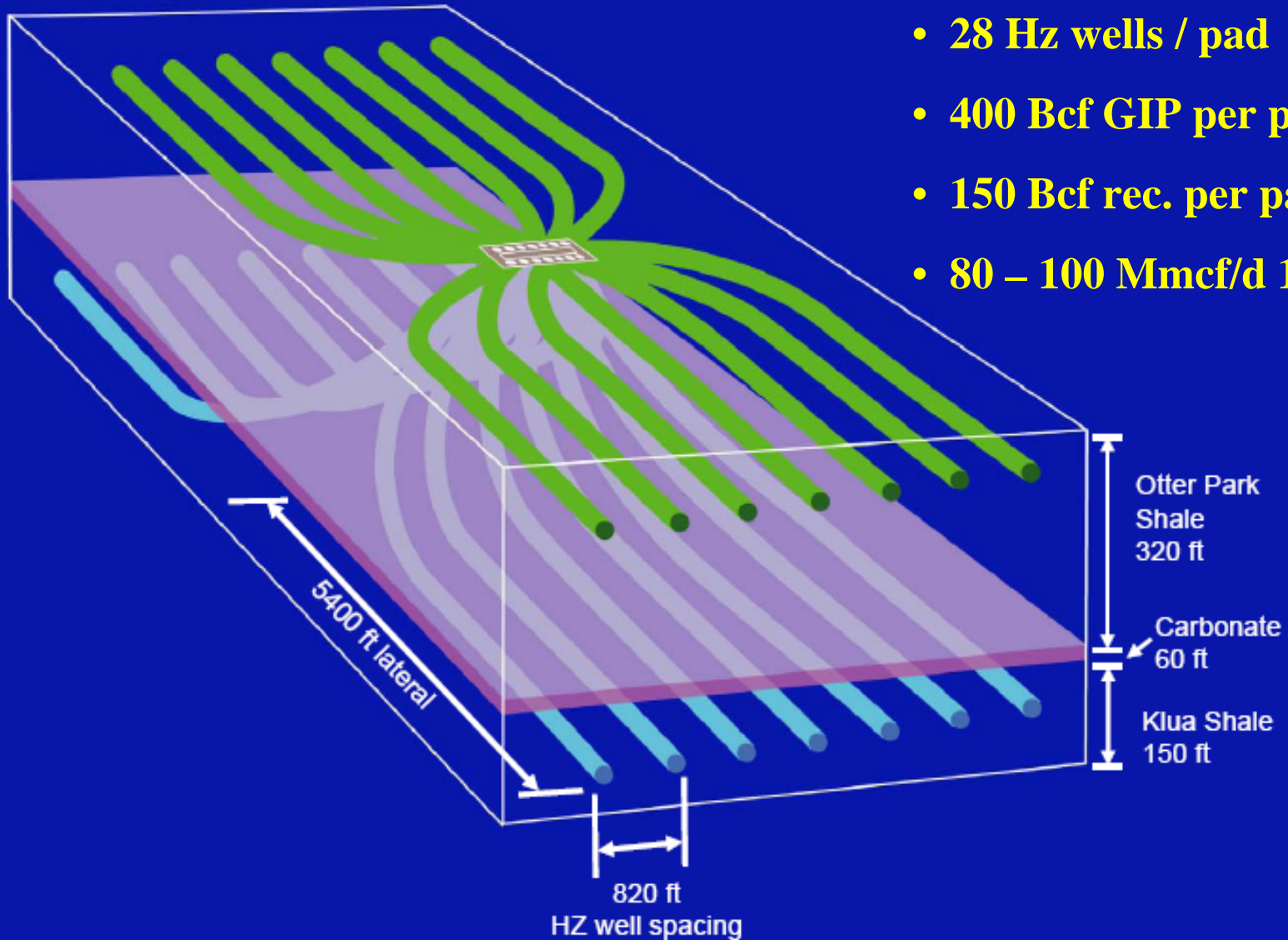


Conceptual Development Model – Apache: Horn River

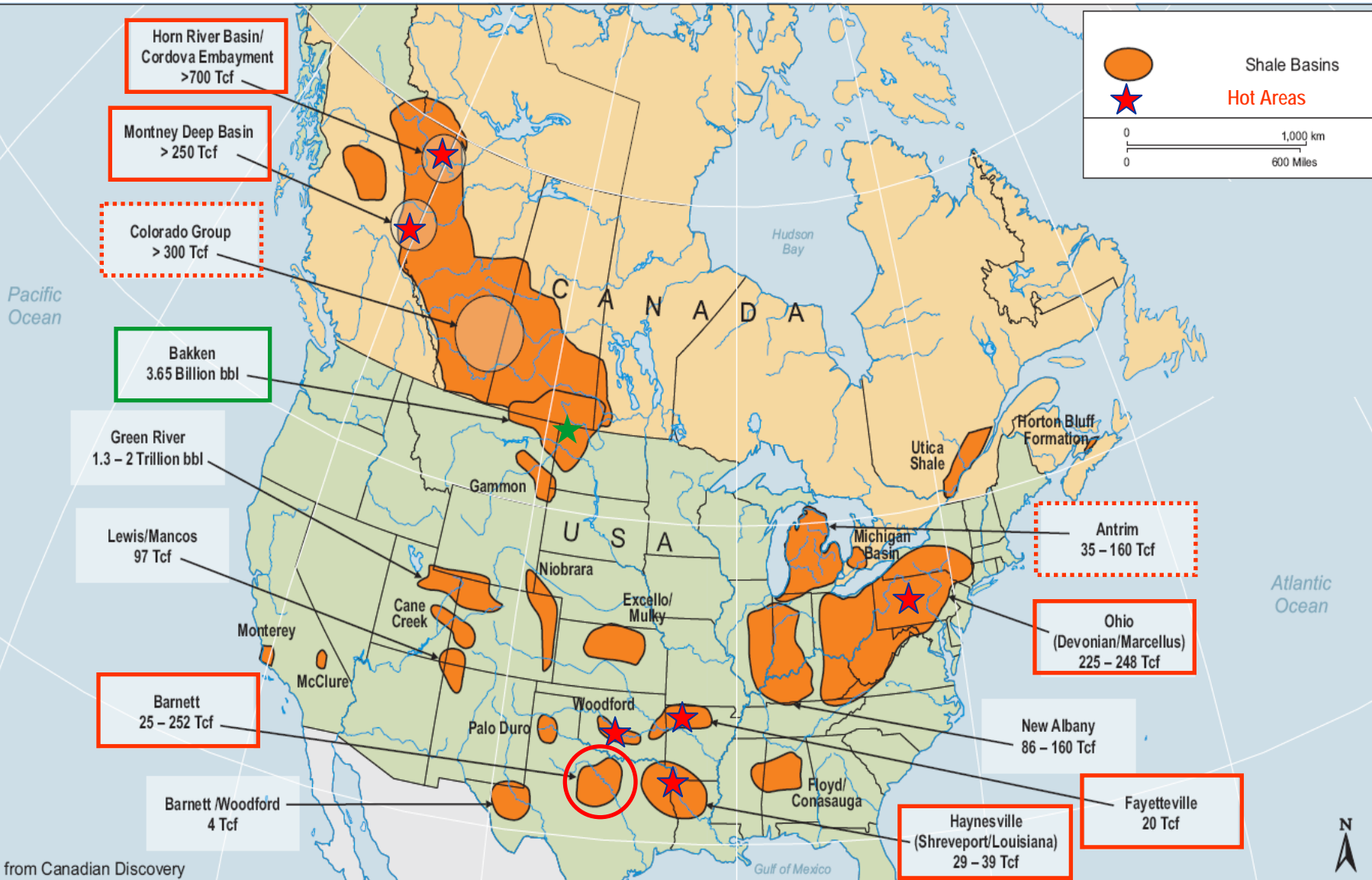
Drainage: 1 Pad (2.7 mi²)

Horn River - Apache Corp

- 28 HZ wells / pad
- 400 Bcf GIP per pad
- 150 Bcf rec. per pad
- 80 – 100 Mmcf/d 1st yr.



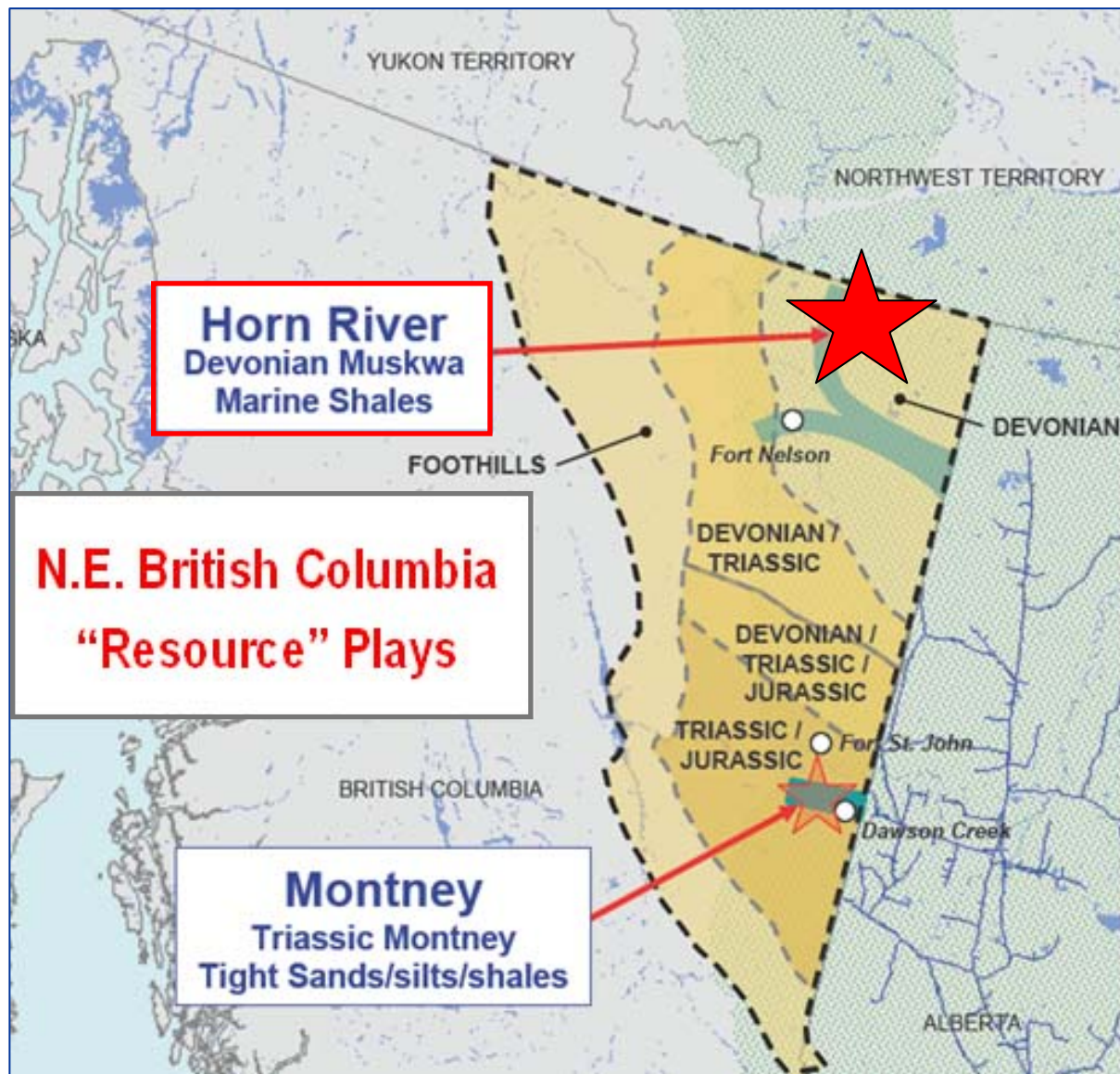
Emerging North American Shale Gas Plays



It all started with the Barnett

Modified from Canadian Discovery

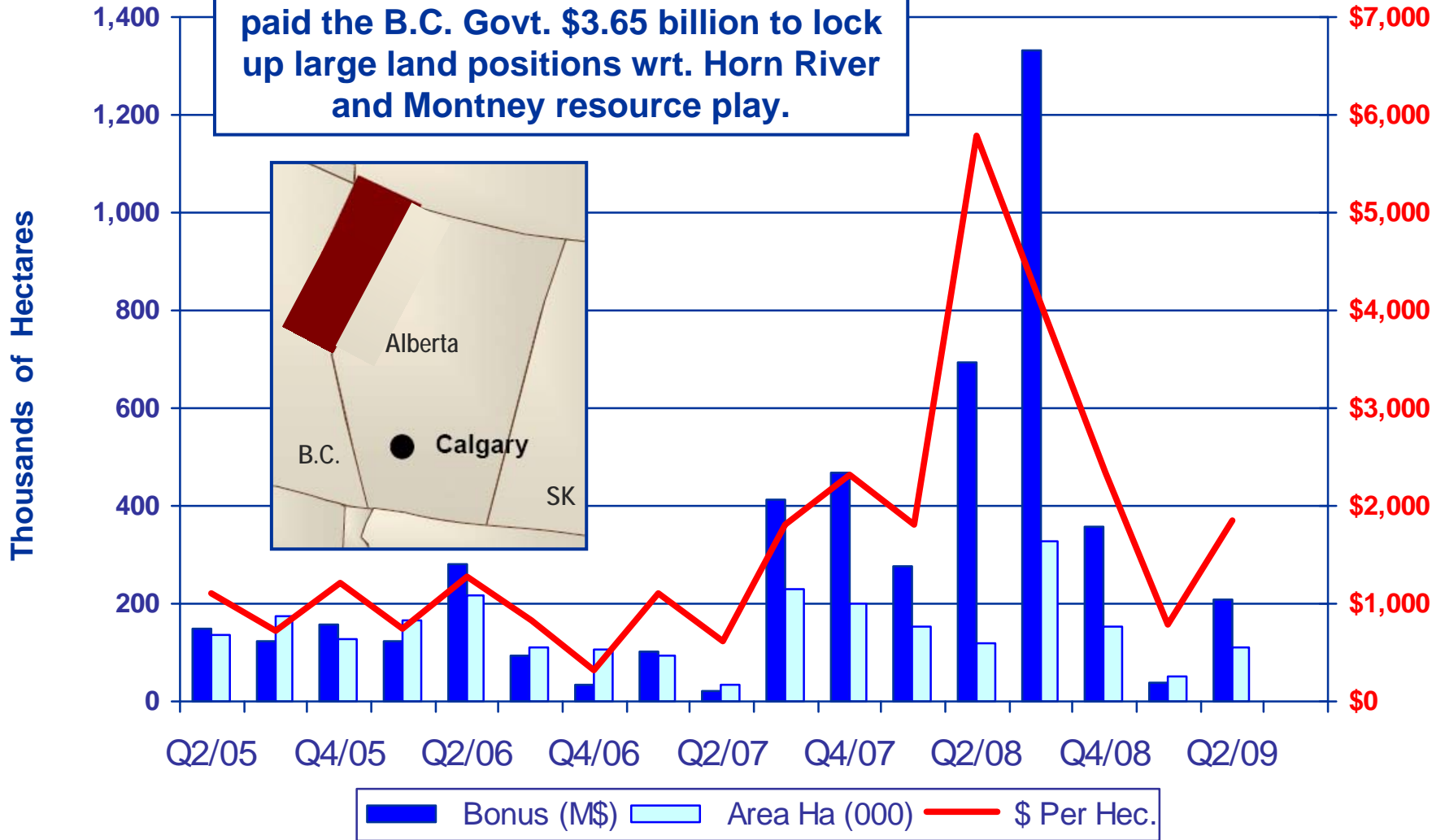
Horn River Shale Gas Play



AGE	NORTHEASTERN BRITISH COLUMBIA		
LATE DEVONIAN	BANFF		
	EXSHAW (BAKKEN EQUIV.)		
	BESA RIVER	KOTCHO	WABA-MUN
		TETCHO	
	TROUT RIVER		WINTER-BURN
KAKISA / REDKNIFE	JEAN MARIE		
MIDDLE DEVONIAN	IRETON		
	FORT SIMPSON		
	SLAVE WATER POINT -WAYS	MUSKWA	HORN RIVER
	WATT MT	OTTER PARK	
	SULPHUR POINT		
	(Presqu'île)	KLUA	
	UPPER KEG RIVER	EVIE	
	LOWER KEG RIVER		
	CHINCHAGA		
	OLDER DEVONIAN STRATA NOT SHOWN		
EARLY			

Robust N.E. British Columbia P&NG Landsales

Since 2006, at least 19 companies have paid the B.C. Govt. \$3.65 billion to lock up large land positions wrt. Horn River and Montney resource play.



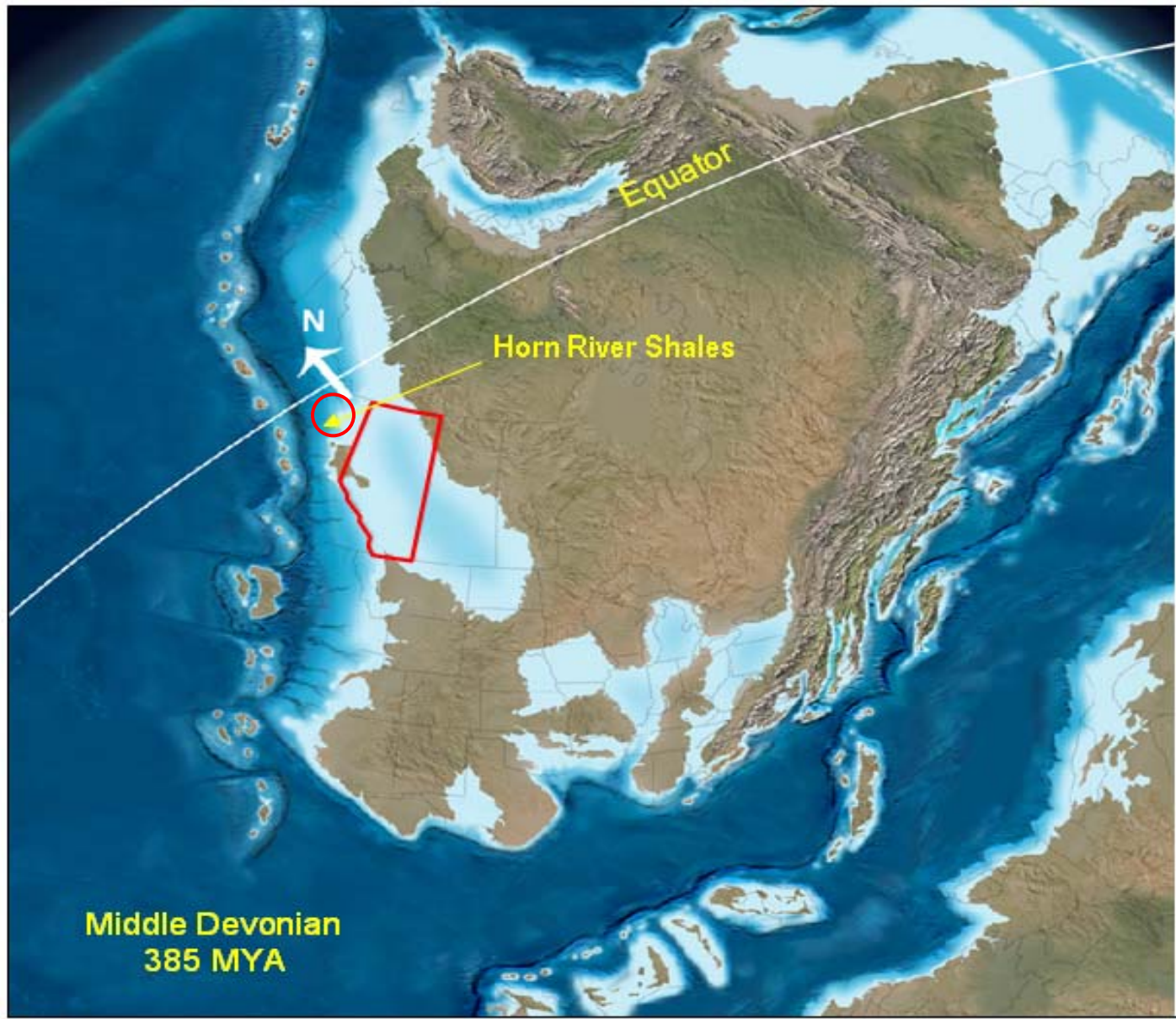


Swampy muskeg terrain requires winter drilling



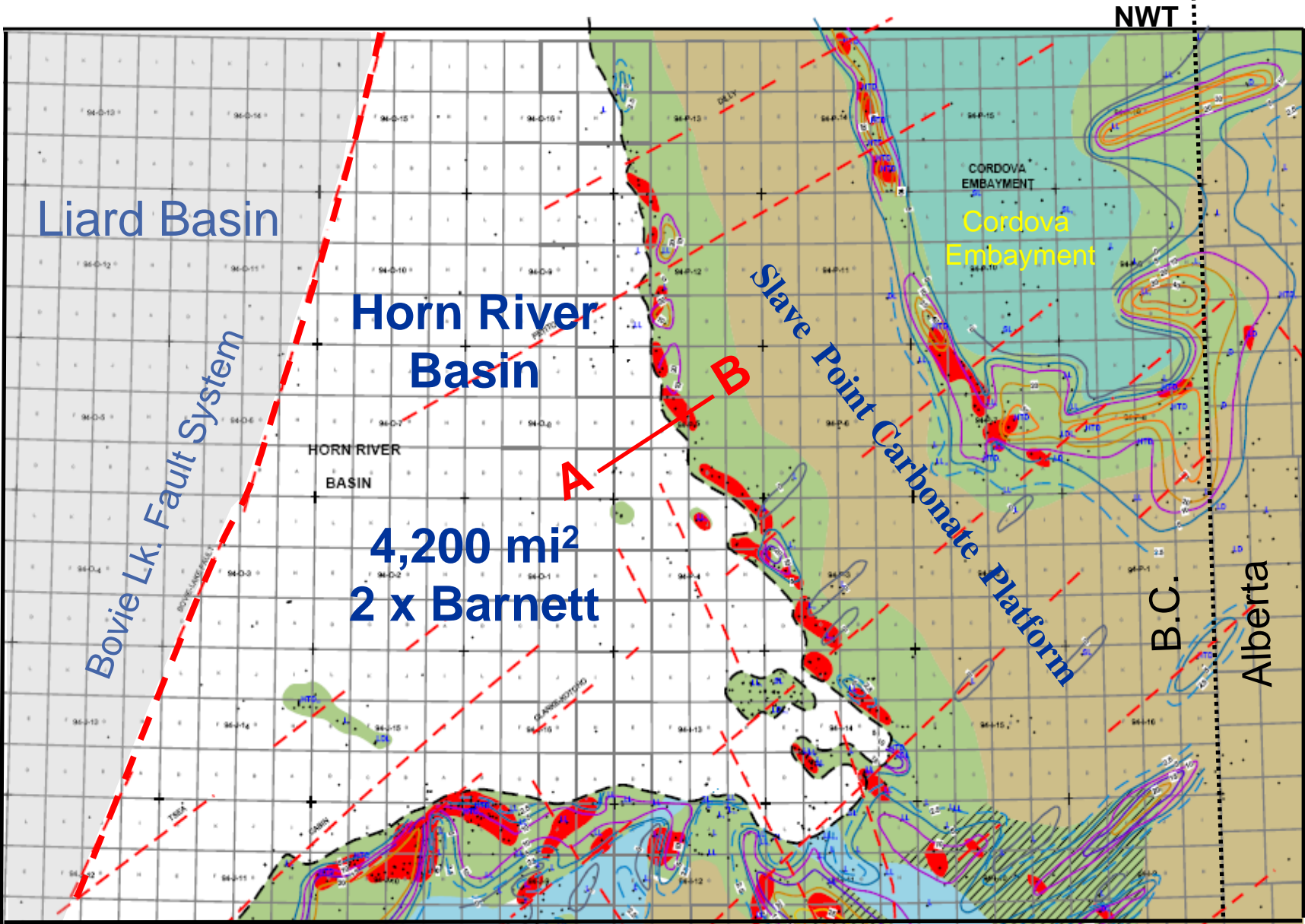
Tough sledding during spring thaw

Horn River: Devonian Paleo Geography



After R. Blakely, University of Arizona

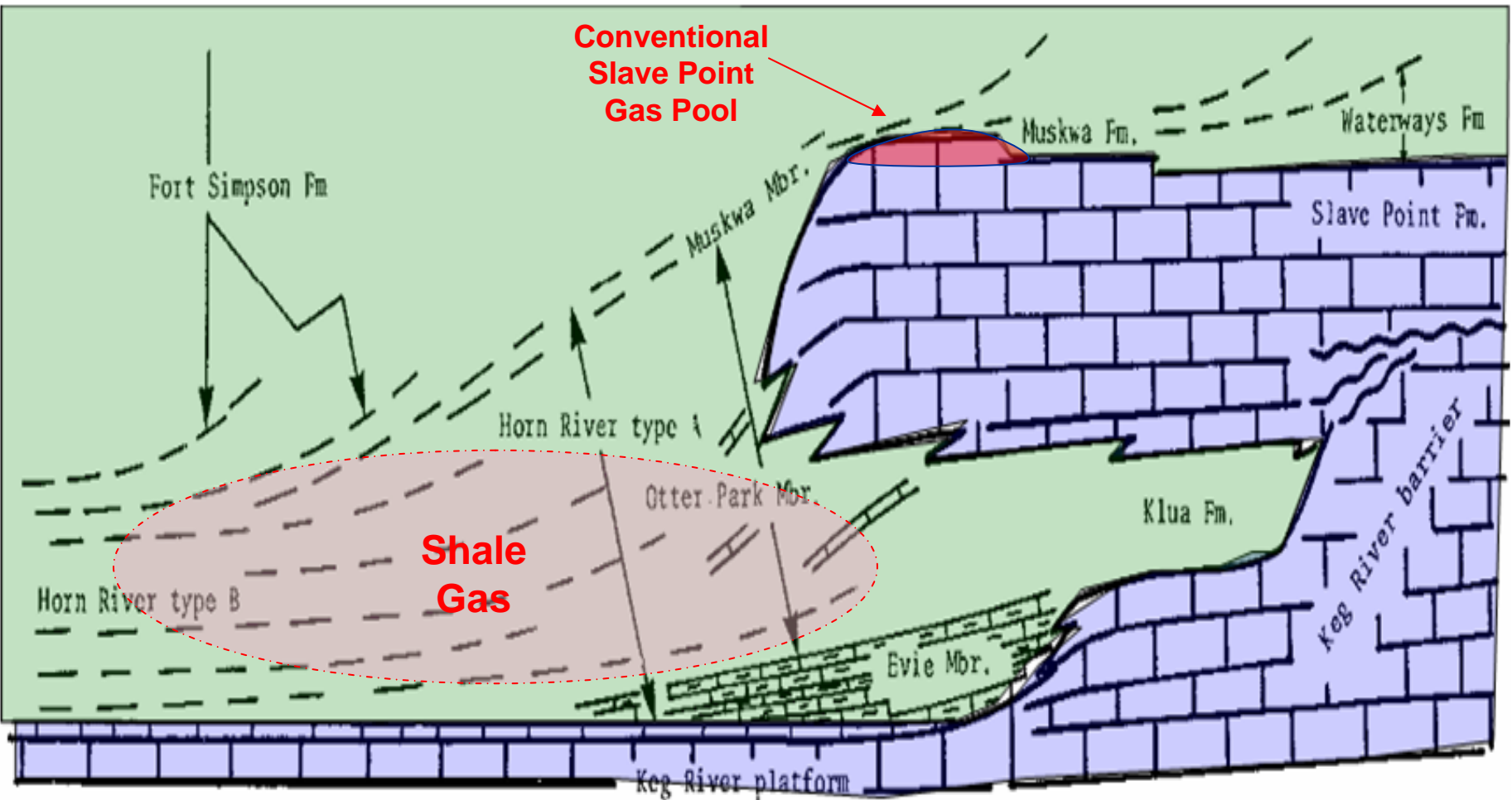
Horn River: Geological Setting



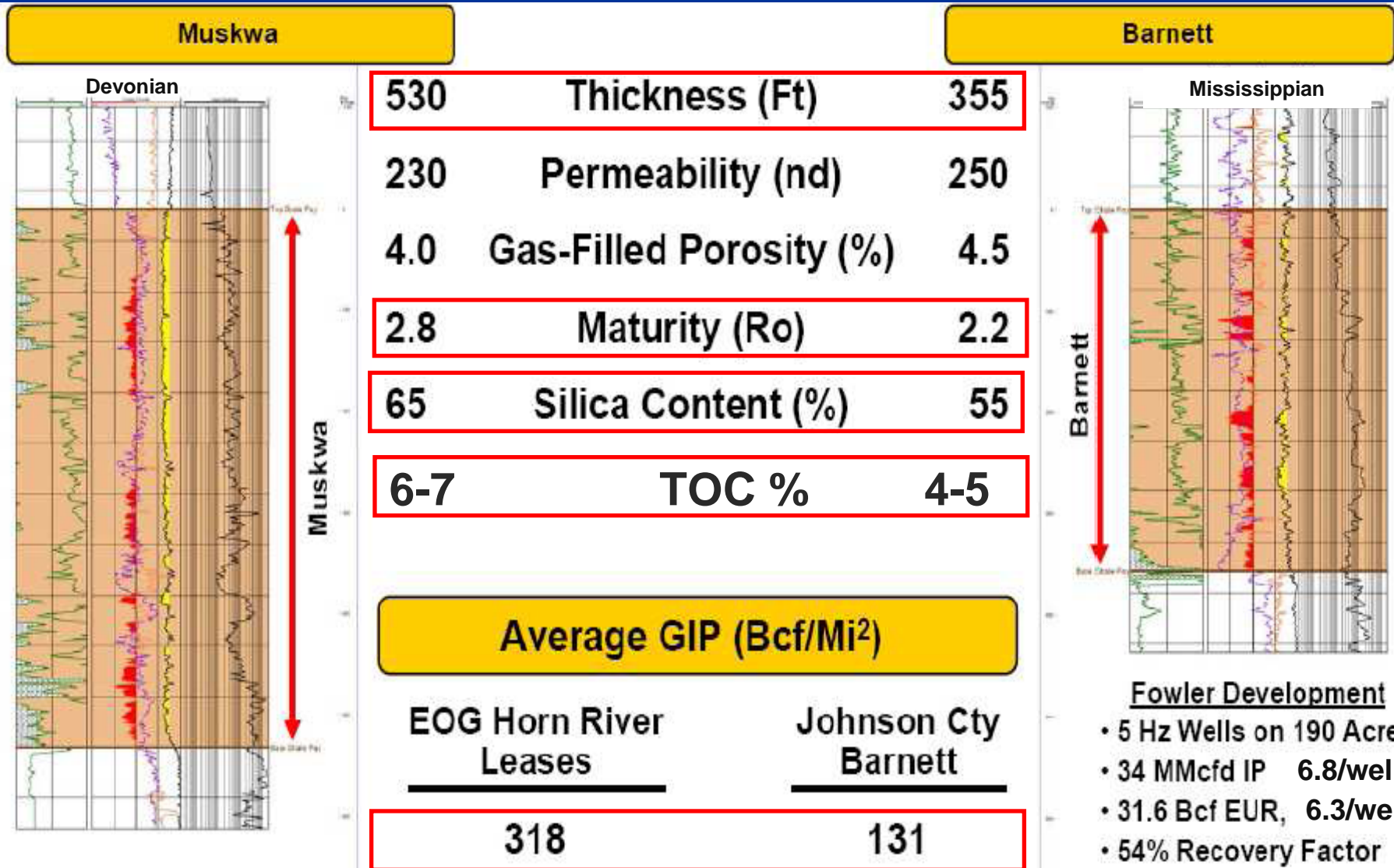
Horn River: Depositional Setting

A

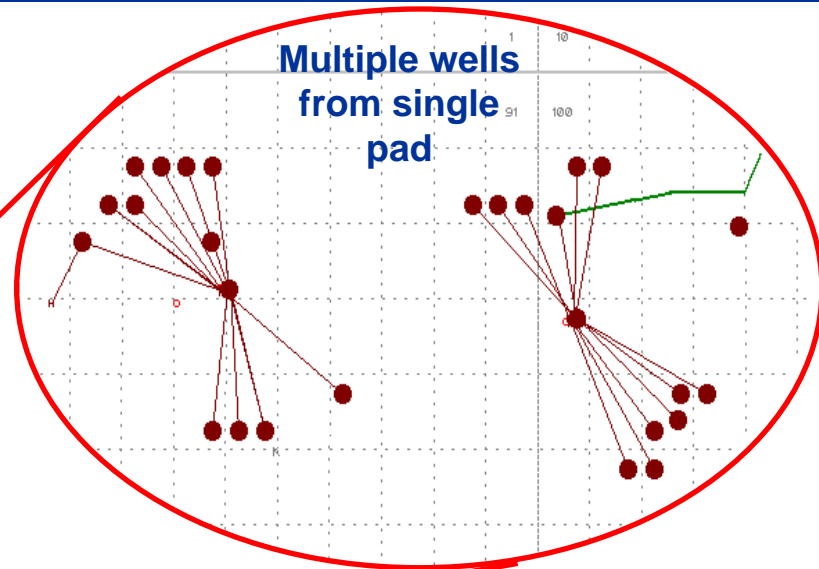
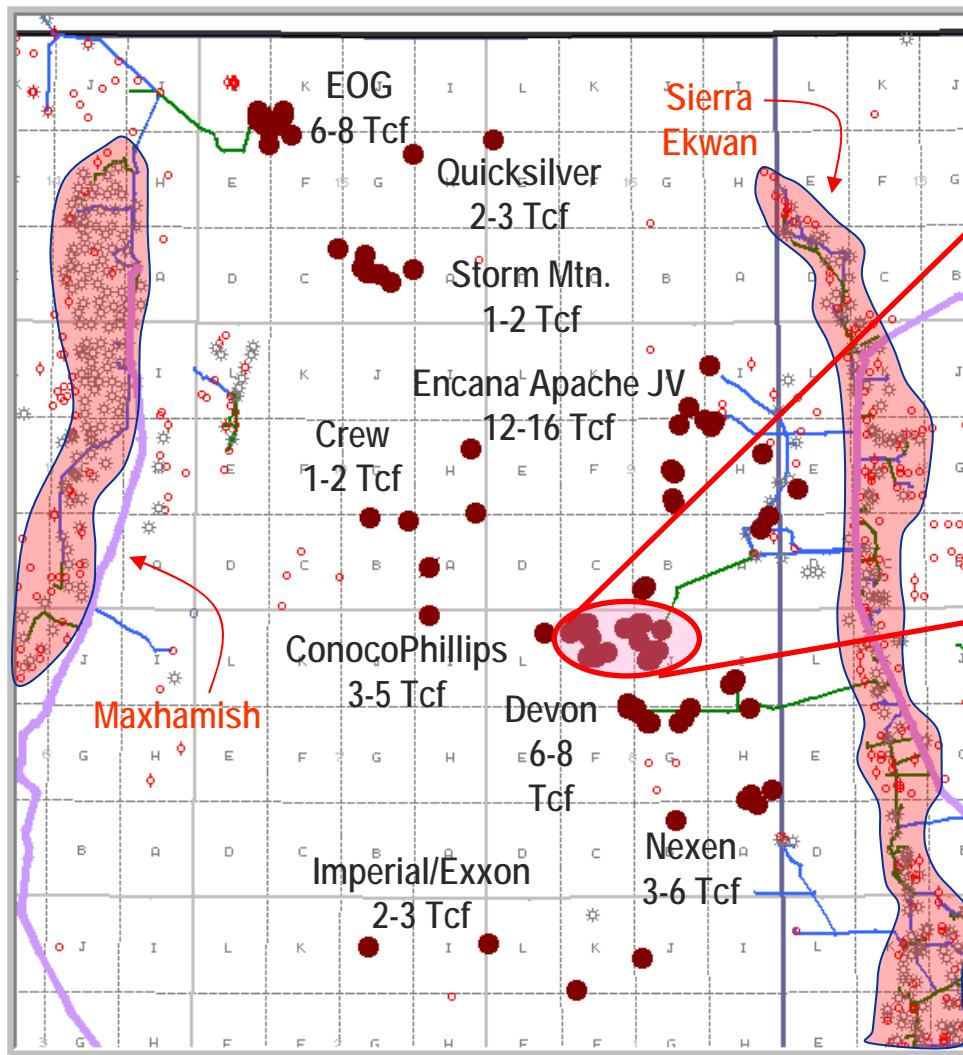
B



Horn River Muskwa vs. Barnett Shale (EOG)



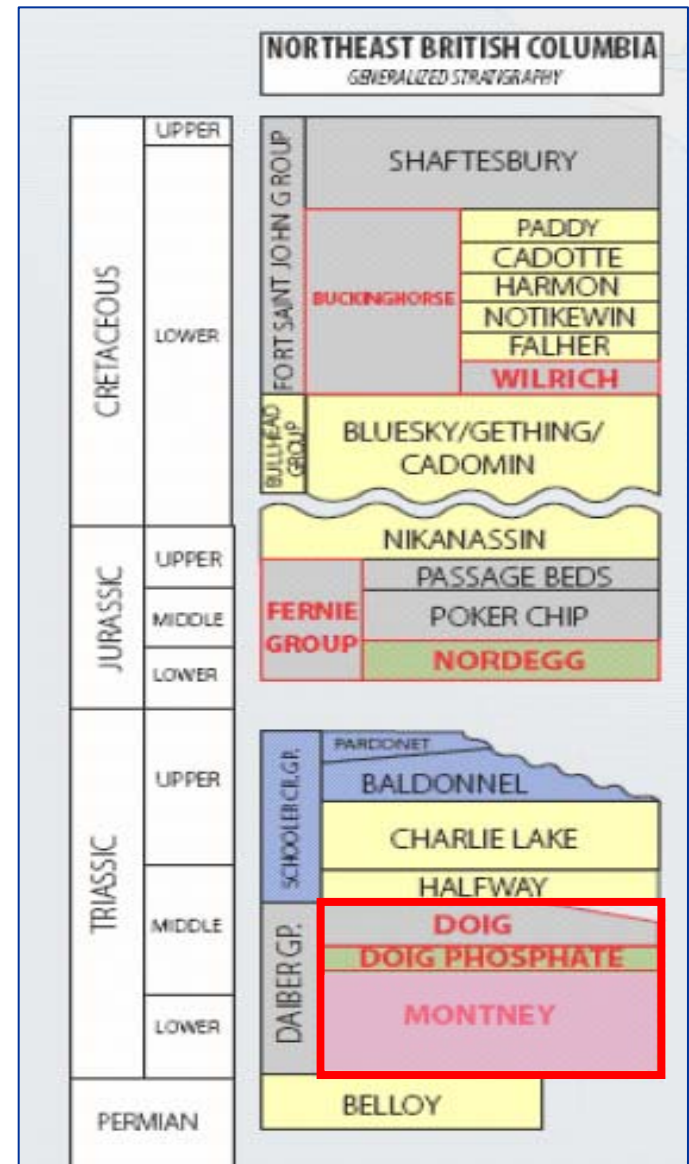
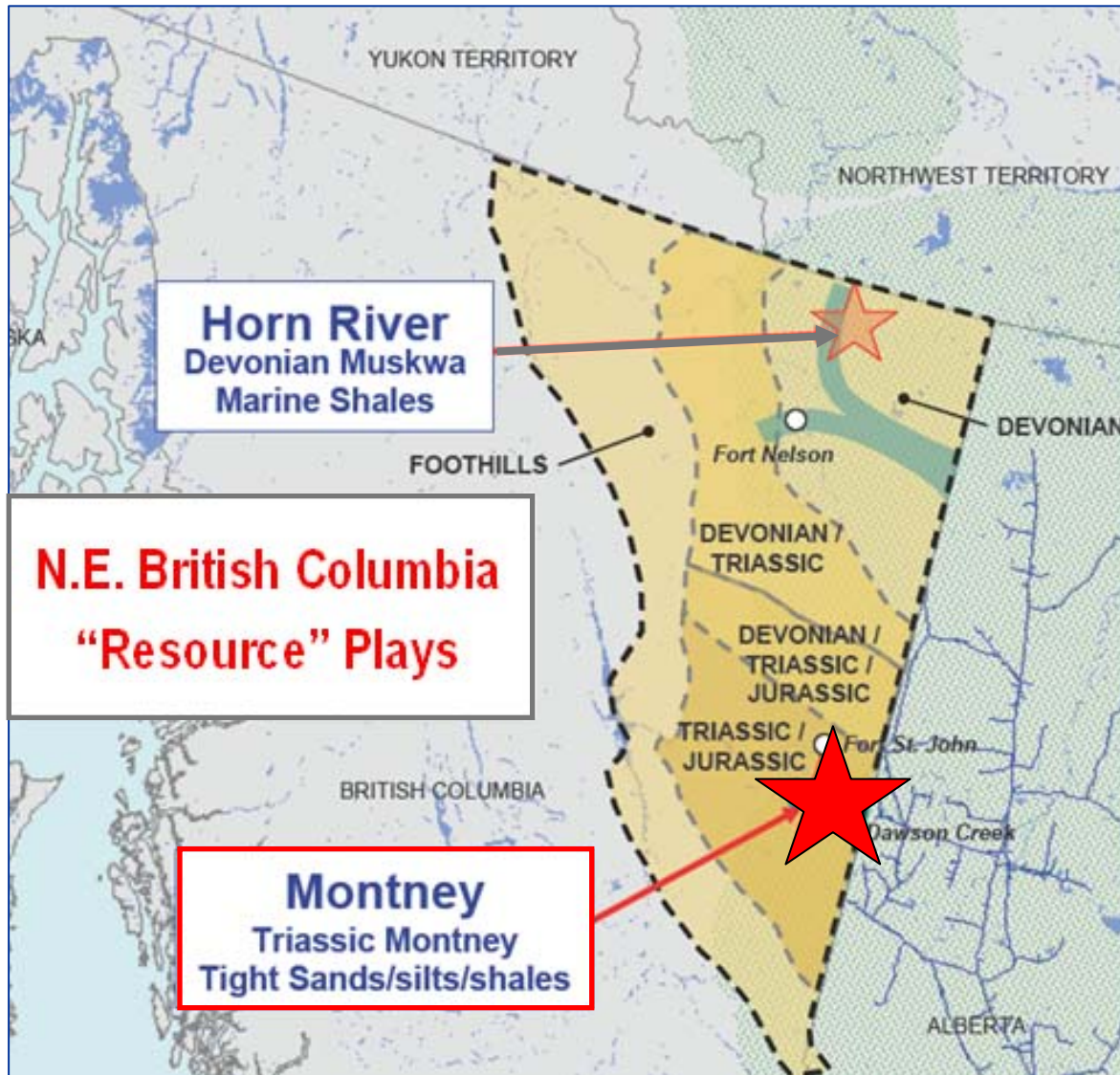
Horn River Play Summary



- Area is extremely remote & winter drilling
- Lack basic infrastructure (roads, plants)
- 2,700 m vert. & 1,500 hz. leg
- \$10 – \$20 Million per completed well
- Dry gas with 10 - 12% CO²
- Potential 500 - 700 TCF OGIP “basin wide”
- Est. production of 50 Mmcf/d & potential for 1.0 – 1.5 Bcf/d by 2020

IP's of 3 - 8 Mmcf/d and total “discovered” resources of 37 - 55 Tcf have been announced by various operators in the basin.

Montney Hybrid Gas Play



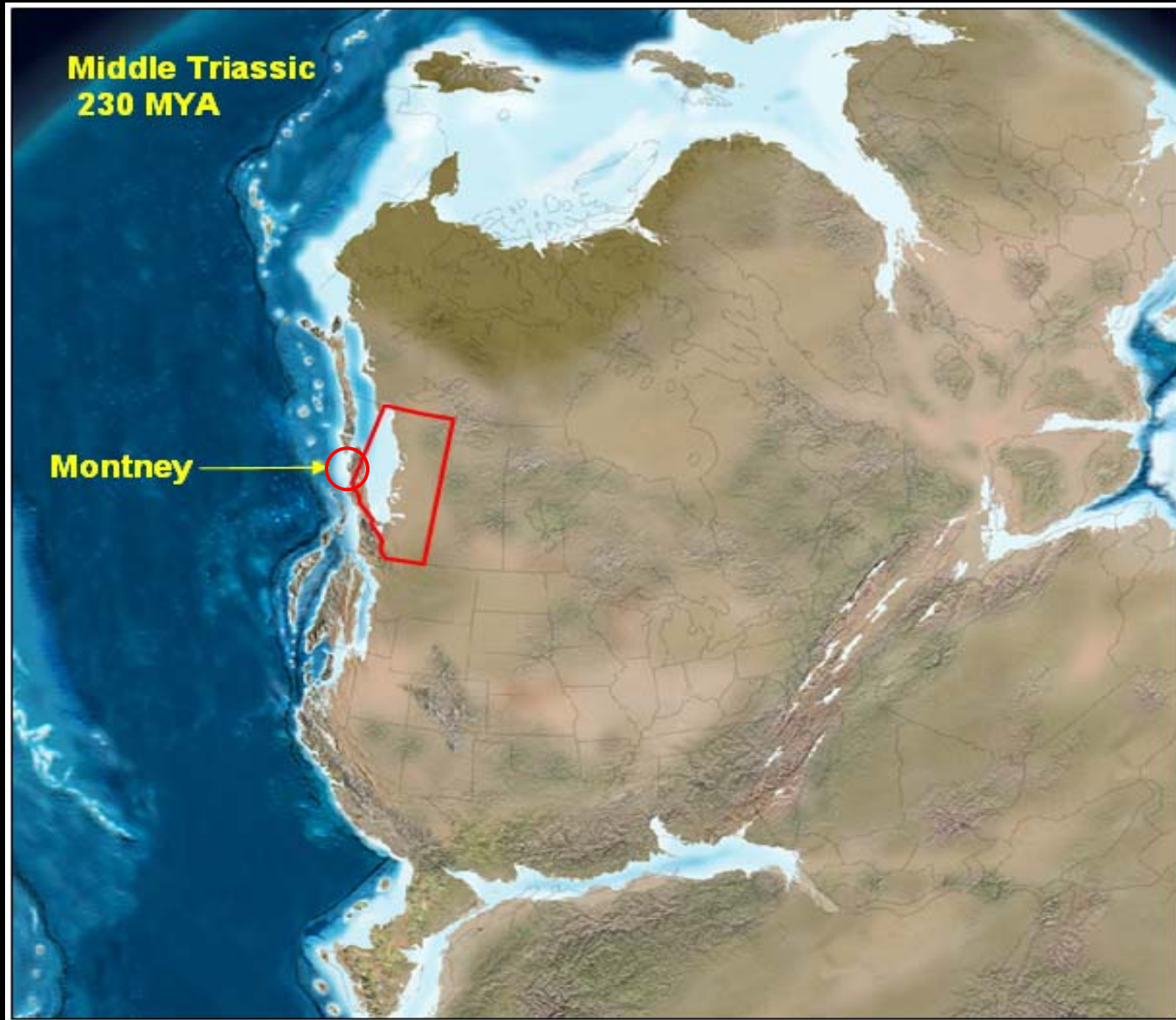


**Outcropping Montney Formation
Interbedded sandstones,
siltstones & shales**

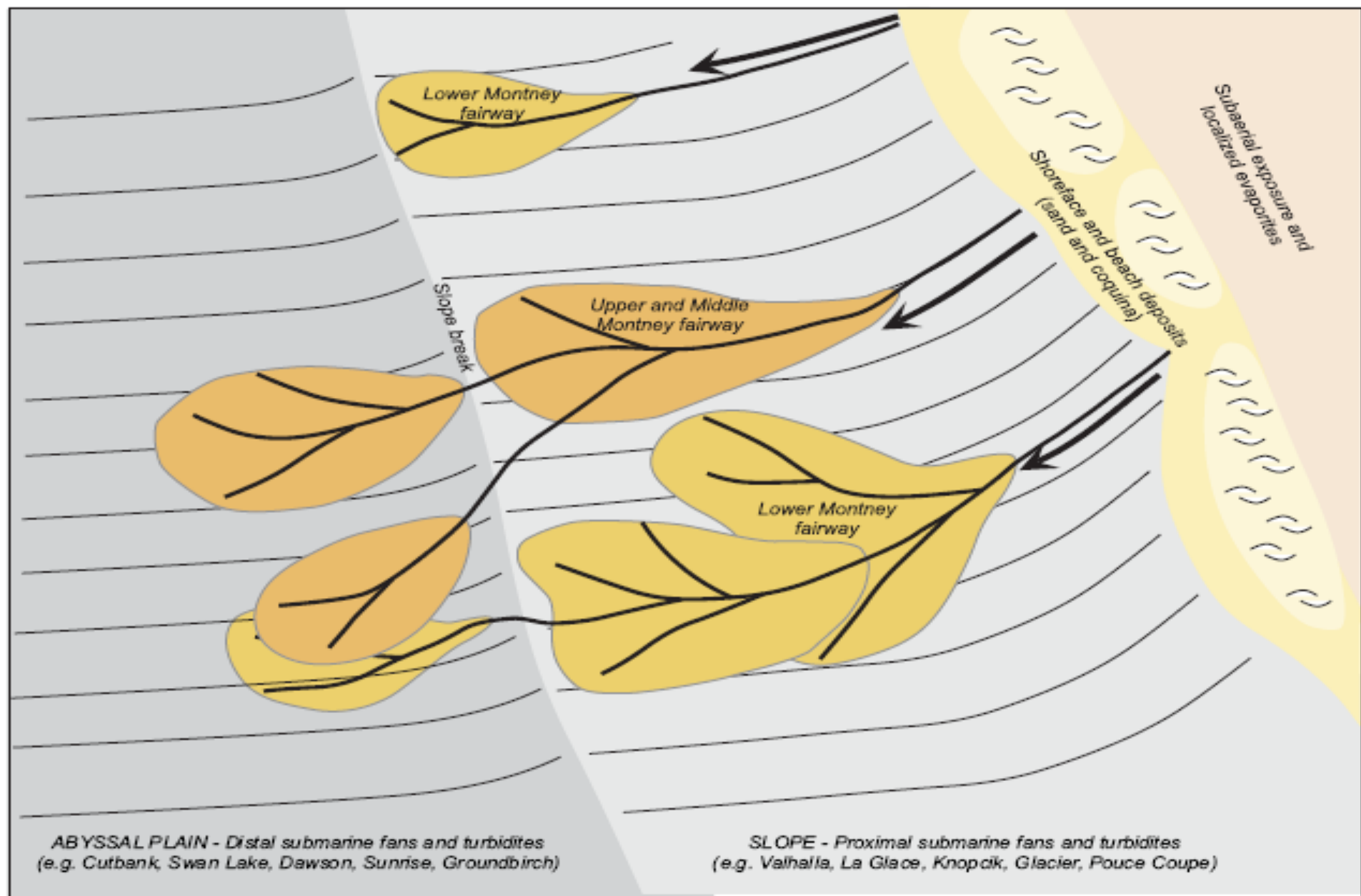


Montney well pad near Dawson Creek B.C.

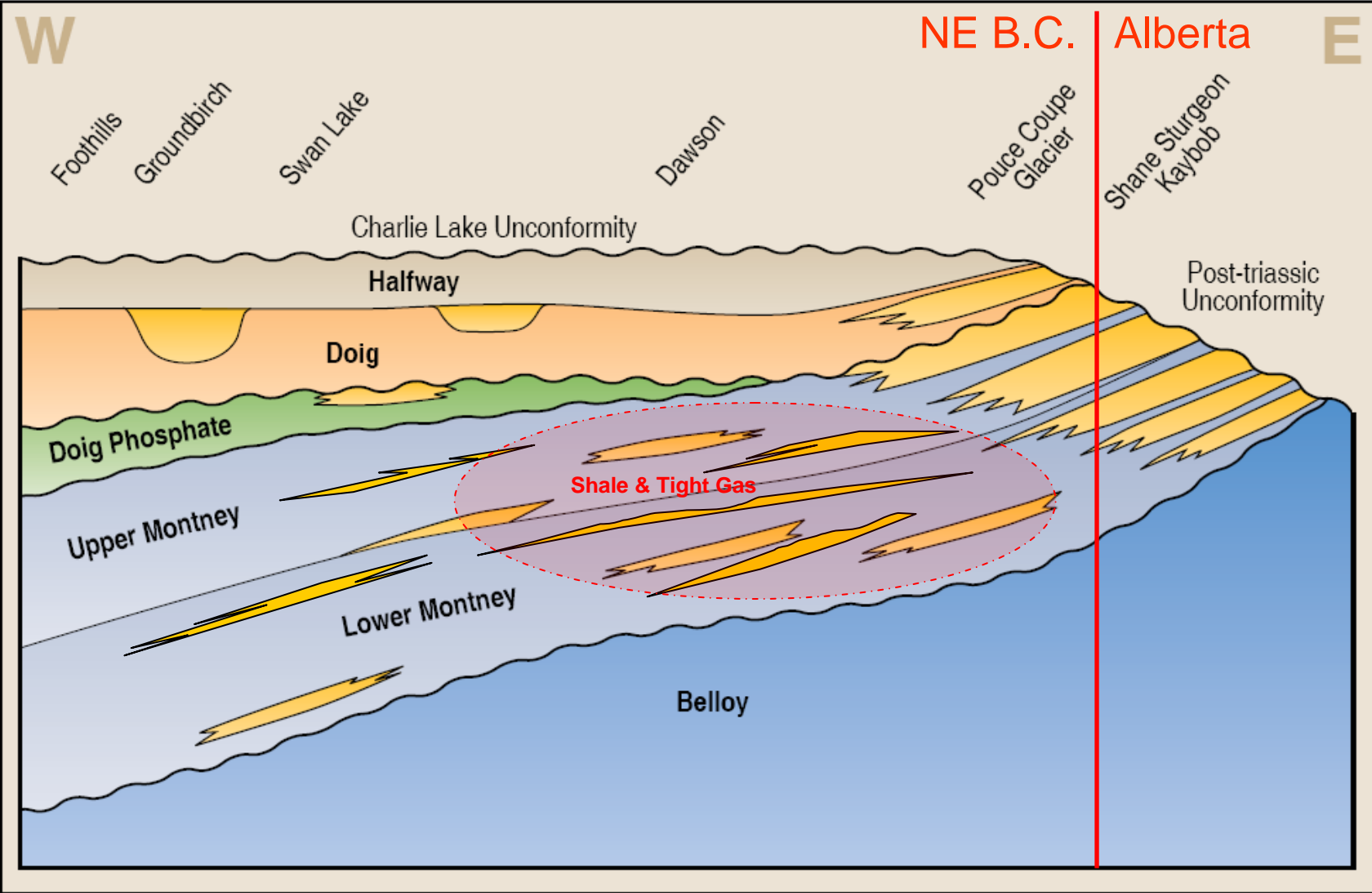
Montney – Triassic Paleo Geography



Montney: Depositional Setting

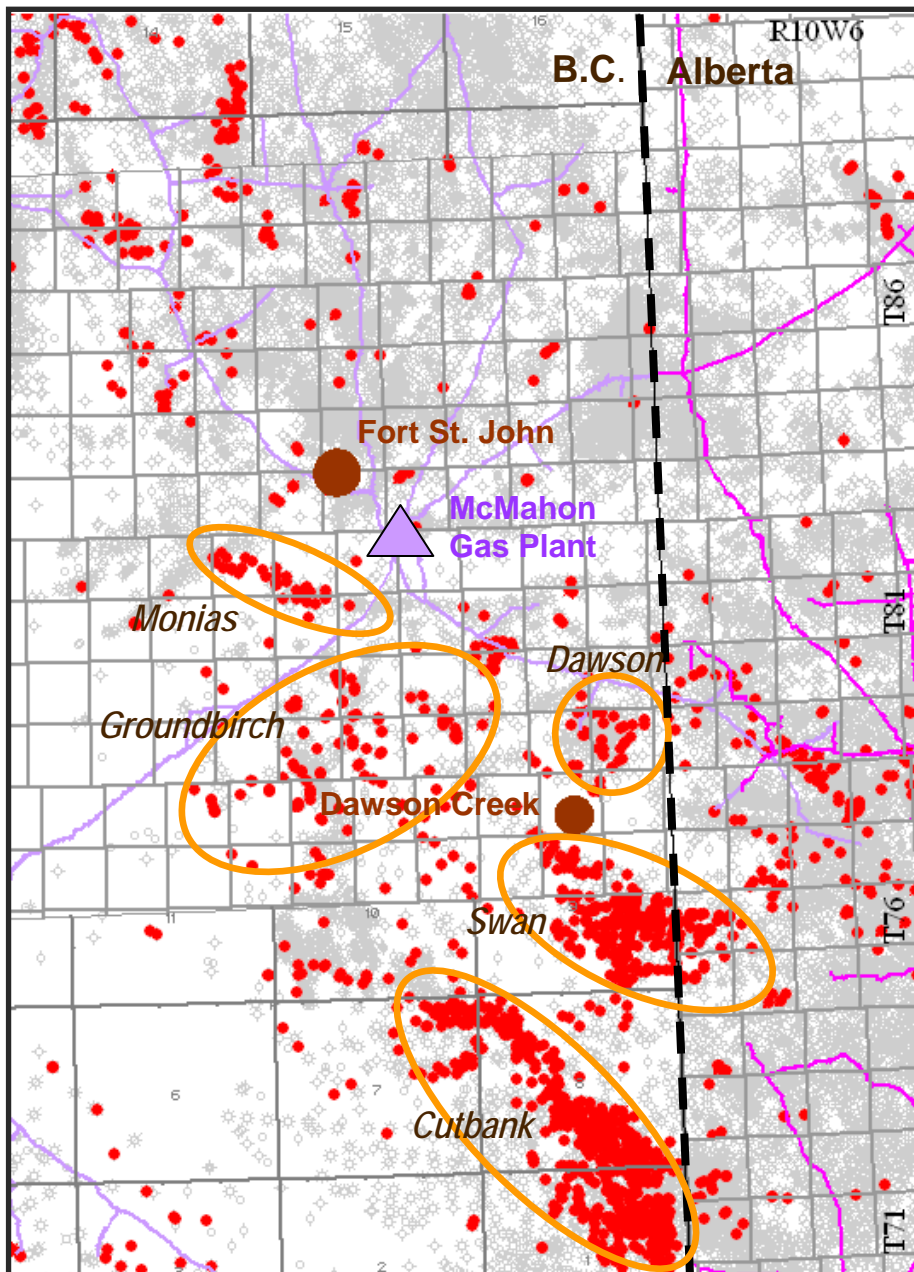


Montney: Stratigraphy



Modified from Discovery Digest

Montney Play Summary



- Not a “pure” organic marine shale play like Horn R.
- Montney is a “hybrid” play consisting of a mix of inter-bedded tight sands, siltstones & shales
- Play becomes “shalier” going west into B.C.
- Target formations include: Upper & Lower Montney, Doig & Cadomin
- Considerable existing infrastructure in place – less so to the west
- Completed Hz. wells & tie in cost \$5 – \$10 Million
- Current drilling focus is on clastic “sweet spots”
- Hz. drilling & multi stage fracs key to development
- Potential for 400 – 500 TCF of OGIP
- Potential for 1.0 - 1.5 Bcf/d by 2020
- Key players: Encana, ARC Res., Advantage, Devon, Birchcliff, Cinch, Talisman, Murphy Shell (bought out Duvernay)

WCSB Shale Gas - Key Messages

- **WCSB** is undergoing a significant **shift** from conventional gas to continuous accumulation unconventional “**resource**” plays
- Shale plays like other “resource” plays are easy to find but challenging to produce
- WCSB shale gas resource base is vast > **1,000 Tcf OGIP**
- Development is extremely capital intensive requiring players with “**deep pocket**” as the current gas price environment is **extremely** challenging.
- **Horn River Basin** drilling & piloting is yielding very encouraging early results, however development is **R&D** in nature & future pace of development is uncertain.
- **Montney play** is already **commercial** and results are exceeding initial producer expectations – development pace is on track.
- Large scale shale gas developments will take **several years** to make a significant impact on the overall gas supply picture
- WCSB shale gas is generally **remote**, lacks infrastructure, distant from major markets U.S. markets requiring innovation & cost efficiency to be price competitive with Lower '48 shale gas plays.

TransCanada (NGTL) Pipeline Expansions

November 2008 TransCanada Binding Open Seasons:

Horn River

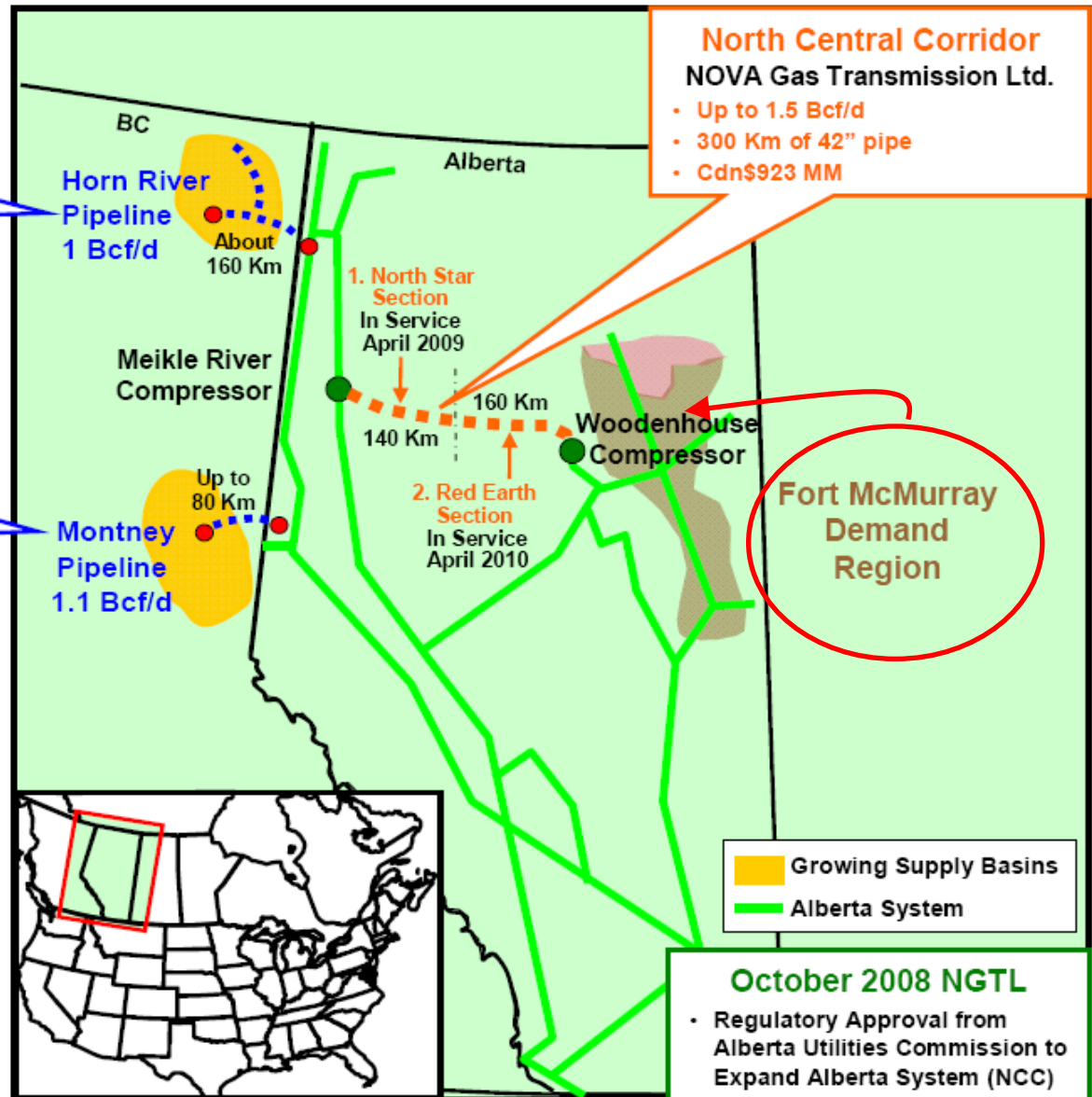
- 380 MMcf/d of Firm Commitments
- In service: Q2 2011

Montney-Groundbirch

- Expected to Reach 1.1 Bcf/d of Firm Commitments by 2014
- In service: Q4 2010

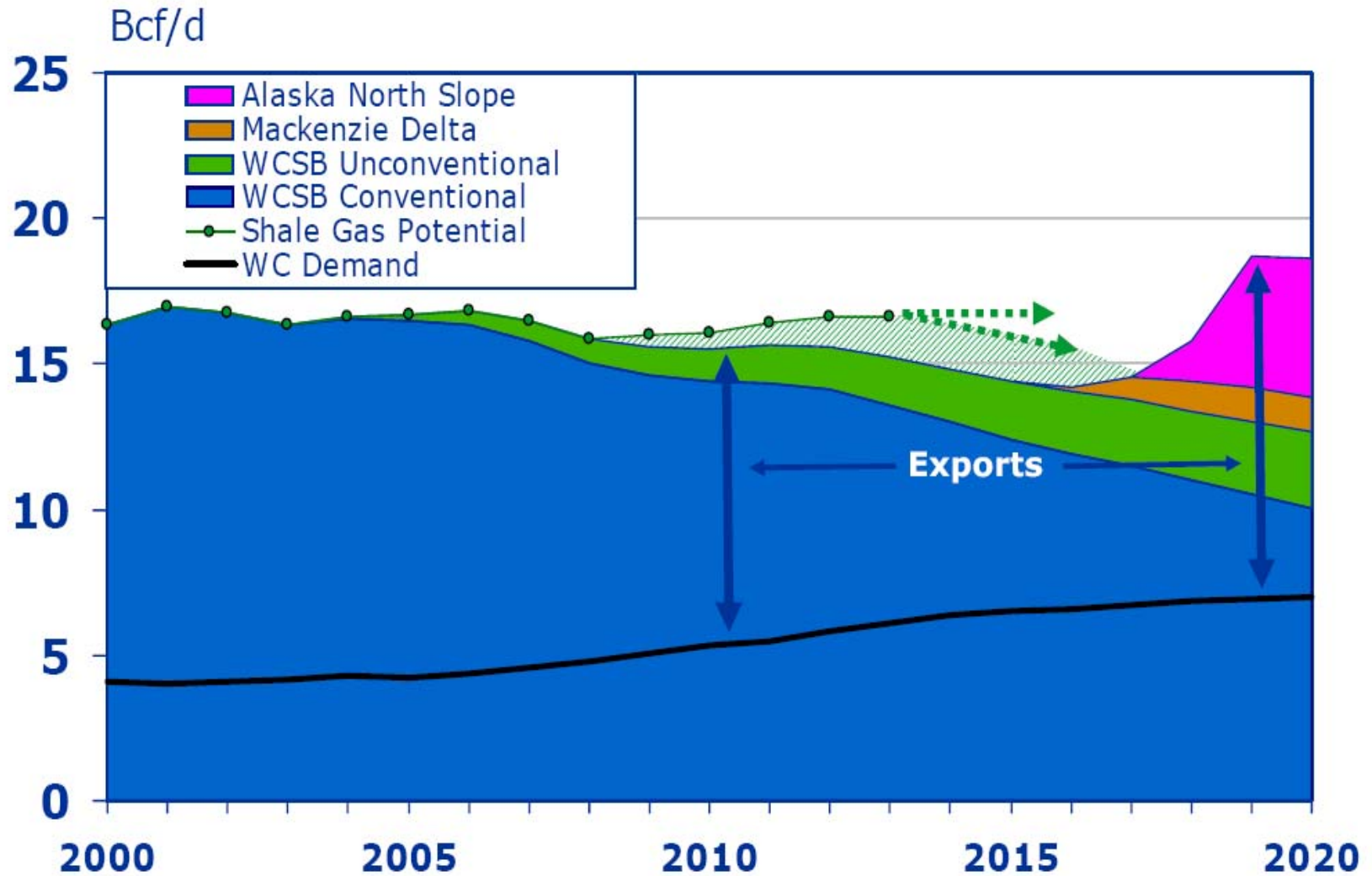
February 2009

- TransCanada Alberta System Under NEB Jurisdiction



Ziff Energy 2009

WCSB Gas Supply & Demand



The pace of development is the biggest uncertainty for WCSB shale gas supply due to the low gas price environment

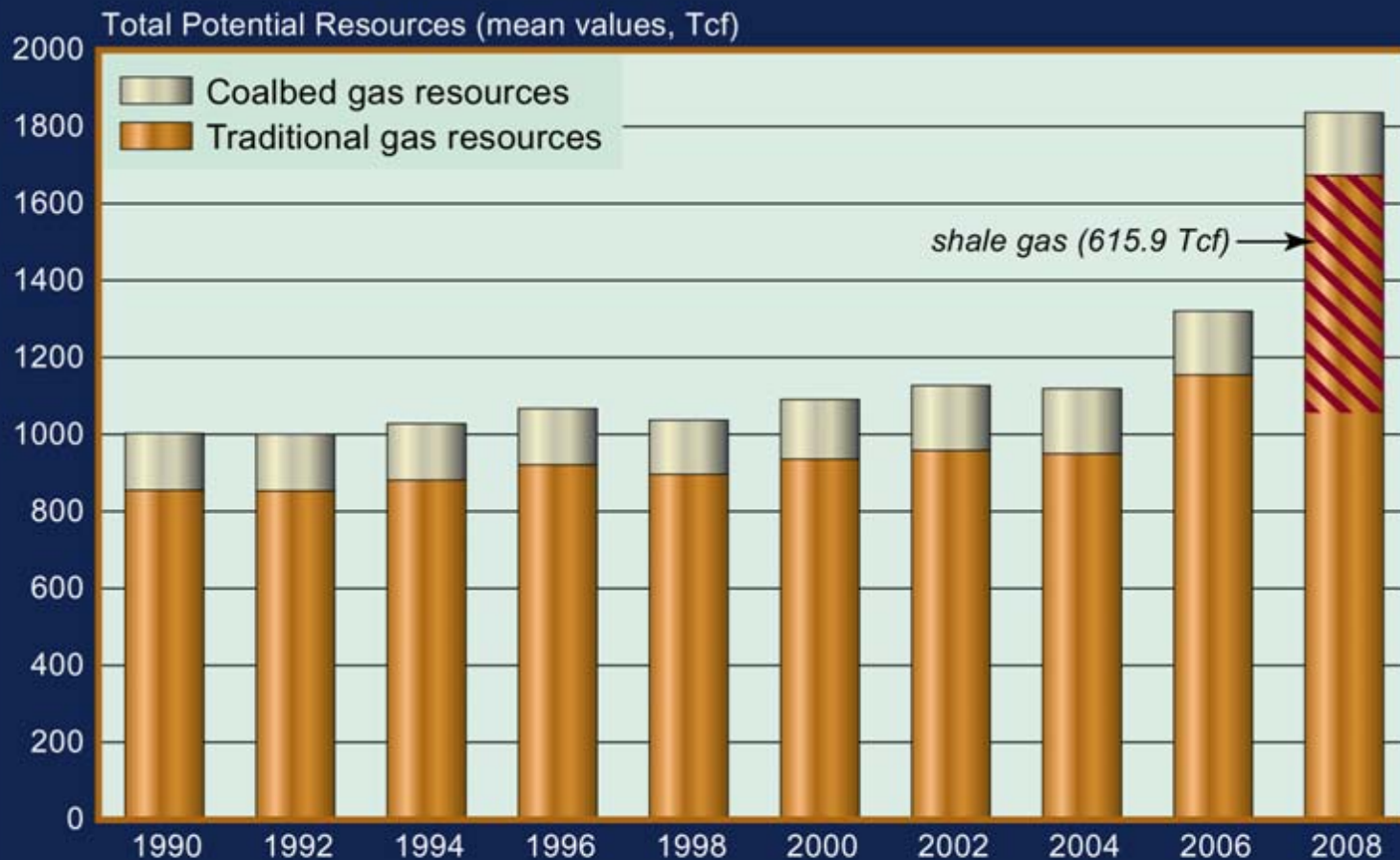
U.S. Lower 48 Shale Gas Plays

The first producing gas well in the U.S. was completed in 1821 in Devonian aged shales near the town of Fredonia, New York.

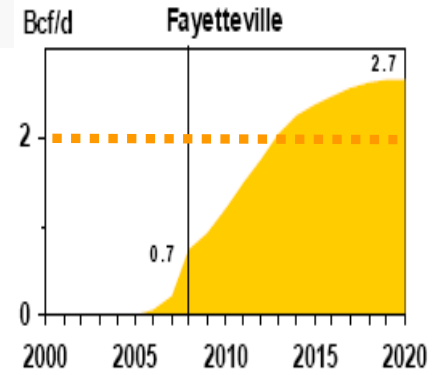
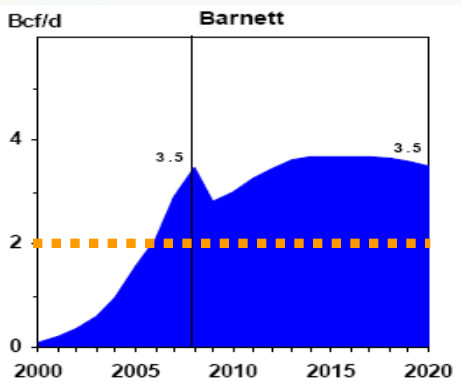
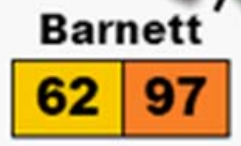
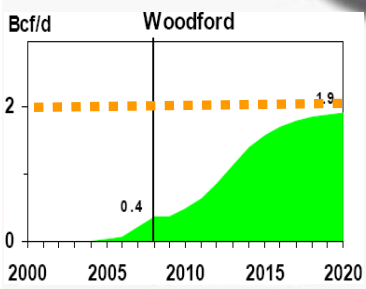
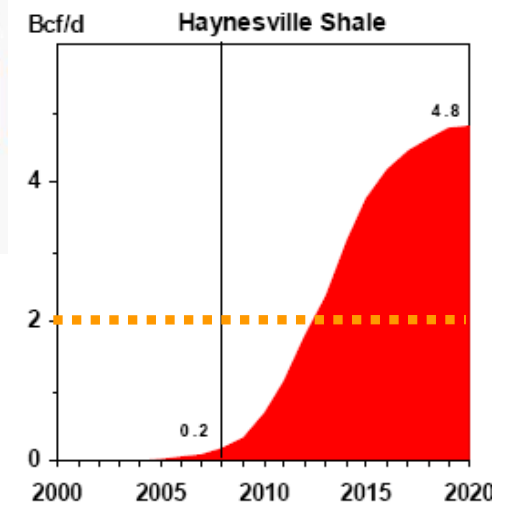
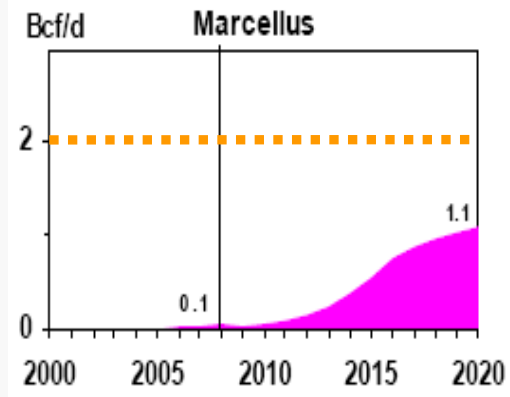
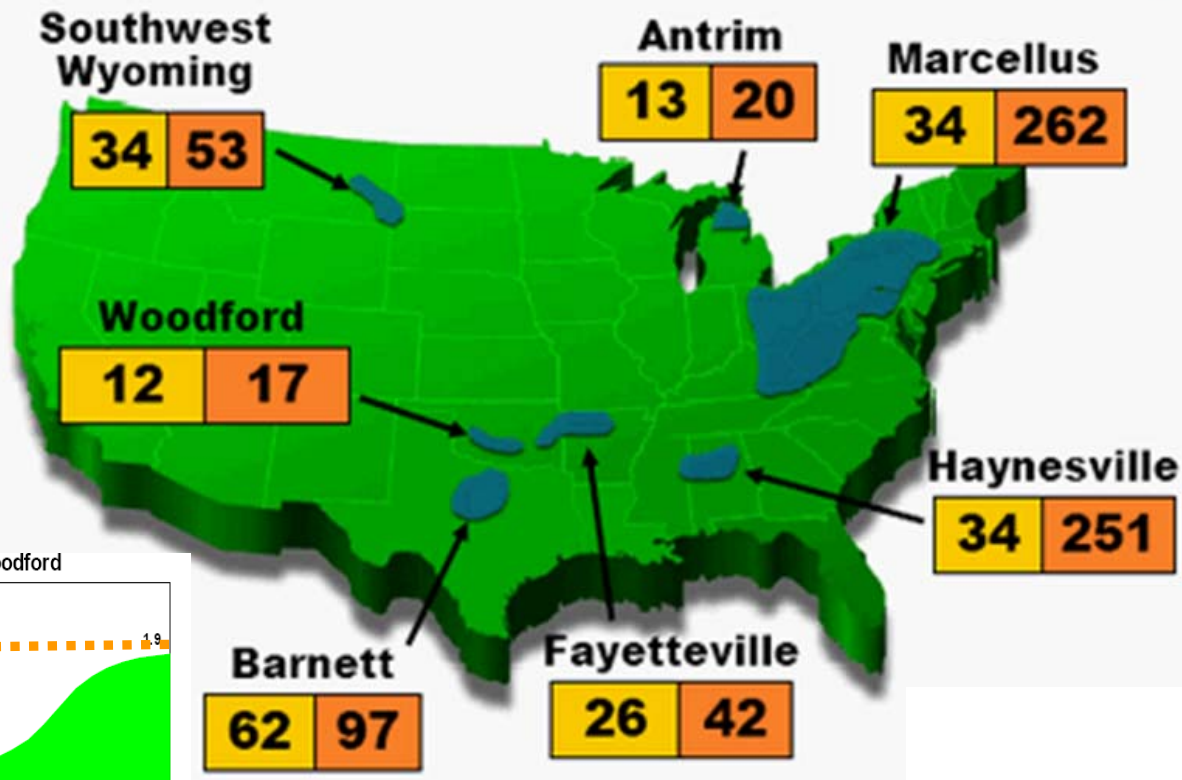


PGC Resource Assessments, 1990-2008

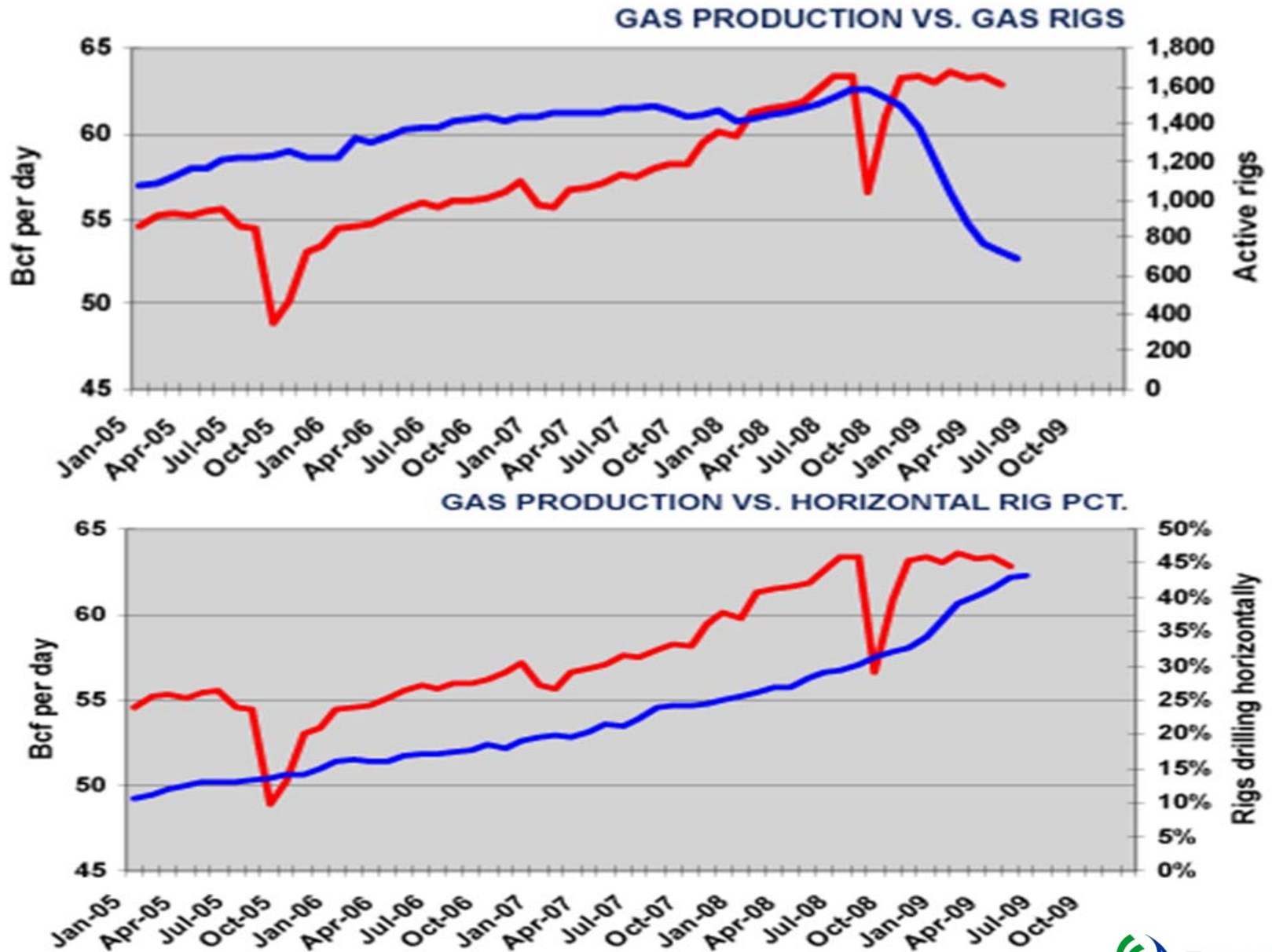
Total Potential Gas Resources (mean values)



Shale Gas Resource Estimates

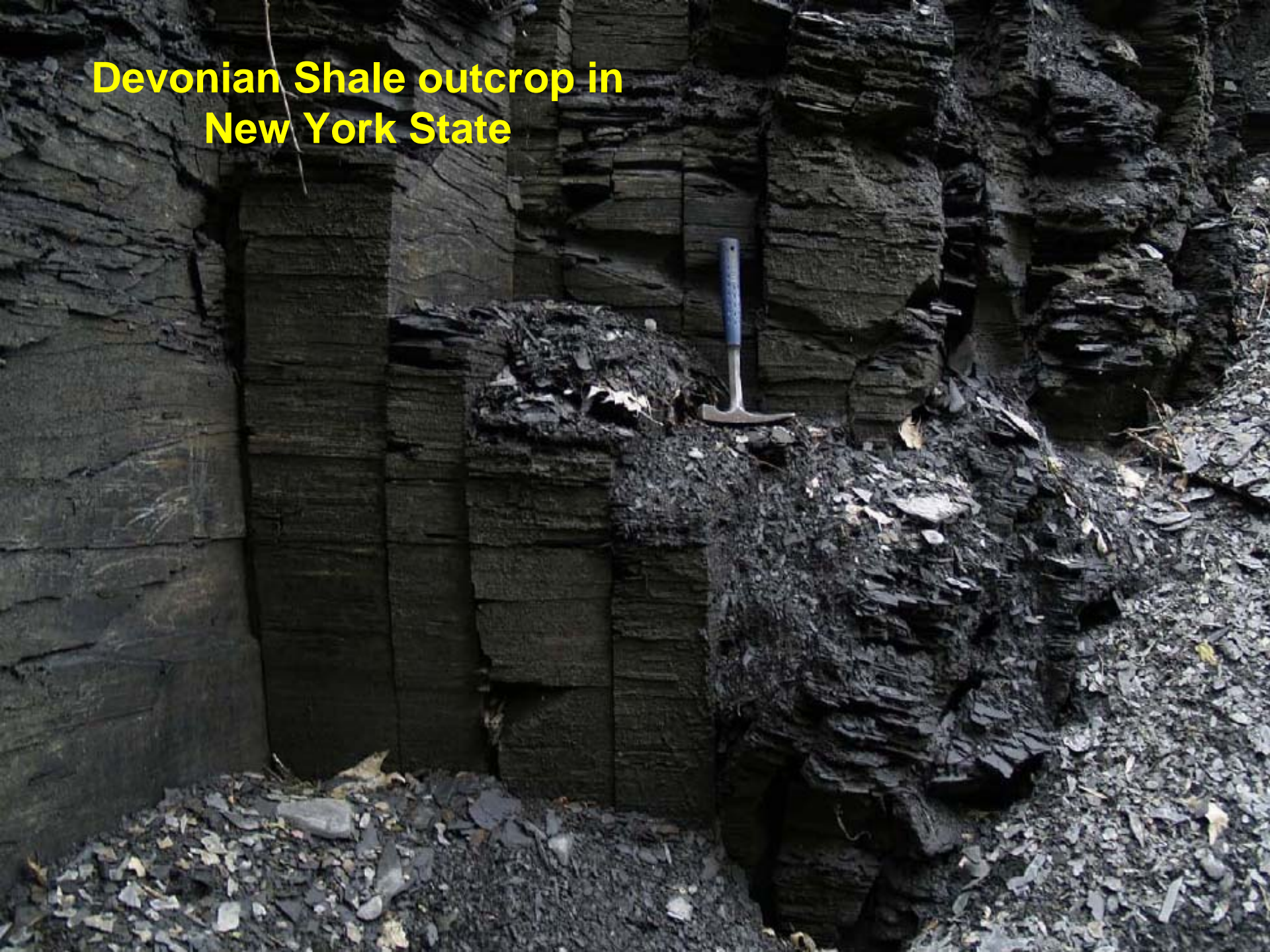


Horizontal drilling supports U.S. gas production



Source: Baker Hughes

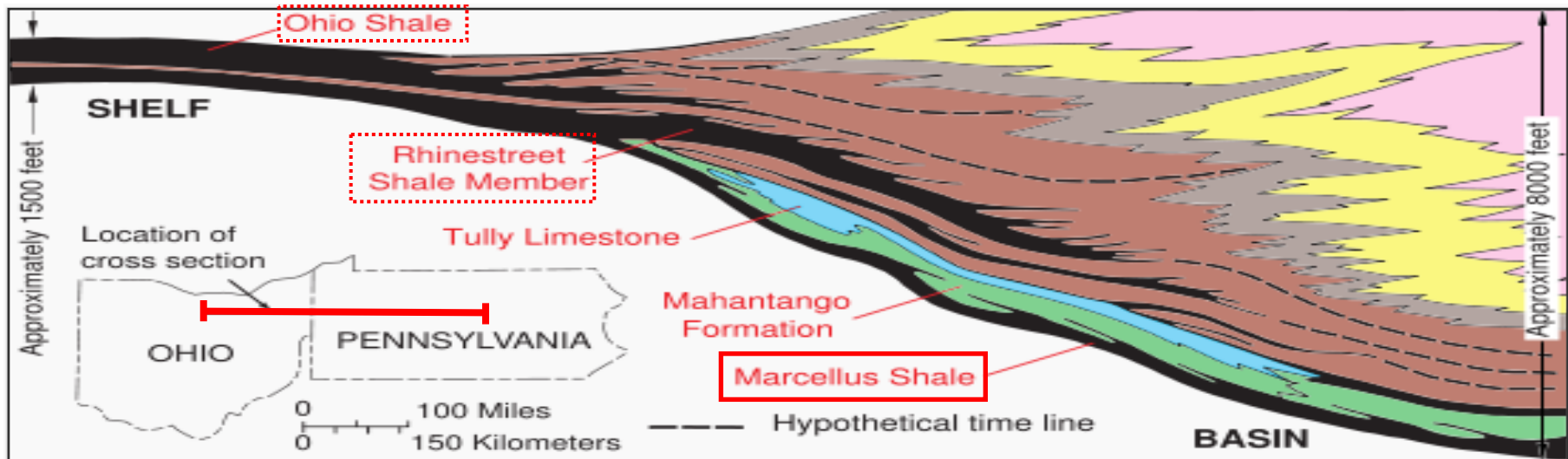
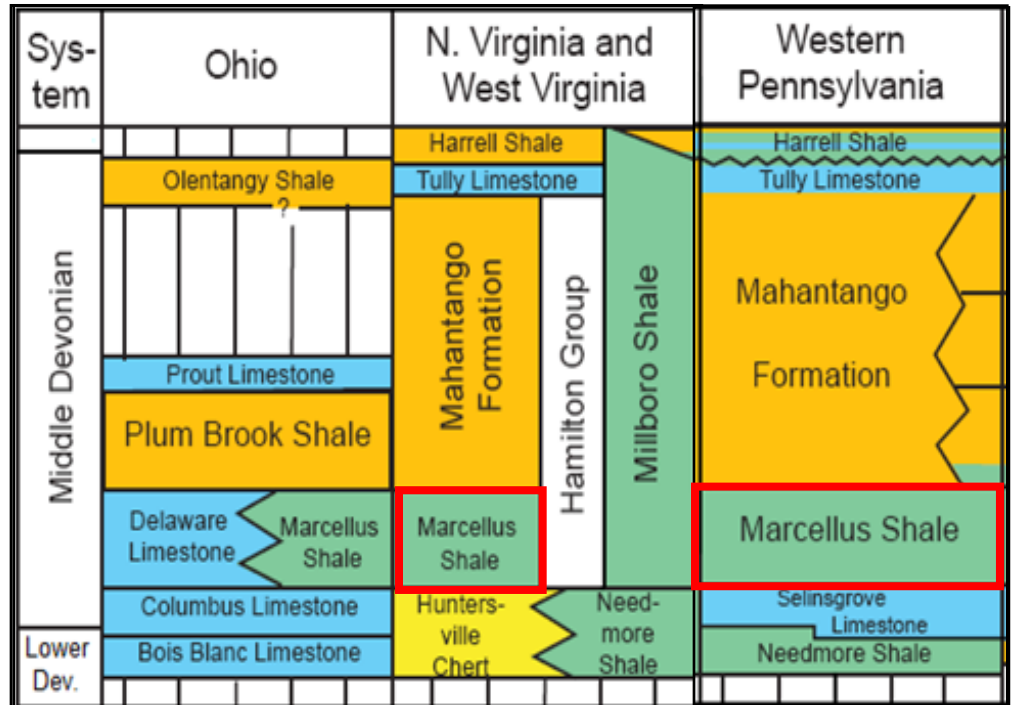
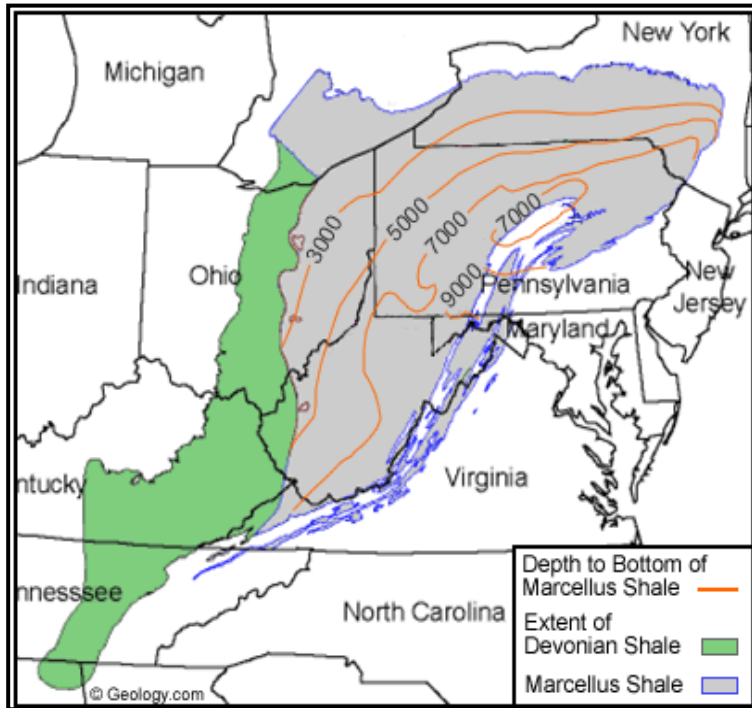
**Devonian Shale outcrop in
New York State**



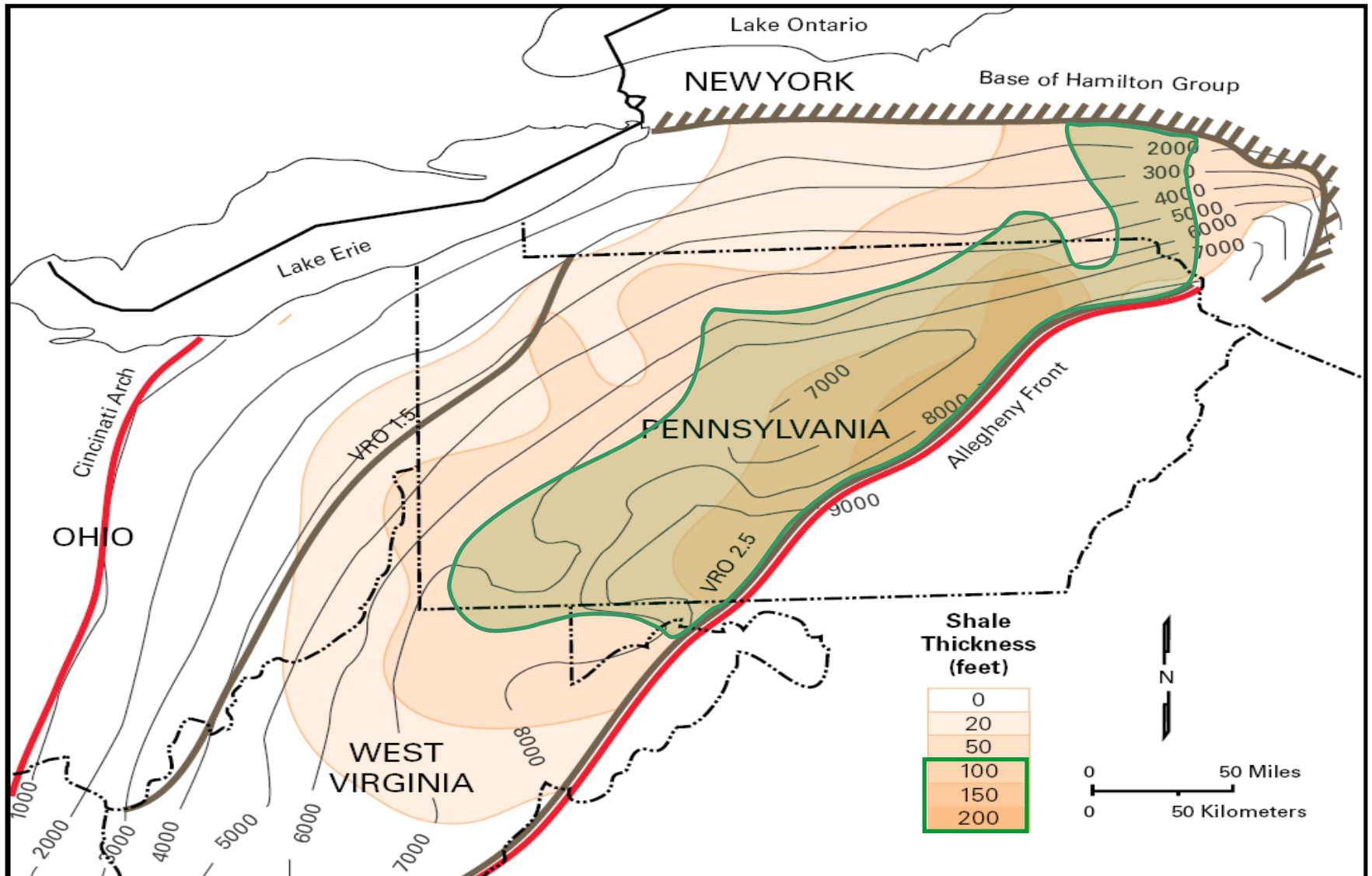
Marcellus Shale Paleo Geographic Setting



Marcellus Shale – Appalachian Basin

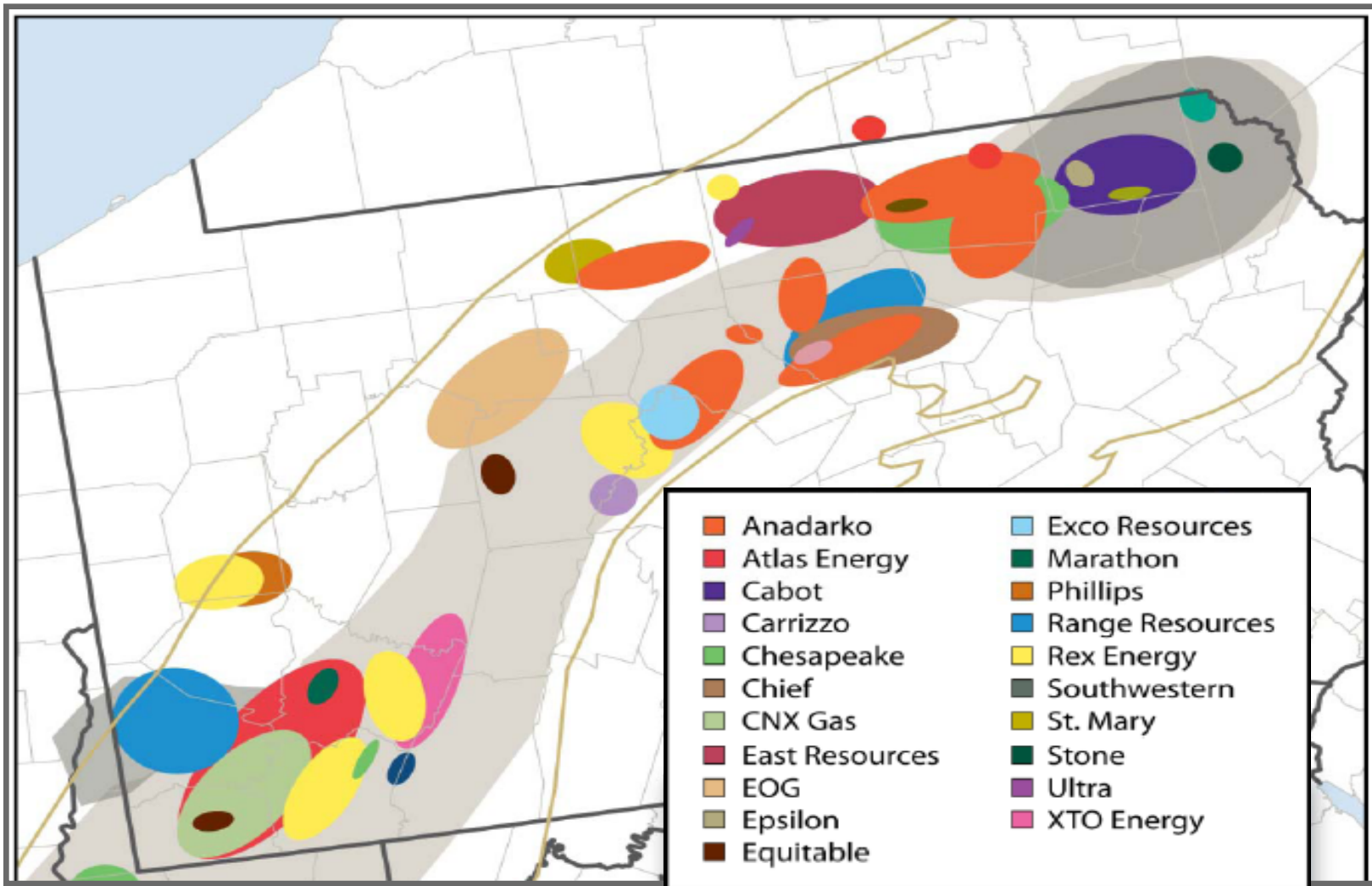


Marcellus Shale: Thickness & Depth



Source: RSEG, Atlas of Major Appalachian Gas Plays

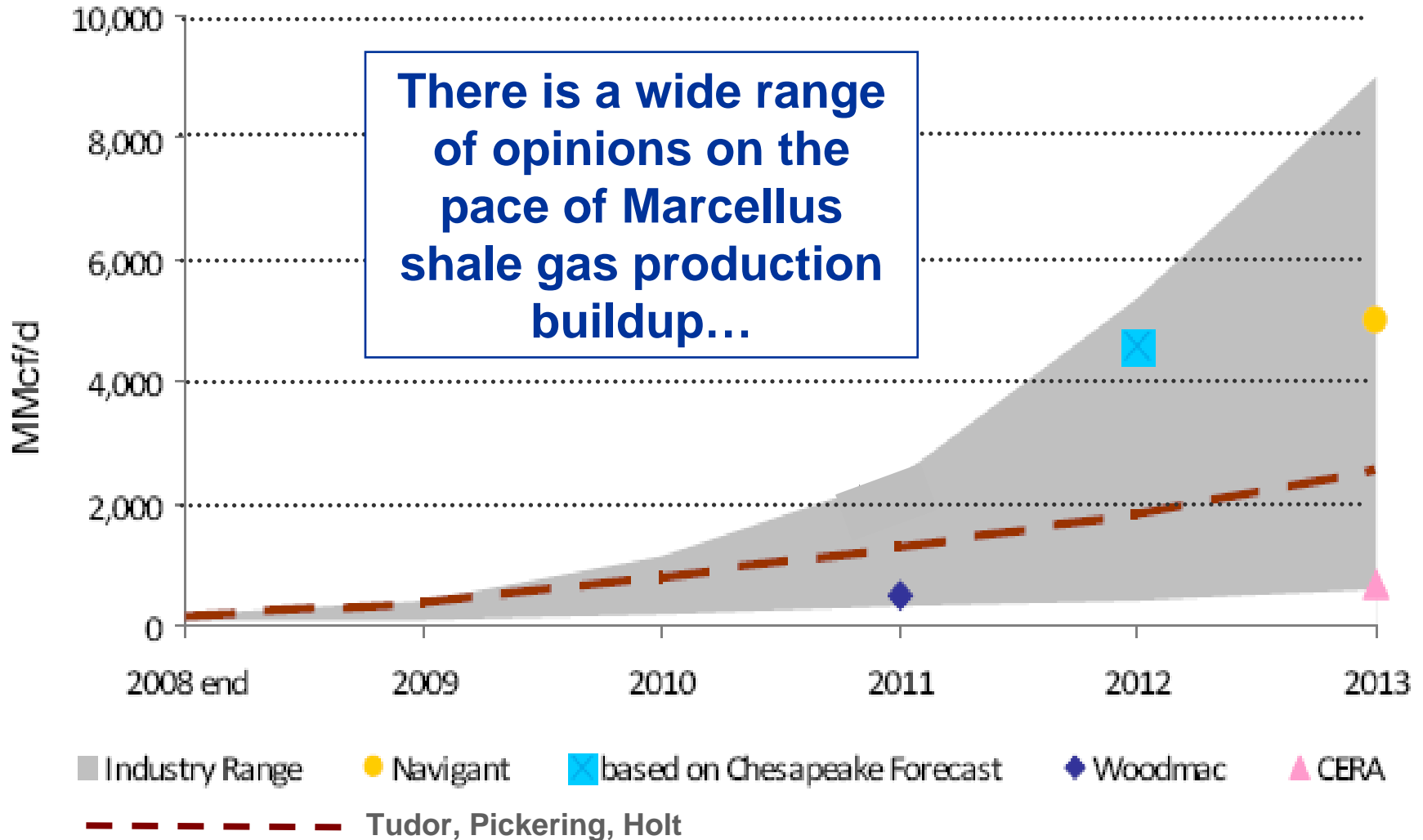
Marcellus Shale Play: Operators



Top 10 Operators by Acreage position:

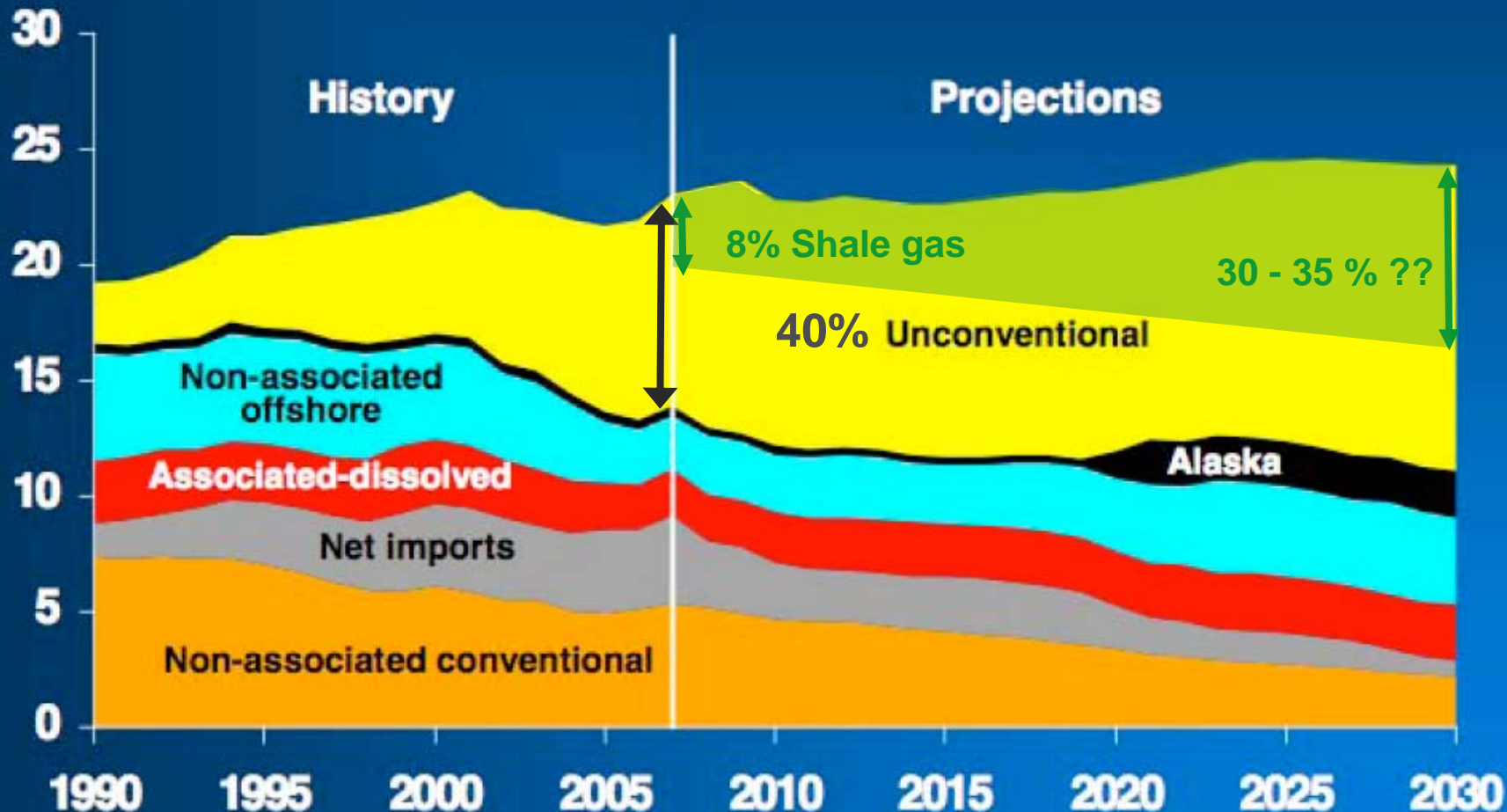
1. **Chesapeake**
2. Range
3. East
4. Talisman
5. National Fuel
6. Dominion
7. StatOil Hydro
8. Atlas
9. Chief
10. Equitable

Marcellus Shale Production Forecast



Unconventional production meets most growth in natural gas demand and offsets the decline in conventional production and imports

trillion cubic feet



“The future ain’t what it used to be”

– Yogi Berra *New York Yankees 1946 - 1963*

The background of the slide is a photograph of an oil field at sunset. The sky is a vibrant orange and yellow, with the sun low on the horizon. In the foreground, several oil pumps (jack-o'-lanterns) are silhouetted against the bright light. The overall mood is one of transition and the end of an era.

***As the sun sets on the conventional
oil and gas industry***

*... it's rising on the
unconventional gas
industry!*

Need gas ?
Drill and it
shale
be given...

*Thank you for your
interest and attention!*

