

# ***Status of Unconventional Gas in North America***

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Gas Symposium  
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## Predictions:

2002 – Predicted Alberta’s and probably Canada’s natural gas production had peaked. (Published: CSPG Reservoir, January 2003)

2004 – Predicted North American natural gas price would hit \$10/mcf. (DOB, November 19, 2004)

2005 - .....

## ..... And a Challenge

We are all experts in the field of natural gas so.....

Take out your business card and write the answer to the following question on the back:

**What will the AECO spot price in \$'s CDN per GJ be on the 1st November 2006?**

– The price was \$9.98 CDN per GJ on 1<sup>st</sup> November 2005

Drop your card in the container at the entrance.

I will report back at the next Conference and award a prize to the person closest to the correct answer.

# Presentation Format

- What is unconventional gas?
- Current production in North America
- Resources and reserves
- What unconventional opportunities should we consider?
- Issues
- The need for more research and a comprehensive energy plan

# Unconventional Gas Reservoirs

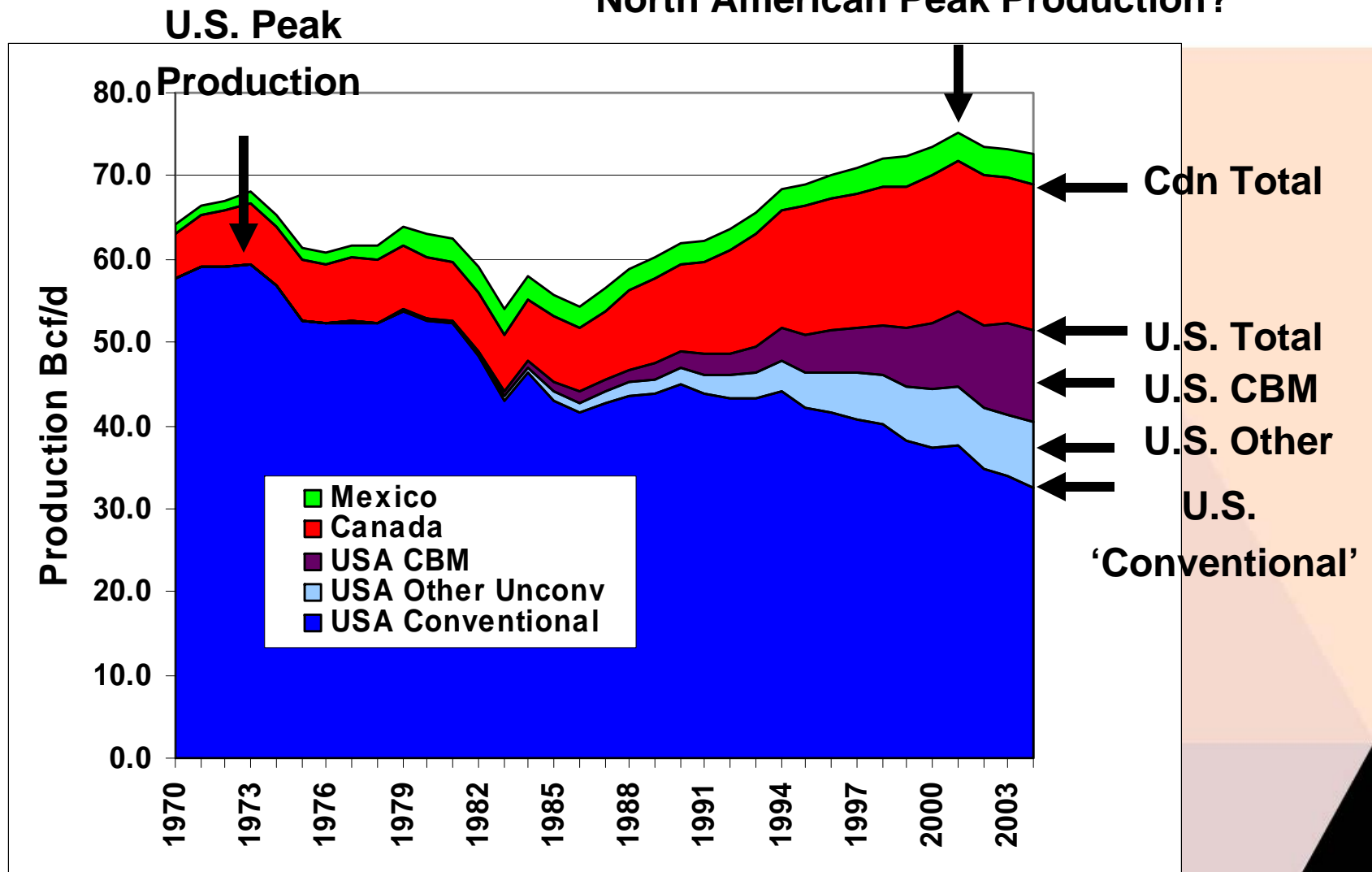
- ‘Any methane not trapped in a porous, permeable, buoyancy driven system’
- Characteristics – extremely variable – (often)
  - Methane not freely dispersed
  - Low or heterogeneous permeability
  - Source rock and reservoir closely related
  - Large, low concentration resources
  - Unusual pressure regimes
- ‘More Challenging to extract’
- In many cases a poorer quality of conventional gas

# Current Gas Production in North America

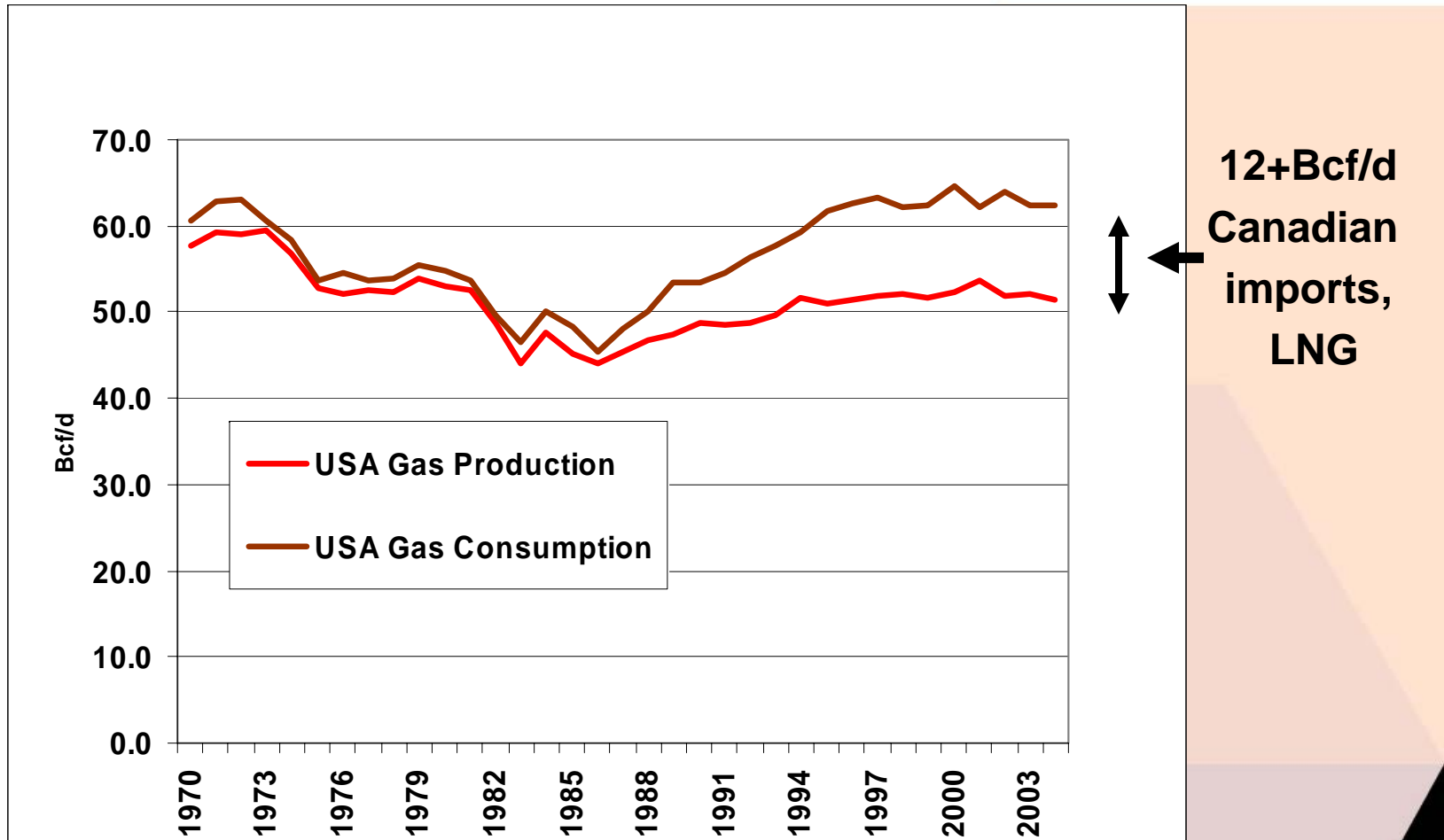
# North American Gas Production



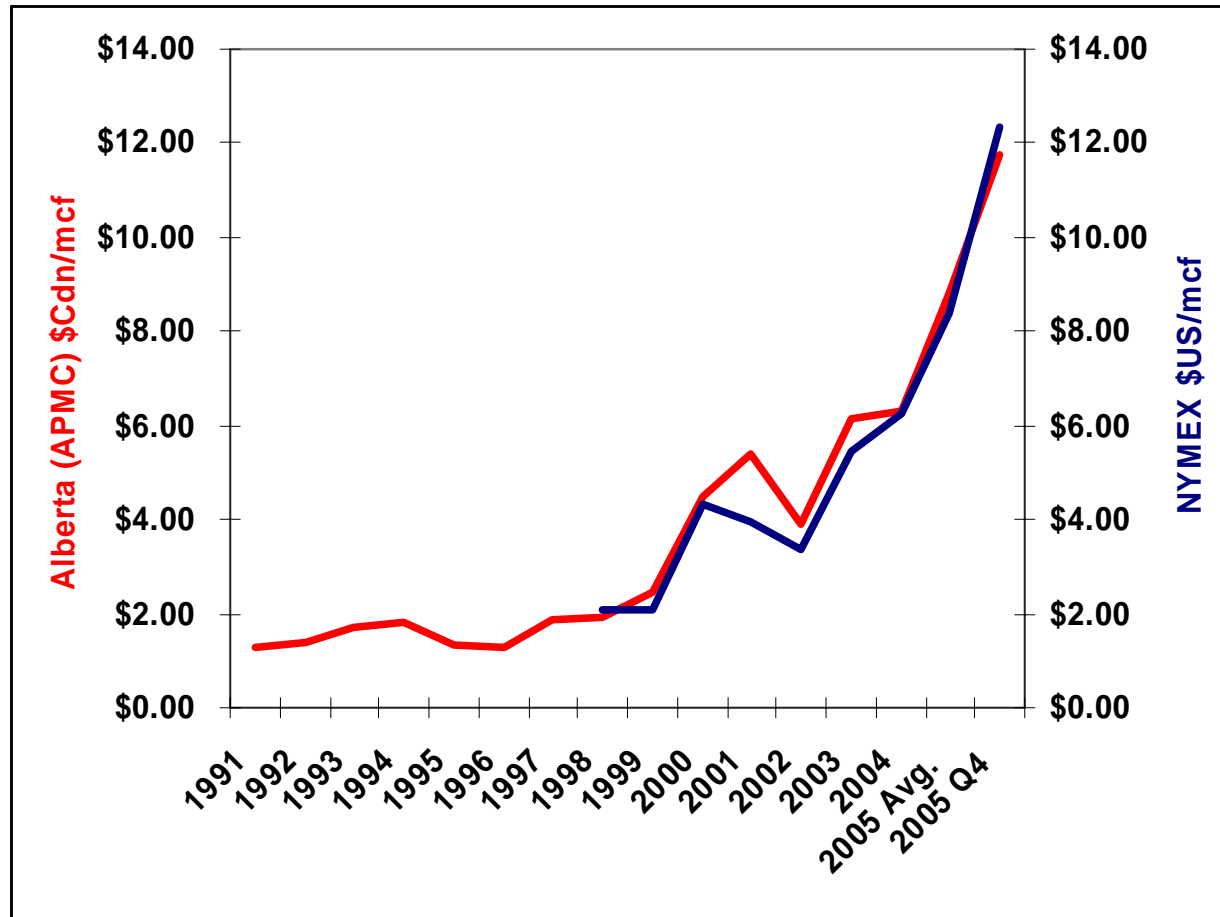
North American Peak Production?



# The Gap between US Gas Production and Consumption (BP, 2005)



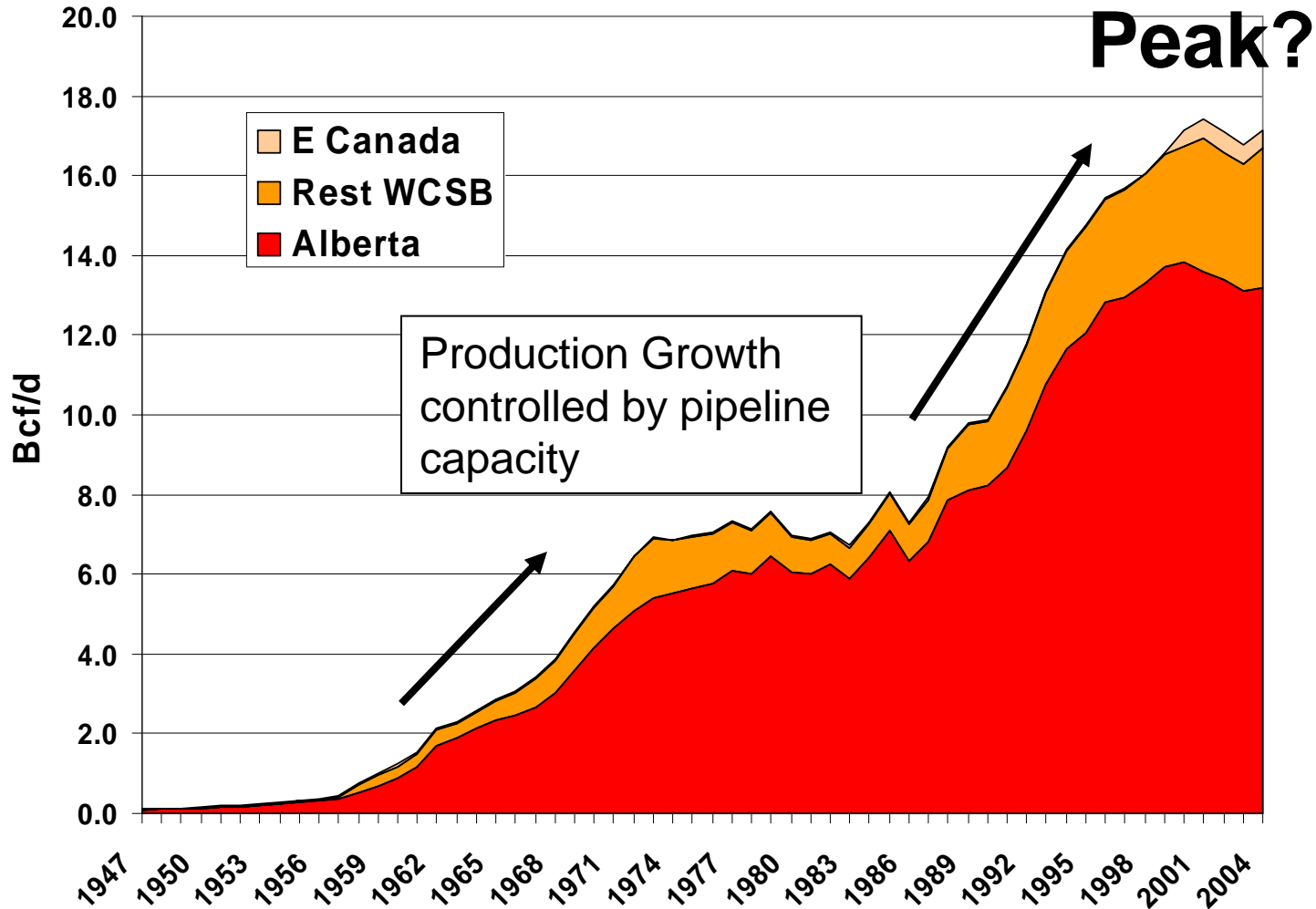
# Gas Price



**Prices began to rise in North America when Alberta production growth failed to meet demand**

# Canada's Natural Gas Production

(Bcf/d Adapted from CAPP Data)



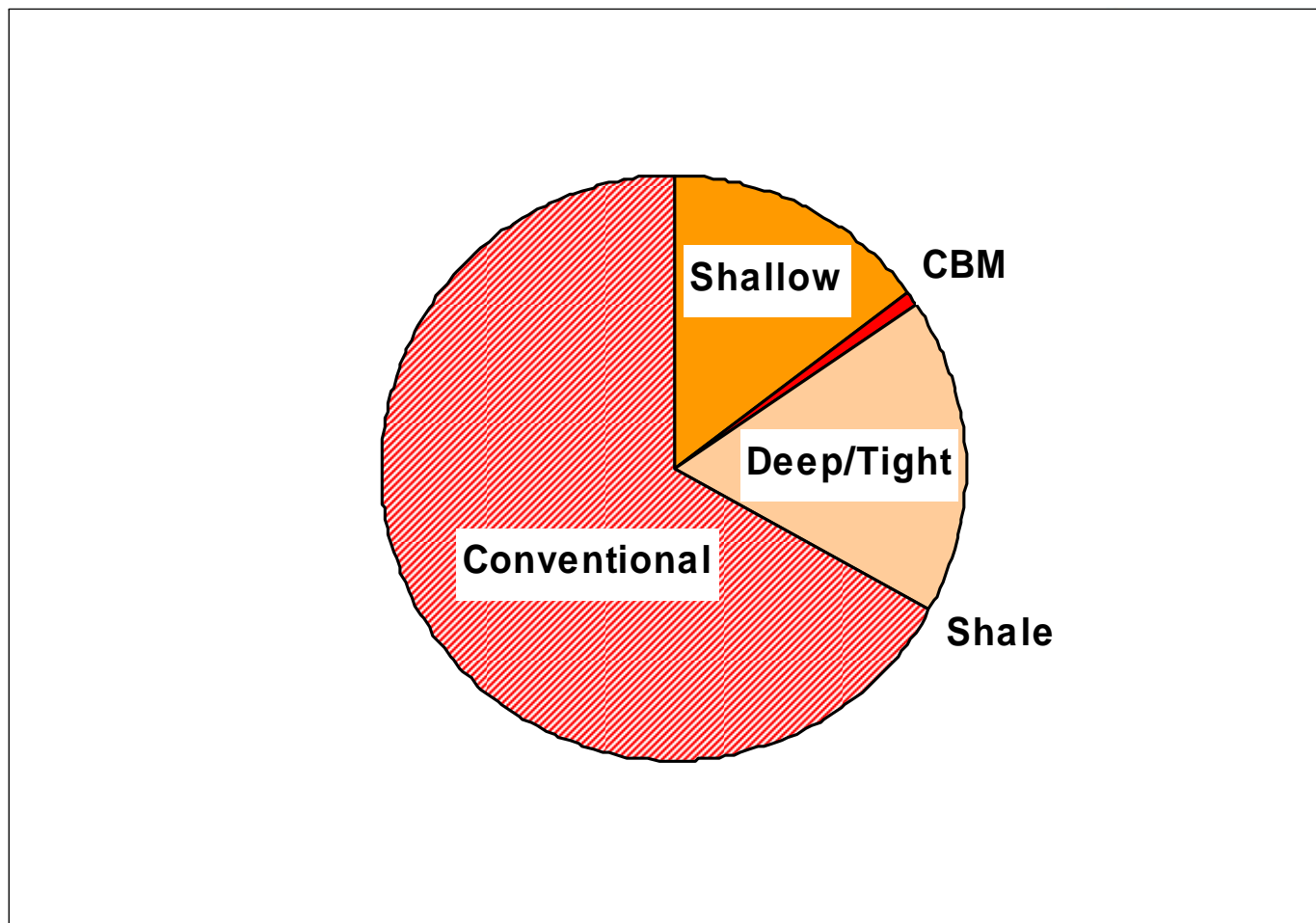
**Record Prices**

**Record Activity**

**Production Flat to Declining**

**Not Sustainable**

# Contribution of Unconventional Gas Production, WCSB, December 2004



**33% of Production, 50% of Current Activity?**

## In North America:

Approximately 22Bcf/d of current gas production is  
“Unconventional Gas”

Unconventional gas production may outstrip  
conventional production within 5 years

(Which is why North America has the most  
expensive natural gas production in the World)

# The Difference Between Resources and Reserves

# Canada's Resources and Reserves

## Natural Gas

(Conventional data adapted from CGPC 2001)



**?10,000Tcf**

**Ultimate Resources**

**Total Conventional + Unconventional**

**592Tcf**      **?>1,000Tcf**

**Discovered**

**340Tcf**

**Raw Gas**

**Sales Gas**

**204Tcf**

**Unproduced**

**Remaining Reserves**

**55Tcf**

**(>95% WCSB)**

**Rate of Conversion:**

**Accessibility  
Technology**

**Price  
Motivation**

# Understanding Remaining Gas Resources



– Accessible and Economically Available

	Accessible	Accessible with restrictions	Inaccessible
Available at current prices	Presently Available Resources (Reserves)	Future Available Resources	Unavailable Resources
Available at higher prices or New Technology	Future Available Resources	Future Available Resources	Unavailable Resources

**Can apply this approach to Conventional and Unconventional Resources**

# Understanding Remaining Gas Resources



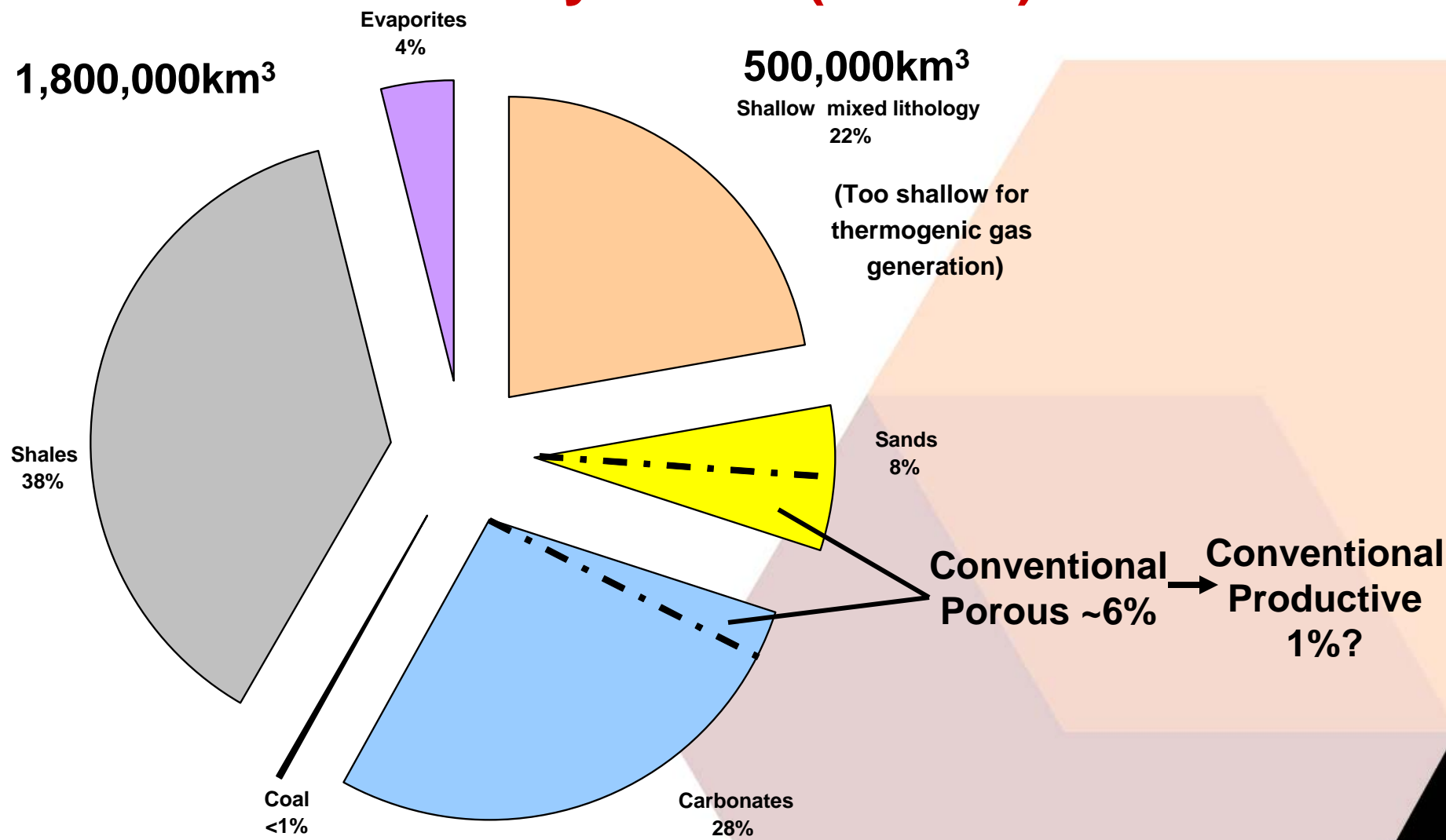
– Accessible and Economically Available

	Accessible	Accessible with restrictions	Inaccessible
Available at current prices	55Tcf Discovered Reserves, 20Tcf? Undiscovered	50Tcf? Resources	20Tcf? Resources
Available at higher prices or by New Technology	50Tcf? Resources	100Tcf? Resources	10000Tcf??? Resources

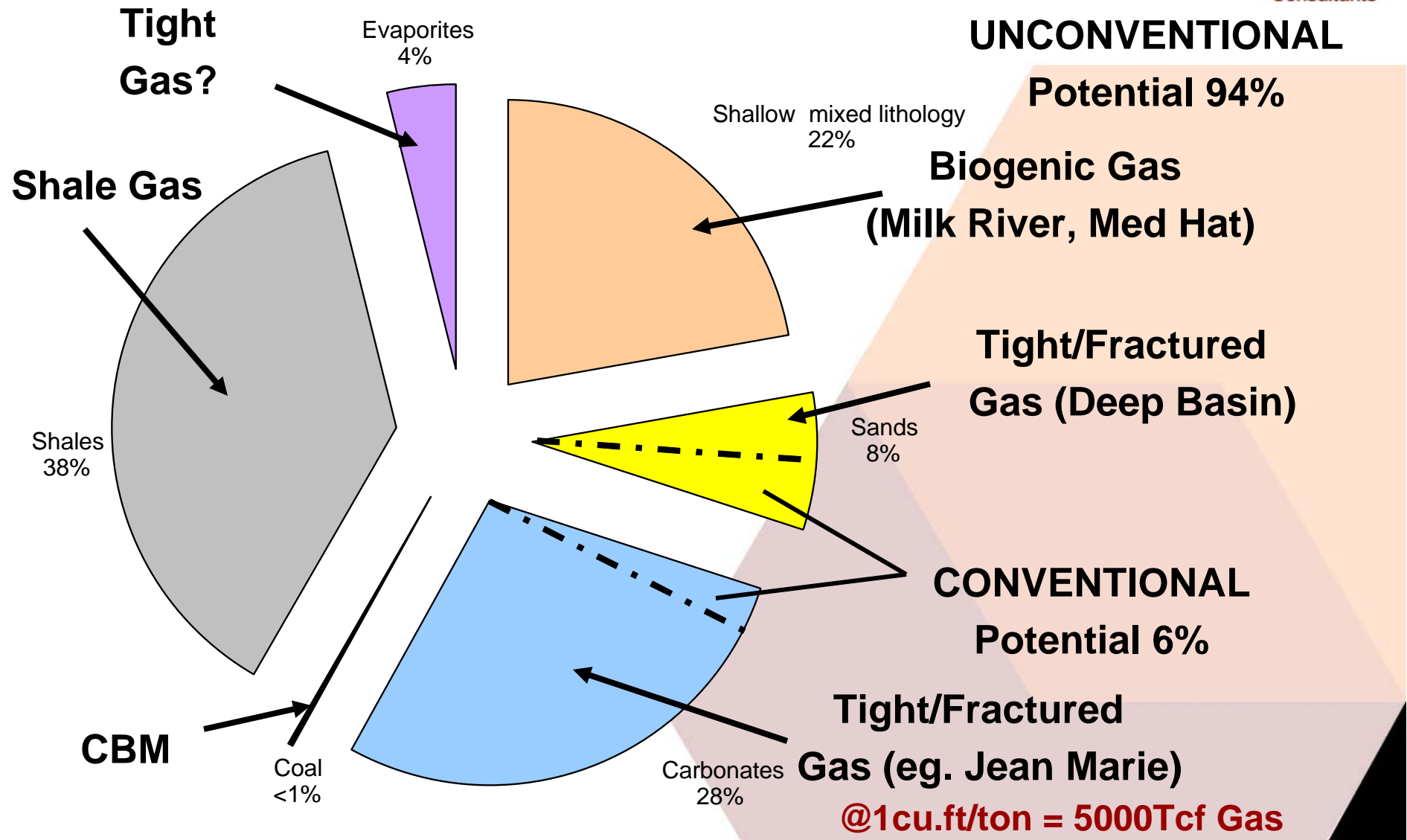
**Will be updating these numbers with the CGPC**

**Much of amber and red resources are unconventional – the Challenge**

# Distribution of Rock in the Western Canada Sedimentary Basin (WCSB)



# Distribution of Rock in the WCSB



# **What Unconventional Opportunities Should we be Considering?**

# Unconventional Gas - Types

- Shallow Gas
  - Biogenic in clastic reservoirs
  - Ultra shallow gas
- ‘Tight’ Gas
  - In clastic and carbonate reservoirs
- Deep Basin Gas (Basin Centred Gas)
- Coalbed Methane (CBM)
  - Also called Natural Gas from Coal (NGC)
- Shale Gas
- Gas Hydrates
  - in molecular structure of ice
- Inorganic Methane(?)
- Continuously (Currently) Generated Methane

# Unconventional Gas – Resources and Status (\*From various sources)



	Resource in USA*	Status USA	Resource in Canada*	Status Canada
Shallow Biogenic Gas	20Tcf	On-going Production	40Tcf	Production since 1905
Tight Gas (<0.1md)	>700Tcf	Opportunity?	600Tcf	?
Deep Basin/BCG		Growth Opportunity		Production since 1976
Coalbed Methane	749Tcf	Production since 1970's	400-700Tcf	Production since 2002
Shale Gas	600Tcf	Production since 1827	100-900Tcf?	Experimental activity
Gas Hydrates	1000Tcf?	Experimental Research	5000Tcf?	Experimental Research
Inorganic Methane	?	?Theoretical	?	?Theoretical
Continuously Generated Methane	3Bcf/d?	Pilot Projects	400Mmcf/d?	Pilot Projects

# Unconventional Gas – Issues

(Scale 1-5, where 1=Good, 5=Bad)

	Resource in Canada*	Status Canada	Timing	Environmental	Cost	Score
Shallow Biogenic Gas	30Tcf	Production since 1905	1	2	1	4
Tight Gas (<0.1md)	600Tcf	?	3	3	5	11
Deep Basin/BCG		Production since 1976	1	2	2	5
Coalbed Methane	400Tcf	Production since 2002	1 - 4	2 - 5	2 - 4	5 - 14
Shale Gas	100Tcf	Experimental activity	3	3	3+	9+
Gas Hydrates	5000Tcf	Experimental Research	5	5	5	15
Inorganic Methane	?	?Theoretical	5	2	5	12
Continuously Generated Methane	400Mmcf/d ?	Pilot Projects	2	-2	5	5
Liquefied Natural Gas	(Imports)	Start-up 2008	2	3	2	7

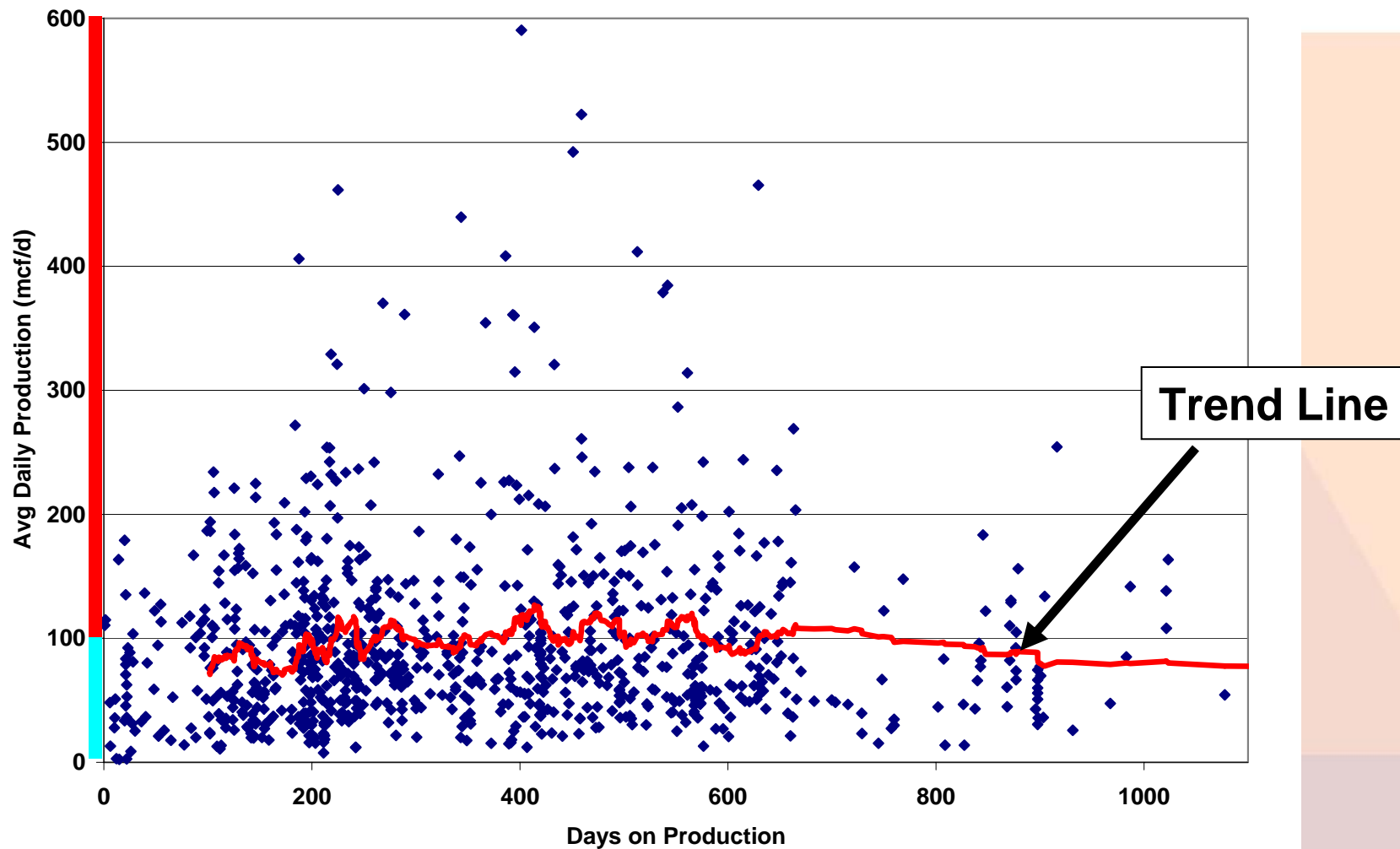
# ***Coalbed Methane***

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# Horseshoe Canyon Current Productivity

(AJM Database, production to June 2005)

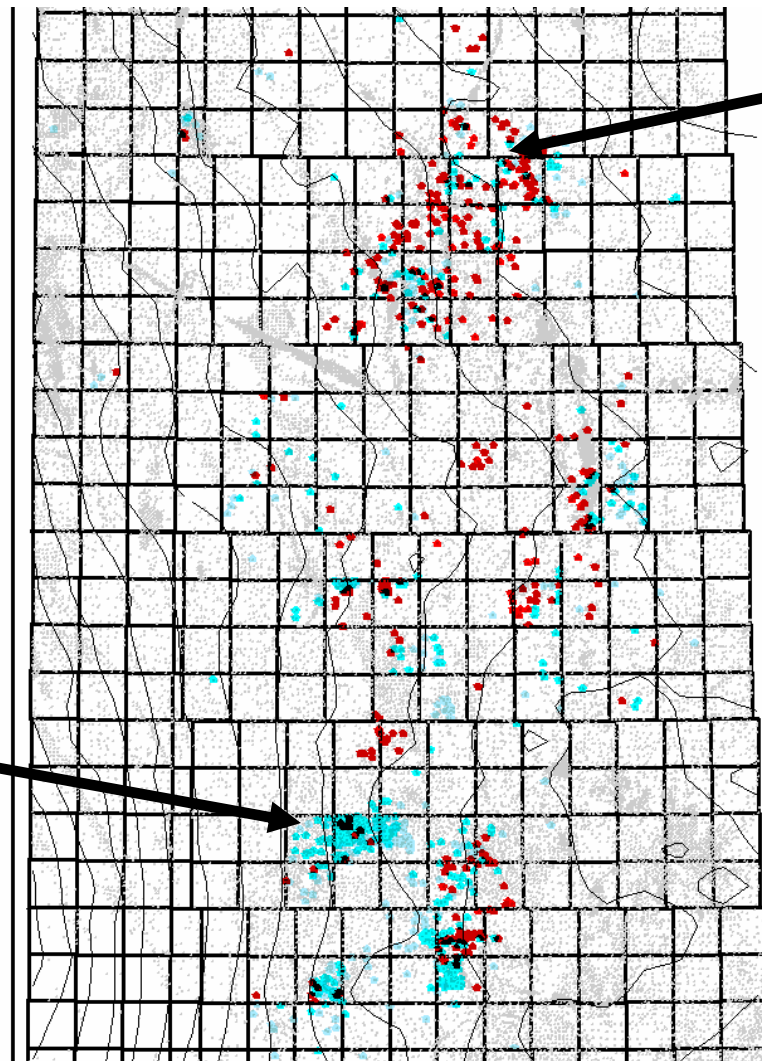


# Horseshoe Canyon Production (AJM, 2005)



 >100mcf/d  
 <100mcf/d  
Median = 79mcf/d

Coal depth  
300-800m



Coal depth  
200-300m

Map: Belly River TVD

# WCSB Coalbed Methane



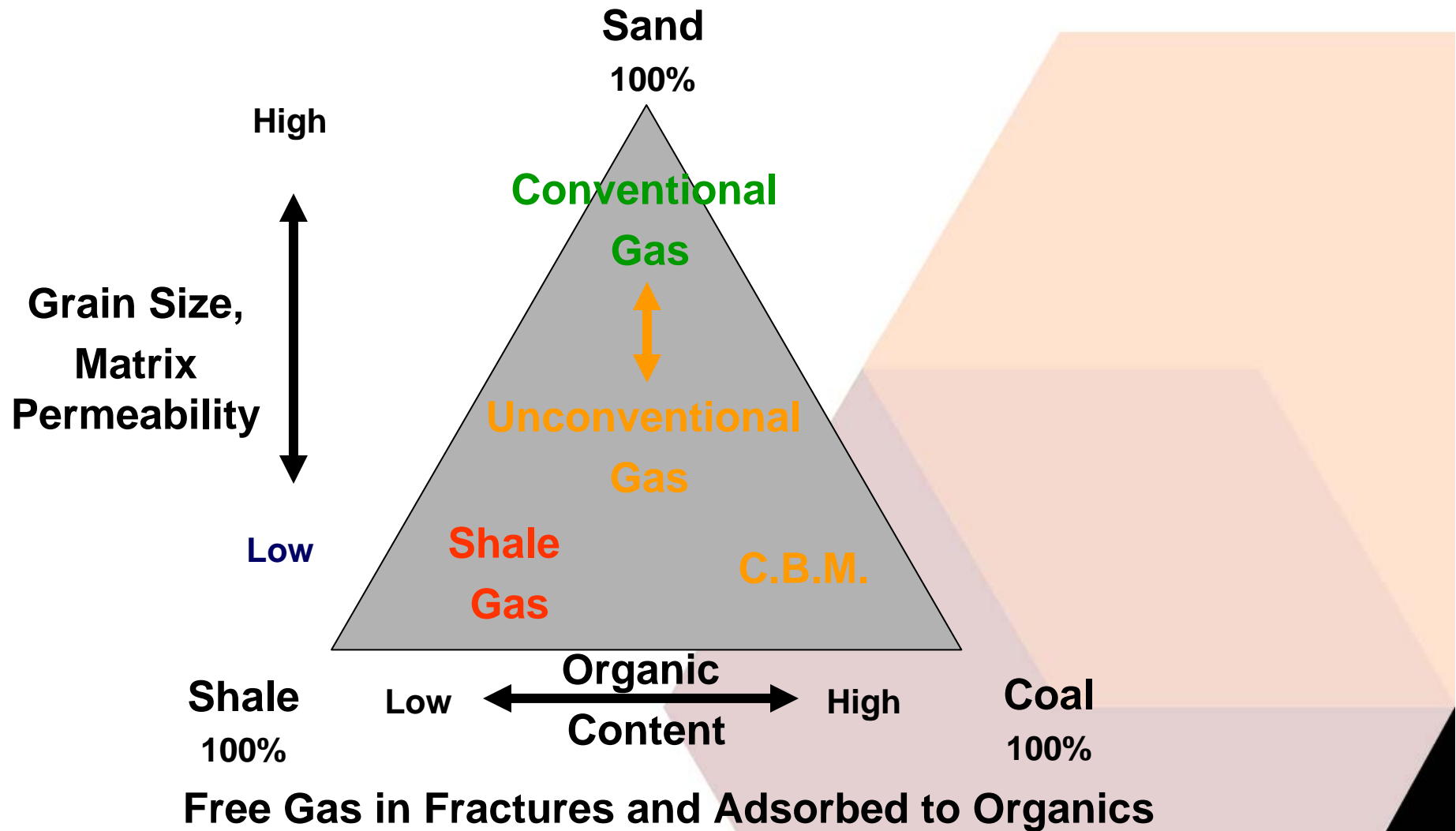
	Resource Potential	Status	
Ardley Coal WC Alberta	Low/Moderate	Limited activity, freshwater issues	Red
Horseshoe Canyon Coal	High	Focus of current activity, readily accessible, dry gas	Green
Mannville Coal WC Alberta	Very High	Requires de-watering – moving to commercial phase e.g. Trident/Nexen, Corbett Creek	Orange
Mannville Coal NE BC	Moderate?	Experimental activity, - 7 permits granted, confidential results	Orange
Kootenay Coal SE BC	Moderate	Experimental, Encana, Devon. Coal continuity and environmental challenges	Red

# ***Shale Gas***

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# What is Shale Gas?



# Typical US Gas Productive Shales (Curtis, 2002)



## Major producing Shales:

**Devonian:** Antrim Shale (Michigan Basin), Ohio Shale (Appalachian Basin), New Albany Shale (Illinois Basin).

**Mississippian:** Barnett Shale (Fort Worth Basin).

**Cretaceous:** Lewis Shale (San Juan Basin)

## Criteria:

**Total Organic Carbon (TOC):** Min >1%, Prefer >3.5%

**Thermal maturity:** Vitrinite reflectance Min >0.4%, Prefer >1%

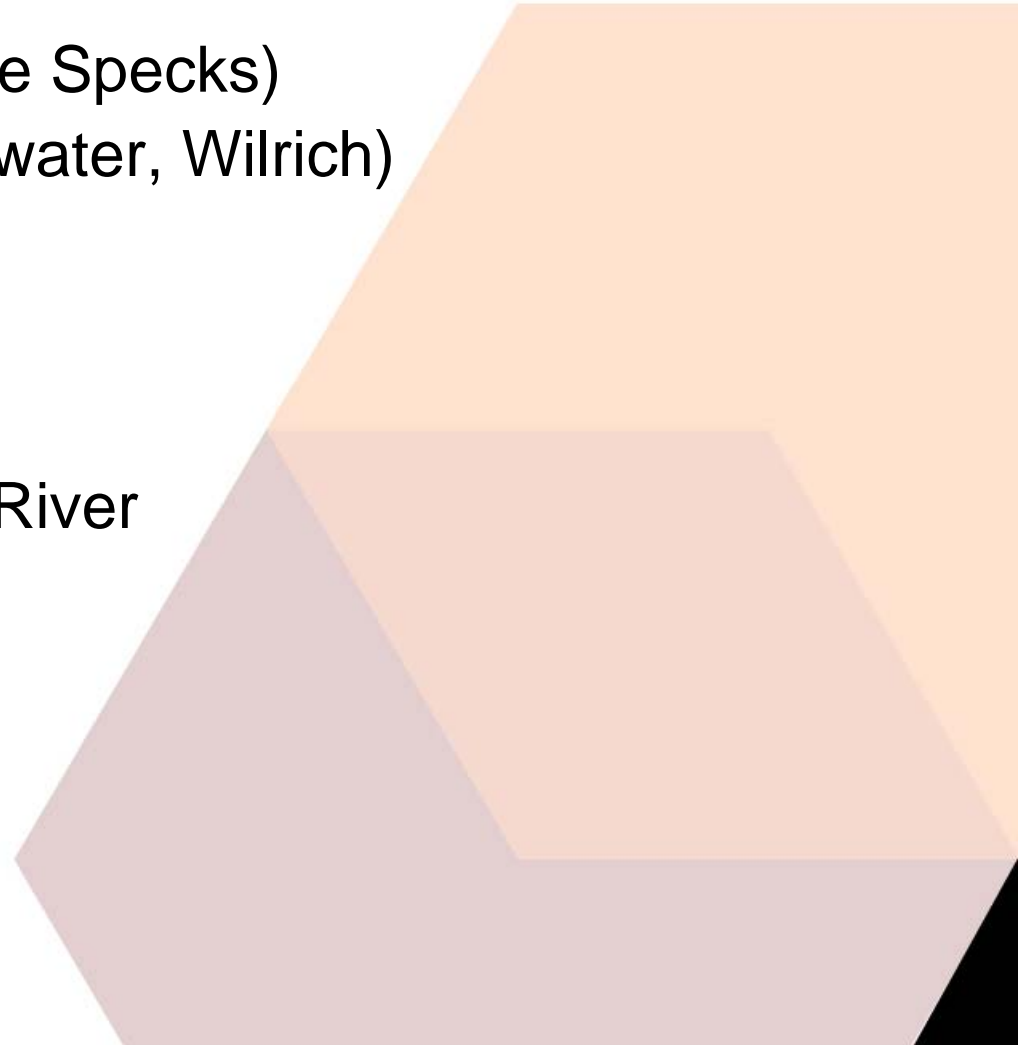
**Shale thickness:** >10m

**Gas content:** Free gas + adsorbed gas >1.2cc/g. (>40scf/ton)

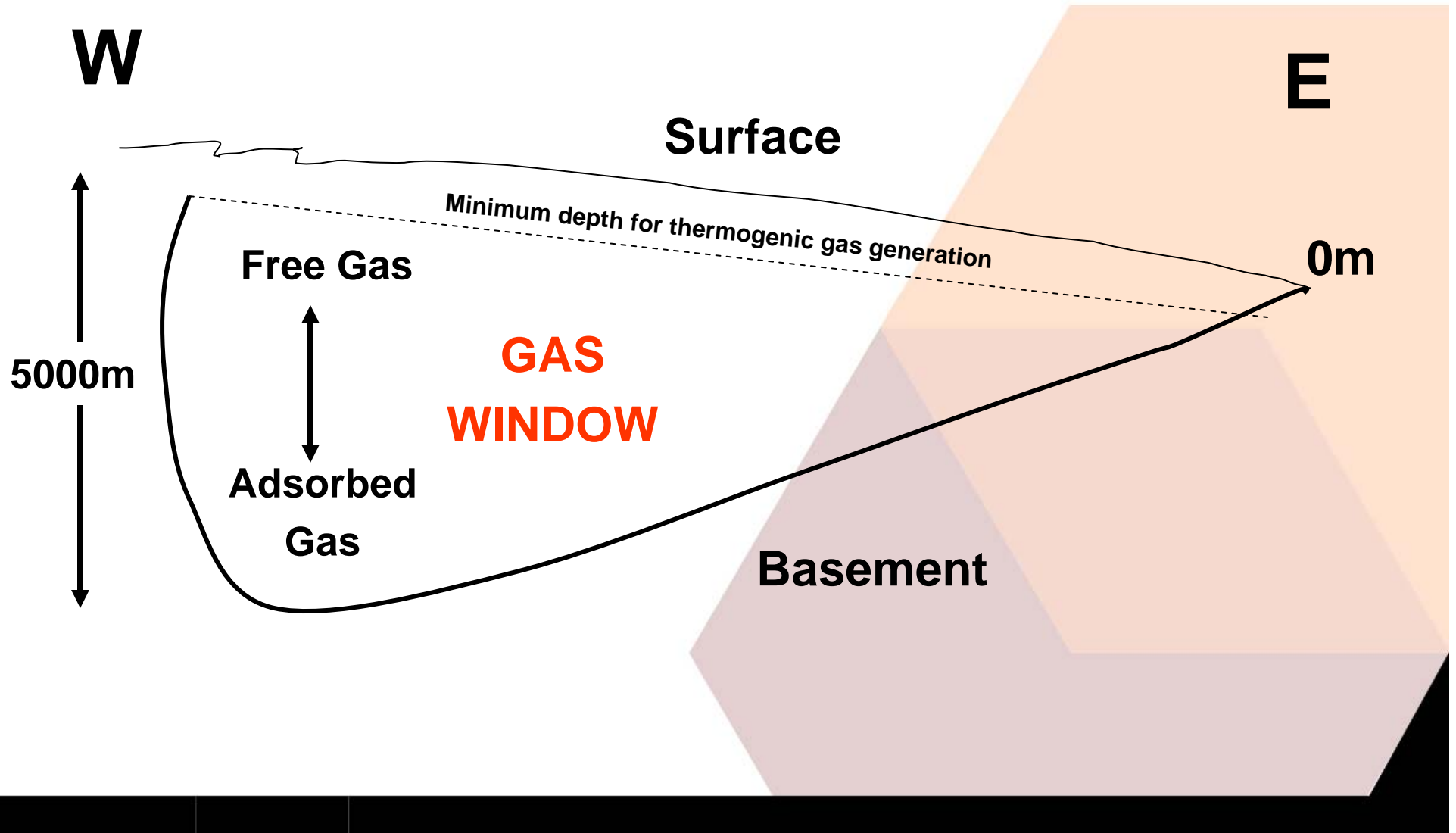
**Natural permeability:** Fractured (or ability to fracture)

# Shale Gas potential in the WCSB

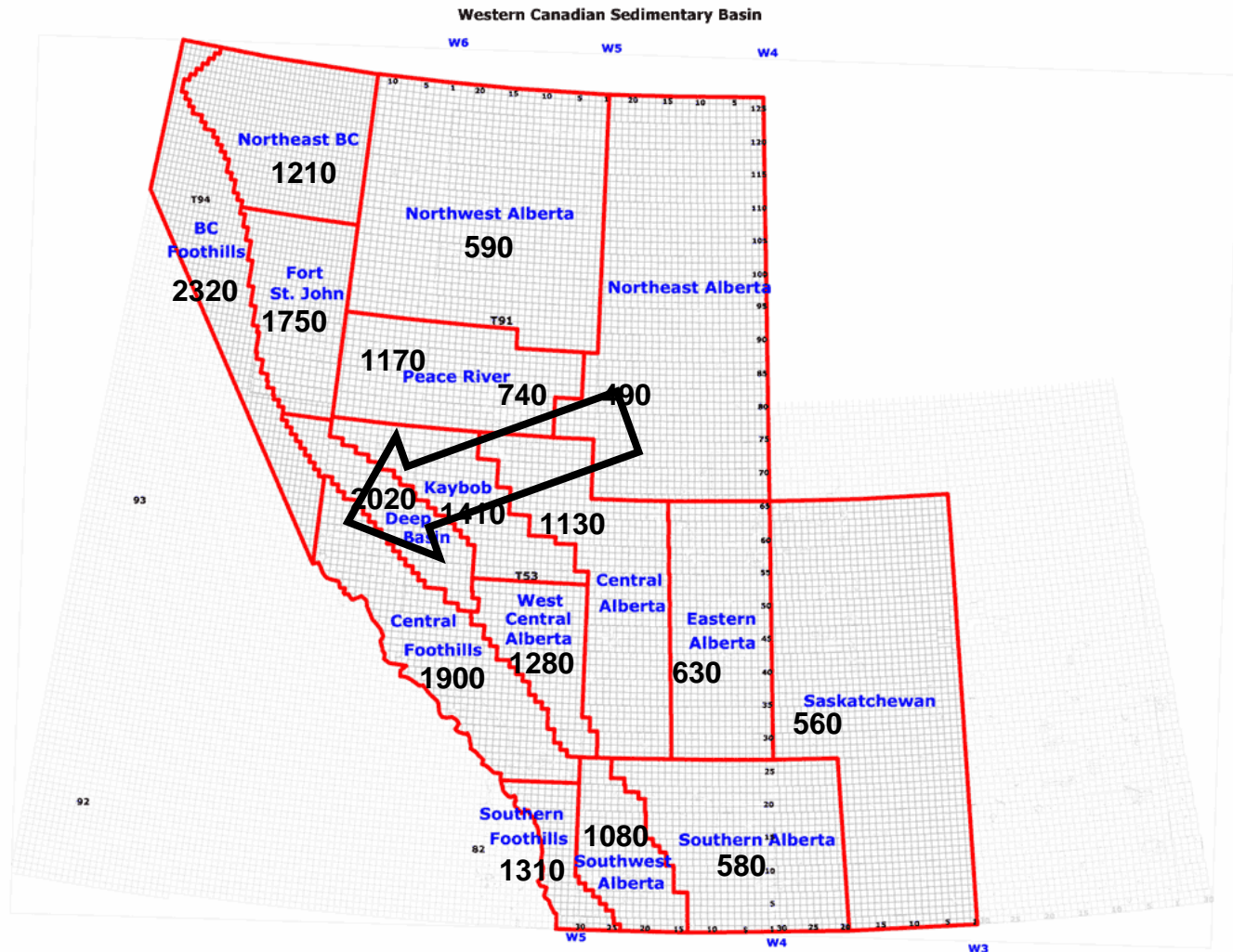
- Cretaceous
  - Colorado (Second White Specks)
  - Upper Mannville (Clearwater, Wilrich)
- Jurassic
  - Fernie
- Mississippian
  - Exshaw/Bakken, Besa River
- Devonian
  - Besa River
  - Fort Simpson
  - Muskwa
  - Duvernay



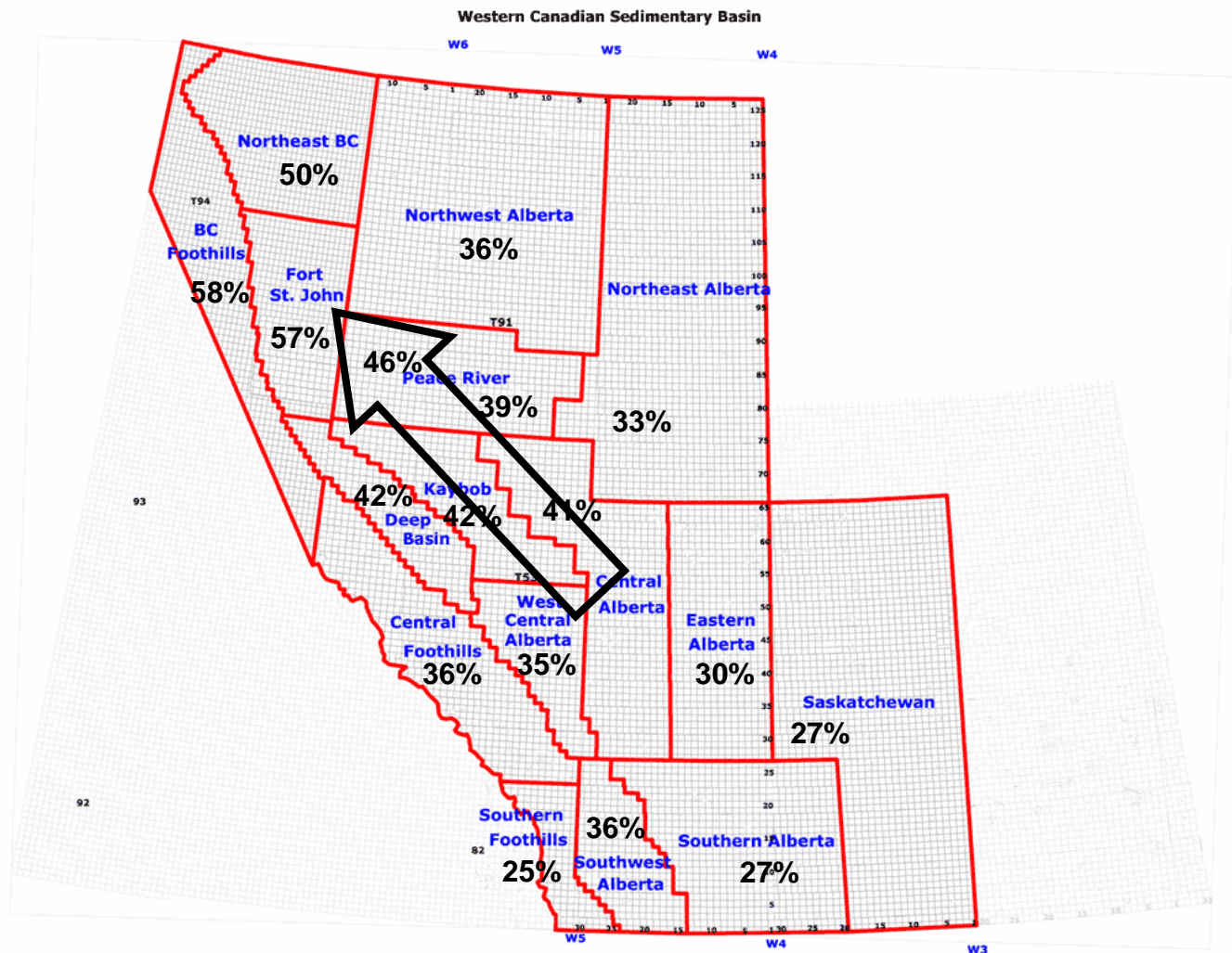
# Geometry of WCSB



# Thickness of Shale in WCSB (Metres)



# Shale in WCSB (% of Sedimentary rock)



# Comparison of Devonian shales, NEBC

(adapted from CBM Solutions, 2005)



	<b>Avg. Thickness (meters)</b>	<b>Avg. TOC (%)</b>	<b>Avg. Gas Capacity (cc/g)</b>	<b>Thermal Maturity</b>	<b>Natural Fractures?</b>
<b>Exshaw</b>	5 - 10	5%	1.3	Mature	Selective
<b>Besa River</b>	450 - 500	4.3%	0.8	Mature	Selective
<b>Fort Simpson</b>	475 - 525	0.4%	0.3	Mature	Selective
<b>Muskwa</b>	15 - 25	3.1%	0.7	Mature	Selective

# Challenges for Unconventional Gas Production

# Unconventional Gas - Producibility



- Low productivity (low decline rates?)
- Low recovery factors (opportunity)
- Require greater drilling density
- Increased infrastructure and surface impact
- Environmental issues – NIMBY, BANANA, NOPE, NITU
- Technologically challenging to produce:
  - Area and resource specific solutions
  - Low risk once specific solutions identified
- Relatively high development and operating costs

# The Future of Natural Gas in Canada.....

## The Issues



- Natural gas price is currently at record high levels
- What will high prices do to long term demand?
  - Expansion of tar sands and gas-fired power generation in Ontario - growth areas for natural gas?
  - Plastics, fertilizer and methanol - victims of high price
- Who is doing the exploration and research to sustain gas production?
- Canada's obligations to NAFTA if gas production declining?
- Canada's obligations to Kyoto if gas replaced by coal?
- How fast might LNG imports to North America grow?
- What happens to the Canadian gas industry if LNG is cheaper than domestic gas?
- What happens to the Canadian economy if our energy is more expensive than the rest of the world?

# Conclusions

- North America's gas demand will far outstrip conventional North American supply
- Unconventional gas is already a significant contributor but we need to expand that effort many times over
- Governments must take a lead in encouraging research and development of all energy resources along with education on the need for substantial conservation
- A Canadian Energy Plan that recognizes the problems and develops realistic solutions is vital to the future economic well-being of Canada (Alberta Government and Industry should take lead in this process)

# A Prediction.....



A supply disruption (real or perceived)  
or weather related demand increase  
will spike natural gas price to  
>\$20 CDN per GJ  
in the next 12 months

***Thank you*** (Don't forget to drop off your  
*business card with gas prediction*)

## ***More Information?***

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