Western Canada’s Giant Gas and Liquids Fairway:
The Duvernay, Horn River and Canol Shales

Brad J. Hayes
Petrel Robertson Consulting Ltd.

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Emerging unconventional plays offer huge gas and liquids production and potential in western Canada

Montney was the first to establish widespread commercial viability with horizontal wells (2005)

Three closely-related Devonian shale plays aren’t quite there yet
  * Horn River (2007)
  * Duvernay / Muskwa (2009)
  * Canol (2011)

Where are they going, and when will they get there?
North American Shale Plays

North American shale plays
(as of May 2011)
Devonian Shale Fairways

- Organic-rich muds accumulated in warm shallow seas on the flanks of Devonian North America
- These became shales with burial, heat, and the passage of time
- Organic materials evolved into oil and gas
Continuous shale basin subdivided by reef trends and landmasses
• Shale basin can be followed north to Aklavik Arch, just south of Mackenzie Delta

• Immense shale province with fewer internal features than in the south, but more complex structure
Duvernay Thermal Maturity

- Thermal maturity of sediments increases with heat and burial
- Prime determinant of gas / liquids / oil ratios
- More intensive mapping will reveal local variations that will have important economic implications
Duvernay Gas in Place

- Gas resource is focused in western, deeper, more thermally mature part of basin
- Alberta Geological Survey mean gas in place, calculated probabilistically
  - **444 TCF**
    - (12500 $10^9$m$^3$)

Rokosh et al, 2012
Duvernay Liquids in Place

- Natural gas liquids focus is to the east, where organics are less mature

- Alberta Geological Survey mean natural gas liquids in place, calculated probabilistically
  - **11.8 billion barrels** 
    - *(1.87 \times 10^9 \text{m}^3)*
Duvernay Oil in Place

- Oil trend lies furthest to the east
- Alberta Geological Survey mean oil in place, calculated probabilistically
  - 62.8 billion barrels (9.98 $10^9$ m$^3$)

Rokosh et al, 2012
Other Resource Estimates

• Similar maturity fairways and corresponding gas / liquids / oil trends can be mapped for the Muskwa and Canol / Horn River as well

• Muskwa: **413 TCF**, **15.5 BBbl**, **116 BBbl** (AGS, 2012)

• Horn River Basin: **448 TCF** (dry gas only) (NEB, 2011)

• Canol / Horn River (NWT): Insufficient data (NEB, 2014)
  • Husky (2013): 20-90 MMBOE/section in Central Mackenzie Valley
Gas / Condensate Potential

- So why do we see more gas / condensate than oil potential?
- It’s the shale reservoir:
  - Gas moves more readily through very small pore networks in shales
  - Sufficient reservoir pressure and energy to produce fluids lies in the gas and condensate trends
  - There isn’t enough reservoir energy to produce oil at economic rates under most conditions
- How will this potential play out over time?
1. Duvernay – Kaybob and West Shale Basin
Duvernay

- Kaybob – first Duvernay delineation area
  - Optimal reservoir conditions, liquids ratio
  - First land rush late 2009
  - >100 wells
  - Close to commerciality (?)

- Southern West Shale Basin
  - Very little original well control – initially perceived as more risky
  - Now being actively delineated
1. Duvernay – Kaybob and West Shale Basin

2. Horn River Basin
Horn River Basin

- Aggressive land acquisition 2006-2008
- Appraisal and development drilling through 2012
  - Reserves and production rates de-risked
- Development infrastructure largely in place
- Awaiting market for dry gas – B.C. LNG
Devonian Shales – Play Development

1. Duvernay – Kaybob and West Shale Basin
2. Horn River Basin
3. Muskwa – Northern Alberta
Muskwa

- Rich in-place resources, but Muskwa has been tested less extensively
- Many areas remote from gas infrastructure
- Industry is not yet sure when this area is going to be proven commercial
Devonian Shales – Play Development

1. Duvernay – Kaybob and West Shale Basin
2. Horn River Basin
3. Muskwa – Northern Alberta
4. Canol / Horn River - NWT
Canol / Horn River Shale

- Widespread shale reservoirs, but little modern well data
- Very remote areas
  - Expensive field operations
  - No producing infrastructure
- Central Mackenzie Valley has good resource attributes and has attracted exploration interest
- Other areas are prospective but not currently accessible
2011 Call for Bids
- 11 Parcels, $534 million work commitments

Exploration operations took place during winters 2012/13 and 2013/14

No current activity
Western Canada’s Giant Gas and Liquids Fairway

- **Duvernay (Gas and liquids)**
  - Intensive appraisal – near commerciality
  - Tied into existing infrastructure

- **Horn River Basin (Dry gas)**
  - Commerciality demonstrated
  - Awaiting go-ahead for B.C. LNG

- **Muskwa – Northern Alberta (Gas and liquids)**
  - Early stage appraisal, commerciality not proven
  - Some new infrastructure required

- **Canol / Horn River – NWT**
  - Land acquisition, first exploration wells
  - Far from existing infrastructure
  - Needs higher product prices and operating / cost efficiencies
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Conclusion: The Western / Northern Canada Devonian shale fairway has the potential to be a large and steady contributor to North American supply for many years

• So – the pot could overflow again!