

UNCONVENTIONAL GAS A HUGE NEW ENERGY RESOURCE

FOR NORTH AMERICA ?

FOR THE NORTHWEST TERRITORIES ?

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NWT UNCONVENTIONAL GAS INTRODUCTION

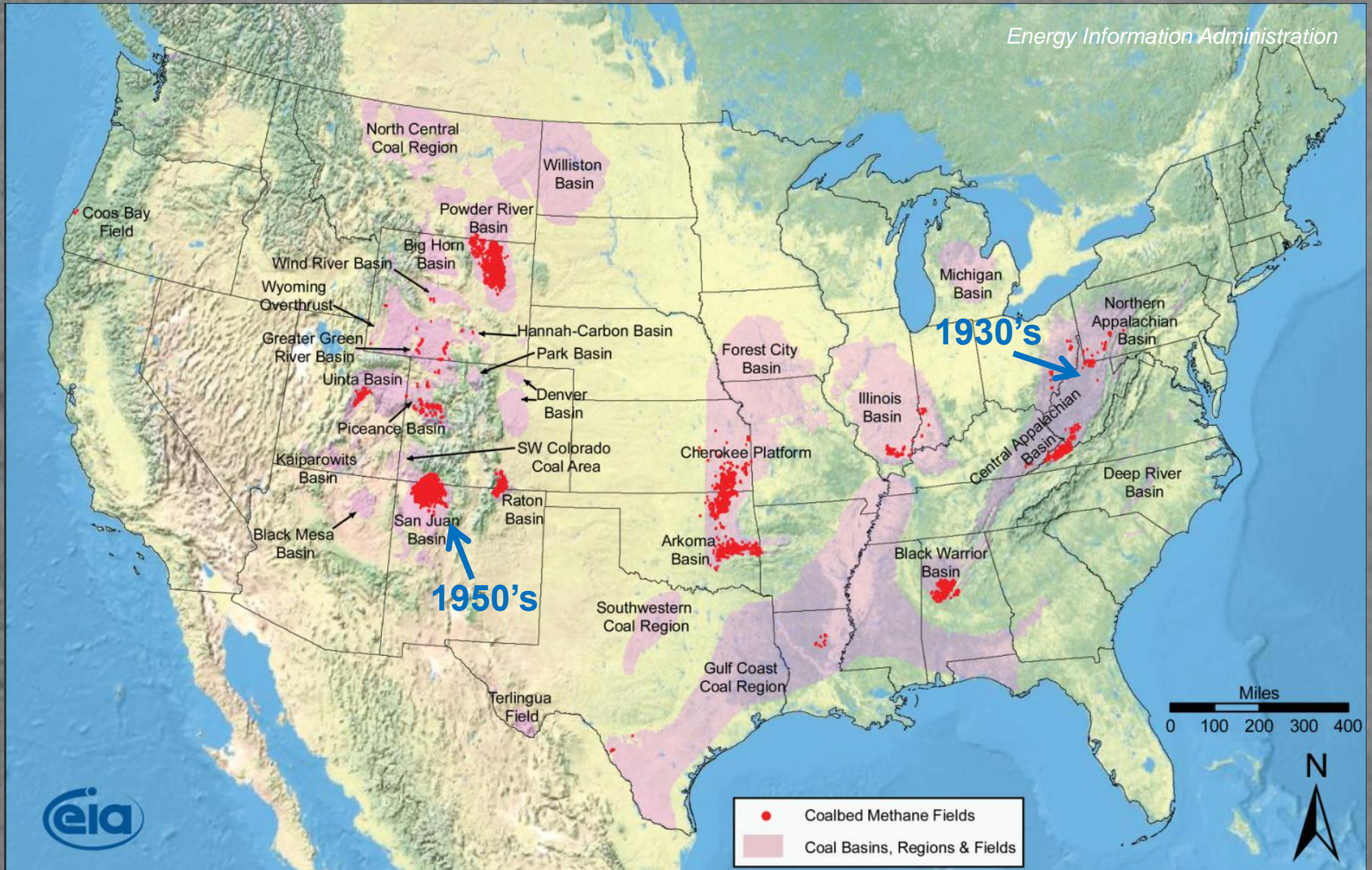
- ❖ Unconventional gas is of increasing importance in North America
 - ❖ Economies of scale associated with unconventional gas projects are attracting much of the new exploration and development investment
- ❖ NWT exploration to date has been driven by conventional oil and gas prospects
- ❖ Is the NWT prospective for unconventional gas ?

UNCONVENTIONAL GAS OVERVIEW

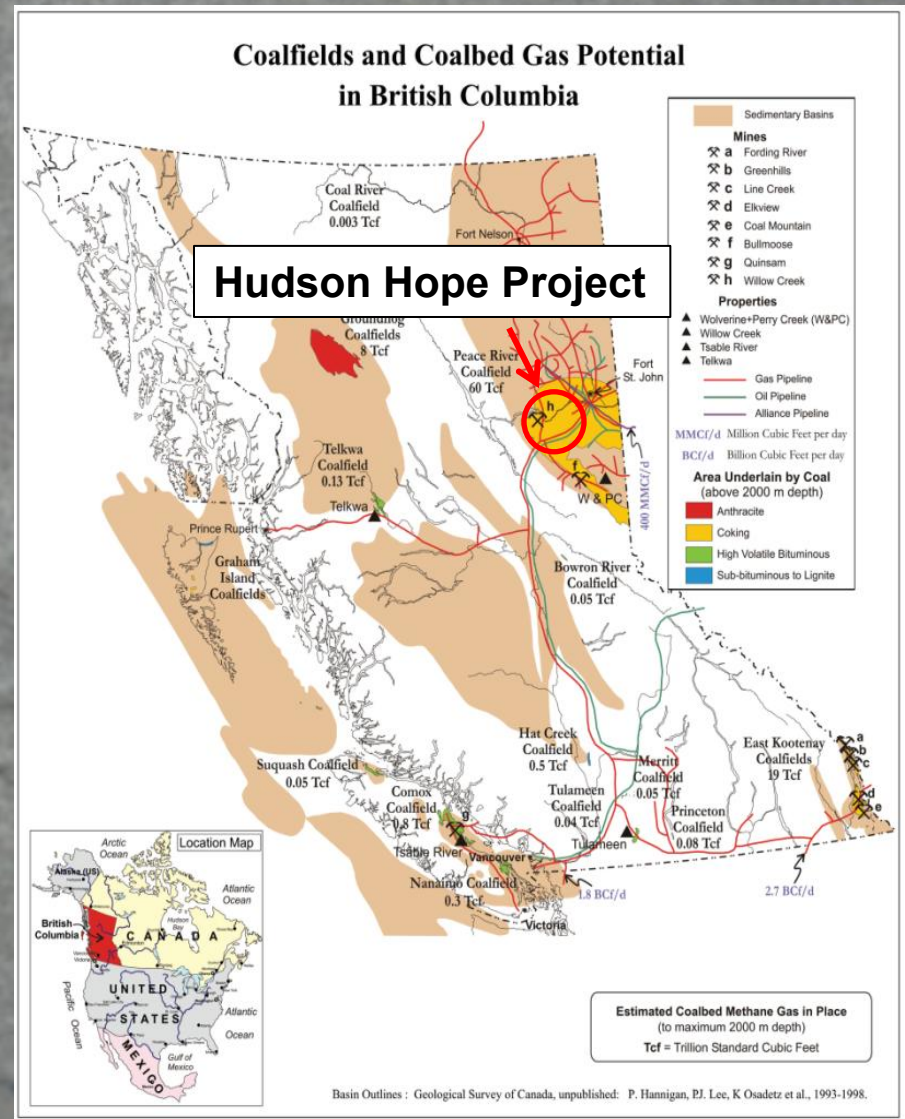
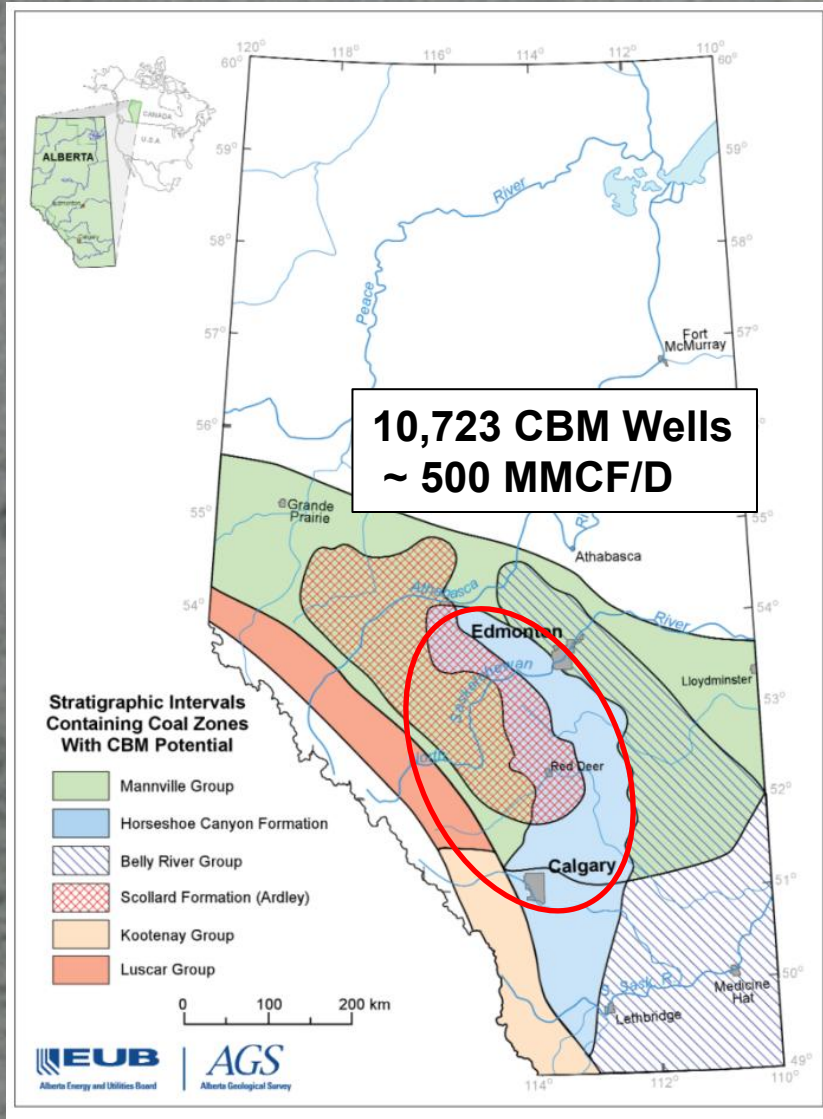
U/C RESERVOIR TYPES

- ❖ Coalbed Methane (CBM)
- ❖ Tight Gas Sands
- ❖ Shale Gas
- ❖ We are not considering gas hydrates

CBM – U.S. PRODUCTION



CBM – CANADIAN PRODUCTION



COALBED METHANE HISTORY AND POTENTIAL

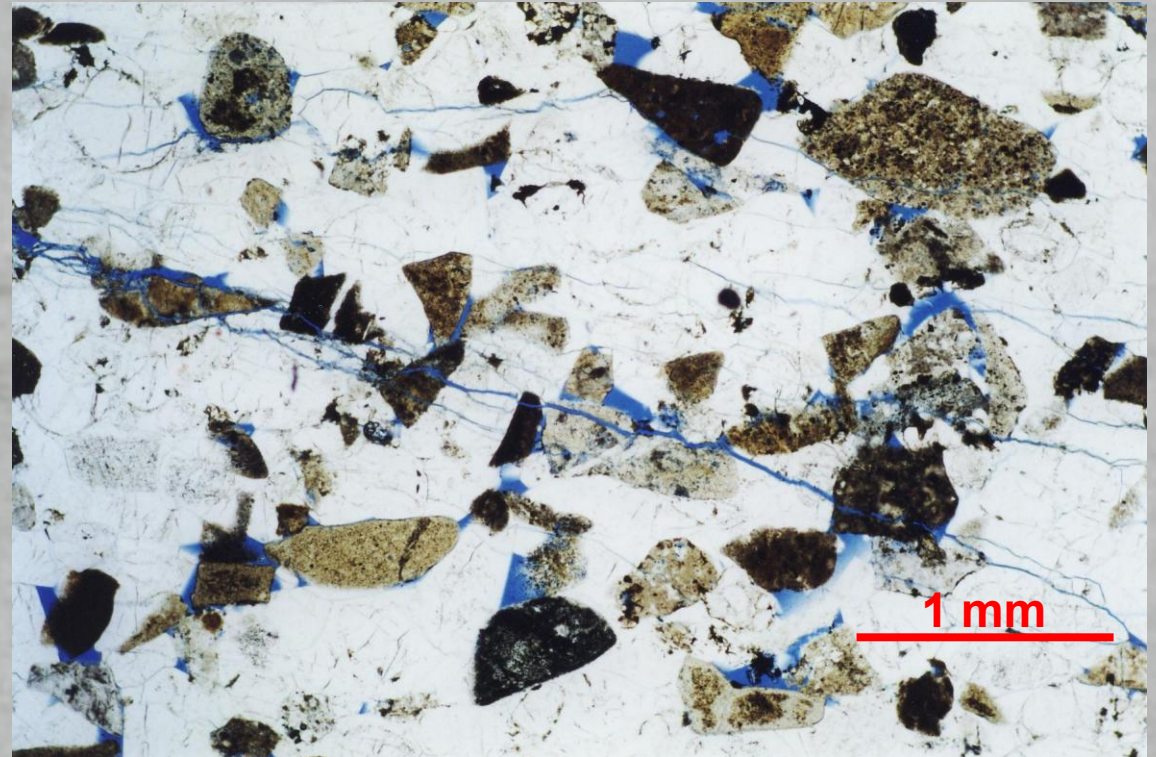
- ❖ Intensive development in Alberta through early 2000's
 - ❖ 2006 production: ~500 MMCF/D
- ❖ Hudson Hope project recently on stream in N.E.B.C.
- ❖ Large gas-in-place resource:
 - ❖ Alberta – 500 TCF
 - ❖ B.C. – 84 TCF
 - ❖ Maritimes Basin – 79 BCF
- ❖ Development has slowed in past few years
 - ❖ Technical issues – especially de-watering
 - ❖ Generally more expensive than tight gas / shale gas



Western Canada TIGHT GAS

NIKANASSIN FM

- ❖ Brittle, tightly-cemented sands
- ❖ Isolated porosity



TIGHT GAS – U.S. PRODUCTION

Energy Information Administration



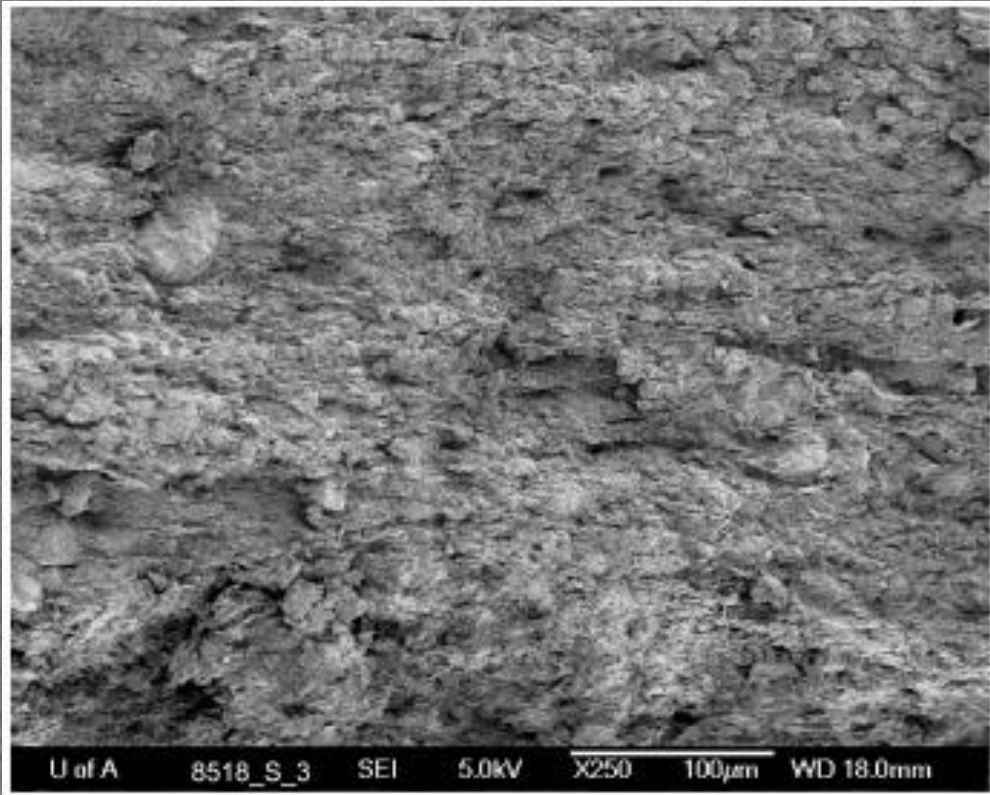
TIGHT GAS

HISTORY AND POTENTIAL

- ❖ Early Western Canada exploration focused on “sweet spots” with good reservoir quality
 - ❖ True tight gas exploitation has occurred only recently
- ❖ Downspacing / commingling and horizontal drilling of WCSB tight gas “resource plays” is highly successful
 - ❖ Alberta Deep Basin producing >5 BCF/D
 - ❖ **Montney** play very active in N.E.B.C. (>0.5 BCF/D)
- ❖ Enormous gas resource base in Alberta and B.C.
 - ❖ Deep Basin: 550-700+ TCF gas in place
 - ❖ **Montney**: 700+ TCF gas in place
 - ❖ New Foothills play area has huge additional potential

SHALE GAS

Alberta Geological Survey



*Scanning Electron Microscope image,
shale gas reservoir*

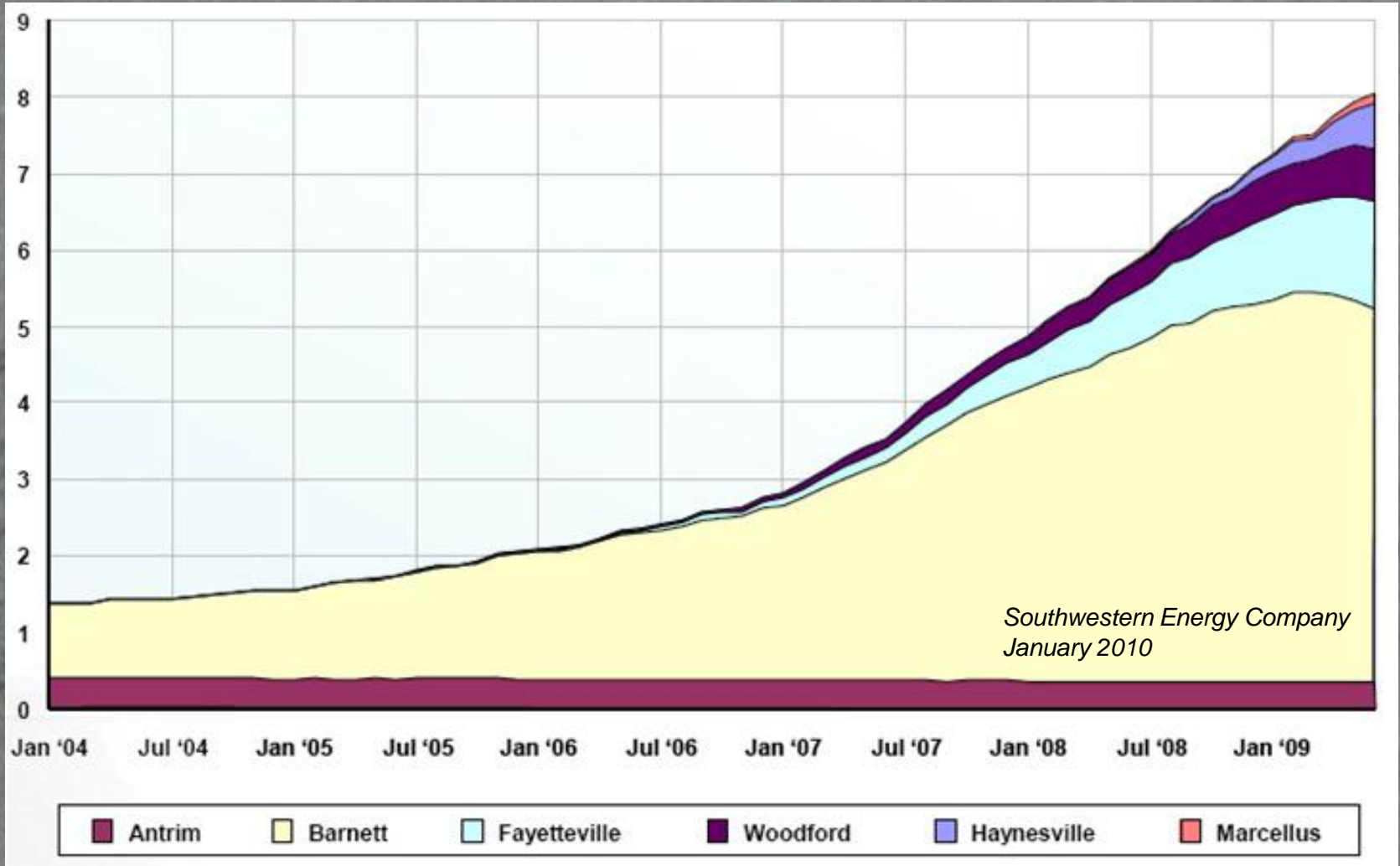
- ❖ Shales consist largely of very fine clay minerals, with very small, poorly-connected pore spaces
- ❖ Optimal drilling and completion treatments must be developed for each shale gas reservoir, as each is unique
- ❖ Horizontal drilling and multistage fracs are required to make most shale plays economic

SHALE GAS – U.S. PRODUCTION



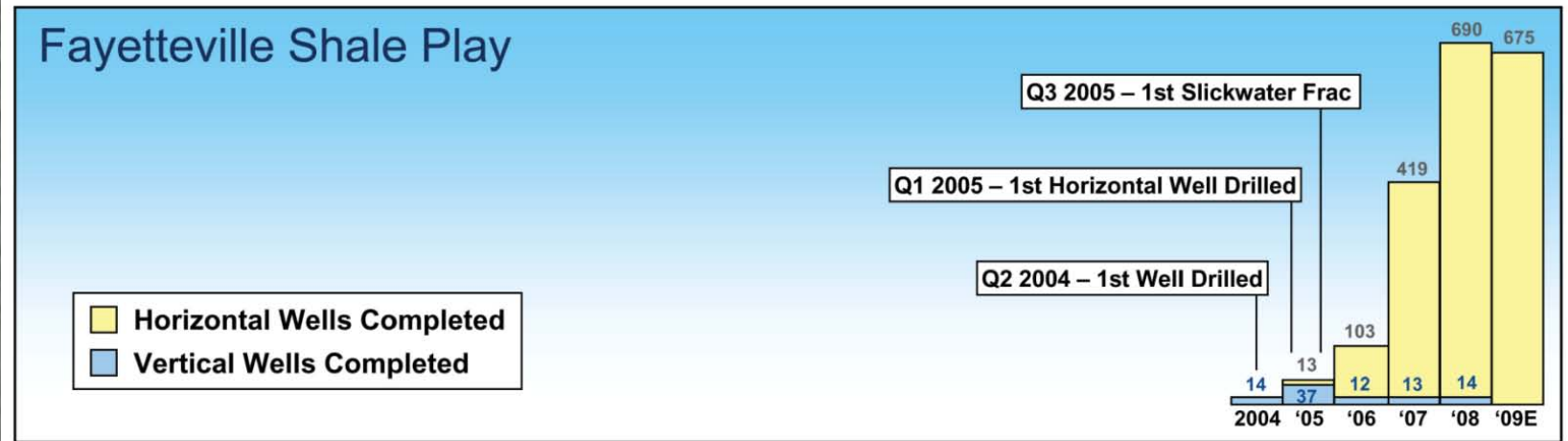
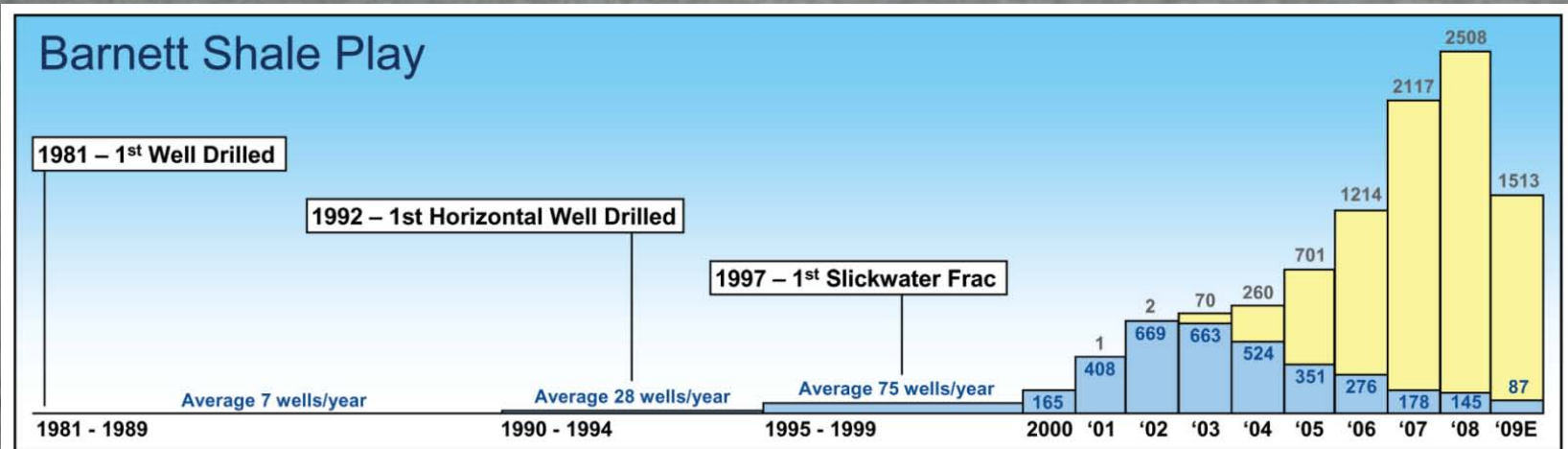
SHALE GAS

U.S. PRODUCTION GROWTH



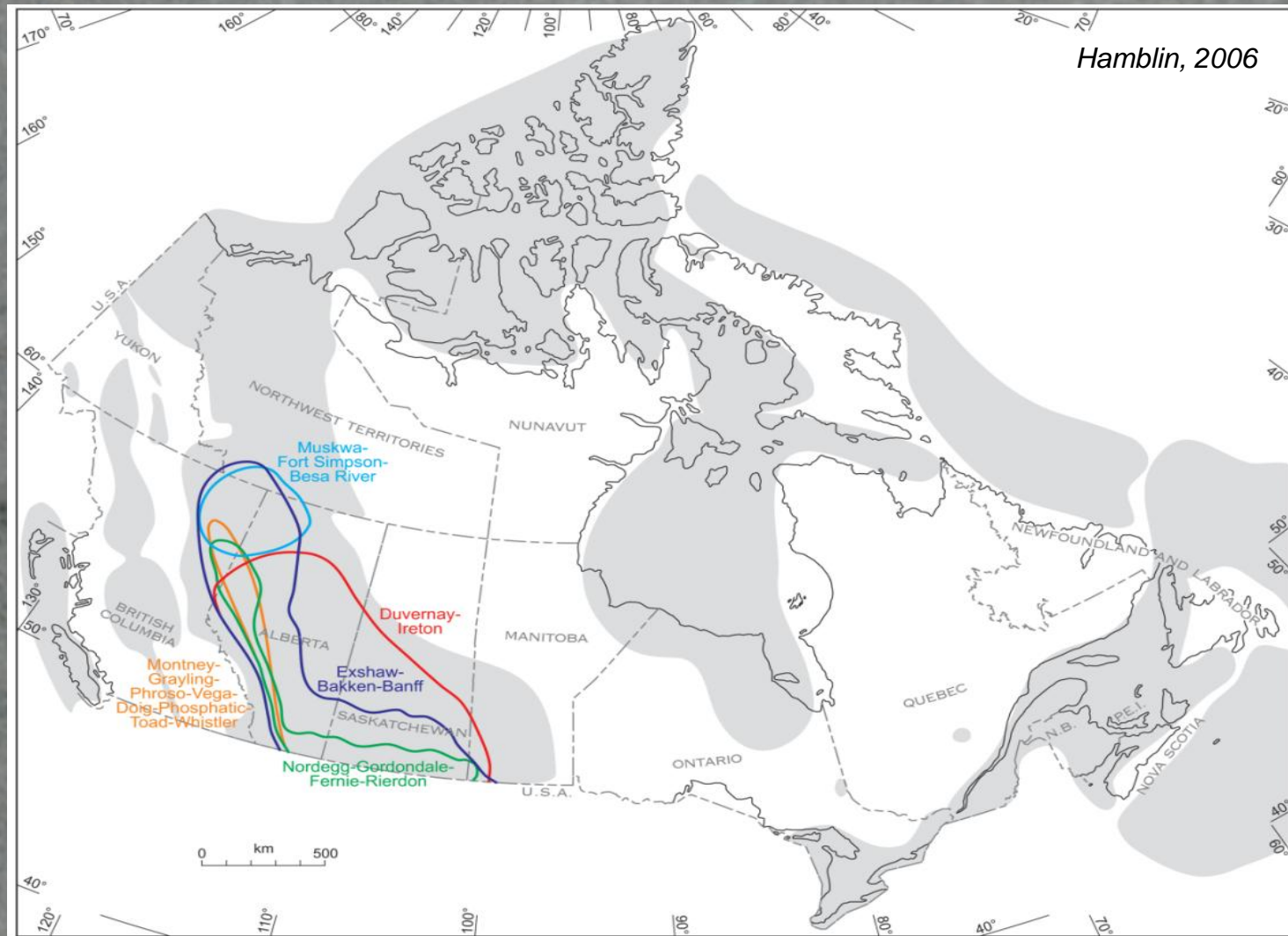
SHALE GAS

ACCELERATING DEVELOPMENT

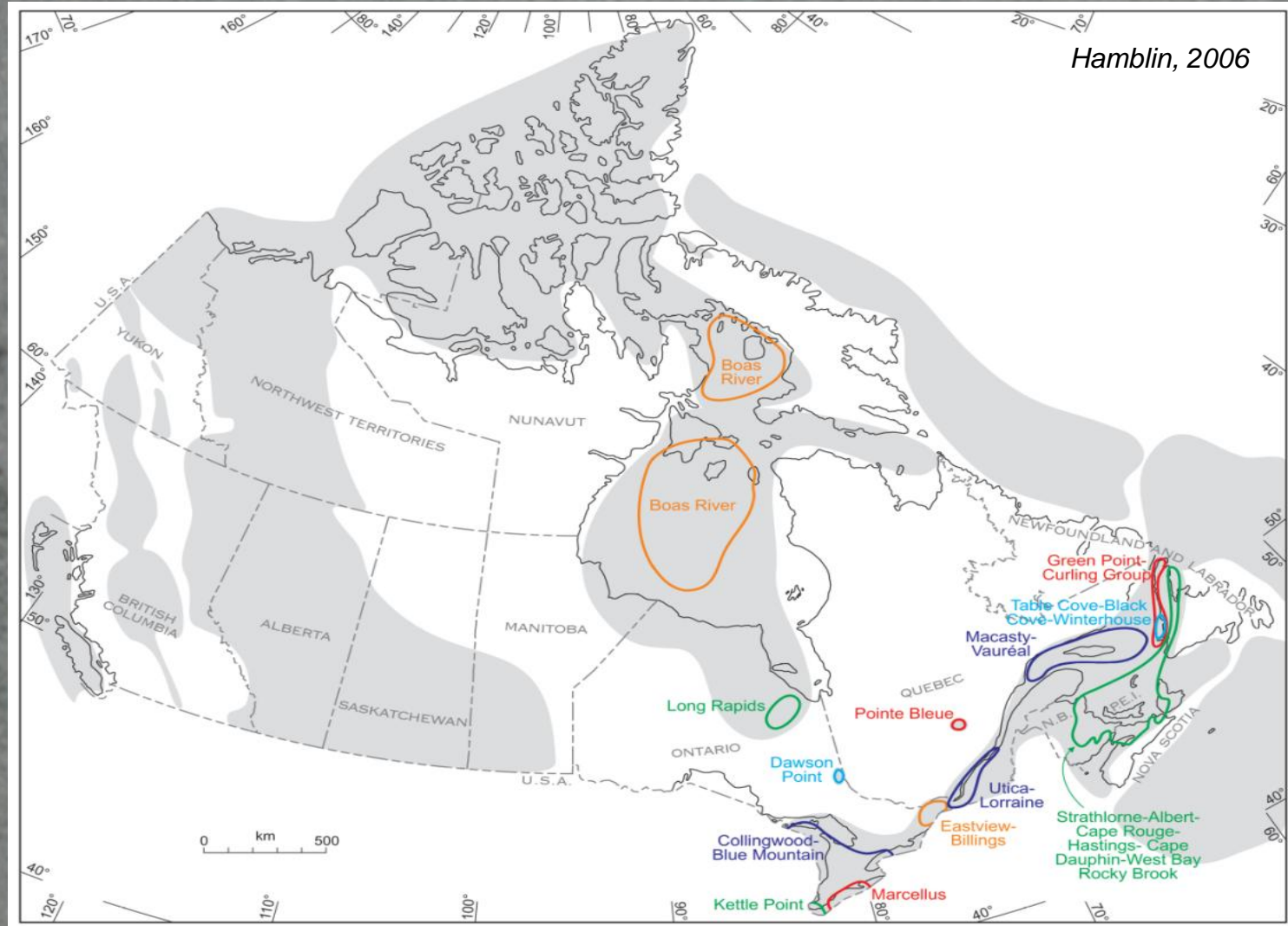


SHALE GAS

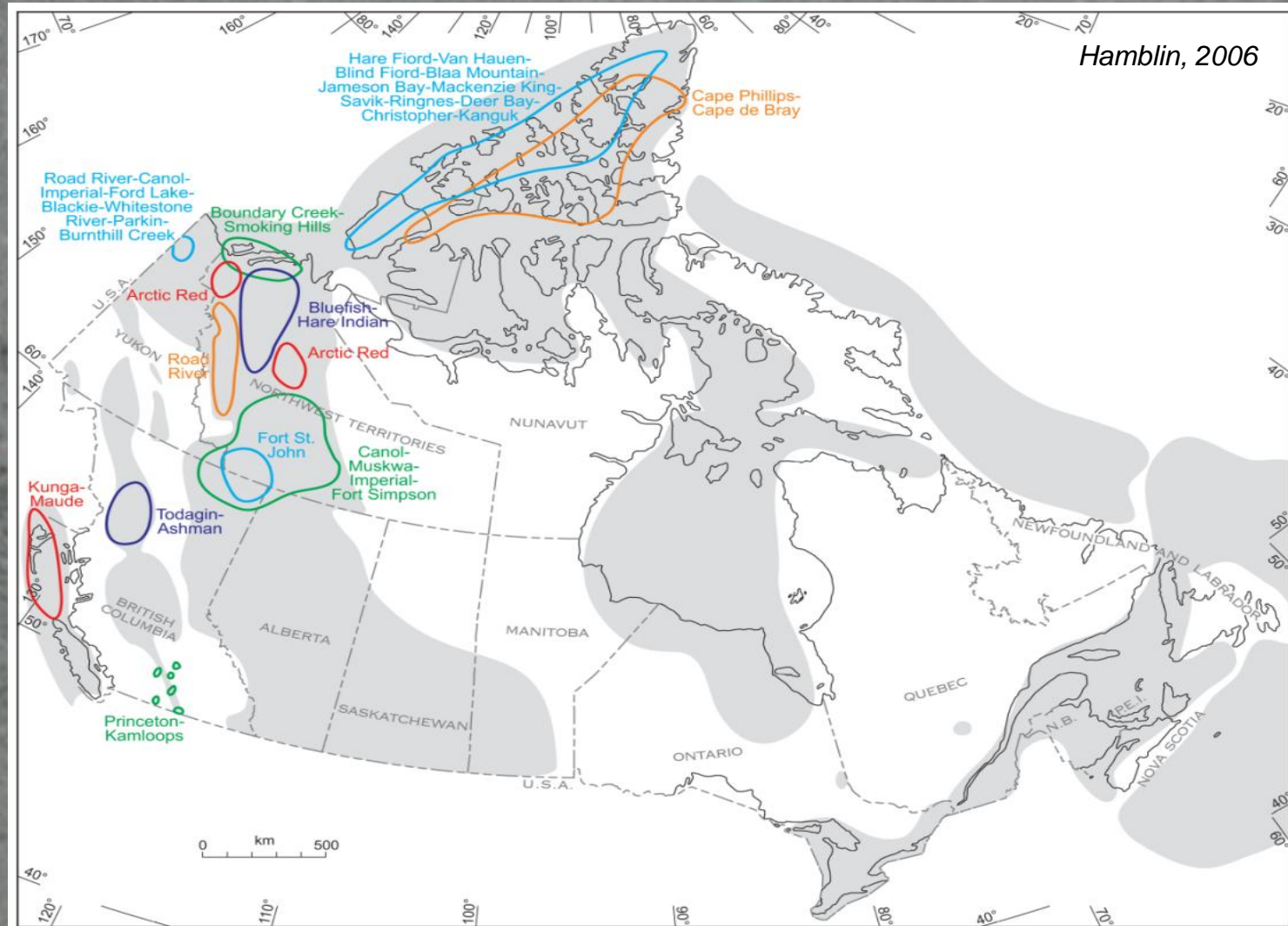
WESTERN CANADA SEDIMENTARY BASIN



SHALE GAS EASTERN CANADA

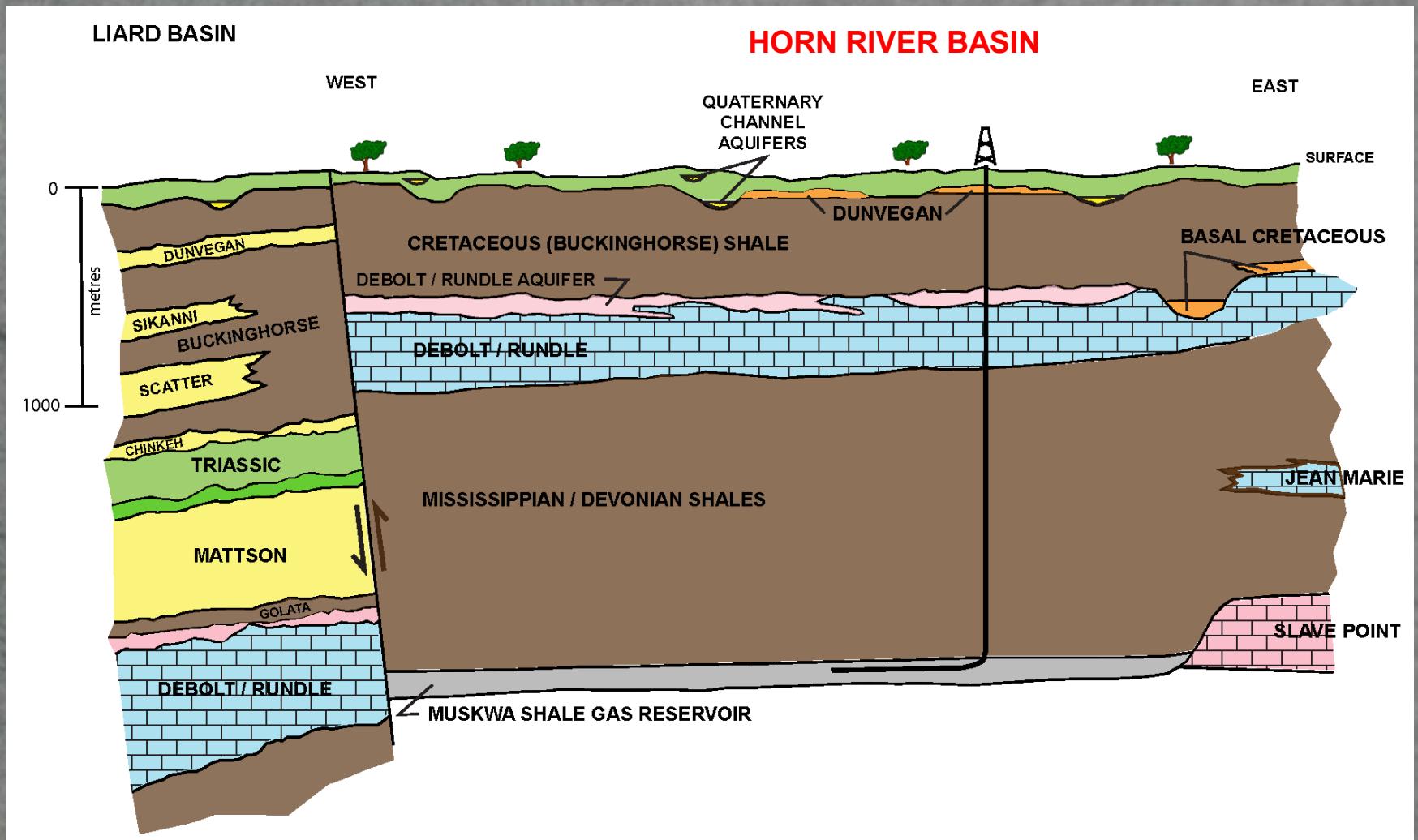


SHALE GAS CANADIAN FRONTIERS



SHALE GAS

HORN RIVER BASIN

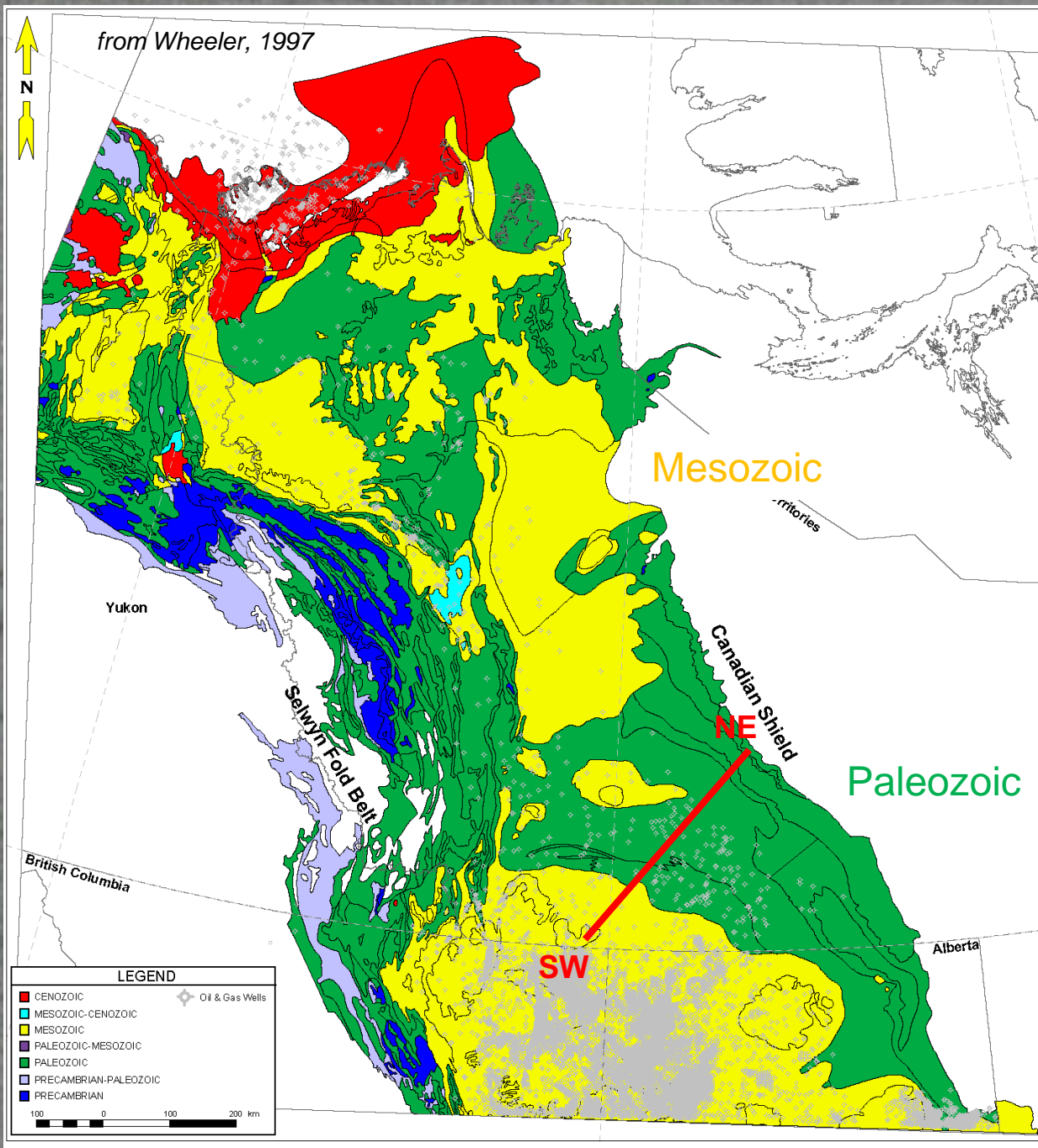


SHALE GAS

HISTORY AND POTENTIAL

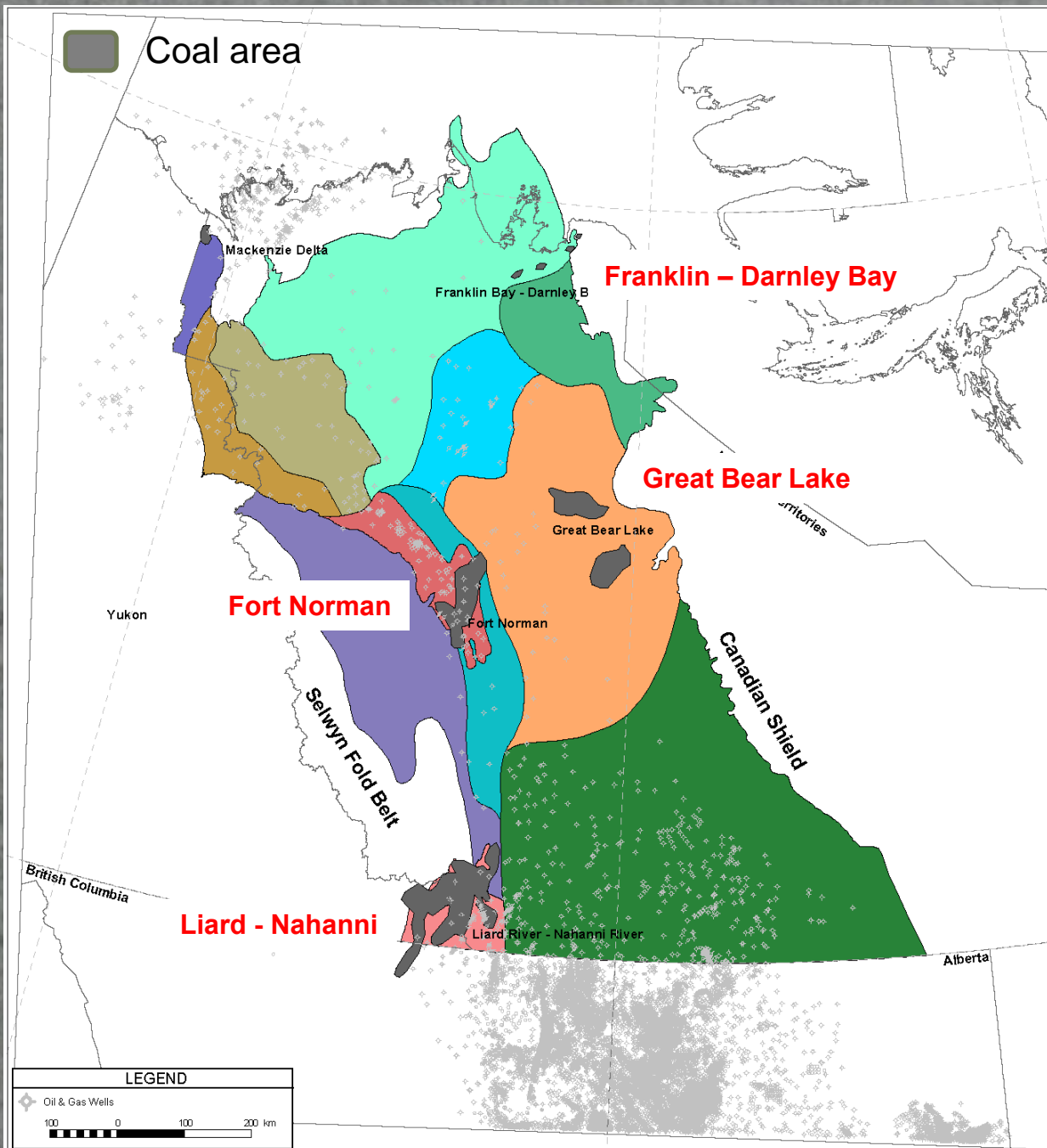
- ❖ Shale gas appears to be the “game-changer”
 - ❖ Potential was seen as marginal until a few years ago – now represents an enormous resource base
- ❖ Horn River Basin is the first big Canadian success
 - ❖ Long-term potential unproven, but knowledgeable players are investing heavily
- ❖ Too early to reliably quantify resource base, but several plays are seen as having >100 TCF potential
 - ❖ Horn River Basin, Colorado Group, Utica Shale, Horton Bluff

NWT SURFACE GEOLOGY



- ❖ Areas west of the Canadian Shield are prospective
- ❖ Potential reservoirs are thinner than much of Alberta / B.C. producing area

NWT COALBED METHANE



- ❖ NWT coals are thin, low-rank, and discontinuous
- ❖ Scattered occurrences, generally shallow or cropping out
- ❖ NWT CBM potential is very low

NWT TIGHT GAS

BASAL CAMBRIAN SANDSTONE

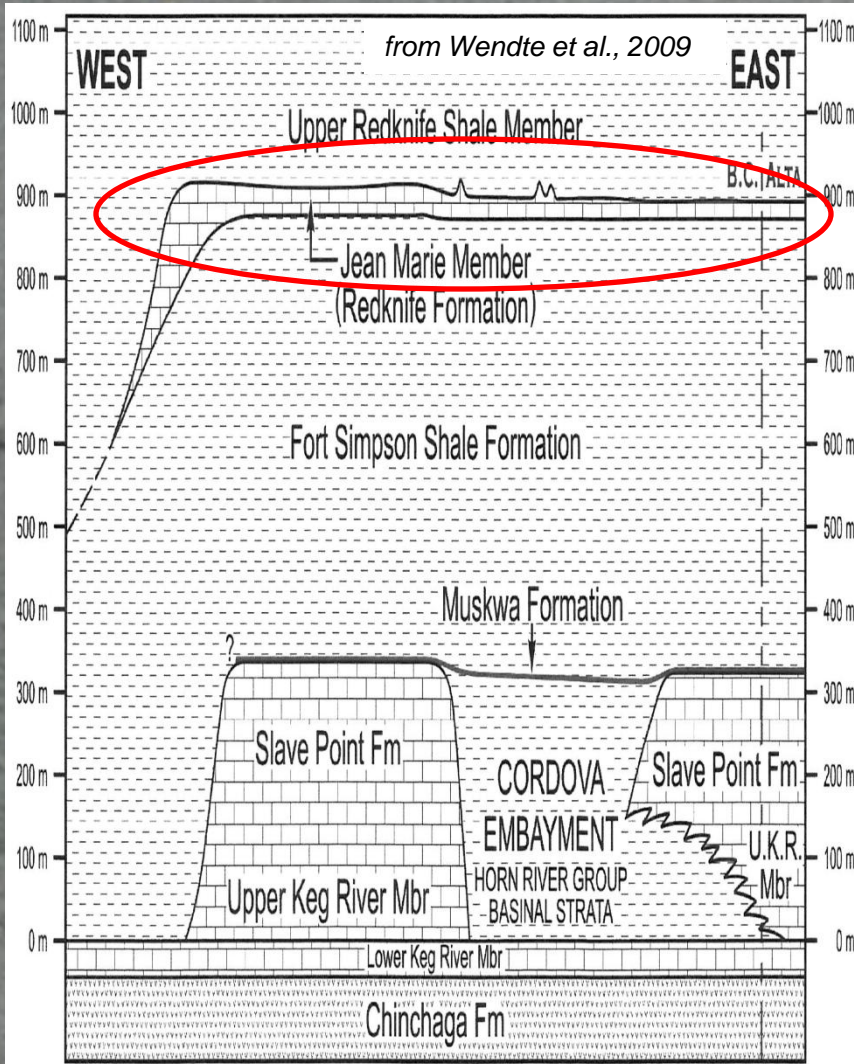


*Mount Clark sandstone lying on
Proterozoic Katherine Gp redbeds*

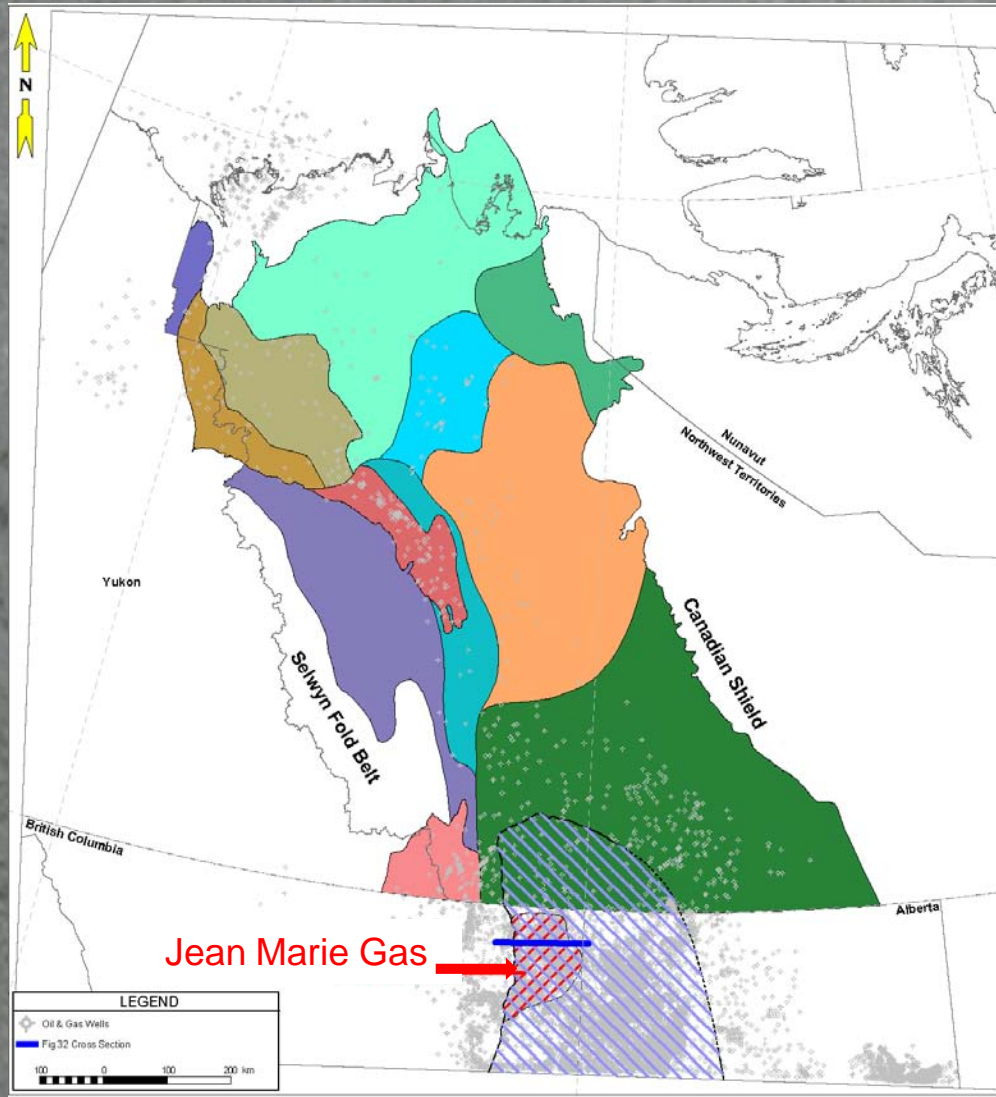
Pyle and Gal, 2009

NWT

JEAN MARIE TIGHT GAS



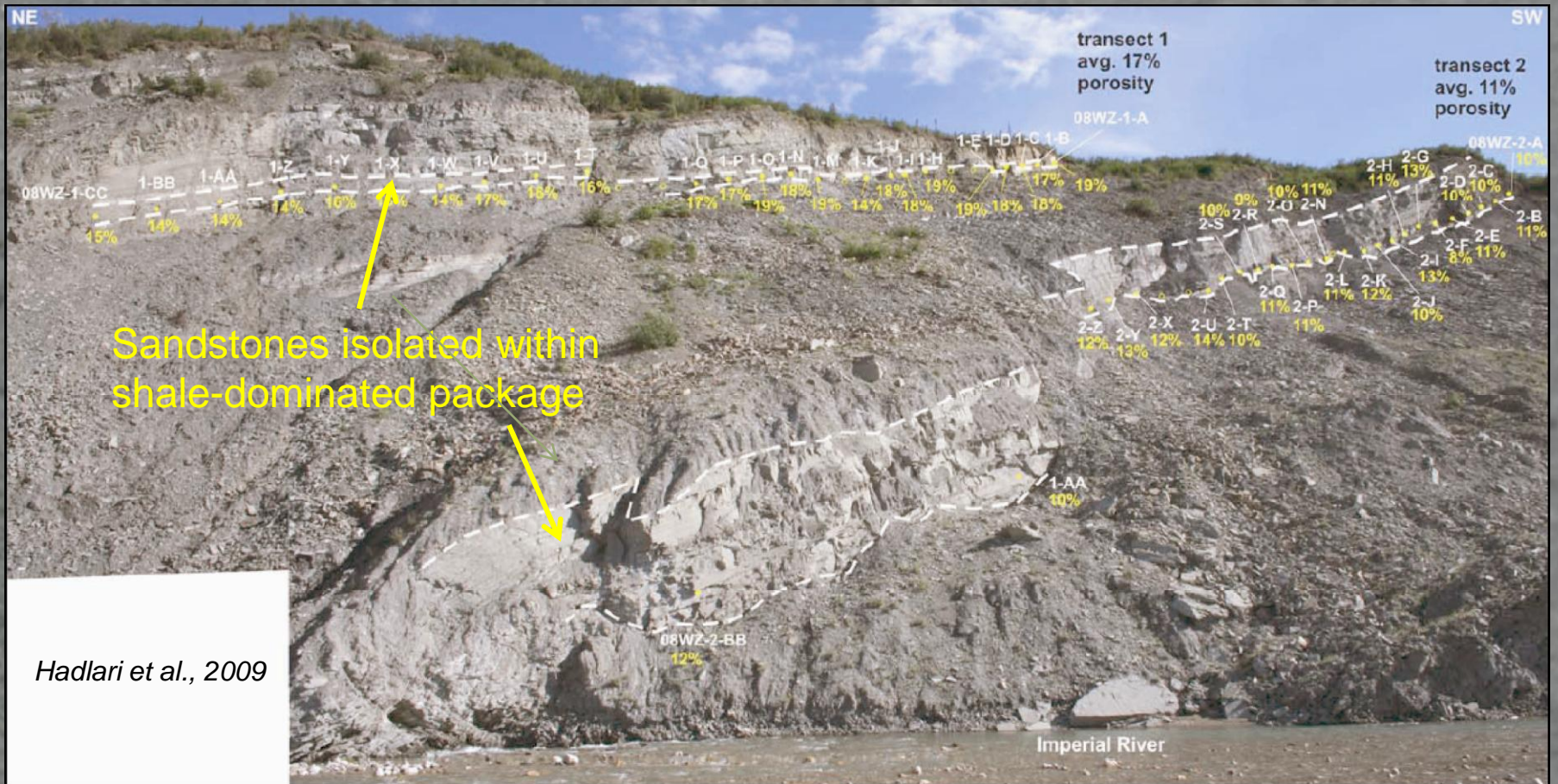
NWT – JEAN MARIE TIGHT GAS



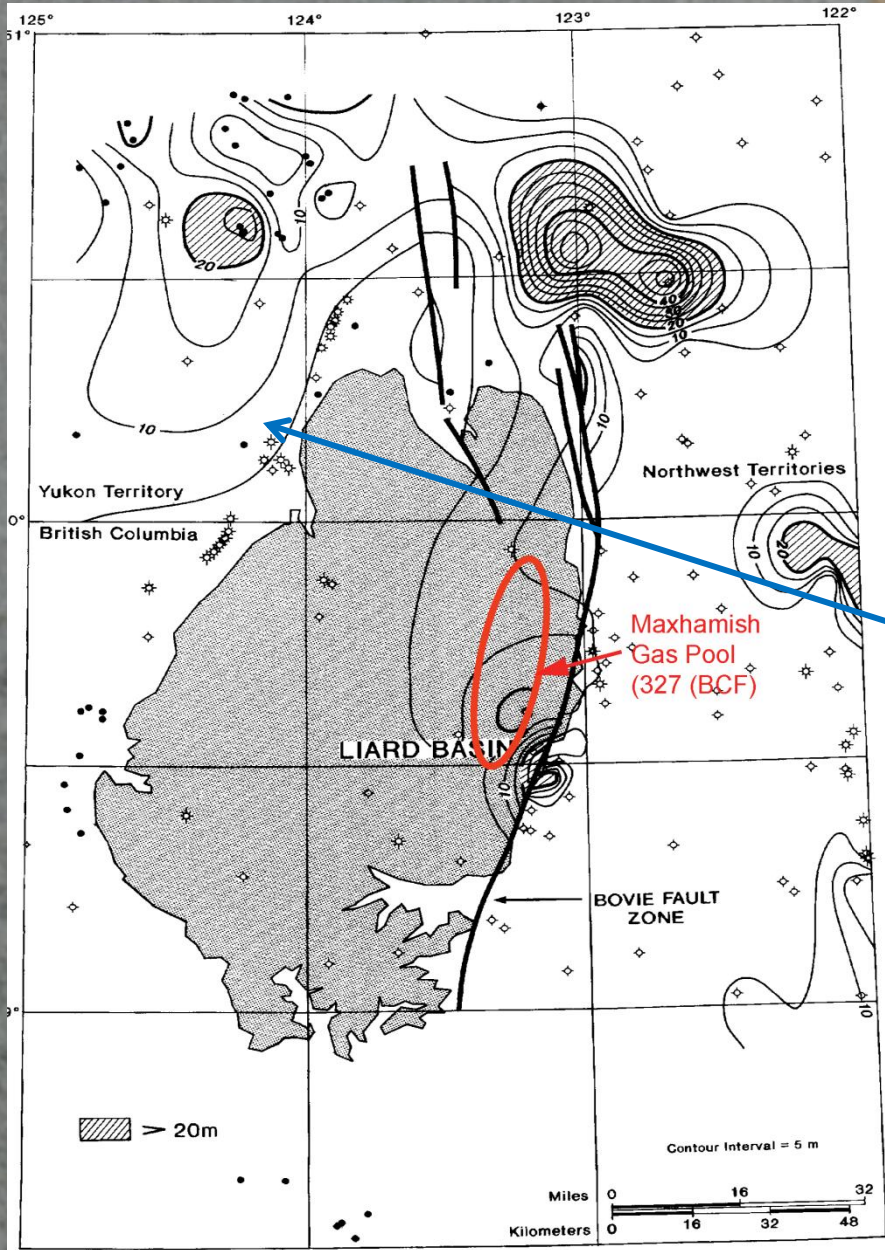
- ❖ Upper Devonian carbonate platform, isolated within basinal shales
- ❖ Subnormally-pressured, continuous gas accumulation has been developed in NEBC
- ❖ Extension into southern NWT?

NWT

IMPERIAL FM TIGHT GAS



NWT CHINKEH TIGHT GAS



from Leckie et al., 1991

NWT

TIGHT GAS SUMMARY

- ❖ No proven tight gas accumulations in NWT
 - ❖ Widespread Cambrian sands show promise, but lightly drilled
 - ❖ Jean Marie carbonate platform – proven in B.C., but how far north is basin-centred gas found?
 - ❖ Imperial Fm sands prospective, but unproven
 - ❖ Triassic – good Montney analogue, but untested in Liard Basin
 - ❖ Chinkeh – Tight gas at Maxhamish – how far north is basin-centred gas found?
- ❖ Conclusion – NWT Tight Gas potential is speculative, but locally prospective

NWT DEVONIAN SHALE SECTION



ROAD RIVER (WESTERN) SHALES



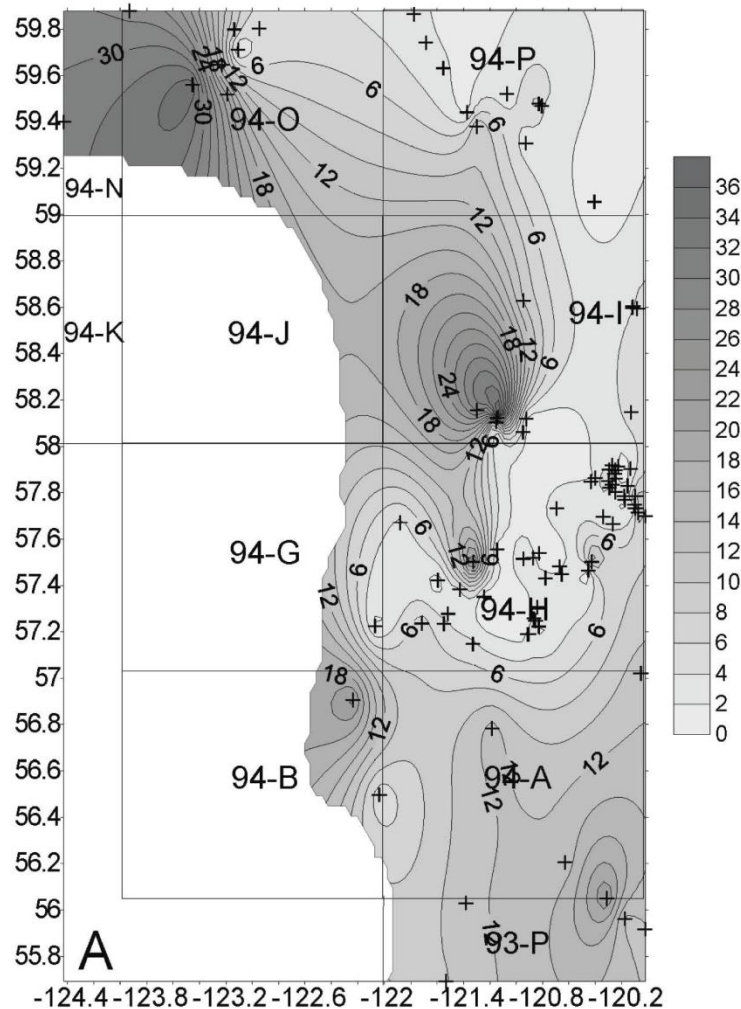
from Pyle and Gal, 2009

FORT ST JOHN Shales (NEBC)

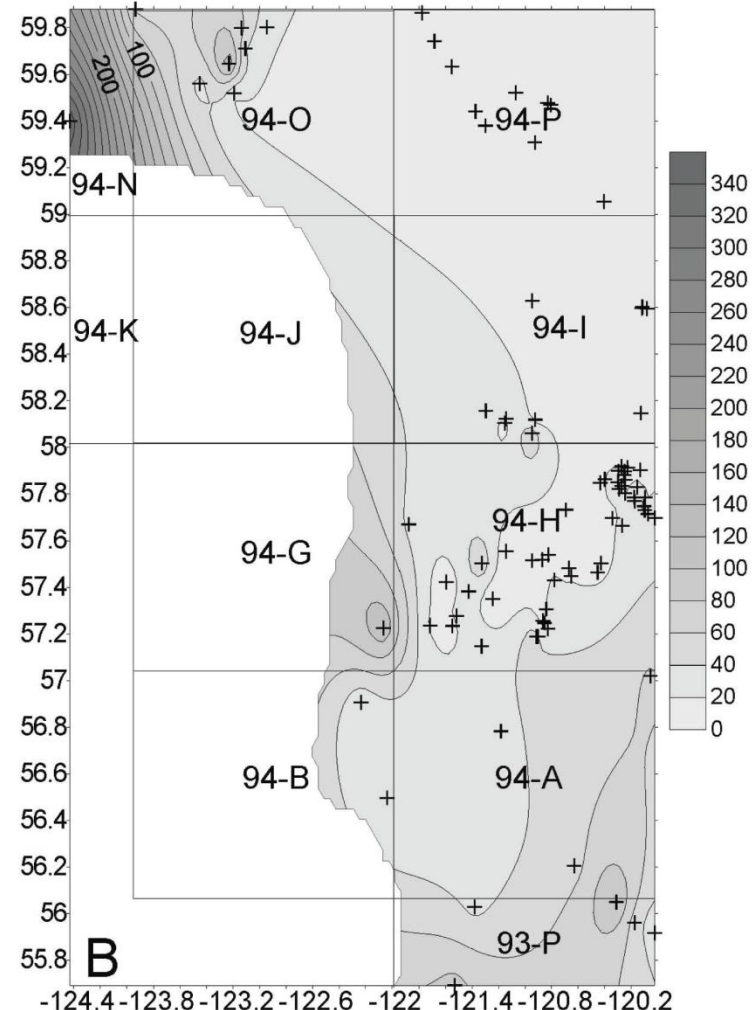
Large Gas in Place

(from Chalmers and Bustin, 2008)

GIP for ORB Unit at Reservoir Pressures (bcf/section)



GIP for Garbutt-Moosebar-Wilrich Formations at Reservoir Pressures (bcf/section)



NWT

SHALE GAS SUMMARY

- ❖ Thick, organic-rich Middle to Upper Devonian shales, equivalent to WCSB Keg River - Slave Point - Woodbend reefs, are widespread and highly prospective
 - ❖ Northern extension of Horn River Basin play
- ❖ Western equivalent – Road River Fm – is very thick, but structure and fracturing lend considerable uncertainty to our ability to access the resource
- ❖ Cretaceous shales are also thick and organic-rich, but much of section is very shallow or exposed
 - ❖ Deeper burial in southwest – Liard Basin
- ❖ **Conclusion – NWT has rich multi-zone shale gas potential**

NWT UNCONVENTIONAL GAS SUMMARY

- ❖ Coalbed methane (CBM) potential is very small
- ❖ Tight gas potential is unproven
 - ❖ Potential targets in central and southern areas
- ❖ Shale gas potential is large but unexplored
 - ❖ Multiple thick targets through most of central and western NWT

NWT UNCONVENTIONAL GAS

THE FUTURE

- ❖ Unconventional gas plays offer potential comparable to many in the south
 - ❖ Some NWT plays are direct extensions from known plays – e.g., Horn River Basin
- ❖ Implications for Mackenzie Gas Pipeline have not been addressed
 - ❖ Heart of shale gas potential lies along the MGP Route
 - ❖ Added gas resource potential can improve the viability of the entire project

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