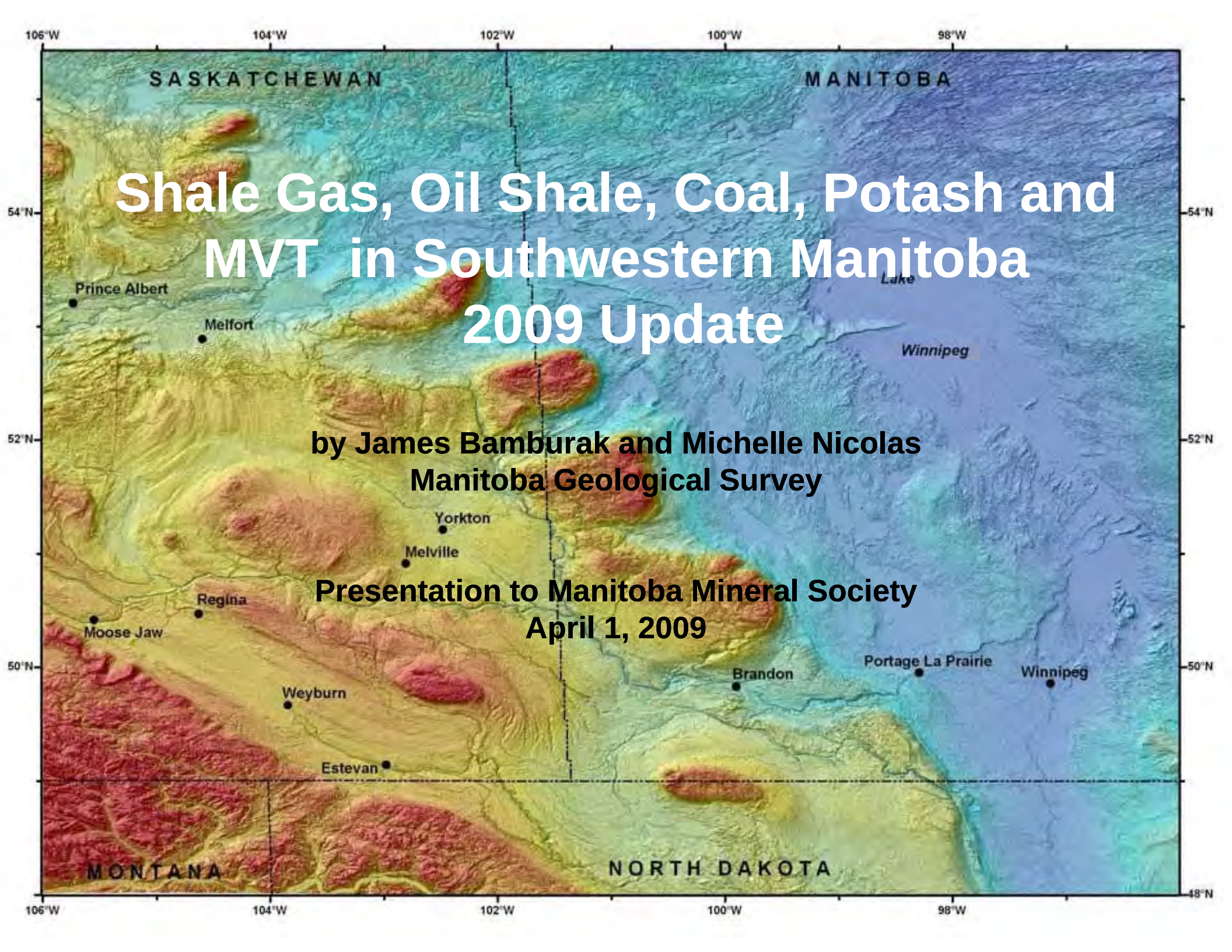
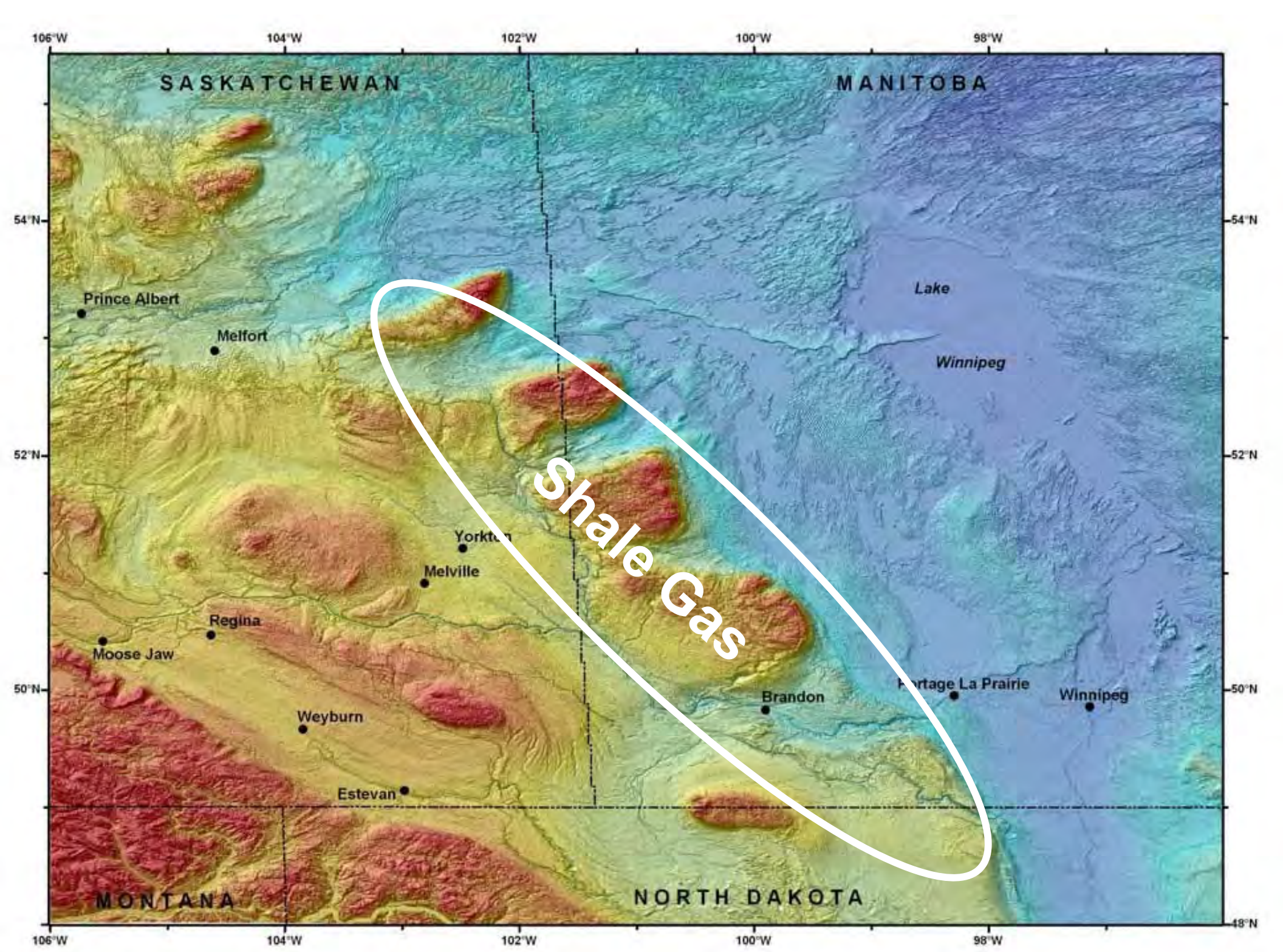


Shale Gas, Oil Shale, Coal, Potash and MVT in Southwestern Manitoba 2009 Update

by James Bamburak and Michelle Nicolas
Manitoba Geological Survey

Presentation to Manitoba Mineral Society
April 1, 2009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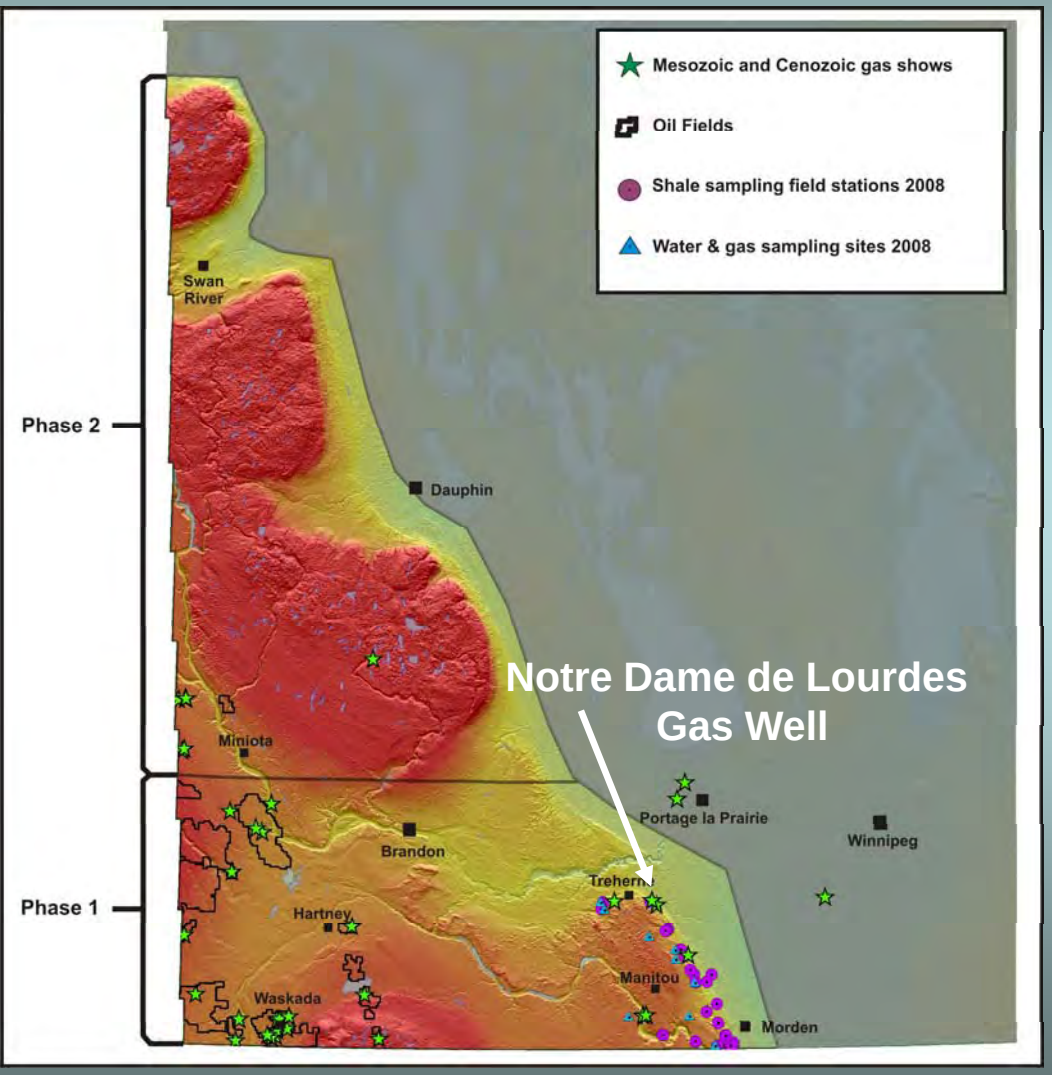
SASKATCHEWAN
MANITOBA
Lake
Winnipeg
Prince Albert
Melfort
Yorkton
Melville
Regina
Moose Jaw
Weyburn
Estevan
Brandon
Winnipeg
Shale Gas
MONTANA
NORTH DAKOTA

Shale Gas



- Michelle Nicolas is undertaking a multi-year shale gas study.
- Shallow Cretaceous shale gas, with up to 276 kPa (40 lbs.) of naturally compressed pressure, known for over 100 years in Manitoba.
- Used intermittently for local lighting, heating and cooking.

Shale Gas

Gas well ignited in 2003, near Notre Dame de Lourdes, by the local landowner, Normand Bosc.

Composition of gas:

methane (CH_4)	81.87 %
nitrogen (N_2)	16.79 %
oxygen (O_2)	0.460 %
carbon dioxide (CO_2)	0.37 %
ethane (C_2H_6)	0.219 %
argon (Ar)	0.151 %
helium (He)	0.1350 %
propane (C_3H_8)	0.0038 %

Shale Gas

May, 2004

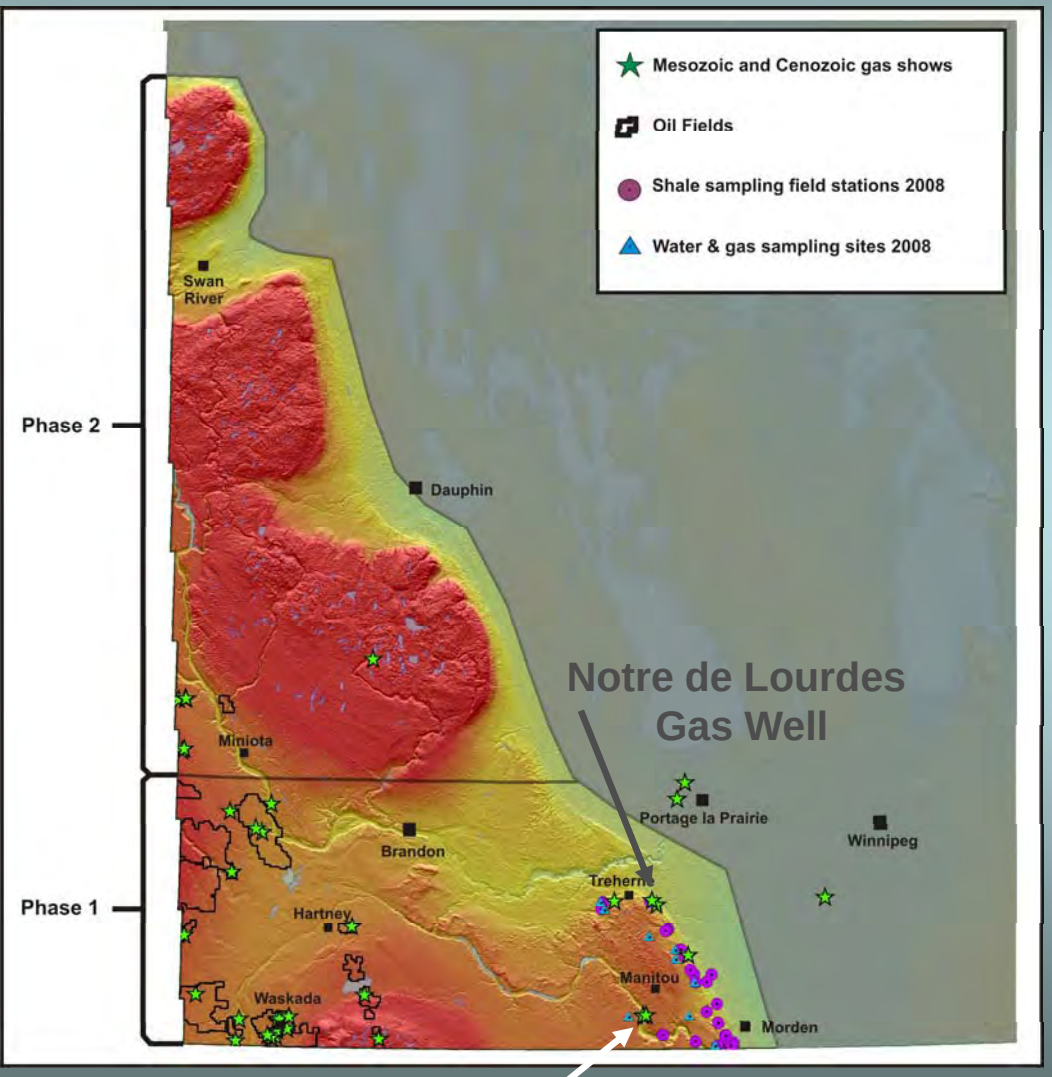
- Well situated near edge of Manitoba Escarpment.
- Source of gas believed to be porous siltstone bed within Boyne Member of Carlile Formation; or possibly the deeper Favel Formation.
- Gas recharges in well 24 hours after ignition.

June, 2006

Oct., 2006

Sept., 2008

Shale Gas



- Two gas wells located in Pembina River valley, near Manitou.
- One well drilled by Federal Dept. of the Interior in 1906/07.


Lea Family and Guests

Shale Gas

Sept., 2008

- Target of drilling was source of oil floating on the river; but in July 1907, high pressure pocket of natural gas struck at depth of about 58 m.
- Oil was not found to a depth of about 167 m; and the well abandoned Nov. 1907.
- Shown at left, is Percy Lea (local landowner), who equipped the well with a small storage tank, pressure gauge and regulator; and who periodically ignites the gas for interested parties.

Shale Gas

2008

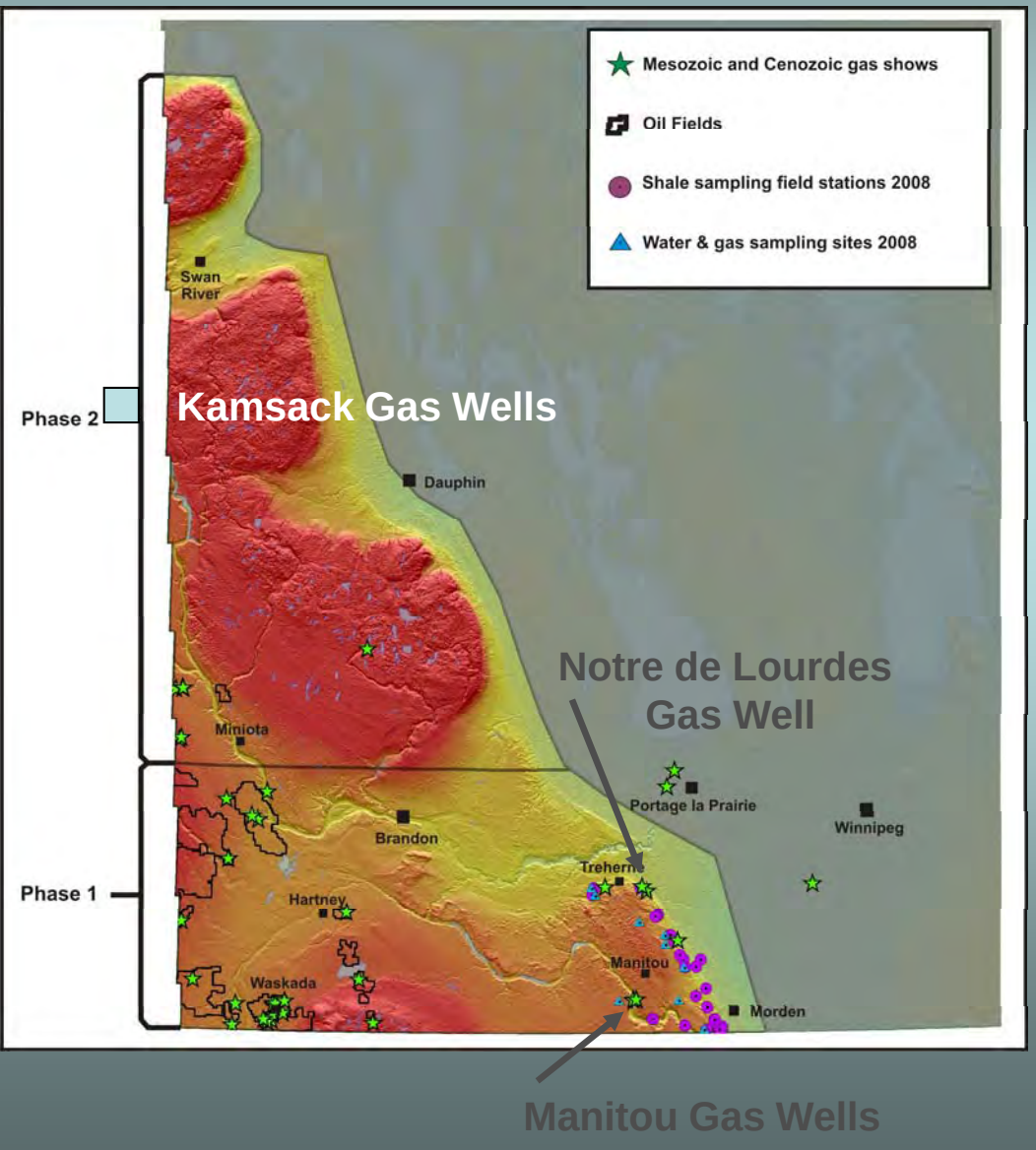
- Another near-by gas well has been fitted with a larger storage tank
- Stored gas is used on special occasions for barbecues.

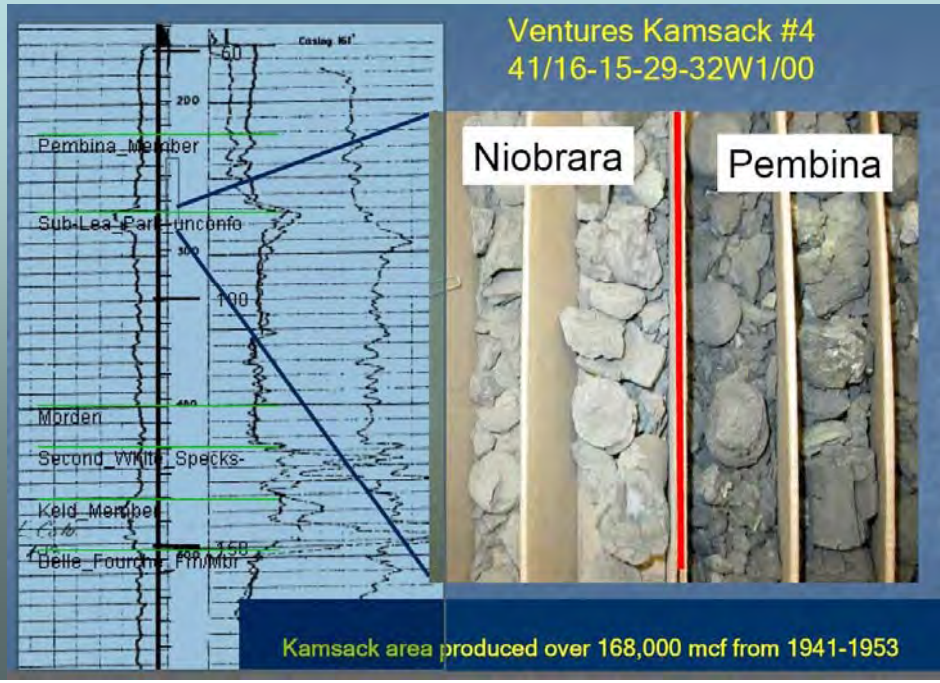
Tastes better with MB natural gas

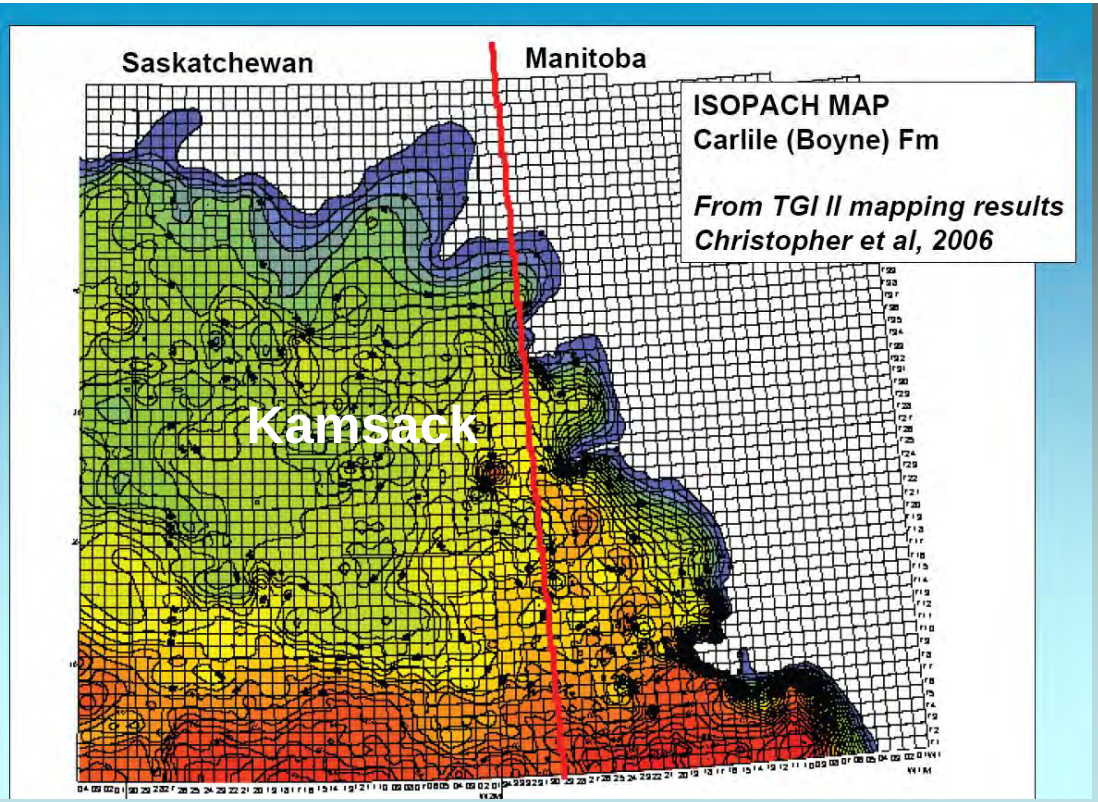
methane (CH_4)	89.69 %
nitrogen (N_2)	9.34 %
oxygen (O_2)	0.375 %
ethane (C_2H_6)	0.260 %
carbon dioxide (CO_2)	0.180 %
argon (Ar)	0.0896 %
helium (He)	0.0379 %
propane (C_3H_8)	0.0171 %
iso-butane (C_4H_{10})	0.0063 %

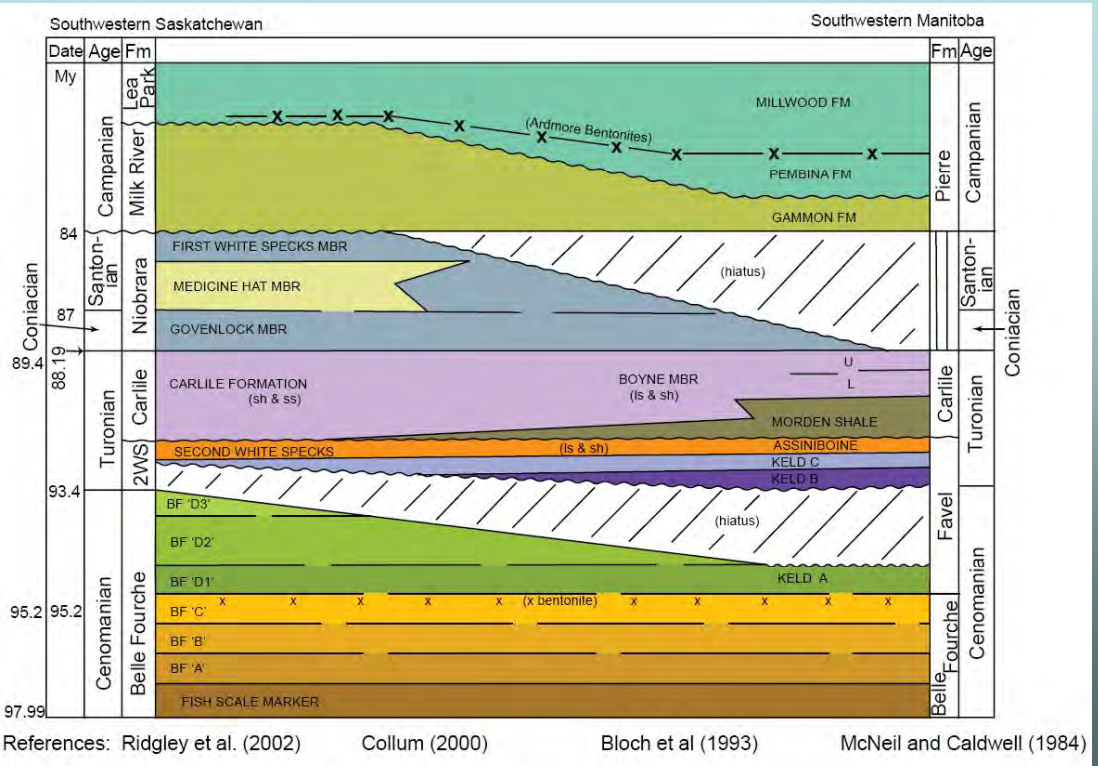
Shale Gas

- From 1941-1953, 4.7 million m^3 of shale gas produced at Kamsack, Saskatchewan (Yurkowski, 2006).
- Gas recovered from 8 wells that penetrated the Boyne Member of the Carlile Formation and the Pembina Member of the Pierre Formation, at a depth of 60 m.
- Used to heat the town.







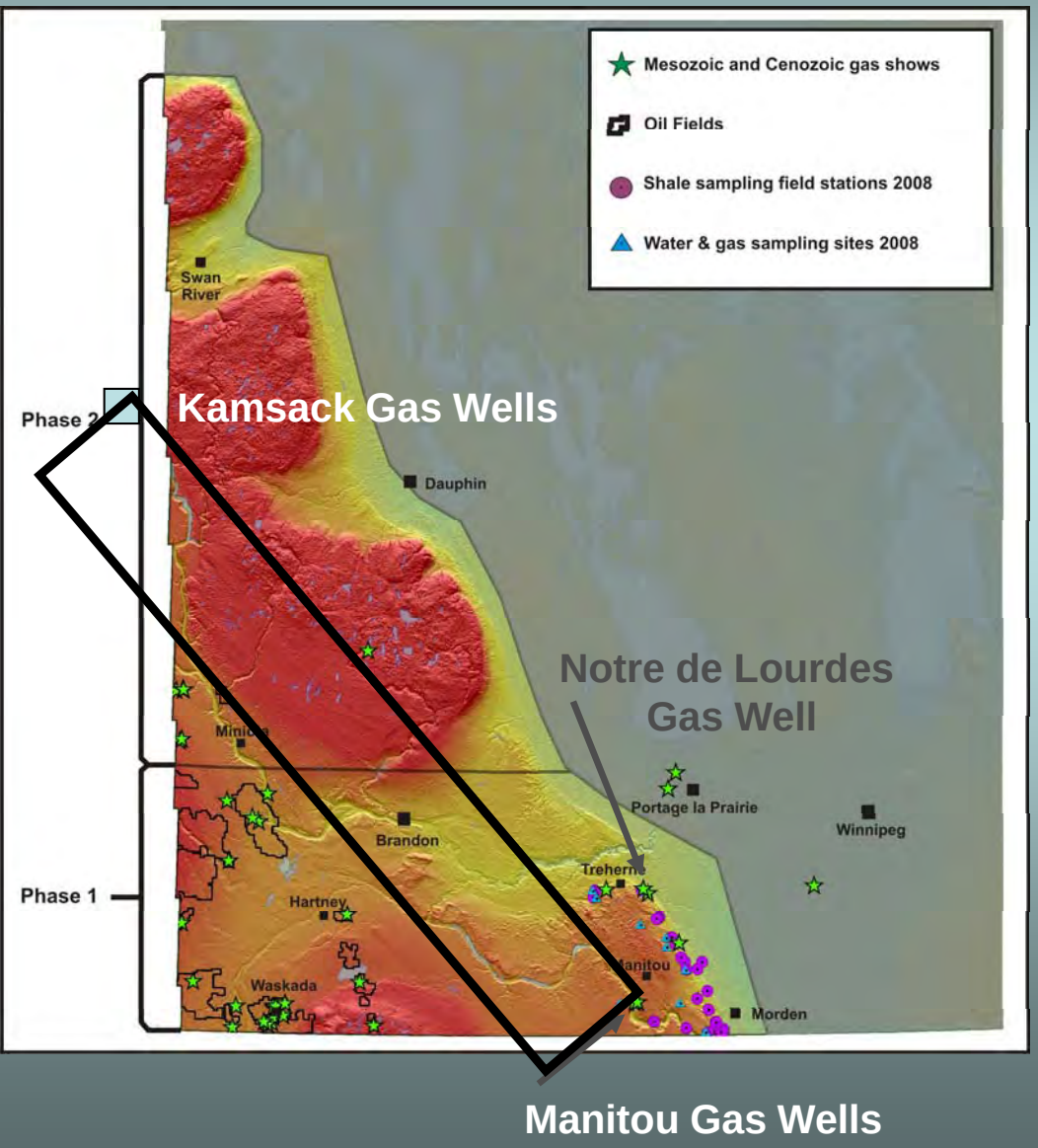


References: Ridgley et al. (2002) Collum (2000) Bloch et al (1993) McNeil and Caldwell (1984)

- Boyne Member of the Carlile Formation is continuous from the Kamsack area of Saskatchewan into southwestern Manitoba, as shown on the isopach map and cross-section.

Figure Credit: **"Oil Shales in Saskatchewan"** prepared by Melinda Yurkowski, Petroleum Geology Branch and Bruce Wilhelm, Energy Development and Climate Change of Saskatchewan Industry and Resources, 2007.

Shale Gas



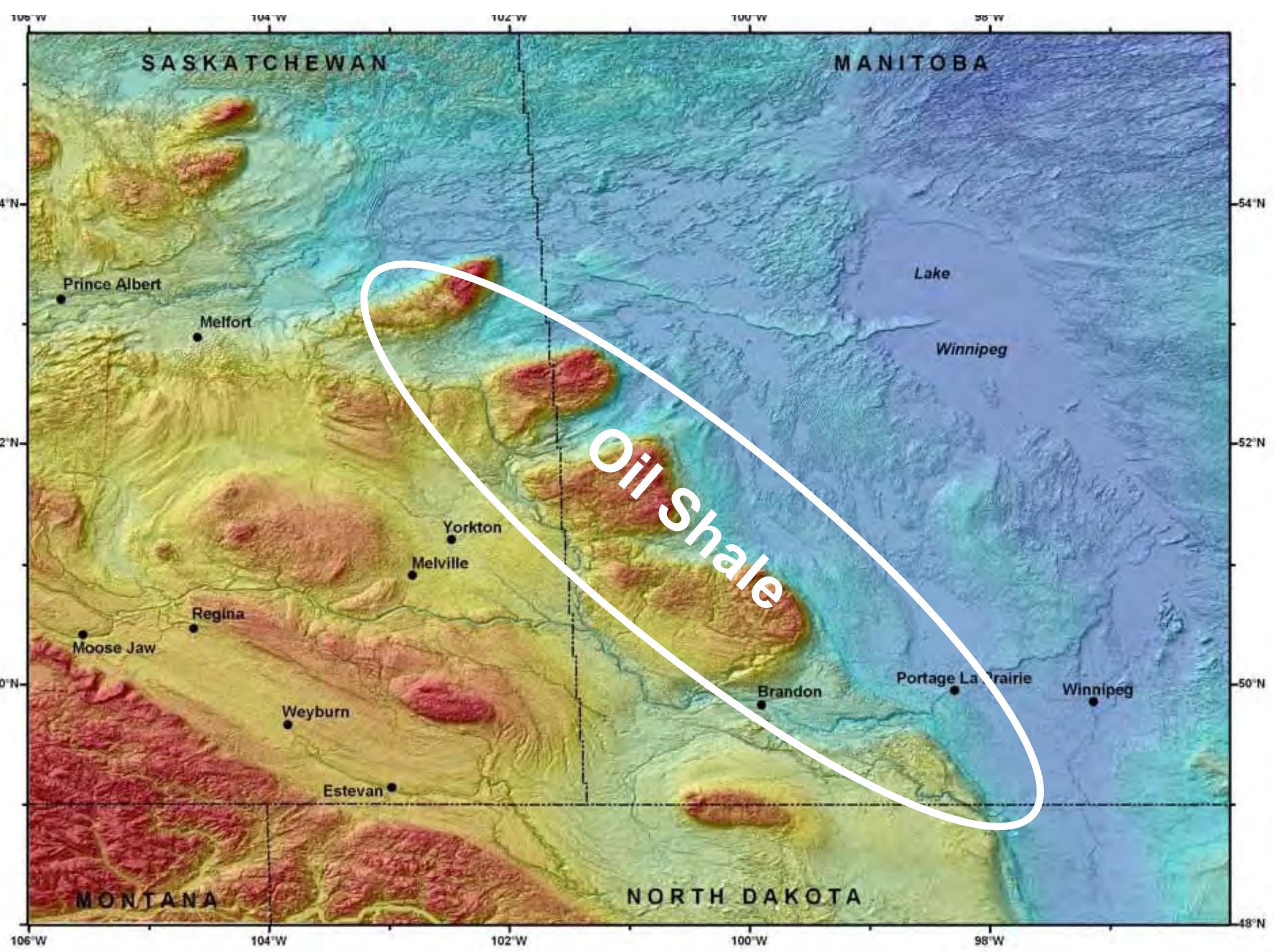
Something to think about

Distance from Manitou gas wells to Kamsack, about 600 km.

If, source of the biogenic? gas is continuous 2 m thick siltstone bed in the Boyne Member of the Carlile Formation.

And, assuming 2% porosity over a width of 50 km.

Then, there is a conservative contingent & prospective resource estimate of 1200 million m^3 of shale gas to be present, mainly in Manitoba.


SASKATCHEWAN
MANITOBA
Prince Albert
Melfort
Lake
Winnipeg
Oil Shale
Yorkton
Melville
Regina
Moose Jaw
Weyburn
Estevan
Brandon
Portage La Prairie
Winnipeg
MONTANA
NORTH DAKOTA
106°W
104°W
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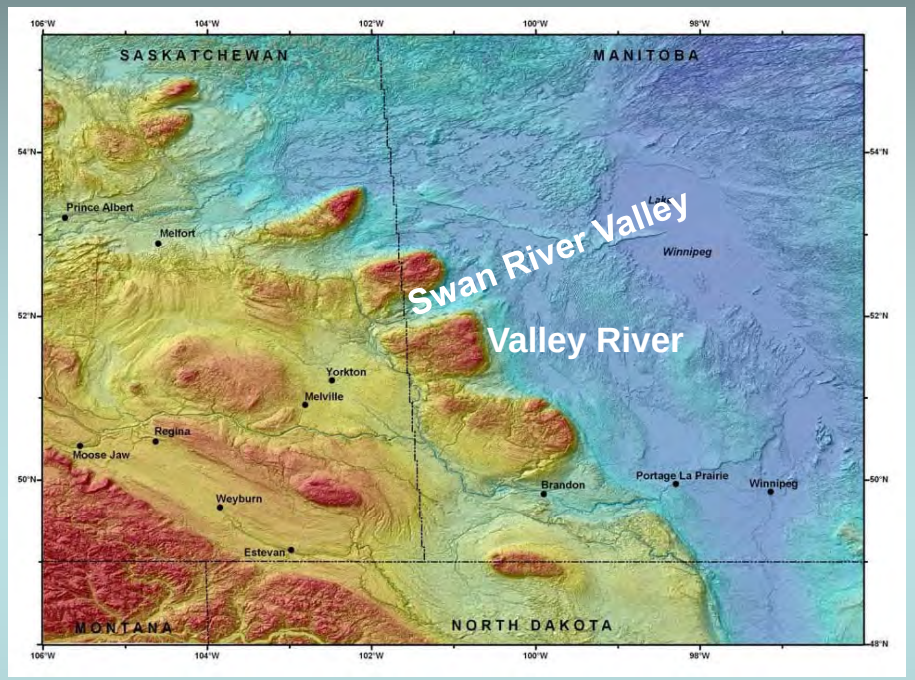
Oil Shale

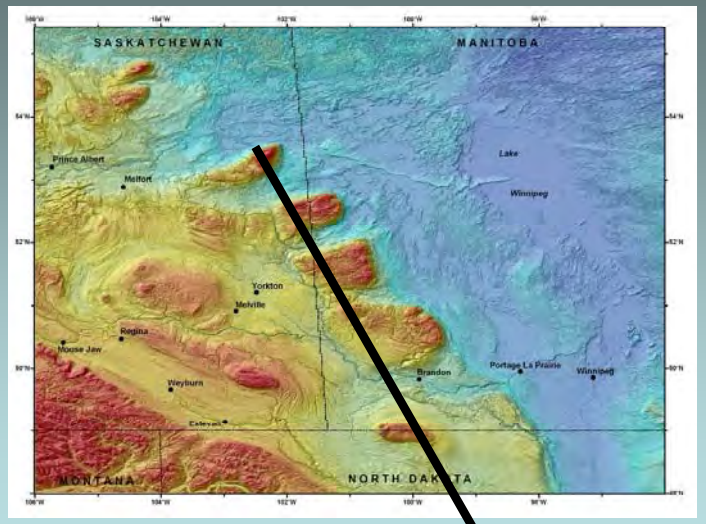


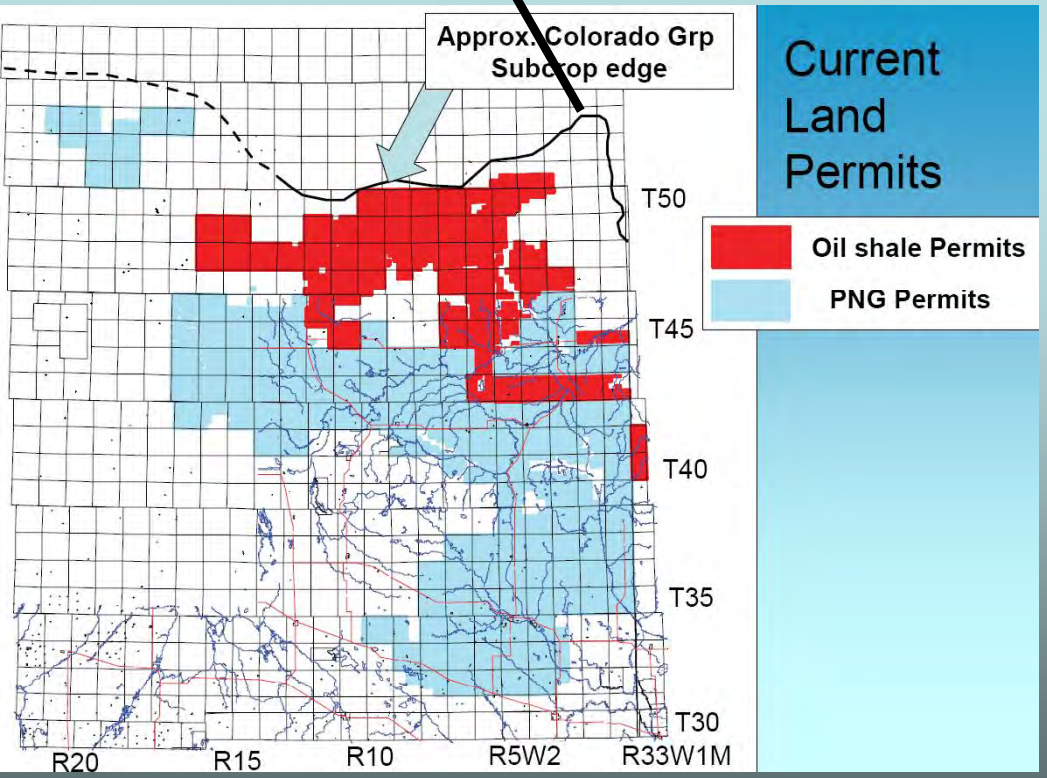
- Cretaceous oil shale, capable of yielding oil upon heating, was also noted along the Manitoba Escarpment over 100 years ago.
- Scoriaceous clinker present in Swan River valley gravel pits; and Valley River burnt shale outcrops, northwest of Dauphin.

Swan River Valley

Valley River

Oil Shale





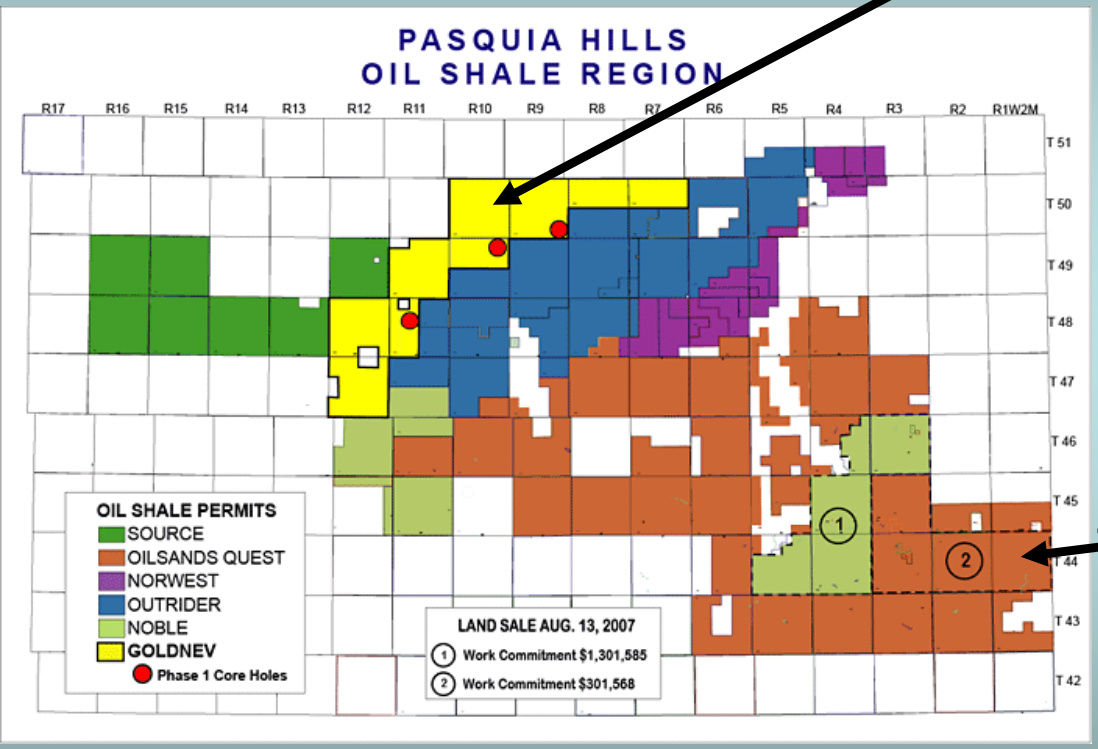
Pasquia Hills, Saskatchewan

- Six companies involved in oil shale evaluation, mainly on the north flank of the Pasquia Hills.
  - Goldnev Resources Inc.
  - Oilsands Quest Inc.
  - Source Petroleum Inc.
  - Norwest
  - Outrider Energy Ltd.
  - Nobel Hydrocarbons Alta Ltd.

Yurkowski & Wilhem (2007)

Oil Shale

- **Goldnev Resources Inc.**
  - In 2007, one drillhole penetrated 22 m of oil shale, beneath 7 m of overburden.
  - Lab results indicated 9 million m^3 of oil could be recovered from oil shale averaging 61 litres/tonne over an area of 256 ha.
- **Oilsands Quest Inc.**
  - 2.4 billion barrel oil resource grading 7.8% kerogen by weight in 45 m thick zone, averaging 35 litres/tonne, beneath 21 m of overburden.



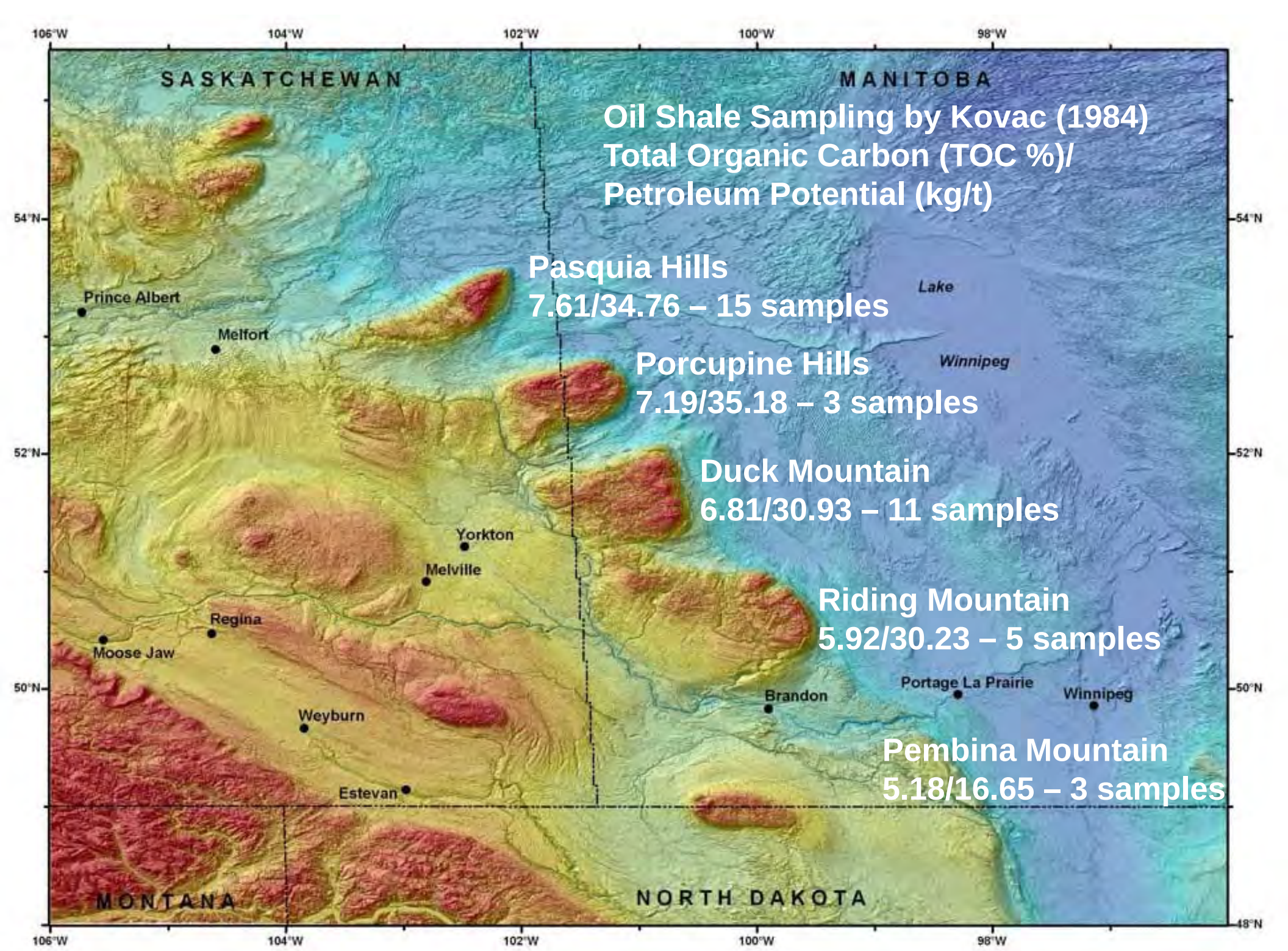
Goldnev Resources Inc. (2008)

Oil Shale

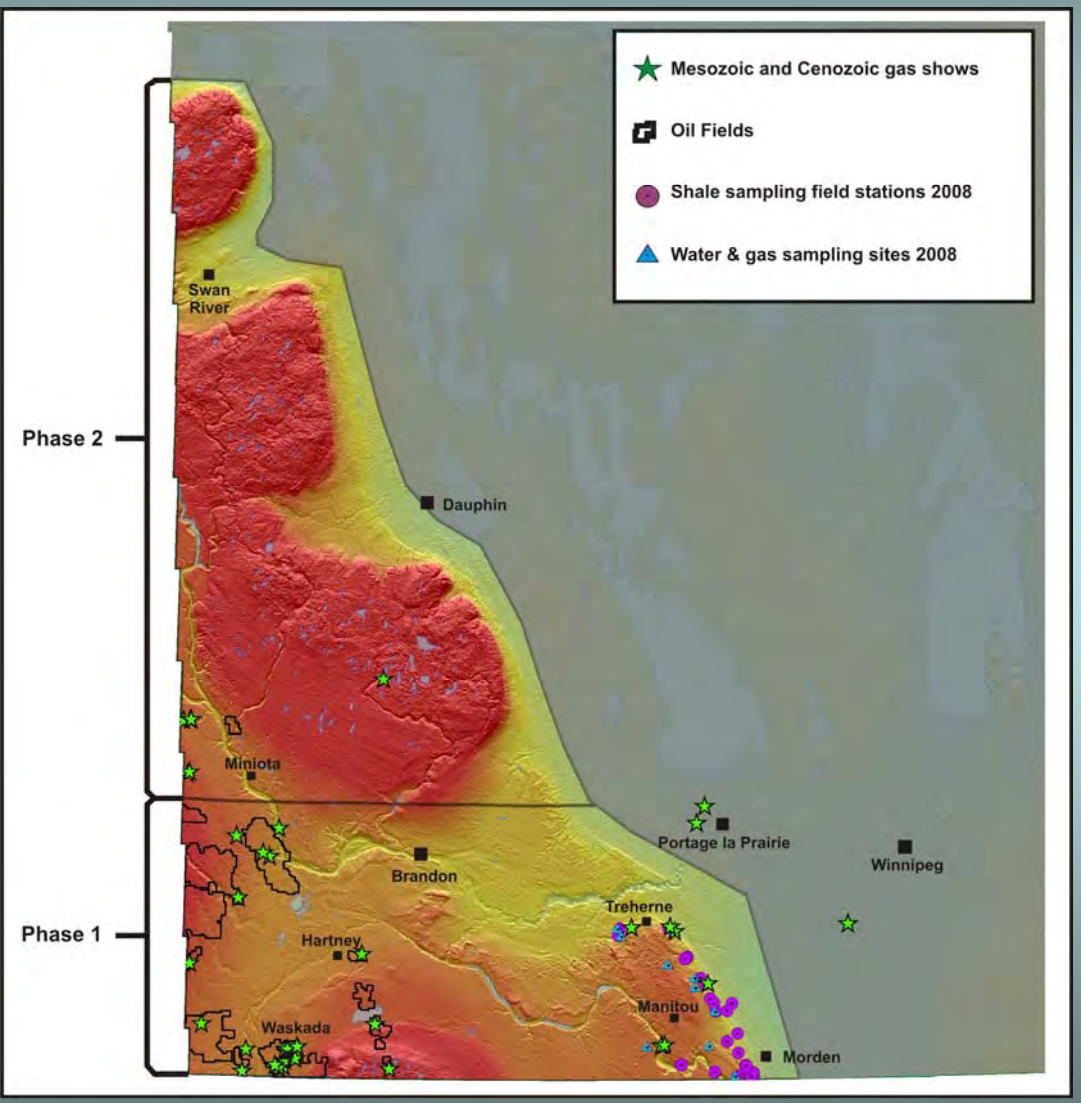
Favel Formation Oil Shale – Sclater River, 2004

Shale sampled along the Manitoba Escarpment by Kovac (1984):

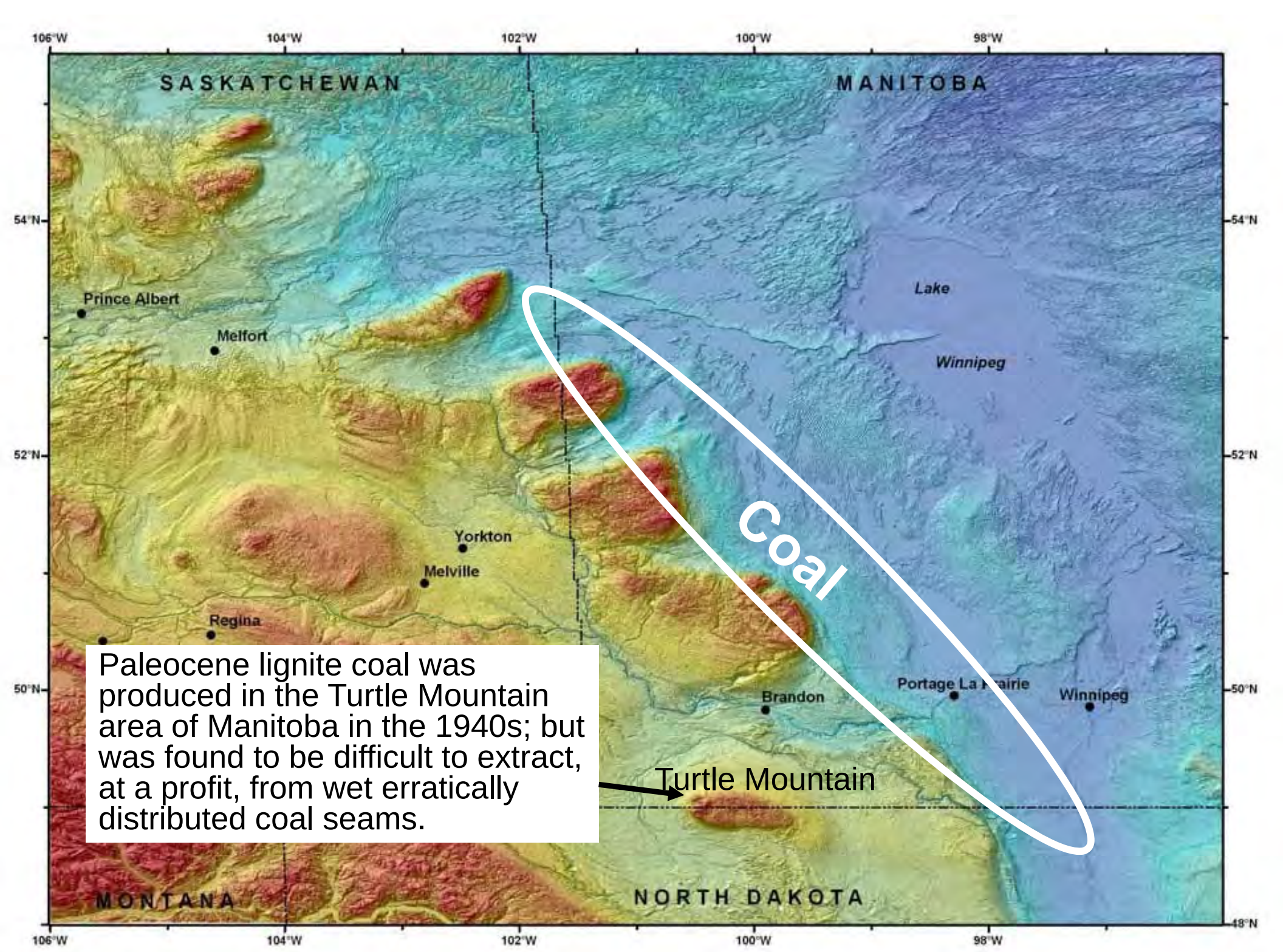
- Average TOC of shale = 6%.
- Average petroleum potential = 30 kg/tonne = 30.2 litres/tonne.
- Favel Formation slightly richer than Boyne Member of the Carlile Formation.
- Richness increases slightly northwestward along the Escarpment.
- **However, conclusions based on:**
  - **Limited number of samples**
  - **Combining several formations**
  - **Including float samples**
  - **And, including relatively thin carbonate units (having low TOC and low petroleum potential).**


Oil Shale Sampling by Kovac (1984)
Total Organic Carbon (TOC %)/
Petroleum Potential (kg/t)
Pasquia Hills
7.61/34.76 – 15 samples
Porcupine Hills
7.19/35.18 – 3 samples
Duck Mountain
6.81/30.93 – 11 samples
Riding Mountain
5.92/30.23 – 5 samples
Pembina Mountain
5.18/16.65 – 3 samples
SASKATCHEWAN
MANITOBA
MONTANA
NORTH DAKOTA
Prince Albert
Melfort
Yorkton
Melville
Regina
Moose Jaw
Weyburn
Estevan
Brandon
Portage La Prairie
Winnipeg
Lake
Winnipeg
106°W
104°W
102°W
100°W
98°W
54°N
52°N
50°N
48°N

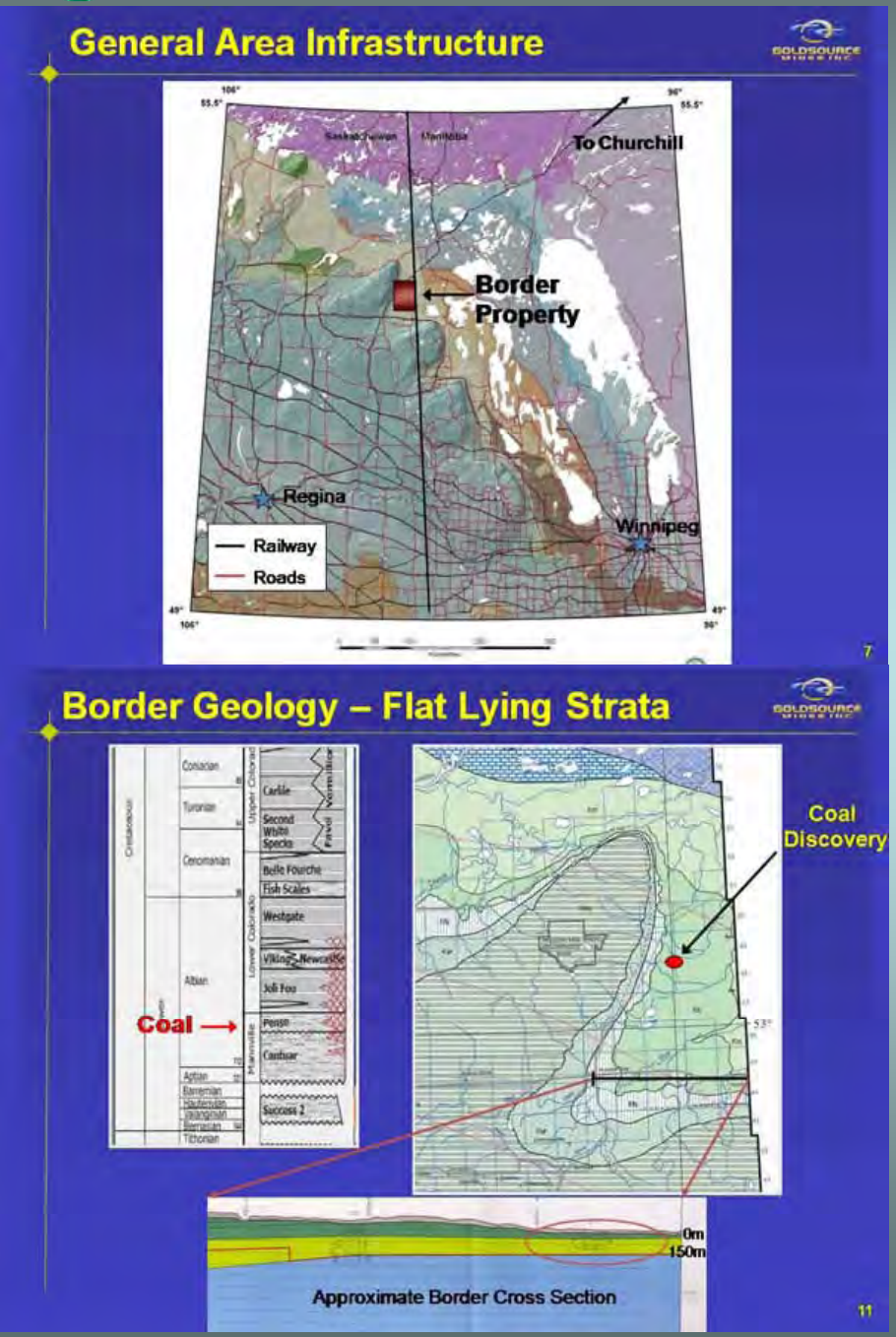
Oil Shale



- Purple dots shown in Phase 1 of Shale Gas Study indicate number of sites where Cretaceous bedrock samples collected this summer. Many of these samples will be used for TOC/Petroleum Potential evaluation.
- Contact Michelle Nicolas for further information



Paleocene lignite coal was produced in the Turtle Mountain area of Manitoba in the 1940s; but was found to be difficult to extract, at a profit, from wet erratically distributed coal seams.



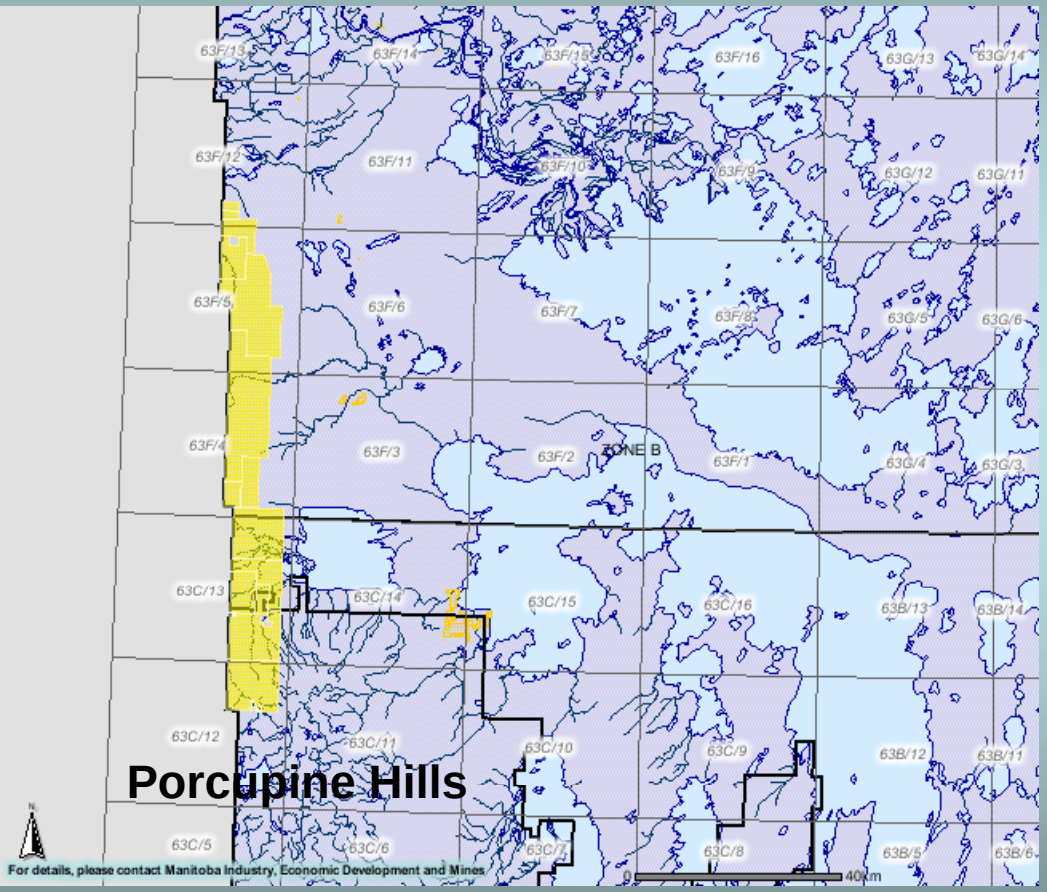
Coal

Saskatchewan Discovery

- Discovery of Durango Coal Seam in Pasquia River basin April, 2008.
- Two coreholes, 1.6 km apart, intersected a flat-lying coal seam with clay partings in the Cretaceous Manville Formation, averaging 32.8 m thick, at average depth of 79 m.
- Results of 213 drillcore analyses, carried out during the summer, confirmed good quality thermal coal ranging from **sub-bituminous C to bituminous C** in rank.
- Average calorific value stated to be generally higher than Alberta thermal coal fields and Powder River basin major producers.

Goldsource Mines Inc. (2008)

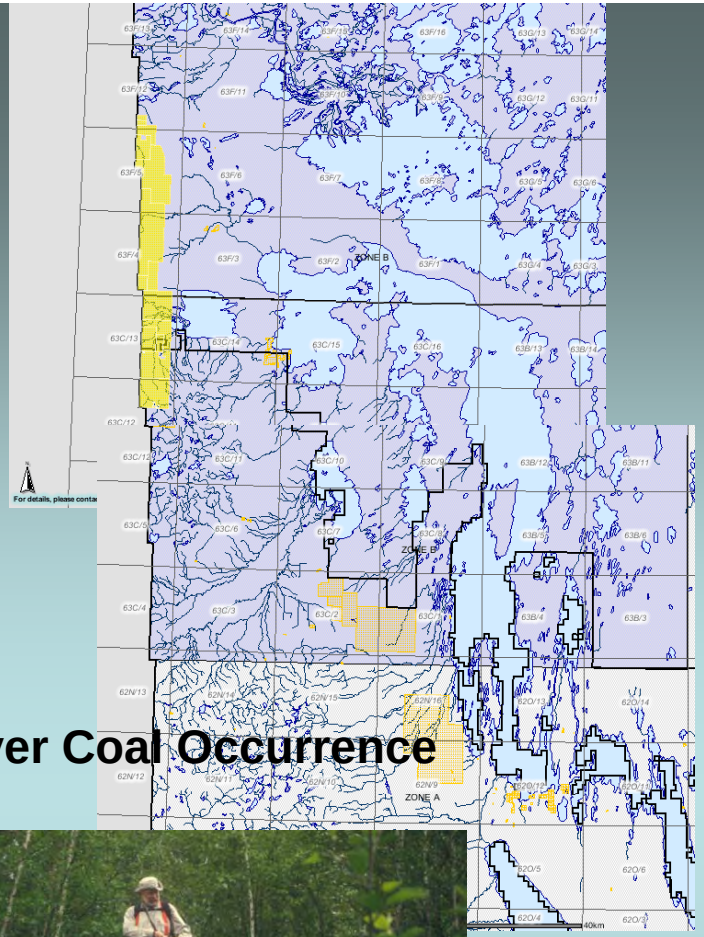
Coal



In Manitoba

- Cretaceous sub-bituminous coal resources may extend eastward across the provincial boundary (as the Manville equivalent Swan River Formation) north of the Porcupine Hills, into Manitoba (shown in dark yellow on map).
- Quarry Exploration Permits have been taken out by a number of parties in west-central Manitoba:
  - Jon R. MacNeill
  - Greencastle Resources Ltd.
  - Nucoal Energy Corp.
  - Minera Pacific Inc.
  - Silver Fields Resources Inc.
  - Westcan Uranium Corp.

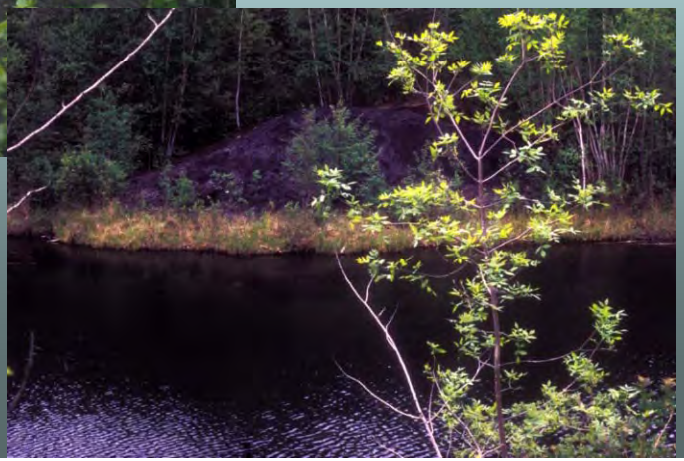
Coal



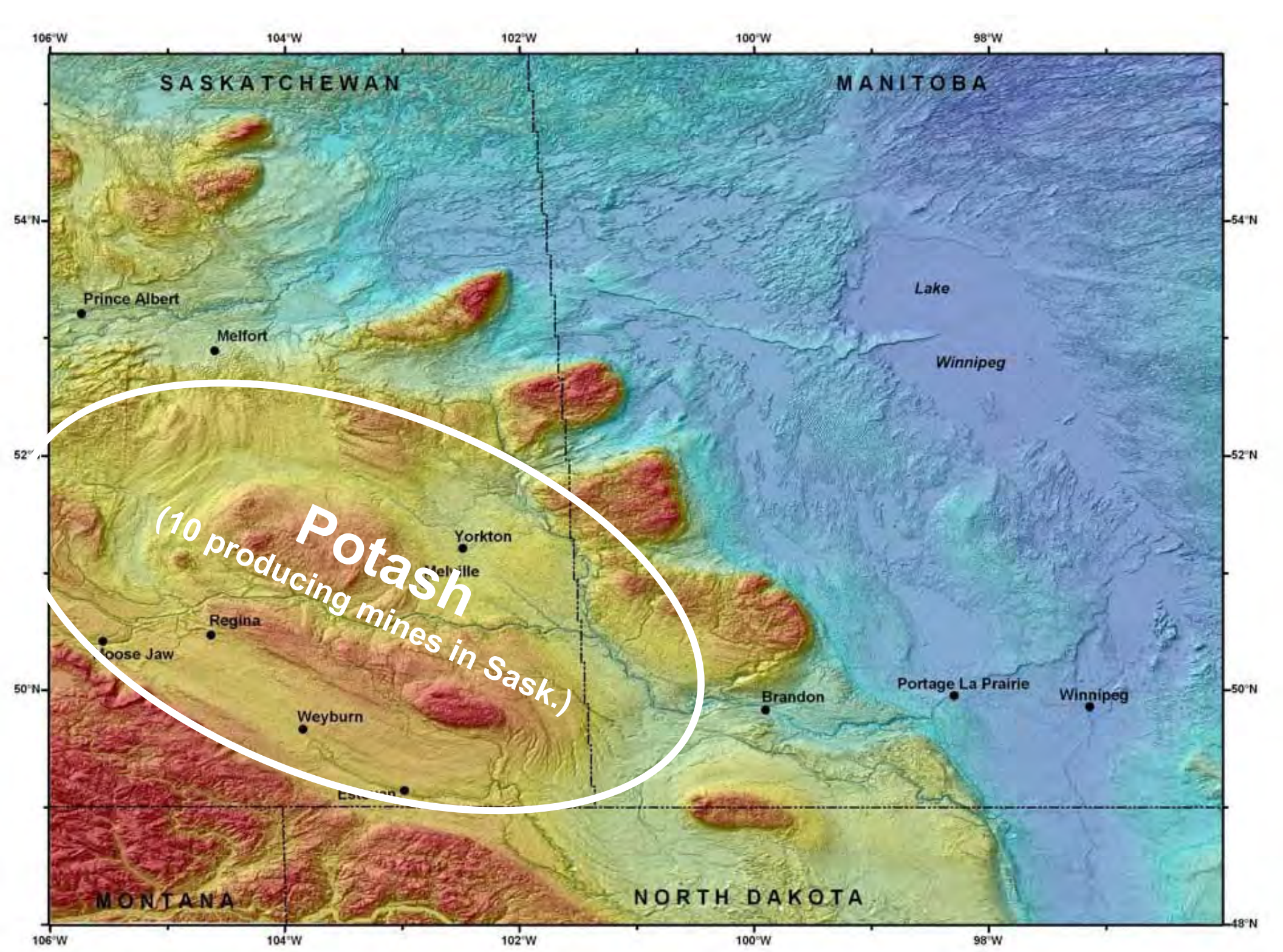
Pine River Coal Occurrence

Pine River Coal

- Two shallow shafts and test holes sunk into lignite occurrence on north bank of Pine River, 22 km northeast of the village of Pine River in 1937.
- Second attempt to mine the coal made in 1948 and 1949 by Silico Limited. Small lignite pile, measuring 4 m in height over an area 15 m in diameter, bulldozed from a pit south of the river.
- 9 m thick lignite seam was also reported in water well drilled near local school in the village of Pine River. Drilling by the MGS in 1978 did not prove up the seam.
- Contact for further information – Jim Bamburak.



2000


106°W
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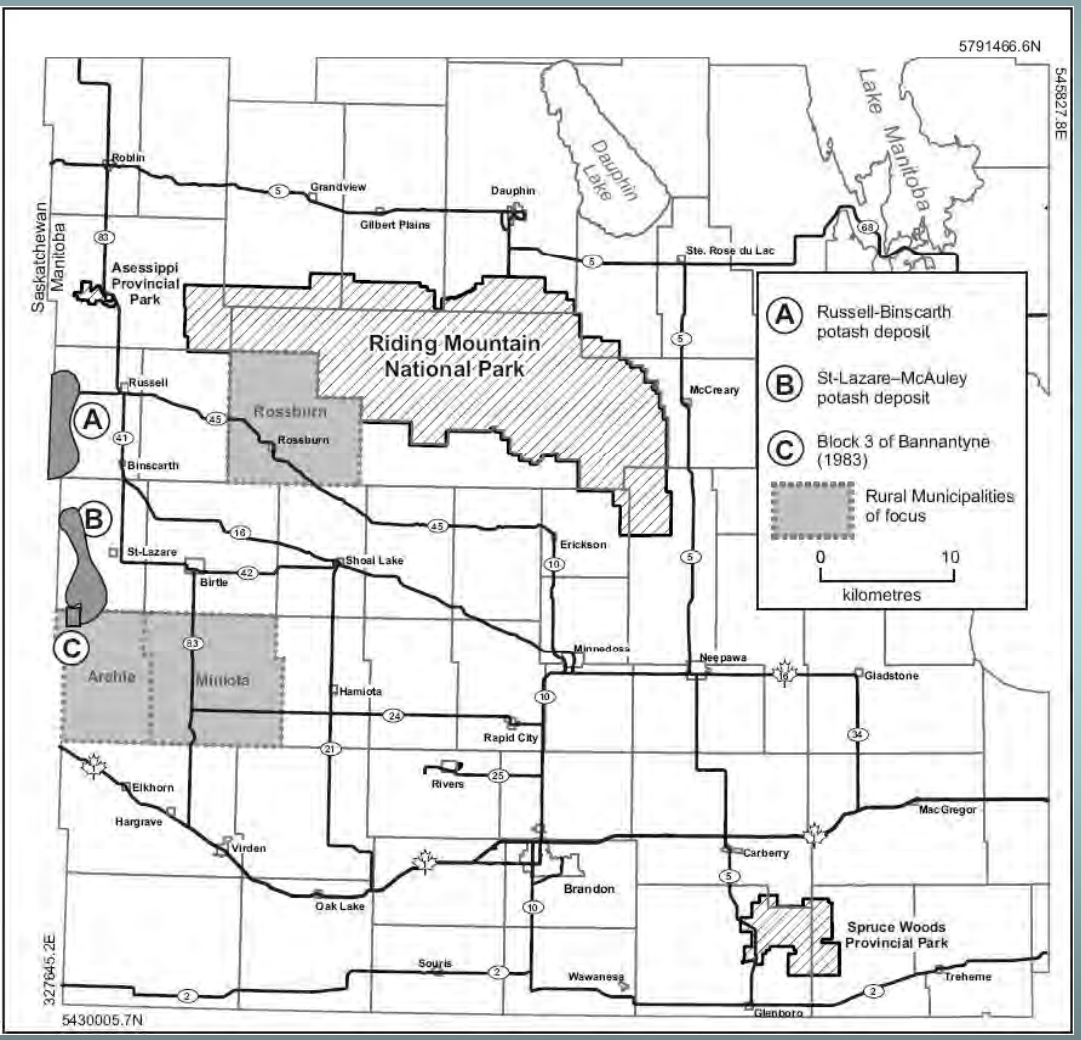
SASKATCHEWAN
MANITOBA
54°N
52°N
50°N
48°N
Prince Albert
Melfort
Lake
Winnipeg
Potash
(10 producing mines in Sask.)
Yorkton
Regina
Weyburn
Brandon
Portage La Prairie
Winnipeg
MONTANA
NORTH DAKOTA

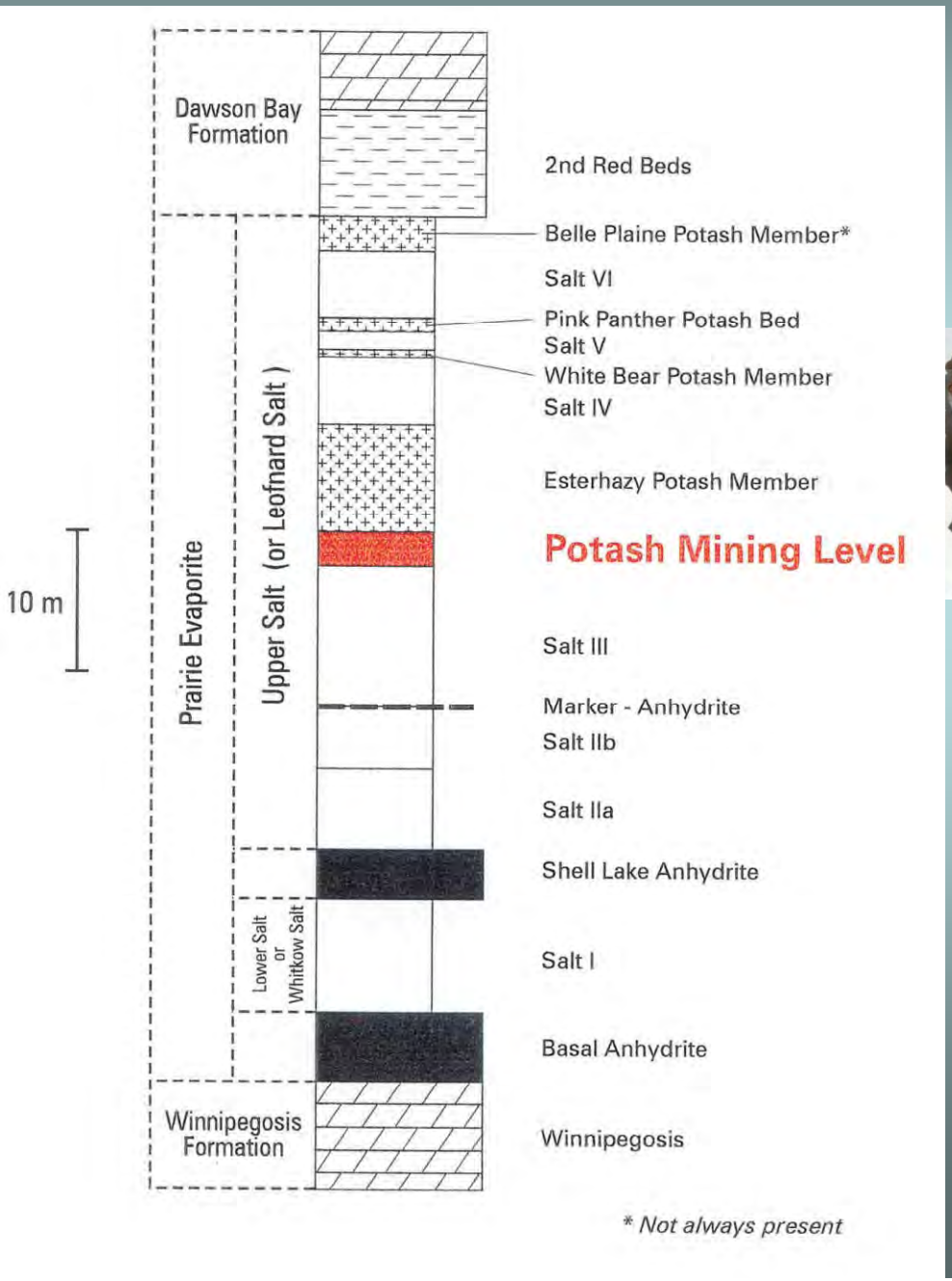
Potash

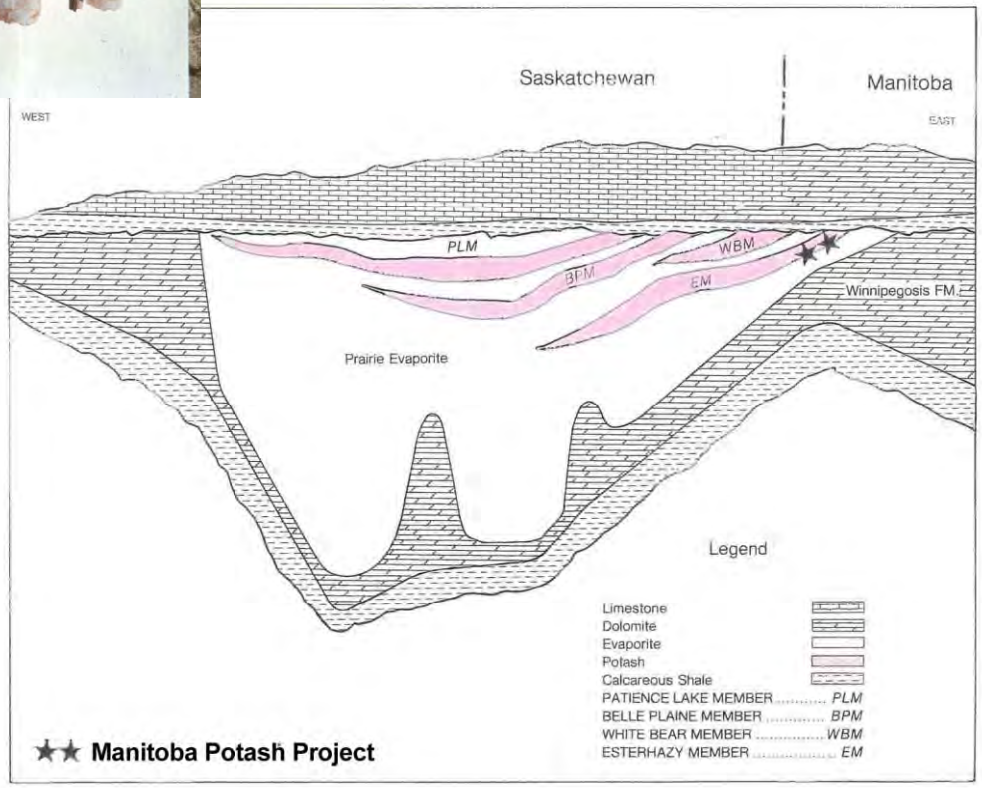


Bamburak, 2007

- Two potash deposits outlined, at depth, within the Devonian Prairie Evaporite, west of Russell and St. Lazare, Manitoba.
- Both deposits contains several hundred million tonnes of ore, averaging more than 20% K_2O (as sylvite).
- Additional deposit potential may be present in the vicinity of the known deposits and southward to the US border, but exploration must recognize Petroleum resource concerns.
- Contact for further information – Michelle Nicolas

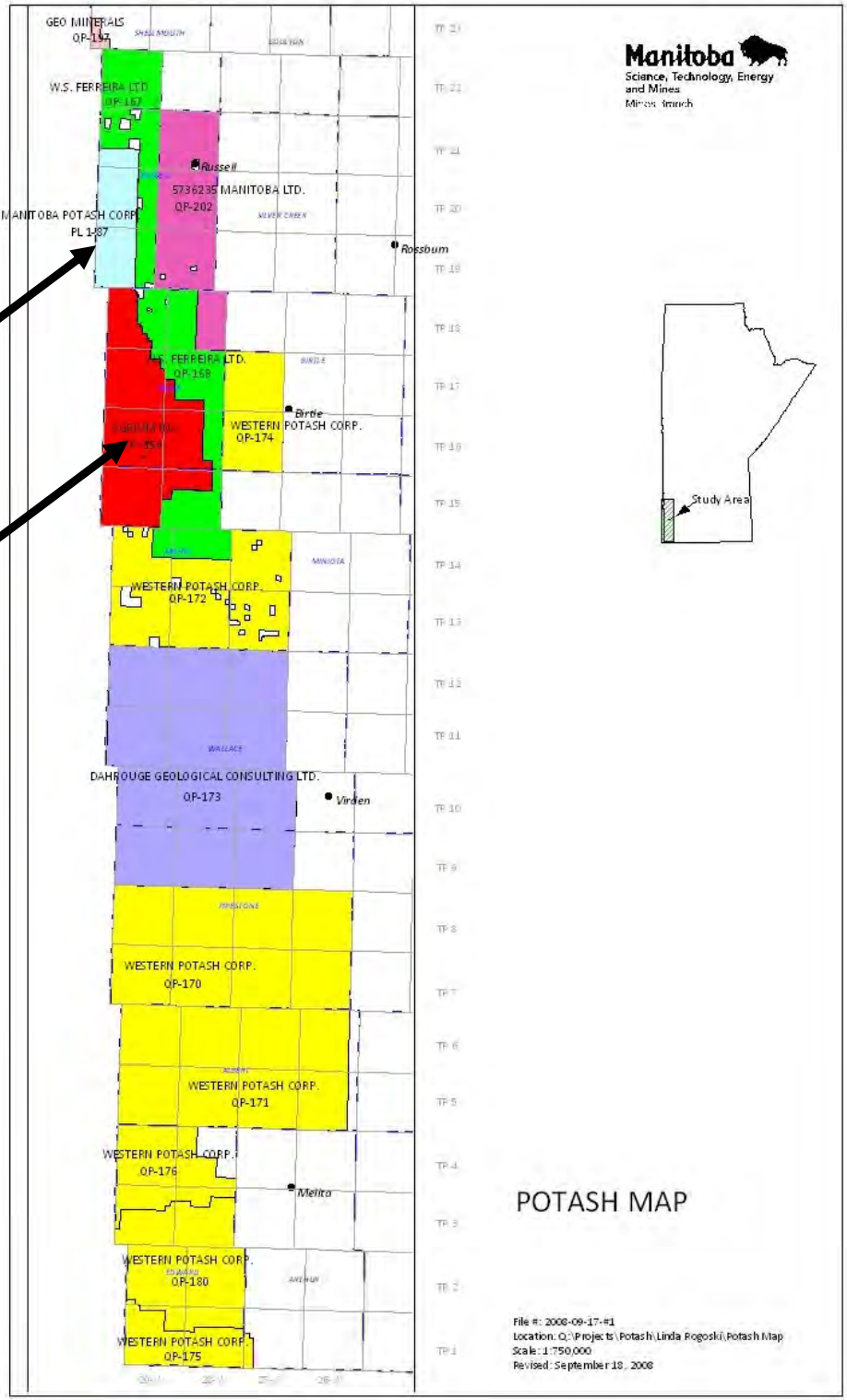
Potash

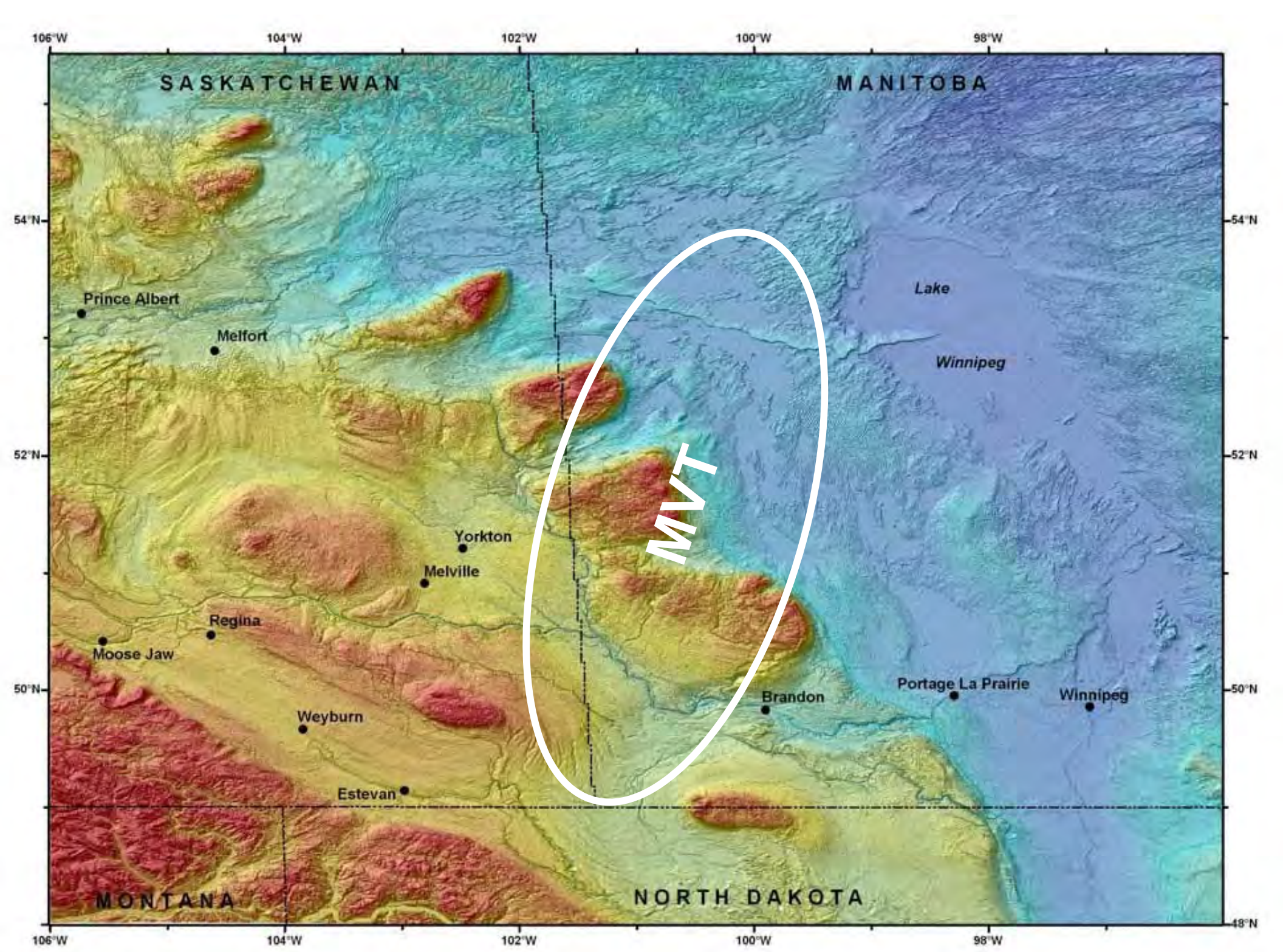

Dawson Bay Formation
2nd Red Beds
Belle Plaine Potash Member*
Salt VI
Pink Panther Potash Bed
Salt V
White Bear Potash Member
Salt IV
Esterhazy Potash Member
Potash Mining Level
Salt III
Marker - Anhydrite
Salt IIb
Salt IIa
Shell Lake Anhydrite
Salt I
Basal Anhydrite
Winnipegosis
Winnipegosis Formation
Prairie Evaporite
Upper Salt (or Leofnard Salt)
Lower Salt or Whitkow Salt
10 m
* Not always present


Saskatchewan
Manitoba
WEST
EAST
PLM
BPM
WBM
EM
Winnipegosis FM
Prairie Evaporite
Legend
Limestone
Dolomite
Evaporite
Potash
Calcareous Shale
PATIENCE LAKE MEMBER ..... PLM
BELLE PLAINE MEMBER ..... BPM
WHITE BEAR MEMBER ..... WBM
ESTERHAZY MEMBER ..... EM
★★ Manitoba Potash Project

Seven companies are involved in potash exploration in Manitoba, stretching from Roblin south to the US border:

- Manitoba Potash Corporation – PL1-87, with non-compliant probable mineable ore reserves of 164.7 million tonnes grading 24.5% K_2O (as sylvite) at a depth of 852 m.
- Agrium Inc. – QP-154, with non-compliant estimated mineable reserves 168.7 million tonnes averaging 21.7% K_2O (as sylvite).
- Dahrouge Geological Consulting Ltd. – QP-173.
- Geo Minerals Ltd. – QP-197.
- W.S. Ferreira Ltd. – QP-167, 168.
- 5736235 Manitoba Ltd. – QP-202.
- Western Potash Corp. – QP-170 to 172, 174-176, 180.

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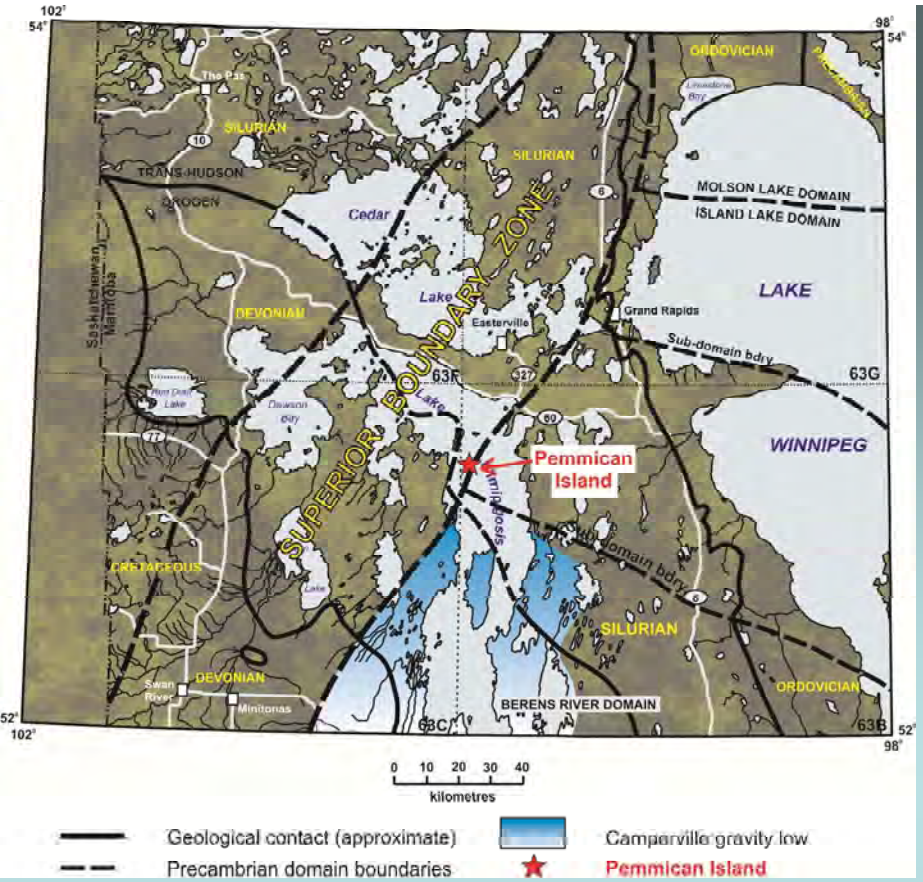
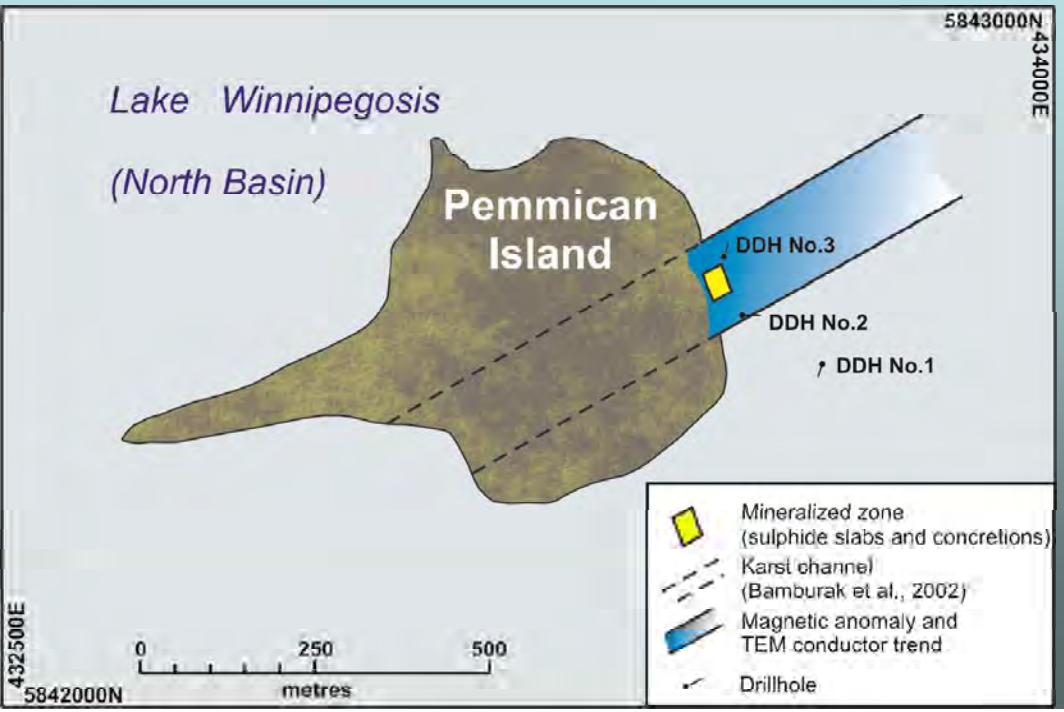
Brandon
Portage La Prairie
Winnipeg
MONTANA
NORTH DAKOTA





MVT

- In 2004, the first Mississippi Valley-type (MVT) mineralization to be discovered in Manitoba was found within a corehole (DDH No. 3).
- The hole was drilled into Silurian Interlake Group dolomite east of Pemmican Island in the north basin of Lake Winnipegosis by Klyne Exploration.
- It should also be noted that argillaceous Devonian Ashern Formation was found in DDH No. 1.

MVT

- The mineralized veinlet hosted by Silurian Interlake Group dolomite in DDH No. 3 comprised a 15 cm interval grading 4.59% Zn, 0.41% Pb, 0.014% Cu, 10.4% Fe and 14.05% S.

- Mineralization was also deposited as euhedral crystals, botryoidal masses, and snake-like tube structures within brecciated dolomite country rock.

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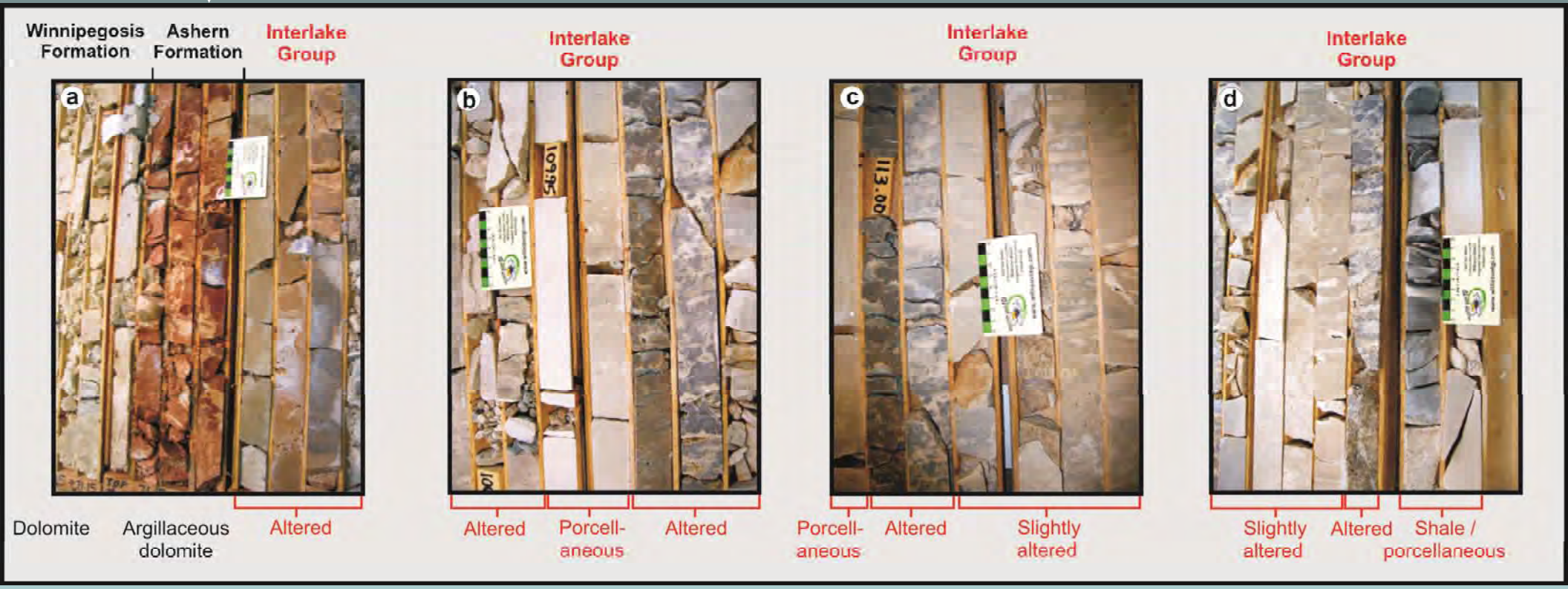
MVT

Top

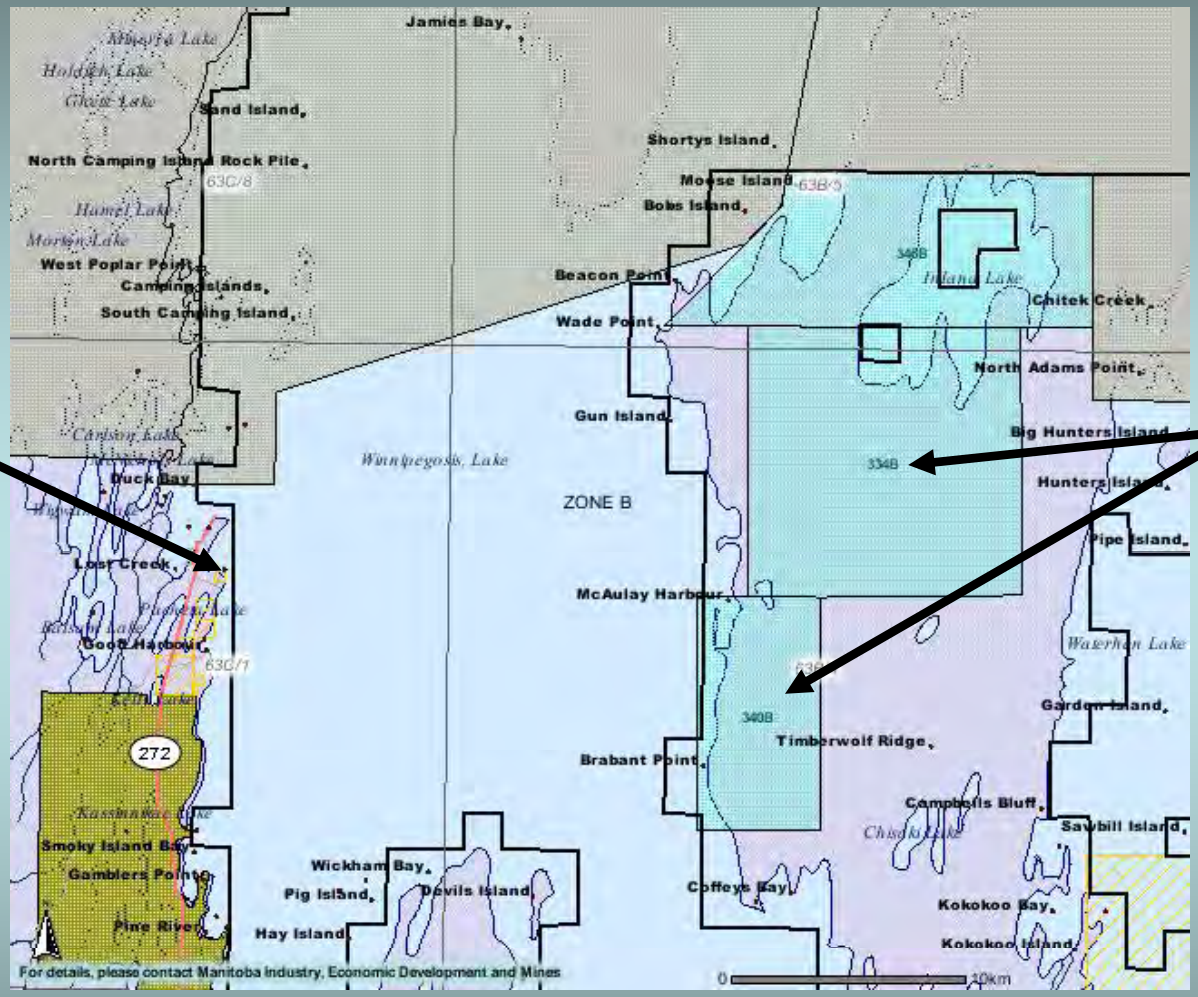
Argillaceous Cap rock

Bottom



- Geothermally-altered drillcore, with observed saddle dolomite, in Duck Bay corehole M-1-07 (shown above) and in Paradise Beach corehole M-6-76, drilled 75-100 km away from Pemmican Island, show that regional heating and alteration was pervasive throughout west-central and Interlake areas of Manitoba.

MVT



- Geothermally-altered Silurian and Devonian outcrops (with argillic alteration, sparry and recrystallized dolomite) have also been noted on the east shore of Lake Winnipegosis, across from Duck Bay by Doug Berk (previously with the Department), who provided the following photos.

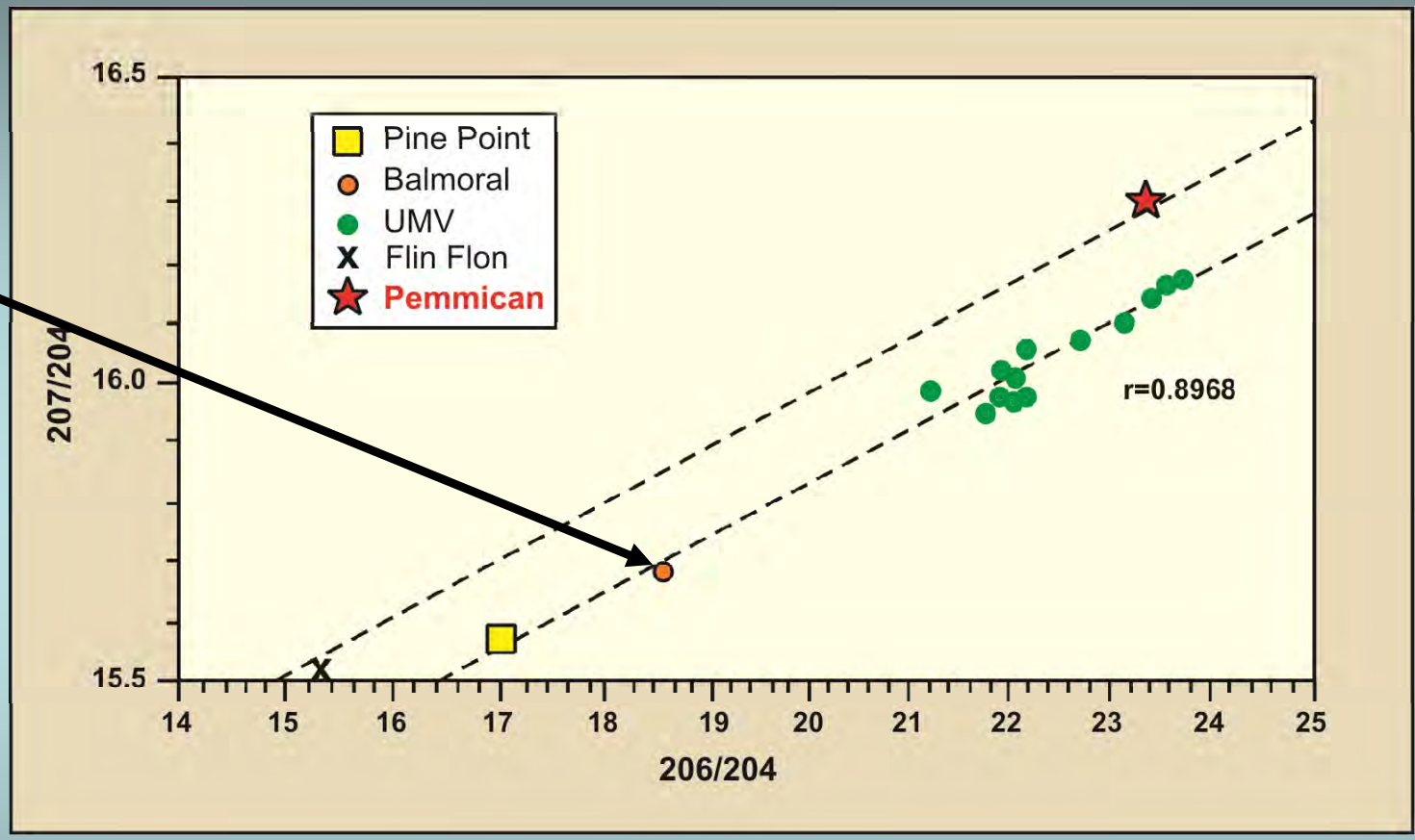

CR10G


CR10B
CENTIMETRE

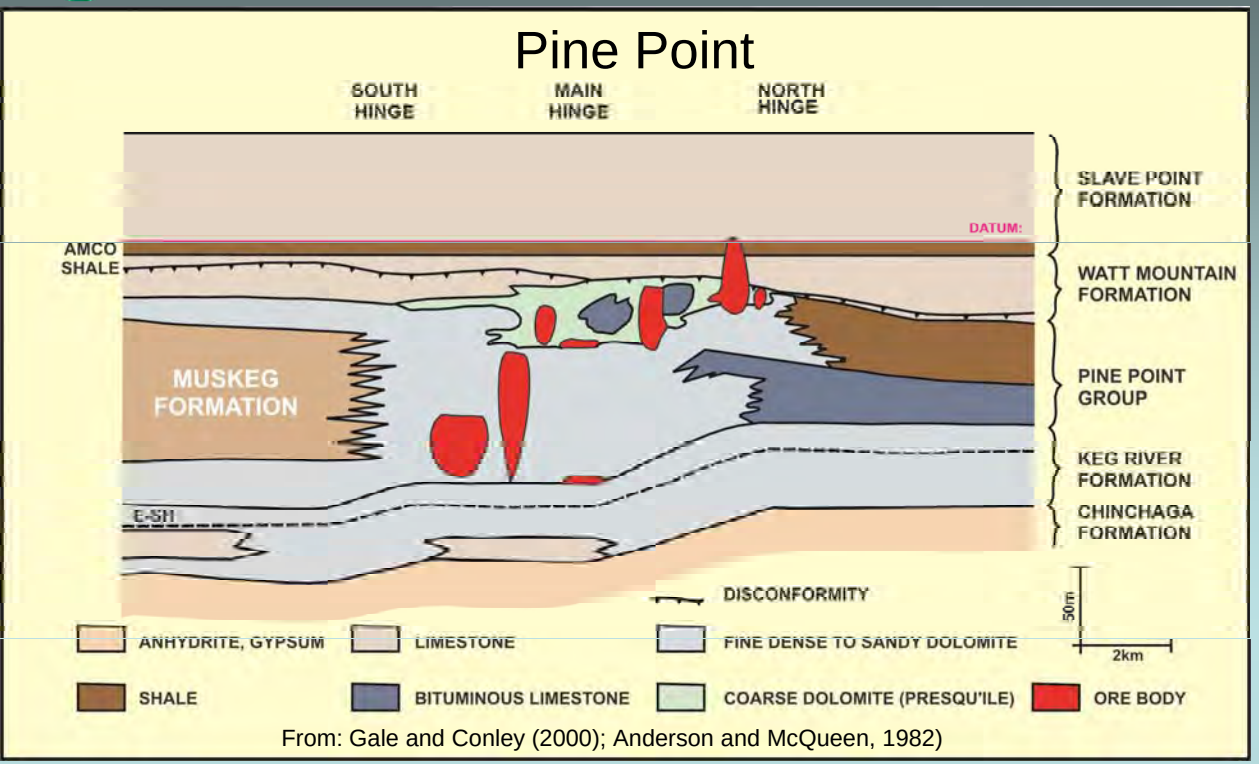

CENTIMETRE

MVT

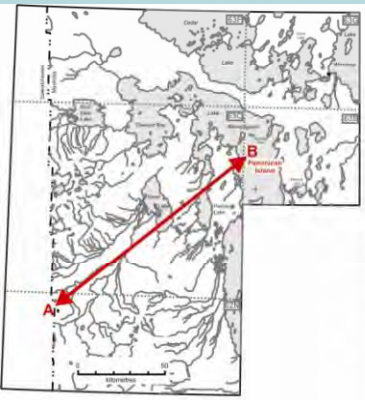
Balmoral Galena Pebble

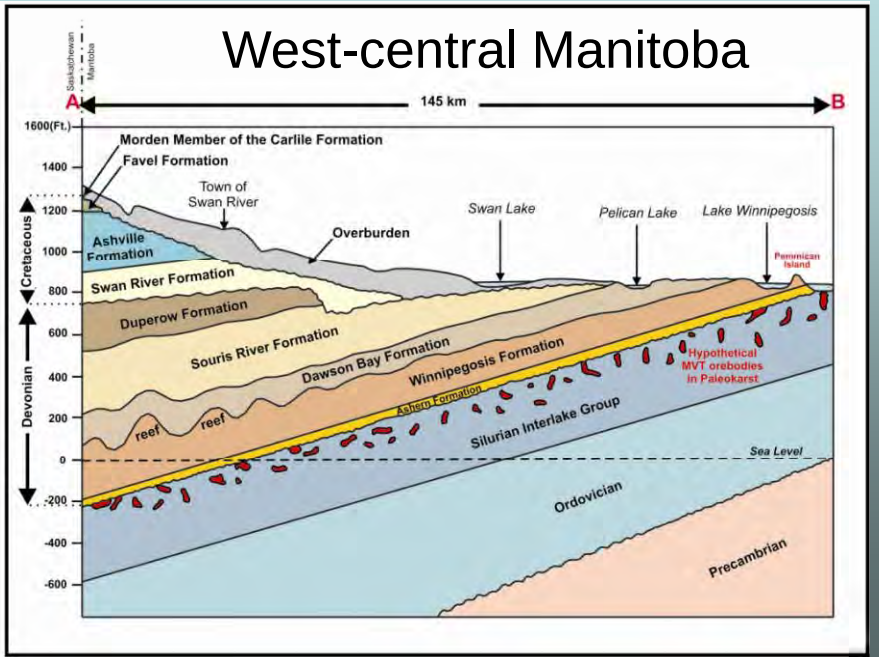


- The Pemmican Island Zn-Pb Discovery has characteristics common with Upper Mississippi Valley-type (UMV) mineralization, such as a comparable lead isotope ratio.



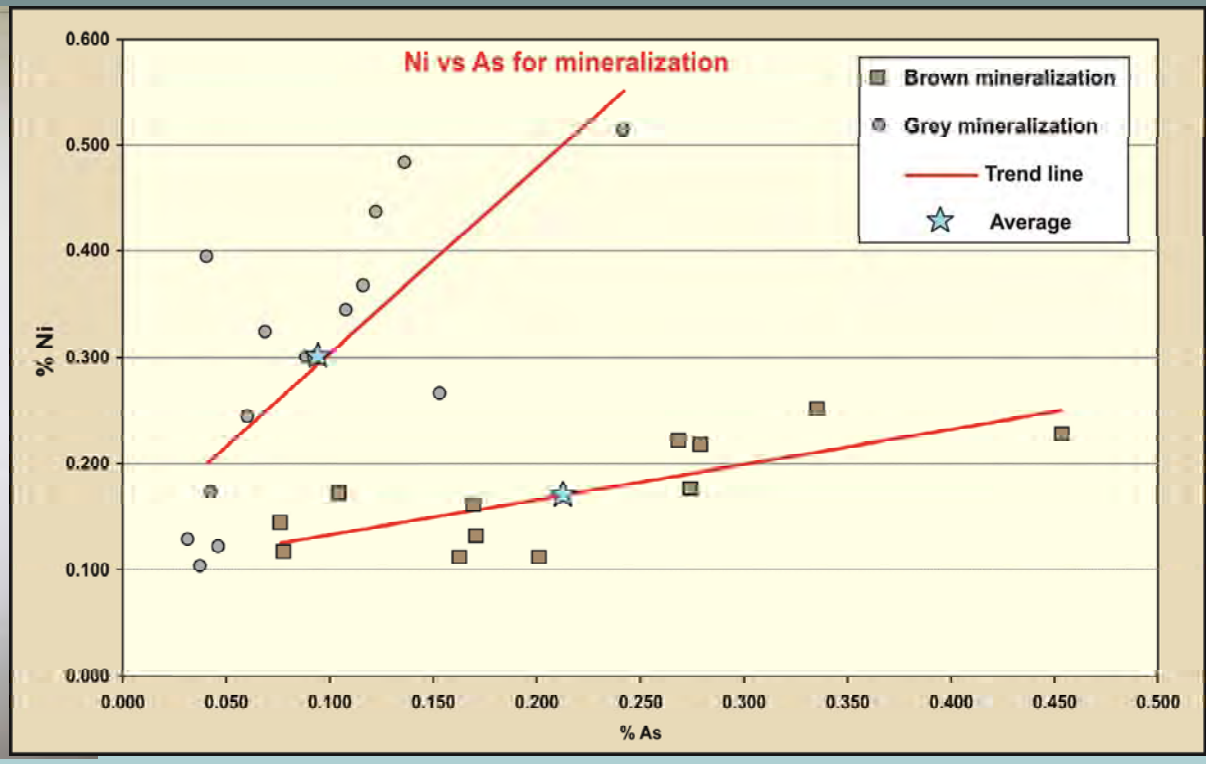
From: Gale and Conley (2000); Anderson and McQueen, 1982)



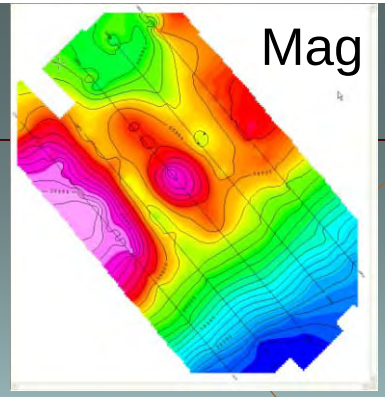


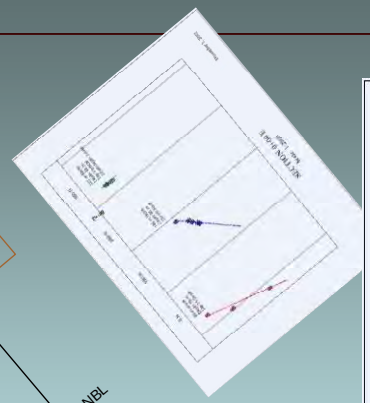
- But, West-central Manitoba also has many features that are similar to Pine Point mining district:
  - hydrothermally-altered karst within dolomite
  - above a major reactivated Precambrian basement structure
  - below argillaceous secondary caprock
  - at the edge of the Western Canada Sedimentary Basin.

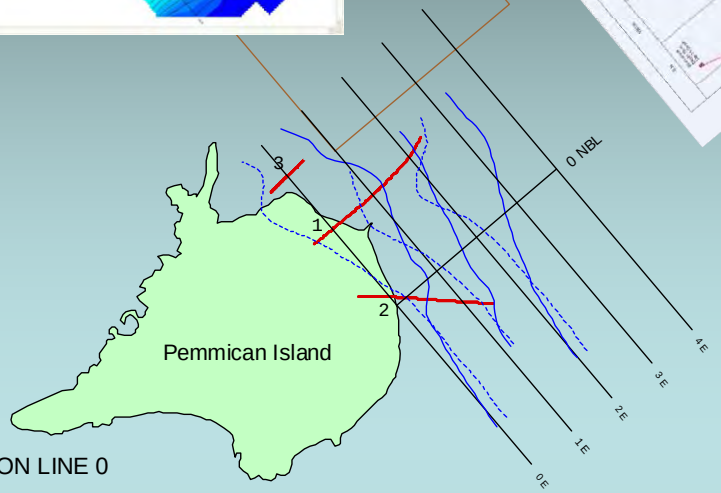
MVT



- Banded marcasite mineralization lining the walls of cavities within the brecciated dolomite is polymetallic; as shown by the two divergent trend lines in the above plot of %Ni vs %As from electron microprobe analysis, and by visual examination.
- This suggests that the sulphide mineralization was deposited during several mineralizing events.

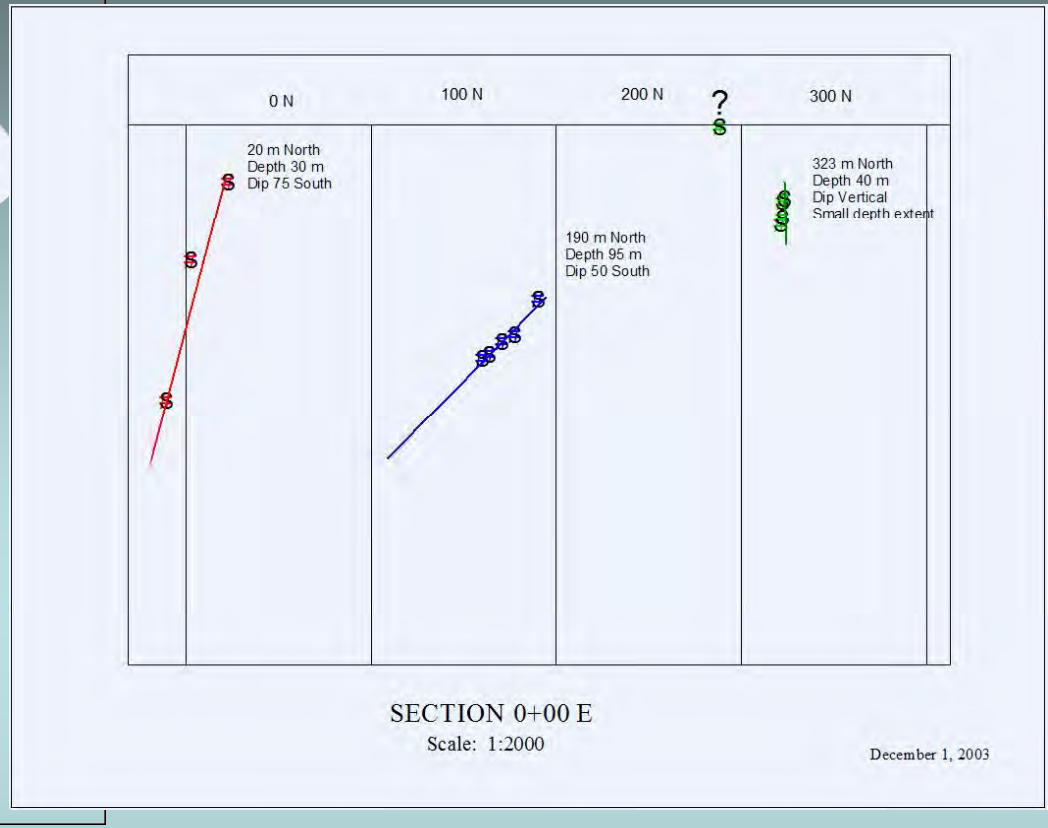






TARGETS ON LINE 0

Target 1: Depth 95 m Dip 50 Deg Grid South
Target 2: Depth 30 m Dip 75 Deg Grid South
Target 3: Depth 40 m Dip Vertical - Small depth extent



Source Loop
Grid Line
PEM X Component
PEM Z Component
PEM Target

G. R. Frazer Consulting Ltd.

PEMMICAN GRID
Scale: 1:10000
January 14, 2004

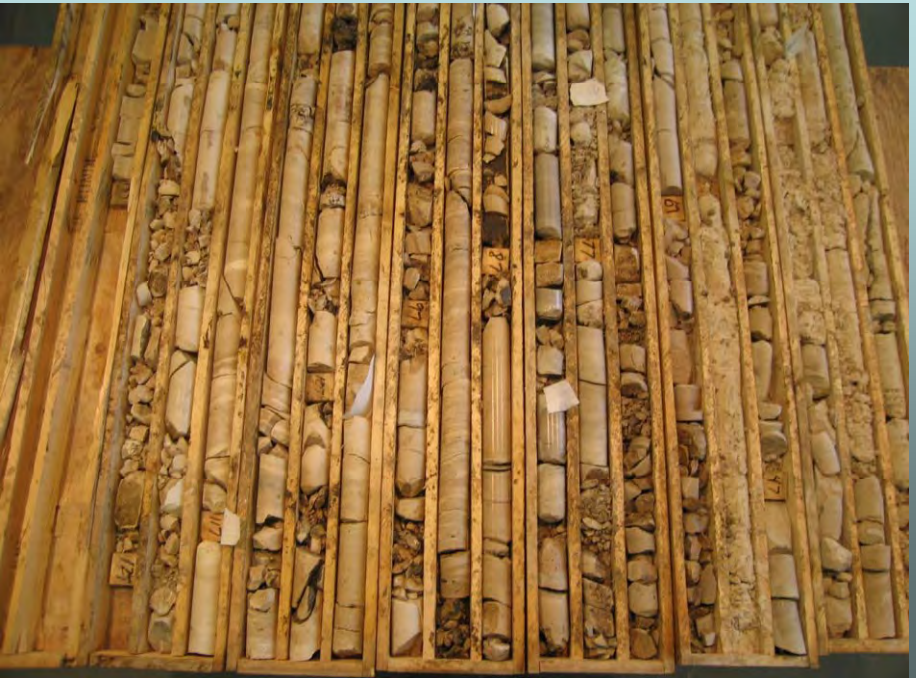
- Additional drilling of transient electromagnetic conductors, within a broad weak magnetic anomaly, is required to locate the source of mineralization found in the 2004 Discovery Hole.

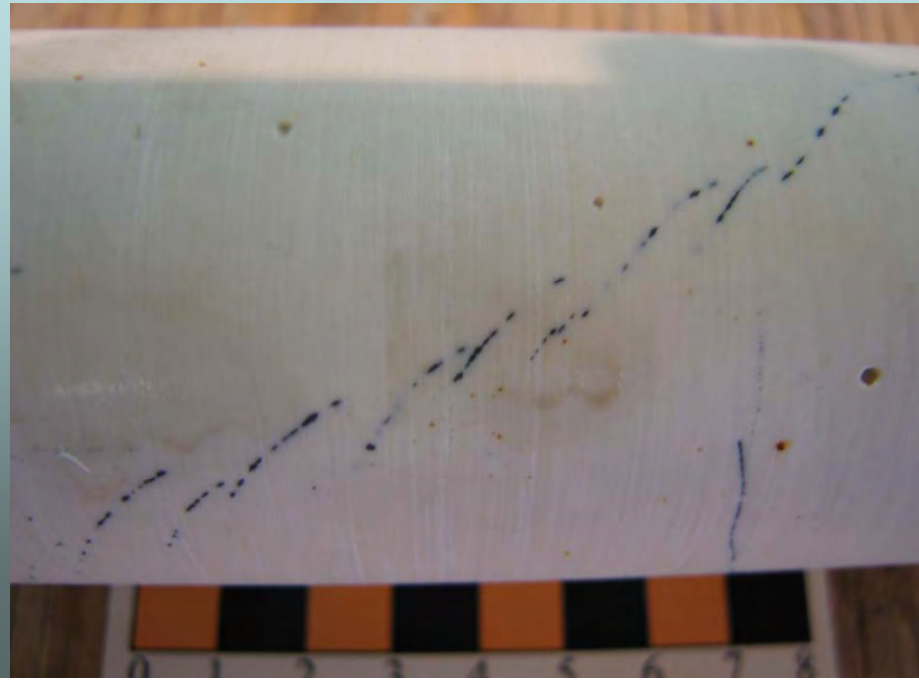
MVT

August
2008

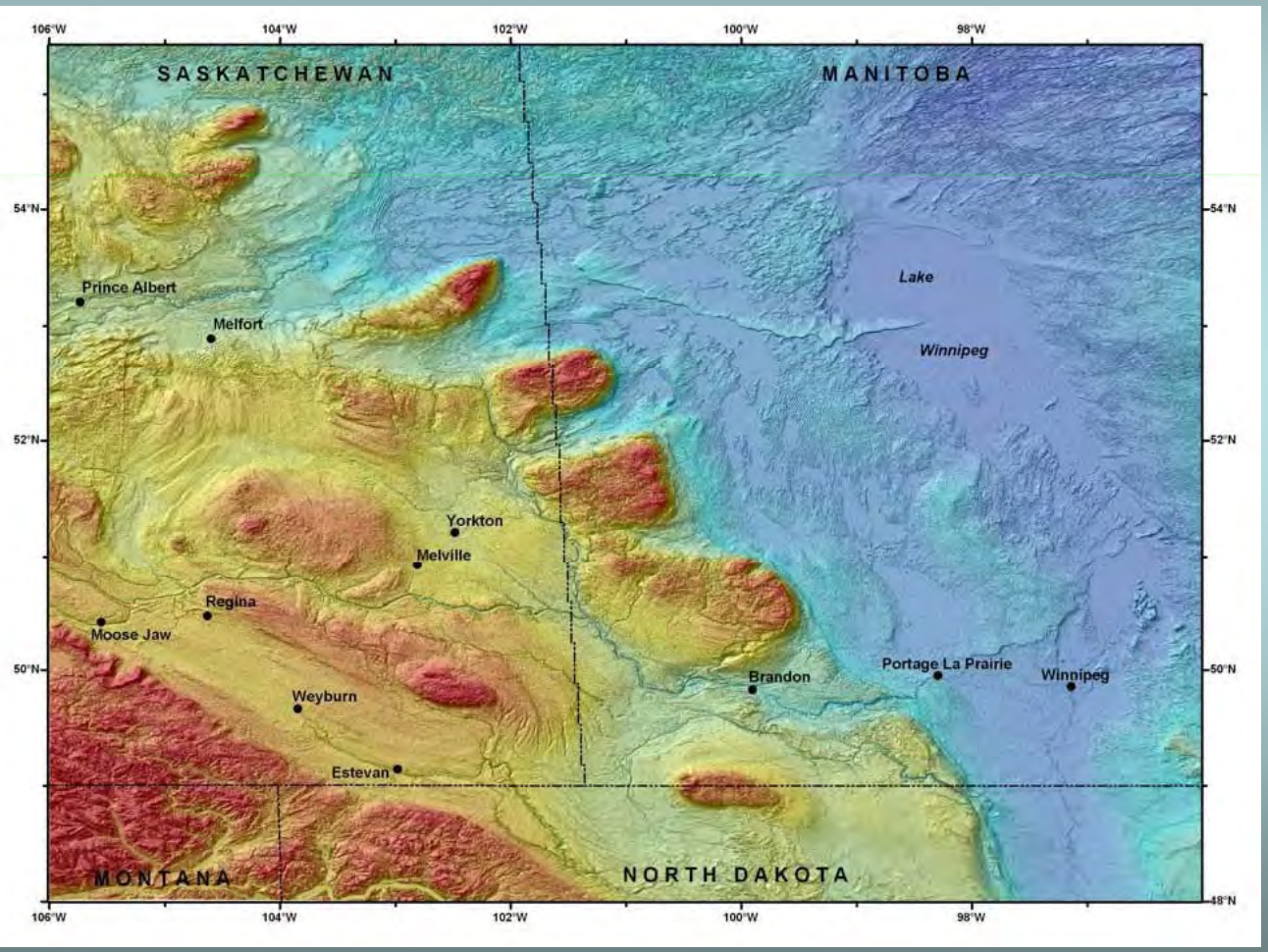
MVT

Feb.
2009





Manitoba's Future Mineral Commodities



- **Shale Gas**
- **Oil Shale**
- **Coal**
- **Potash**
- **MVT**