# [AV]Petroleum Exploration History of British Columbia, Canada*

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## Introduction

Acquiring historical context is an important first step in any exploration program, and without it geology and geophysics cannot be effectively directed. This presentation is meant to suggest to the reader a process and the necessity of studying exploration history, and not just provide the particulars for the exploration history of northeastern British Columbia (NEBC). In this case the process has been applied to a very large area; but it could be used locally to understand activity patterns before making decisions to undertake further geological/geophysical work.

Initial impetus for work on this topic was provided by the simple observation that some portions of NEBC remain relatively unexplored (white areas) while others are much more densely drilled (Figure 1). The question naturally arises as to why development has occurred in this uneven manner. Has it been a matter purely of geology or have other factors played a significant role? If geology has been the primary factor in guiding exploration, then maybe there remains little hope for discovery in the white areas. If other factors, such as roads or settlements, have been more influential in directing drilling, then maybe the white areas warrant intense geological/geophysical study.

## Methodology

With the assistance of a commercial petroleum data vendor program, I divided exploration history primarily into discrete intervals of time, with a focus on drilling activity. This approach, I feel, is consistent with the inherently cyclical nature of this business.

This report focuses on drilling activity rather than other types of activity such as pipelines or seismic exploration mainly because it is the most direct indicator of economic interest.

Much information about past exploration activity came from annual public reports of year-to-year oil industry activity published by the Government of British Columbia. The earliest ones of these reports, dating to the infancy of petroleum exploration in the province, contain much useful information
.
Another valuable source of detailed historical information for individual wells is the publicly available well files, available through the BC Ministry of Energy, Mines and Petroleum Resources. Sometimes individual well files give glimpses of the strategy used for the development of entire regions. These files are available to the public at our office in Victoria.

Maps for each time interval were prepared to provide a visual record for each time interval, and to track trends as they developed.

World-wide events were also considered because the oil industry has been multi-national almost from the beginning, and decisions to drill or not drill have always been influenced by major events elsewhere.

## Exploration History

### Pre-1948

Early settlers had reported the presence of oil seeps, and because most petroleum discoveries in the world had been made near seeps, interest in the area was already high before any drilling had been done. In 1920-21 the first five or six exploration wells of NEBC were drilled in the Peace River area by the British Columbia government. Pouce Coupe Oils drilled a shallow well near the Alberta border to investigate signs of hydrocarbons at surface.

In the early 1930s, the BC government placed all the Peace River lands under reserve to discourage control by American interests. Later on in the 1930s, this policy was changed with the approach of World War II so strategic oil reserves could be established. Despite that shift in policy, little drilling took place.

### 1948–1950

Possibly the single greatest single event in Canada's petroleum history took place in 1947 with the discovery of a middle Devonian reefal play near Leduc, Alberta. Although this was not in BC, it sparked intense activity in NEBC during the post-war years as the reefal trend was followed. Many fields were discovered as a result, not just in middle Devonian carbonates, but also in Lower Cretaceous and Triassic clastics.

### 1950–1955

By the early 1950s, operators were showing that northeastern BC held potential in multiple zones of different geological ages. More wells were drilled for Lower Cretaceous gas in the previously established trend north of Dawson Creek.

A number of wells were drilled deeper, perhaps in hope of there being another Leduc-style reef in the Devonian section. Nothing like that was found in northeastern BC at that time; instead—and of great significance for the oil industry in the region—was the discovery of gas in the Triassic Halfway and Baldonnel Formations. A northwest trend, parallel to the cratonic shorelines of the Triassic, was quickly delineated by drilling. Drilling along this trend was facilitated by the Alaska Highway, which more-or-less followed it.

### 1955–1960

In 1956, the Boundary Lake oilfield —British Columbia's first—was put into continuous production. Ten wells were producing oil by the end of the year.

The previous discovery of gas in the Middle Devonian Slave Point Formation near Fort Nelson at Clarke Lake led to a flurry of activity chasing after this new trend.

### 1960–1965

In 1961, a new core storage facility was opened by the government in Charlie Lake, near Fort St. John. This was an essential step for facilitating the orderly further exploration and development of the province's

hydrocarbon resources.

Drilling extended northward as multiple potential zones allowed the Triassic trend to broaden. In the far northwest of the region, in an area sparsely drilled even now, a discovery was made in the middle Devonian Nahanni Formation at Beaver River. This well was one of the first in the province to be directionally drilled into rock within the deformed belt.

**1965–1970**

Activity had settled into predictable patterns close to the major discoveries, and the rate of discovery had slowed. Most of the big discoveries, of which many are still in production, were being exploited or were in the process of expansion through step-outs. The progression of field development followed the northwest-trending Triassic reservoirs, such as the Inga Field in the Fort St. John region.

In the northeasternmost corner of the province, which was remote from established roads, follow-up wells were drilled for discoveries made in the Upper Devonian Jean Marie Formation. At about this time, the Rainbow Reef Middle Devonian carbonate play in northwestern Alberta was discovered, and development quickly ensued. Reefal plays were still at the top-of-mind for many explorationists in the Western Canada Sedimentary Basin, as they had been since the Leduc discovery

The white area in the extreme northeast defines the extent of the Cordova Embayment, a basin shale correlative portion of the Devonian section. A handful of wells had been drilled there to explore the edges of the shale basin and define the fringes of the Middle Devonian carbonate barrier reef.

**1970–1975**

This was a time of discord between the federal government and western oil producers. As a bargaining tactic, production was withheld, and therefore activity levels were low for part of this period. Also, the pace of discovery had slowed; most of the major discoveries we know about now had already been made. Some exploration wells were drilled in the white areas without success.

Drilling continued to expand the Triassic trend farther to the north-northeast.

**1975–1980**

The first of many wells to follow were drilled during this period in the “Deep Basin” region of northeastern BC, south of Dawson Creek and adjacent to the Alberta border. Although northeastern BC was slowly running out of conventional wildcat targets, many small fields were still being found and existing play trends were expanding. More drilling took place to define the linear foothill trends. Many of the well established plays were heavily exploited during this period because of the oil boom caused by Middle Eastern political tensions.

Despite the prevailing speculative frenzy for any reasonable play, only a few wells (unsuccessful) were drilled within the increasingly clearly defined white areas.

**1980–1985**

This period was one of the most volatile of all time for the oil industry, both within Canada and worldwide. In the early part of the decade, oil prices remained near the record levels of 1979; before long, prices began a steady drop that lasted for the rest of the period. Activity and speculative fever peaked at the beginning but dropped very quickly by 1985. In Canada, the effects of oil price volatility were compounded by a National

Energy Program, which imposed new taxes on production. One of the effects of this new policy was the diversion of significant amounts of investment from conventional plays in the Western Canada Sedimentary Basin to much more risky frontier plays on the north and east coasts (and U.S.A). As a result, drilling activity slumped drastically from the peaks of the late 1970s.

Gas prices also were very low during this period. Many newly drilled gas wells were shut-in indefinitely because tie-in costs were high and no markets existed for the gas. A number of existing producers in more remote regions also were shut-in because low gas prices rendered them uneconomic.

**1985–1990**

The volatility of the previous period was followed by even greater volatility as the price of oil went from a steady decline to the steepest plunge of all time for one year in 1986. While oil consumers revelled in cheaper fuel prices, countries, regions, and individuals that had grown dependent on abundant revenues faced a stark new reality. Prices began to recover in 1987, but they did not approach former levels until they shot up briefly when Iraq invaded Kuwait at the start of the first Gulf War in 1990.

In BC, the downturn in oil prices led to a 40% drop in drilling activity in 1986 from 1985. Despite the drop in prices, infill drilling of oilfields continued. Toward the end of the decade, gas prices recovered, leading to a re-emphasis on gas.

**1990–2000**

Technology began to play an increasingly important role in the exploration of northeastern BC. Seismic imaging, especially 3D, continued to improve. Horizontal drilling opened up possibilities for exploiting previously uneconomic plays or extending the life of oilfields. Within exploration departments, computers appeared on the desktops of all geologists—the mapping capabilities of the personal computer were by this time greater than the most powerful mainframe of the previous decade.

Coinciding with a recession in Asia—and before the emergence of China as an economic superpower—oil prices hit rock bottom in 1998. They had never been so low in dollars adjusted for inflation. In NEBC, uncertainty over oil and gas prices restrained drilling activity until after the price collapse of 1998.

**2000-present**

The steady rise in energy prices led to record levels of drilling activity throughout northeastern BC in the first part of this century. Most of the drilling took place within established areas, which began to resemble the mature petroleum regions of Alberta and the US. Only a relatively small number of wells were attempted in the white areas, despite the overall number of wells drilled and the availability of sophisticated new exploration technologies. The recent drop in oil and gas prices have dampened activity, but not entirely squelched it. A number of large companies are gearing up to develop shale gas in sparsely drilled areas north of Fort St John and Fort Nelson. Some of the white areas appear to be due to be filled in.

## Summary and Conclusions

The earliest wells in northeastern BC were drilled in the 1920s and 1930s in the Peace River area (which had already been thinly populated by settlers). Like elsewhere in the rapidly growing oil industry throughout the world, the earliest wells, and often still the best, were drilled on surface indications like seeps or obvious structures.

A non-seep discovery, the Leduc Field in Alberta, influenced the exploratory pursuit of the deep Devonian

reefal trends in northeastern BC. Deeper drilling for Devonian targets near Fort Nelson also resulted in finding multiple potential producing zones in the Lower Cretaceous, Triassic, and Mississippian.
By the late 1960s, almost every corner of NEBC had been penetrated by a drill bit and the primary exploration fairways had been established. Many of these were centered around or near the Alaska Highway. New discoveries and field developments tended to be close to this road because of difficulties of access. The areas with good access around Fort St. John and Dawson Creek, and with multiple pay zones in the Lower Cretaceous and Triassic, quickly became densely developed.

In the late 20th and the early 21st century, new technologies enabled the development of some of the previously discovered but uneconomic resource-type plays, such as tight sands near Fort St John. Sporadic drilling in the white areas resulted in few discoveries. Impending shale gas development promises to fill in much of the blank space in NEBC.

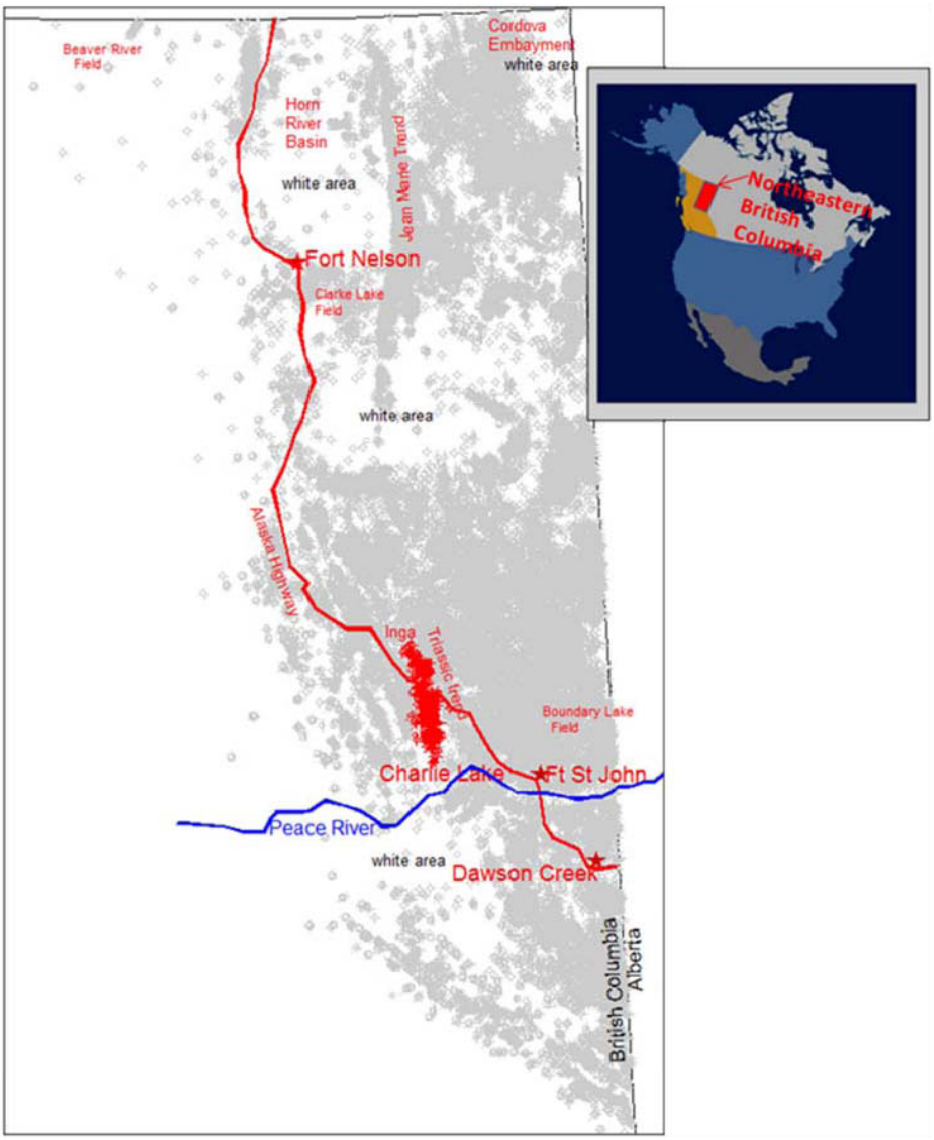


Figure 1. Petroleum exploration history of northeastern British Columbia. Well symbols are indicated in grey. Approximately 21,000 wells had been drilled as of the end of 2008. Note that some areas, noted as “white areas,” remain relatively undrilled. This study was initiated as a first effort in understanding the reasons—geologic or other—for the uneven distribution of wells.

# Petroleum Exploration History of British Columbia

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BRITISH COLUMBIA

Ministry of Energy, Mines and Petroleum Resources

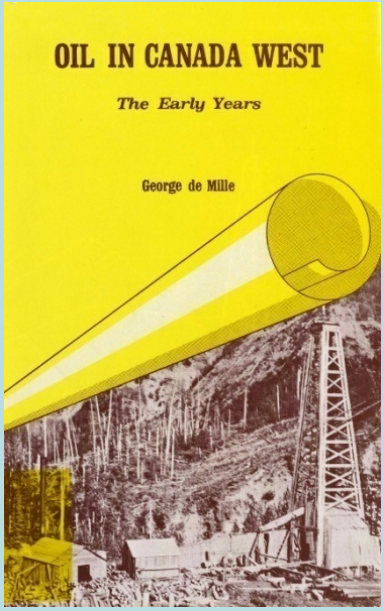
AAPG Annual Convention & Exhibition

7-10 June 2009
Colorado Convention Center
Denver, Colorado

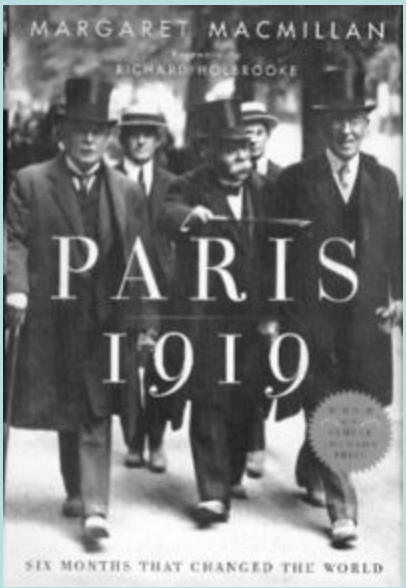
Why study history?  What if we don't?

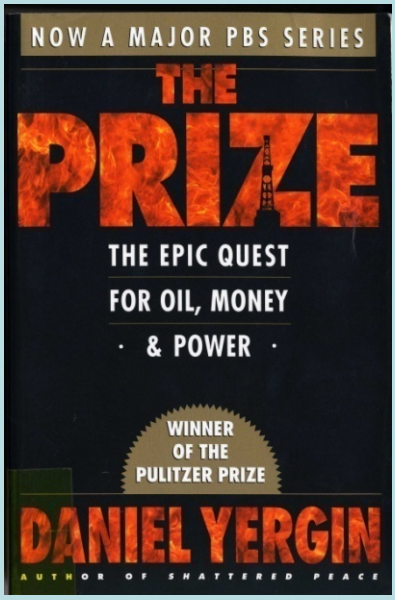
Can we apply lessons of the past to the current situation?

This talk is as much about the process as the story itself.




Peace conference at Versailles, France, Lloyd George, Clemenceau, Wilson

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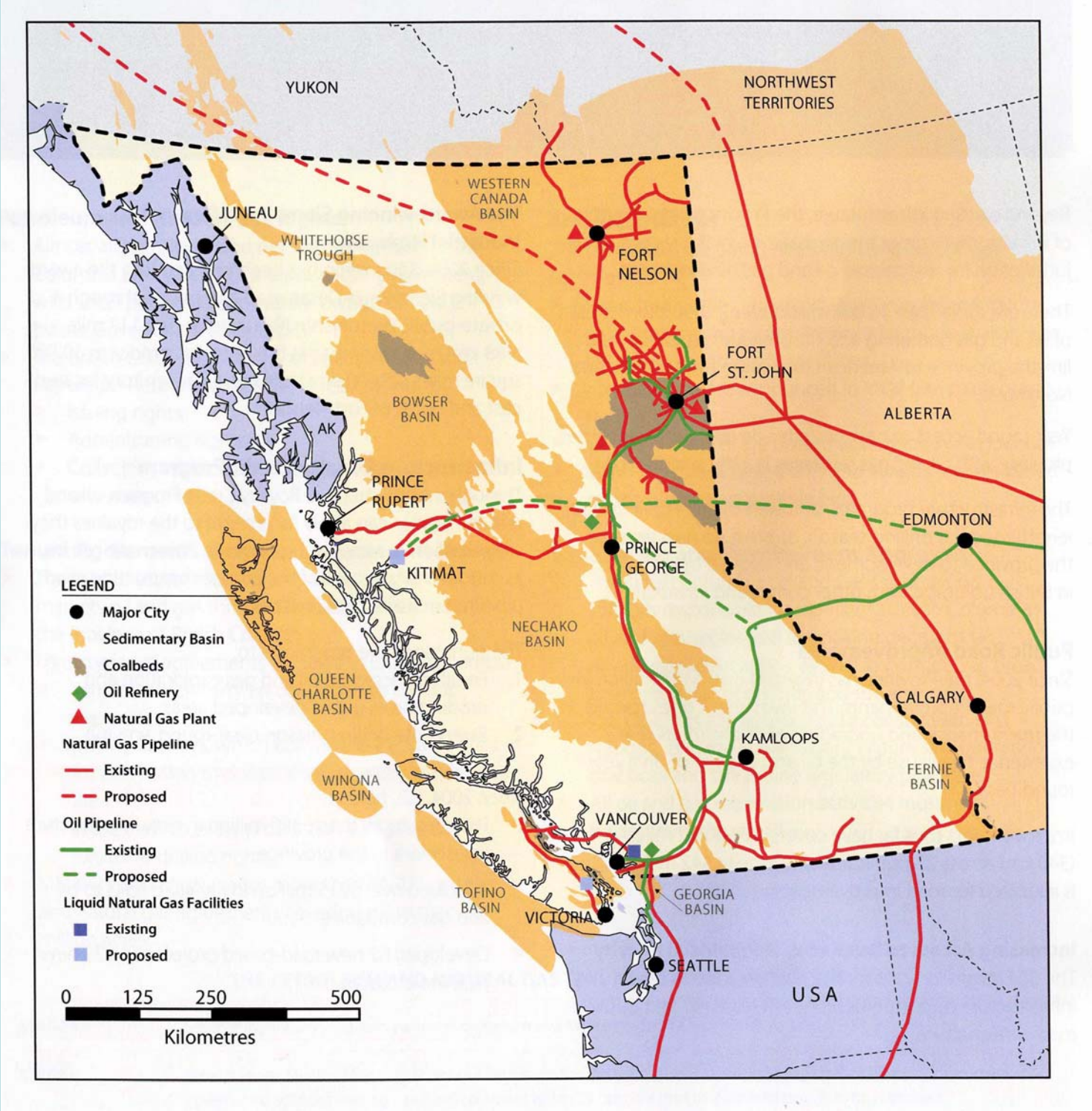


British Columbia (**BC**) has a number of sedimentary basins.

All of them have been explored to varying degrees

Only the northeast produces oil and gas

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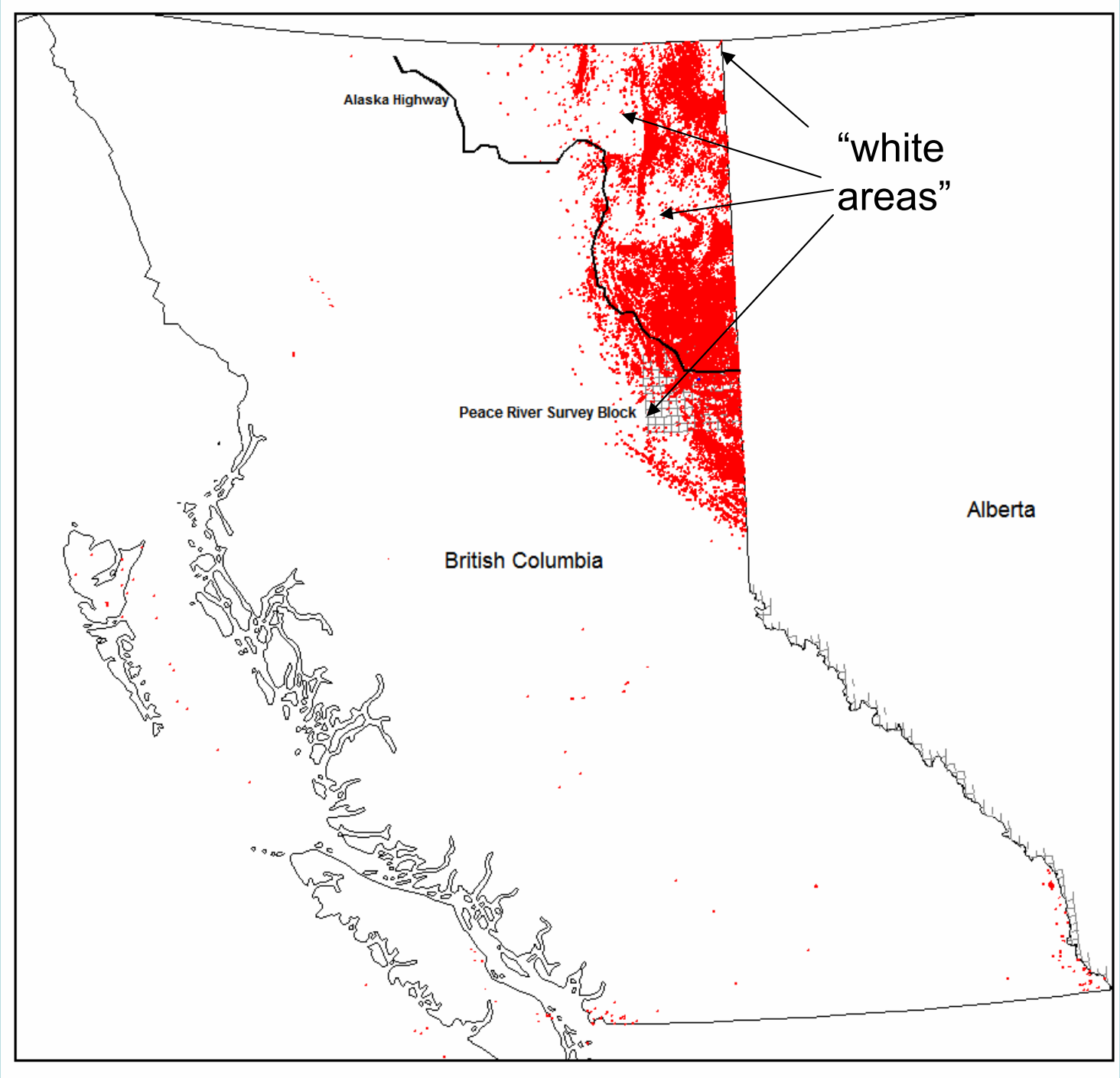


Current Well Density

Approximately 25,000 wells

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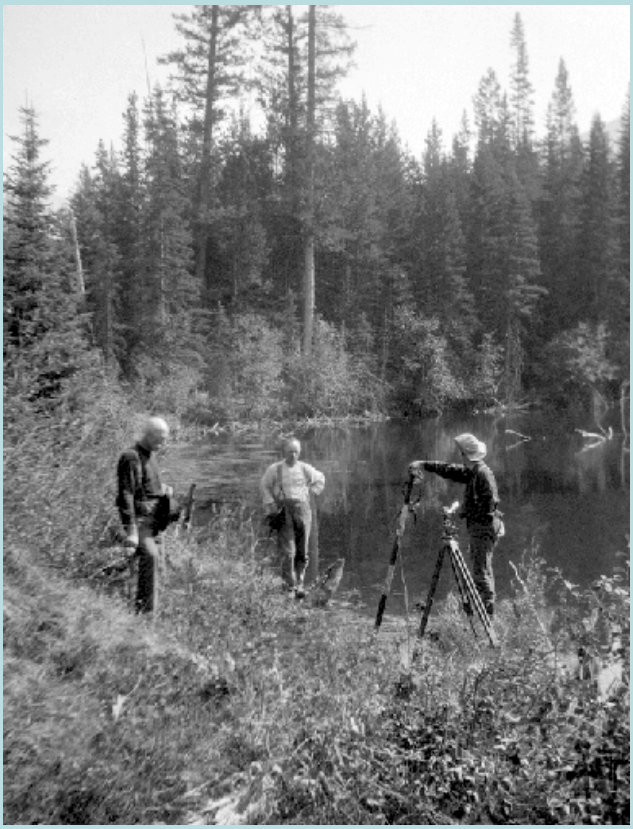
# The Early Days in BC

Oil spring, East Kootenay, ca 1904



**First there were seeps…**

Oil seeps were reported in 1874 near the Alberta-British Columbia border (then the Northwest Territories) in the Flathead Valley

Oil seeps noted by Dominion Geological Survey in 1875 in Peace River country

While drilling for coal the CPR hit gas shows in the Fraser Valley in the 1880's

Oil and tar seeps were reported in the 1870's and 1880's on Graham Island in the Queen Charlottes

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Oil rig, Chilliwack, 1909

Courtesy Royal BC Museum Archives

# Then there was drilling …

First documented well in the southeast near Waterton Park was drilled in 1909; non-commercial quantities of oil found

In 1904 a gas well near Steveston in the Fraser valley was used to light the streets

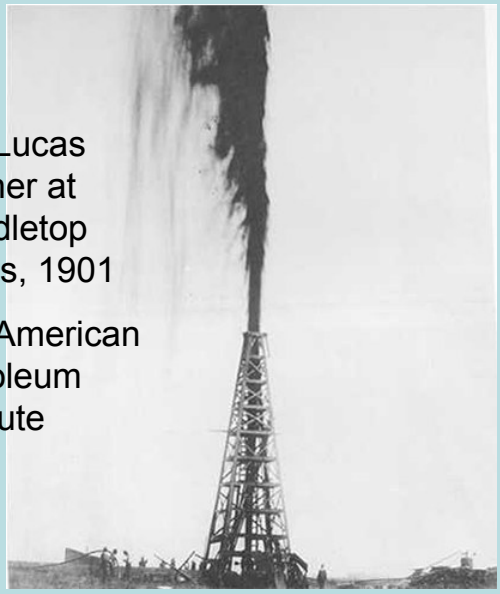
A hospital near Delta used gas at this time

Several wells were drilled on Graham island between 1911 and 1915

# Before 1920 World and BC

Tank (mechanized warfare)
World War I
http://history1900s.about.com/library/photos/blywwi6.htm

Oil truck, Vancouver, 1919 Courtesy Royal BC Museum Archives

The Lucas Gusher at Spindletop Texas, 1901

The American Petroleum Institute

**1901:** Texas was ushered in as a major oil producer with The "Spindletop Gusher". Its prodigious productivity sparked a world-wide frenzy in oil exploration

**1906:** The first wells in **British Columbia** were drilled in the Fraser Delta on what were thought to be oil seeps and a reported gas blow from a diamond-drill hole.

**1909:** Oil was discovered in Persia, now known as Iran.

**1914-1918:** Oil became a strategically important commodity with the highly mechanized armies deployed during World War I.


**Wells drilled before 1920**

2 wells

# 1920 – 1940

# World and BC

Farmer and two sons during a dust storm, Cimarron County, Oklahoma, 1936

http://en.wikipedia.org/wiki/Dirty_Thirties

**1920:** Imperial Oil discovered oil at Norman Wells, NWT, at the location noted by Alexander Mackenzie.

**1921-1922:** Several test holes were drilled in the Peace River district of British Columbia based upon structures observed from surface mapping and reported oil seeps

Adolf Hitler, behind Hermann Göring, at a Nazi rally in Nuremberg in 1928

http://en.wikipedia.org/wiki/Adolf_hitler

**1927:** Conrad and Marcel Schlumberger recorded the first electrical resistivity well log in Pechelbronn, France.

**Ca. 1930's:** Vast oilfields were discovered in the Middle-East giving it great strategic and geo-political importance.

# 1920 – 1940

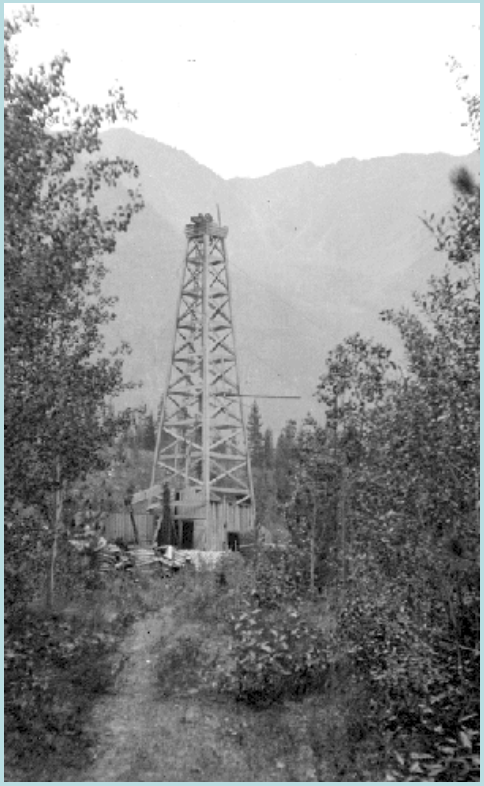
# BC

Drill rig on Peace River, ca. 1921 Courtesy Royal BC Museum Archives

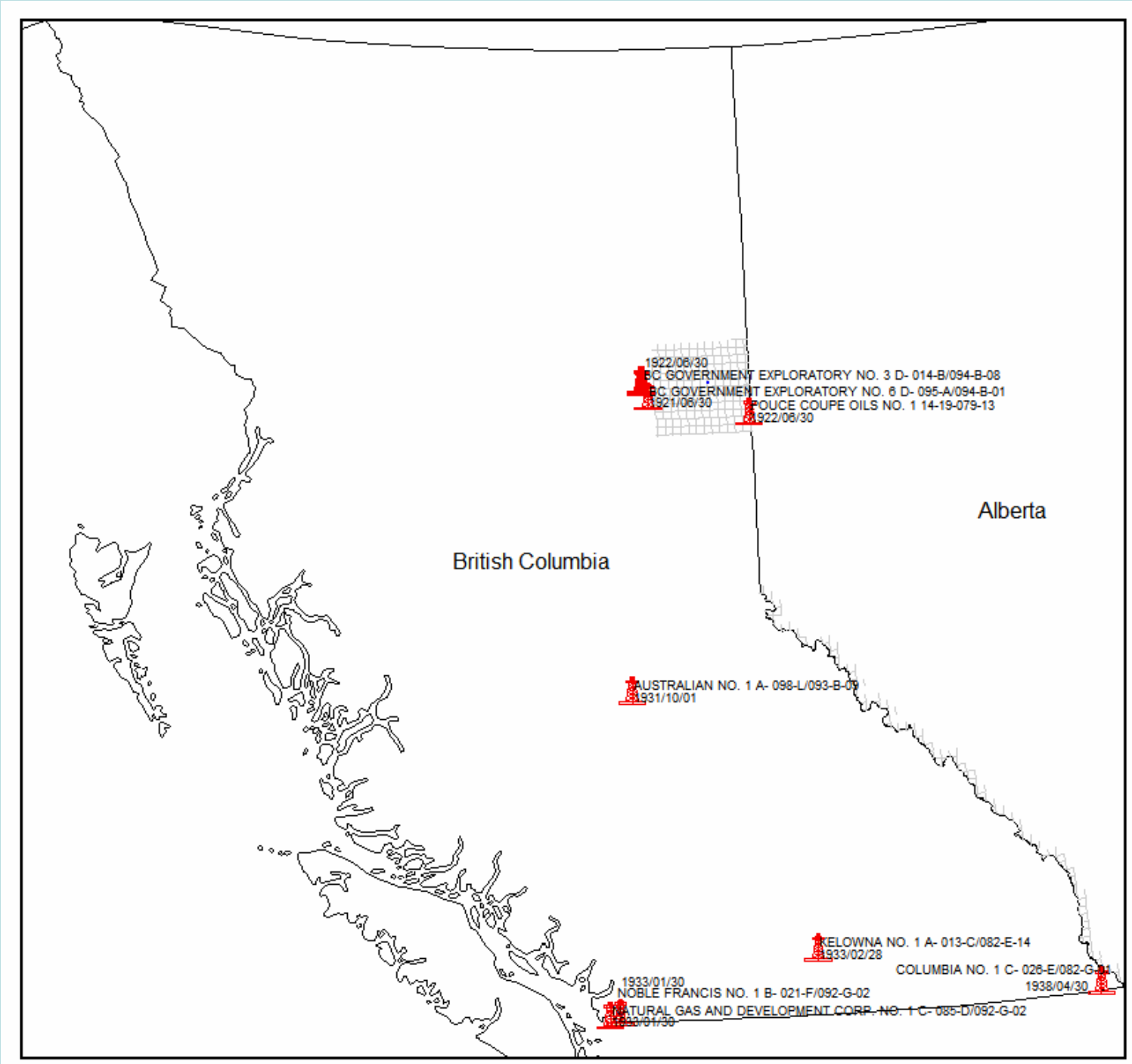
Several test holes were drilled by the BC government in the Peace River country on sites near seeps and promising surface mapping

In the early 1930's BC government placed all Peace River lands under reserve to discourage takeover by American interests.

As war approached in the late 1930's lands were re-opened



Glacier Oil drilling rig, 1930 Courtesy Royal BC Museum Archives




# Wells drilled 1920-1940

12 wells

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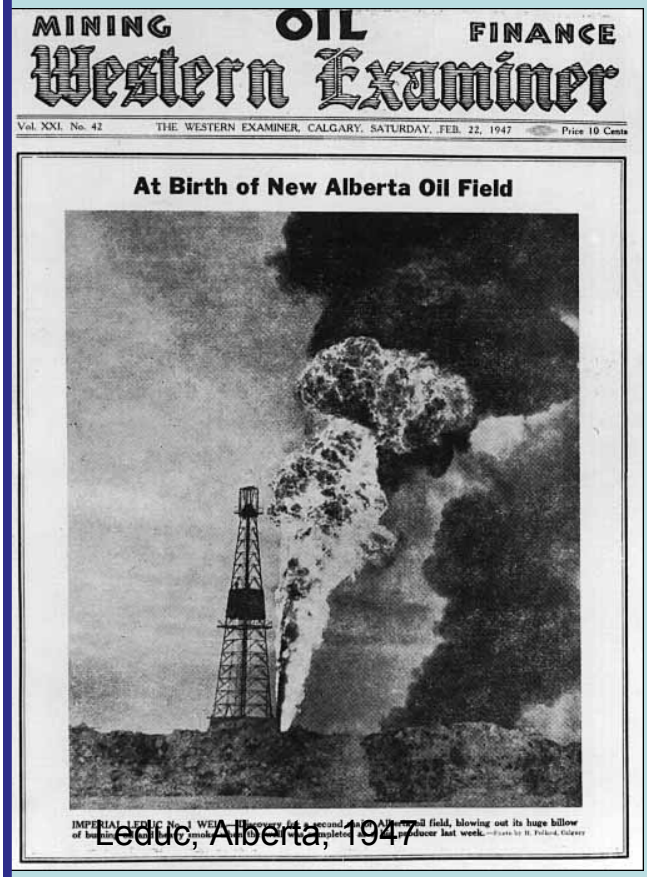
Soviet troops in winter (mechanized and non-mechanized warfare)

http://en.wikipedia.org/wiki/World_War_II

Tank burning in Libyan desert near Tobruk, 1941

http://en.wikipedia.org/wiki/Operation_Crusader

# 1940 – 1950
# World and BC



MINING OIL FINANCE

Western Examiner

Vol. XXI. No. 42 THE WESTERN EXAMINER, CALGARY, SATURDAY, FEB. 22, 1947 Price 10 Cents

**At Birth of New Alberta Oil Field**

Leduc, Alberta, 1947

**1942:** Adolf Hitler's plans to take the Russian oilfields in the Caucasus were thwarted on the battlefields of Stalingrad.

**1943:** Oil began to flow from Norman Wells to Whitehorse in the CANOL pipeline.

**Ca. 1947:** The first seismic surveys were conducted in the Aquitaine Basin of France.

**1947:** Imperial Oil discovered oil at Leduc #1 near Edmonton.

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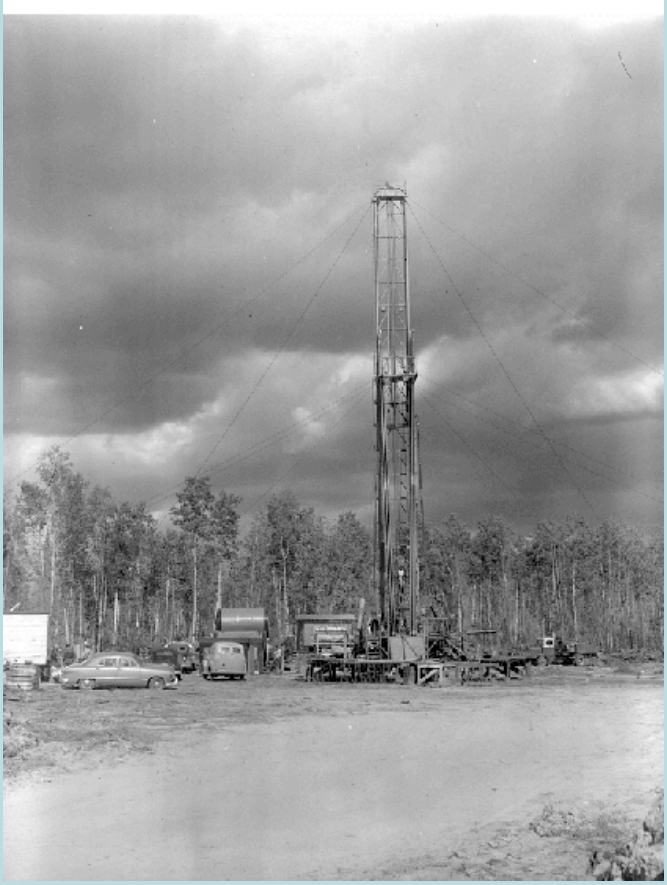
# 1940 – 1950

# BC

Drill rig, Alaska Highway, mile 25, 1950
Courtesy Royal BC Museum Archives



As part of the war effort a well was drilled by the BC government near Pine Pass along an existing road from East Pine to Dawson Creek

In 1947 the Petroleum and Natural Gas Act came into effect.

Building the Alaska Highway, 1942
http://en.wikipedia.org/wiki/Image:Alcan_construction.jpg

Much of the Alaska Highway - built as a war-time supply line - passes through BC

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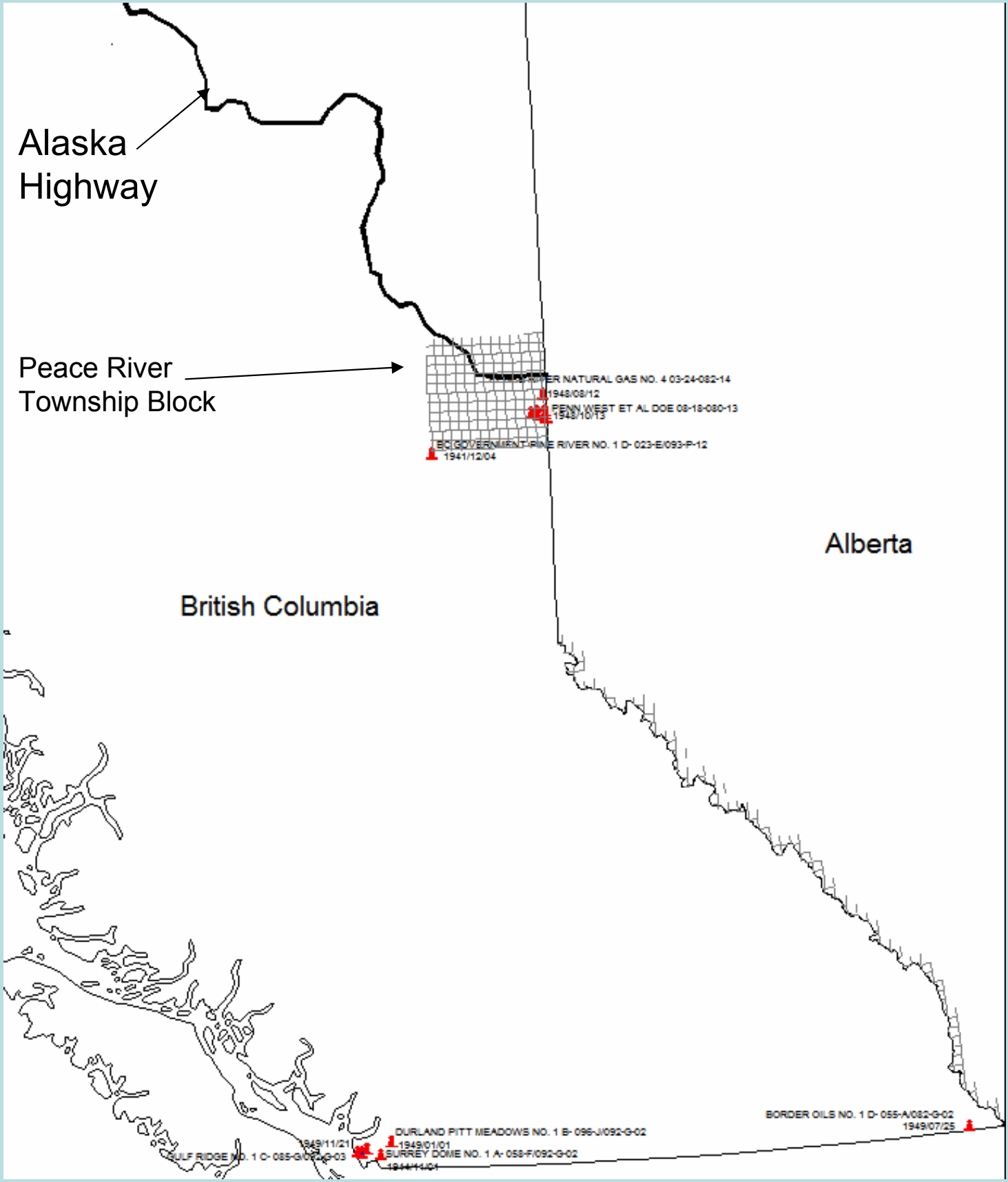


**Wells drilled 1940-1950**

15 wells

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# 1950 – 1960

# World and BC


USSR postage stamp depicting Sputnik 1. The caption reads: "The world's first Soviet artificial satellite of the Earth".

http://en.wikipedia.org/wiki/Sputnik

**1953:** Oil supply problems during the Korean War led to the development the Trans-Mountain pipeline from Edmonton to Vancouver and Seattle.

**1955:** The first MacDonald's opened.

**1955: The first commercial oil well in British Columbia was completed at Boundary Lake**.

**1956:** President Nasser of Egypt expropriated the Suez Canal thereby threatening supplies of oil to Europe.

**1957:** A pipeline was built from the **Peace River** area of **British Columbia** and Alberta.

**1959:** Several major sources of oil came into the market causing a softening of oil prices.

# 1950 – 1960

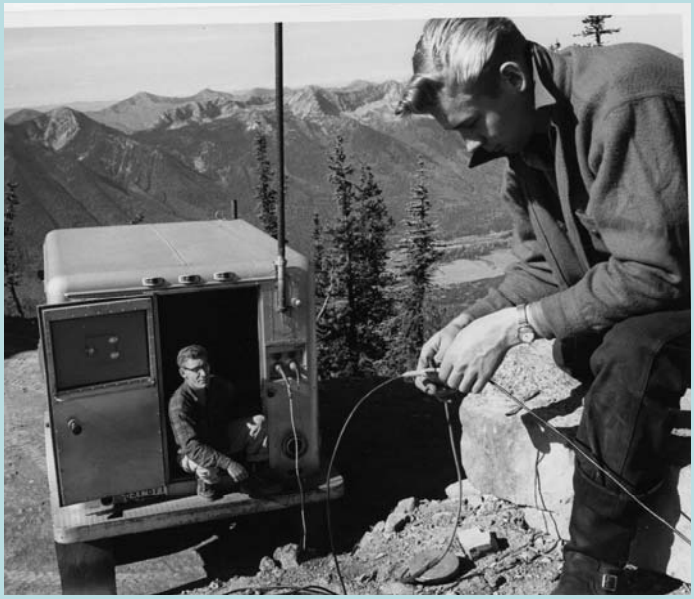
## BC

Shell Canada geologists at work, ca. 1960

Many fields discovered in proximity to Alaska Highway

The first gas field began production in 1952 near Pouce Coupe

The first oil well began production in 1955 at Boundary Lake



Laying seismic line near Fernie, BC, ca. 1960

Fort St John #4 14-21-83-18W6M Photo by George L. McMahon
Spud Jan 18/52, rr **July 16/52** Belloy gas well TD 6908', Belloy 6202'
The well was "blown off" on the occasion of the Queen's visit to Ft St John

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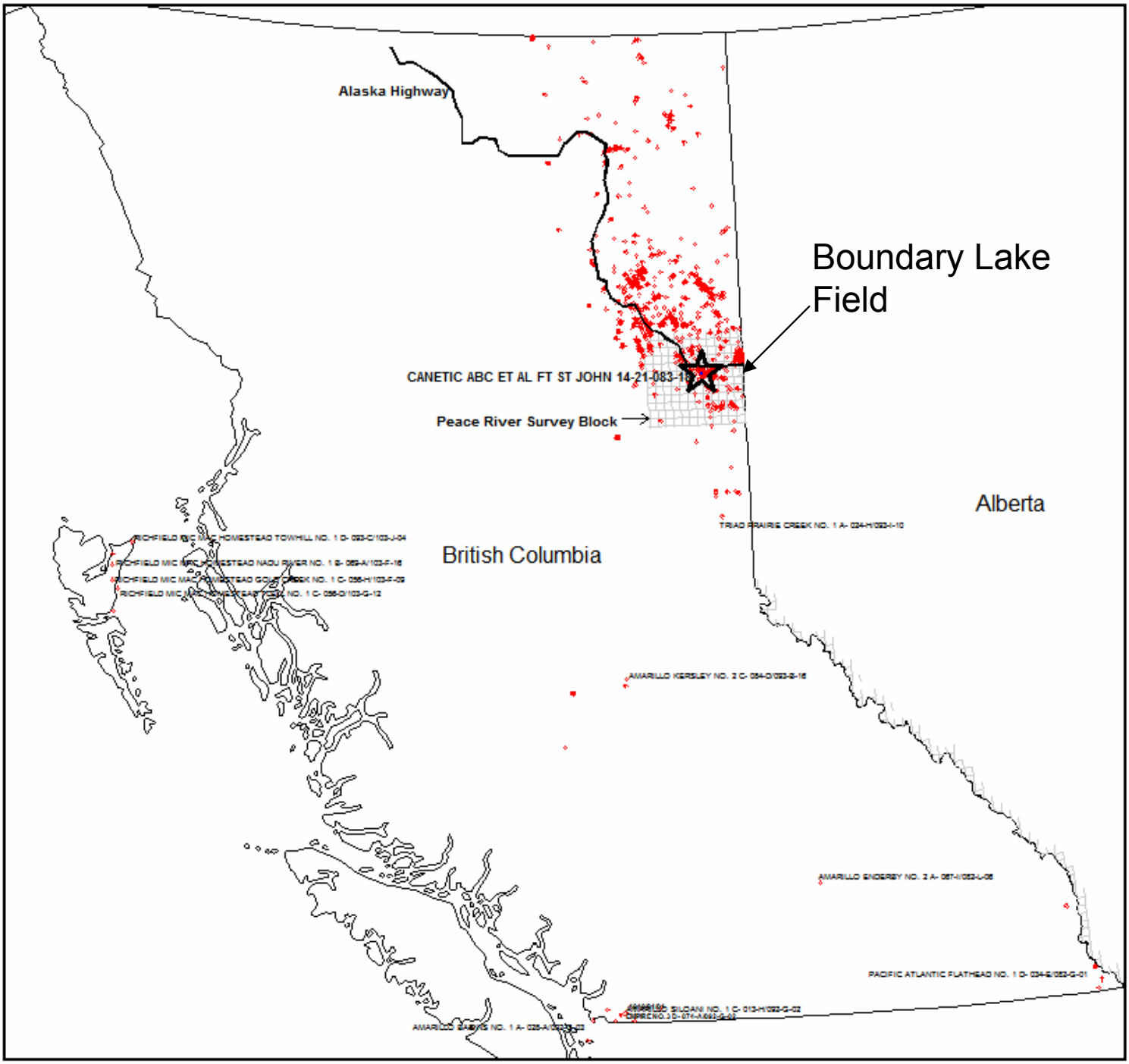


# Wells Drilled 1950-1960

651 wells

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# 1960 -1970 World and BC


Moammar Gaddaffi shortly after the Sept 1/69 revolution in Libya
http://news.bbc.co.uk/onthisday

Castro and Khrushchev, ca 1962
http://en.wikipedia.org/wiki/Fidel_Castro

**1960:** OPEC (Organization of Petroleum Exporting Countries) was formed.

**1960:** Western Canadian oil producers sought market protection from the federal government.

**1965:** Substantial oil discoveries were made in Devonian reefs of Rainbow Lake. Exploration intensified along the Devonian barrier **reef trend extending into NEBC.**

**1968:** Prudhoe Bay, Alaska led to the construction of the Alaska Pipeline and an intensification of exploration in Canada's Beaufort Sea and Mackenzie Delta.

Neil Armstrong works at the LM in one of the few photos taken of him from the lunar surface. NASA photo as 11-40-5886.

# 1960 -1970 BC

The deepest well in Canada was drilled to a depth of 16,540' in the Crowsnest Pass area of southeastern British Columbia in 1960.

A facility dedicated to the storage and viewing of drill cores cut in British Columbia was opened in 1960 at Charlie Lake.

The first wells were drilled in the "deformed belt' near the BC / NWT border

Offshore drilling rig in Victoria's harbour awaiting deployment on the west coast, 1966 Royal BC Museum Archives I-31974

Trans Mountain right-of-way. Preparing for the weld on a valve installation. Ca. 1969 Photo Credit: Trans Mountain Oil Pipe Line Co

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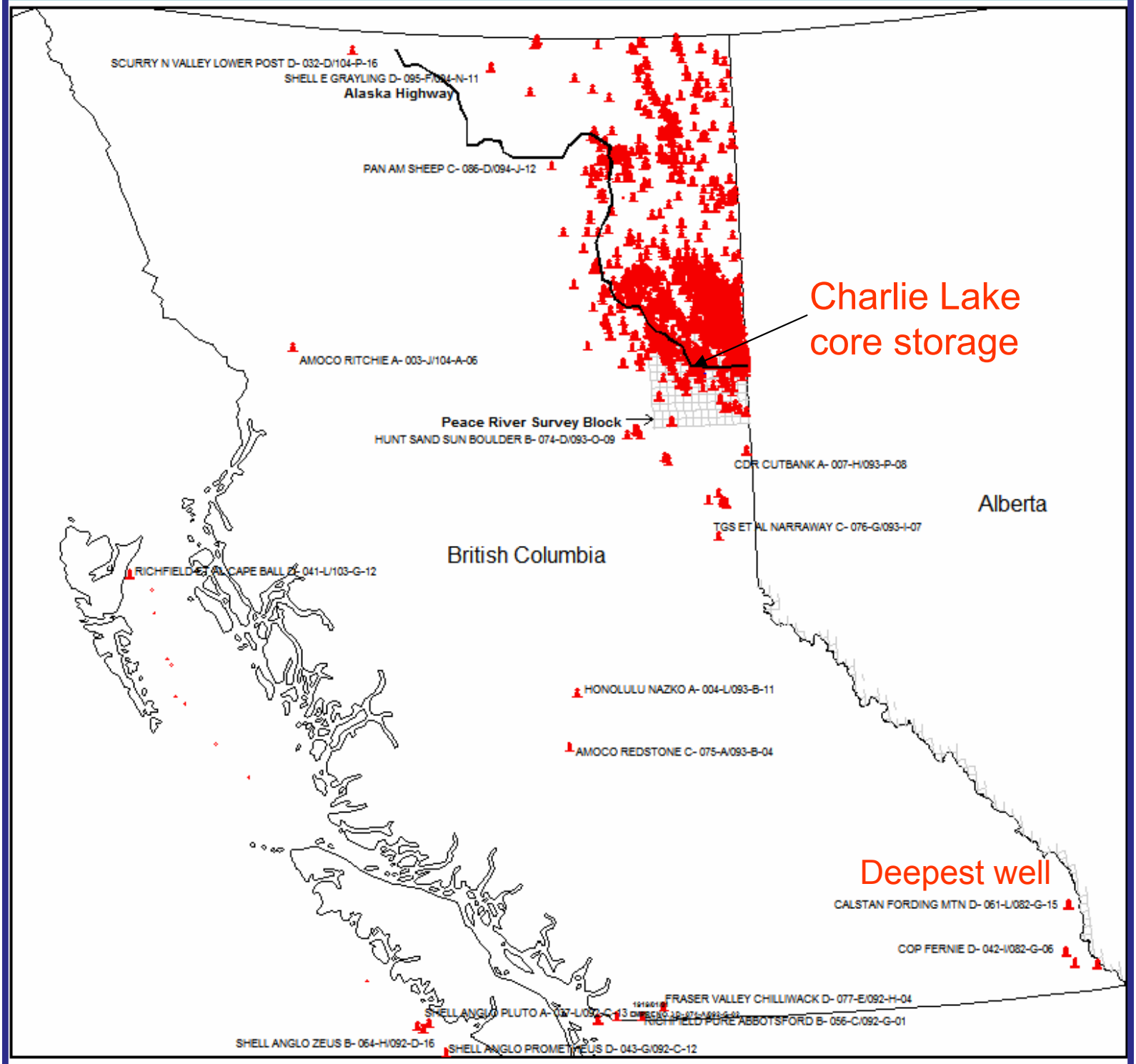


# Wells Drilled 1960-1970

2409 wells

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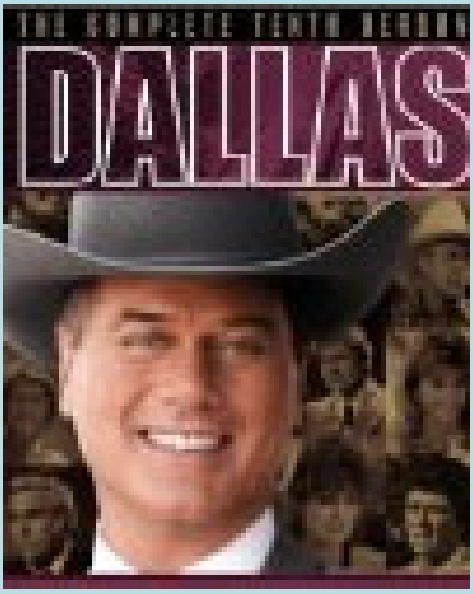
# 1970 – 1980 World and BC

*Conclusion of a war: A North Vietnamese Army T-54 tank breaking into the grounds of the Presidential Palace, April30, 1975.* http://en.wikipedia.org/wiki/Vietnam_War




Return to Iran from exile of Ayatollah Khomeini on February 1, 1979
http://en.wikipedia.org/wiki/Ayatollah_Khomeini

**1970:** Imperial Oil made a large oil discovery at Atkinson Point in the Mackenzie Delta.
**1972:** Moratorium imposed on offshore BC
**1973:** A sharp rise in oil prices followed the Yom Kippur War.
**1973-1975:** Activity in NEBC declined due to the drop in gas prices.
**1975:** Activity jumped in NEBC and the rest of western Canada with a rise in gas prices. The boom of the late 1970's began.
**1979:** The price of oil reached the highest level up to that time in constant dollars in December ($100.28 US in January 2007 dollars).
**1980:** The Canadian Federal government imposed the National Energy Program.

# 1970 – 1980 BC

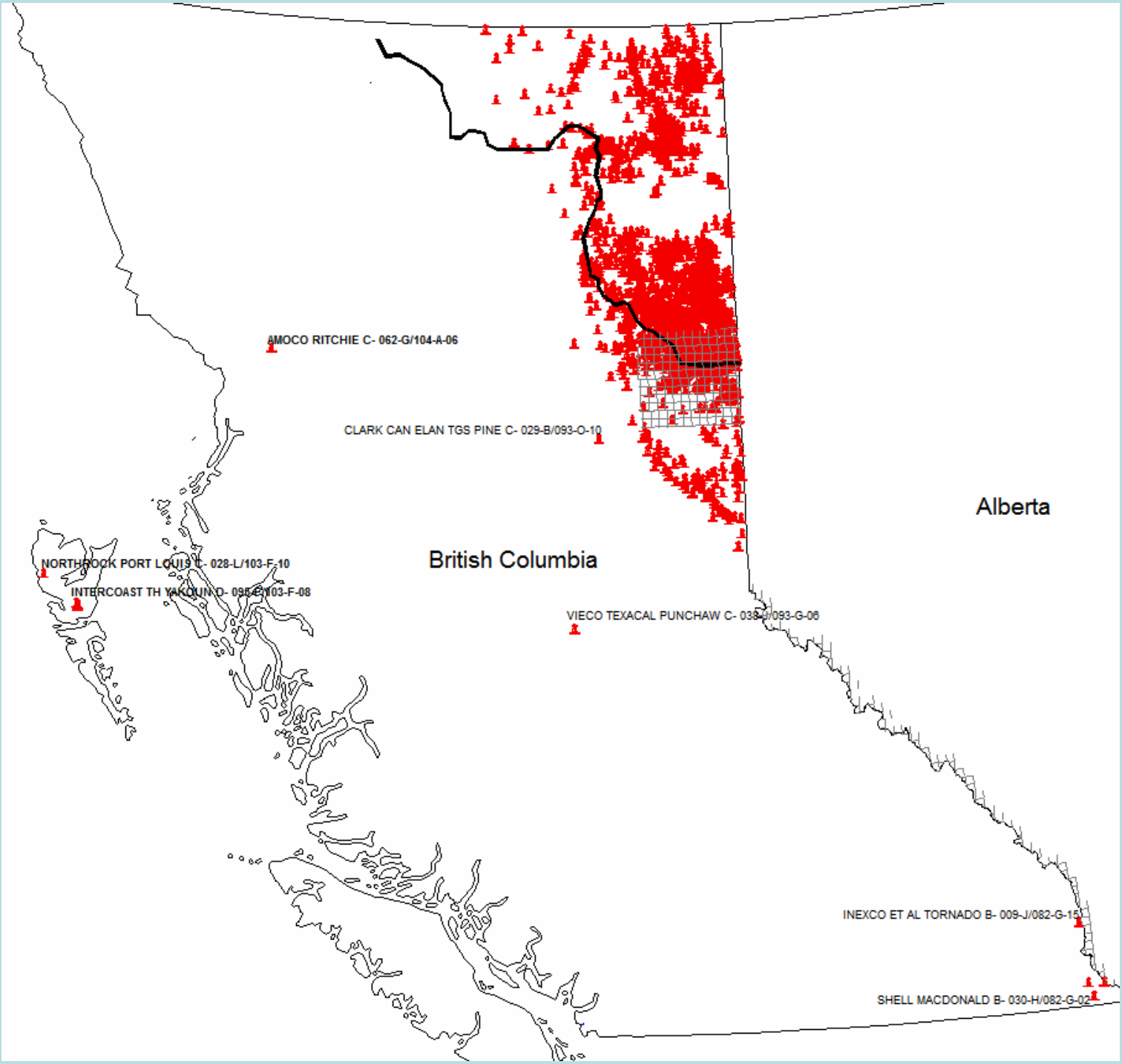
The pace of new discoveries in BC began to slow

Many wells were drilled for shallow gas in the north-easternmost part of BC

Activity fluctuated by alternating high and low prices combined with tensions between the provincial and federal government

President Jimmy Carter, ca. 1977

Prime Minister Pierre Elliot Trudeau, ca. 1980




# Wells Drilled 1970 – 1980

2979 wells

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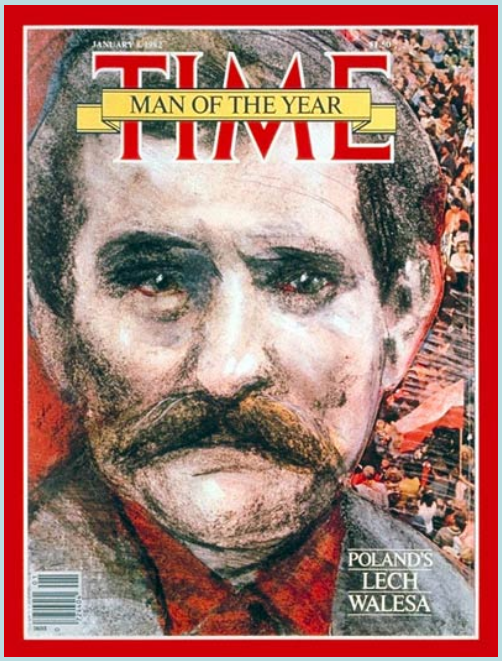
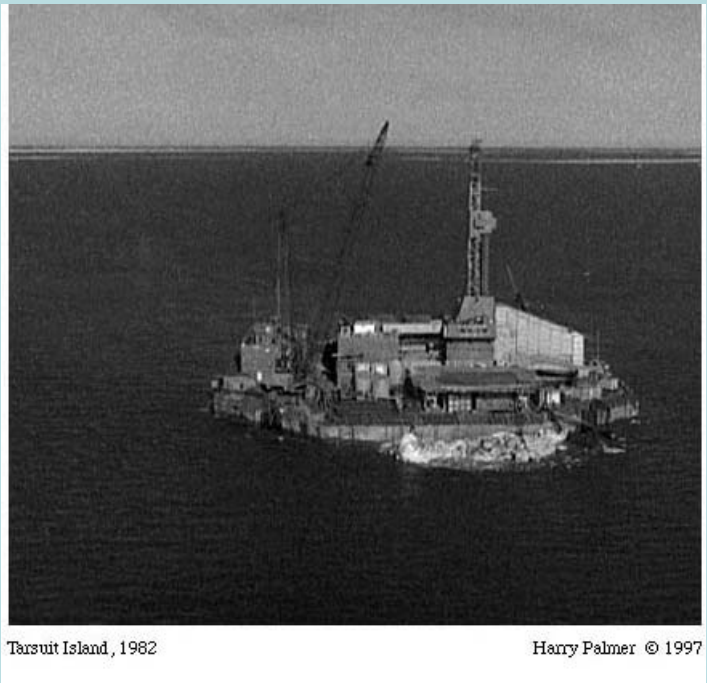
# 1980 – 1990 World and BC




1982

Ronald Reagan speaking at Berlin Wall, 1987



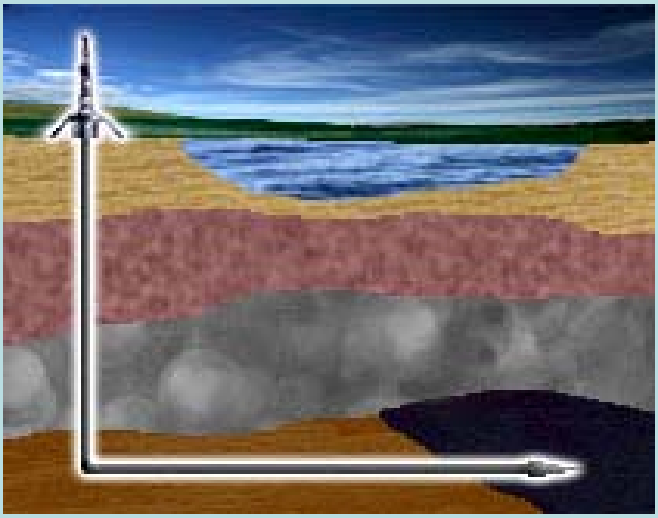

Drill rig on artificial island, Beaufort Sea, 1982
http://www.harrypalmergallery.ab.ca/galarctdrill/tarsuit.html

**1982:** Oil prices began a steady drop

**1986:** A dramatic drop in world oil prices to the levels found prior to the first energy crisis led to re-evaluations of exploration projects, company amalgamations, layoffs and a general drastic cut-back in activity.

**Ca. 1988:** Horizontal drilling technology opened up new possibilities for exploiting tight, but continuous formations.

# 1980 – 1990 BC

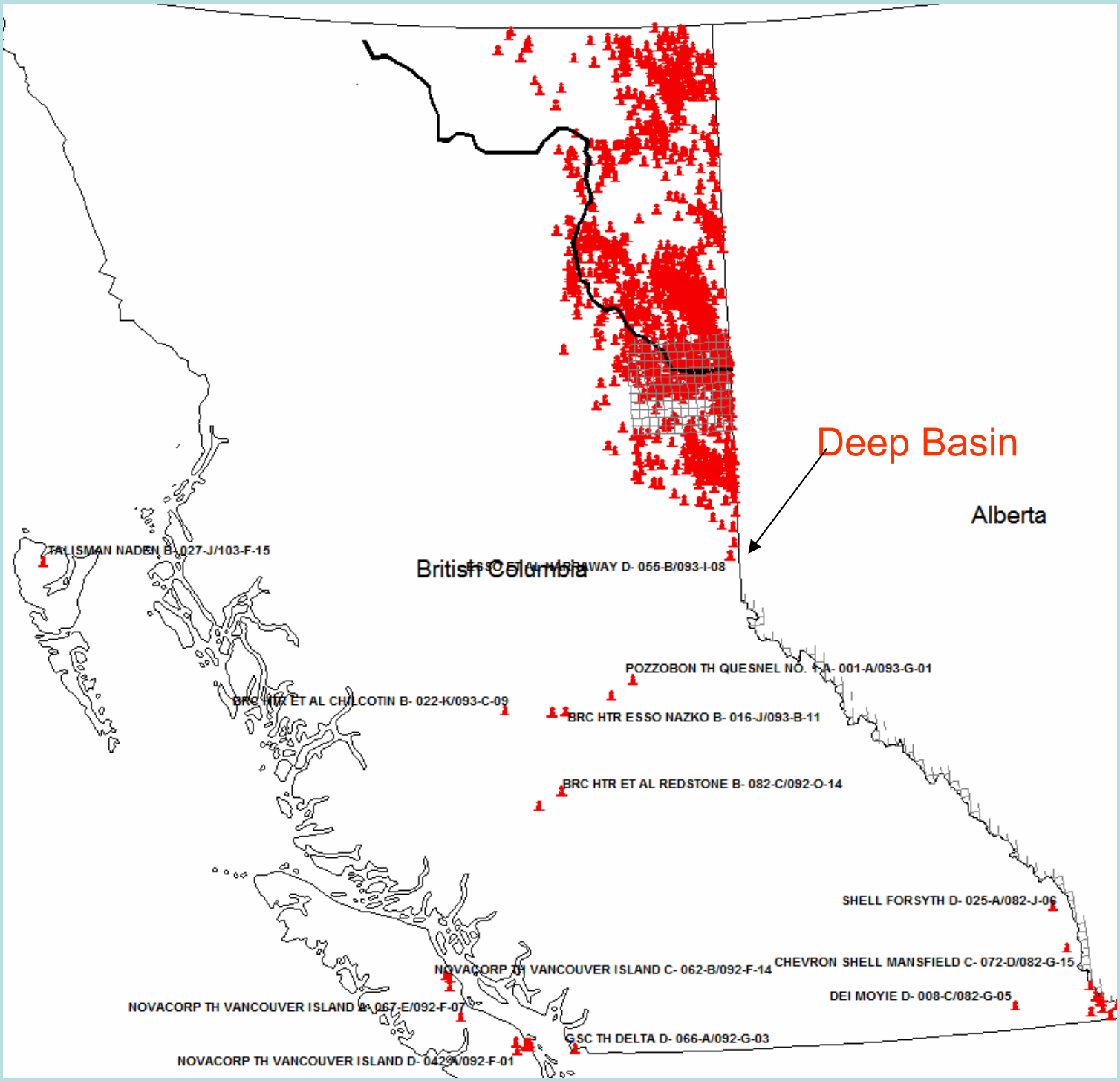


Horizontal drilling, a sophisticated technology that has become commonplace in the new century

Drilling activity in BC dropped due to volatile oil prices

Many BC gas wells were shut-in due to low gas prices

The “Deep Basin” was one part of BC that did not suffer




# Wells Drilled 1980 – 1990

2498 wells

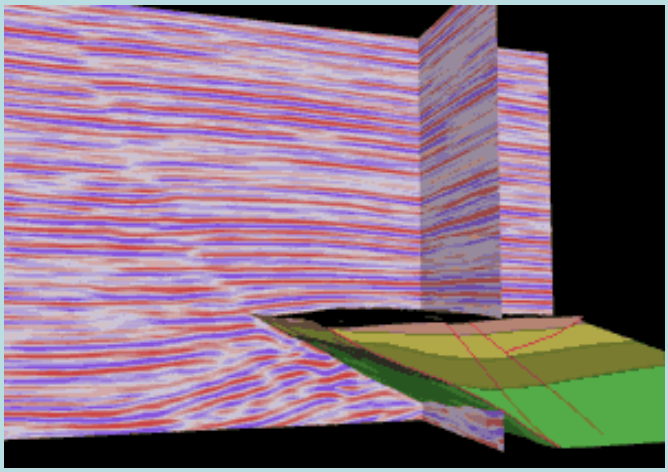
BRITISH COLUMBIA

Ministry of Energy, Mines and Petroleum Resources

# 1990 – 2000 World

صدام حسين المجيد التكريتي

Saddam Hussein



3D seismic transformed petroleum exploitation
http://www.dgi.com/support/articles/3D_Seismic_Display.shtml

**1990:** A brief spike in oil prices occurred with the invasion of Kuwait by Iraq.

**Ca. 1995:** Asian economies went into a recession, which caused oil prices to fall to their lowest level ever, in constant dollars, around 1998. Another round of consolidations and layoffs ensued.

**1998:** Oil prices reached their nadir in adjusted dollar value and began their long climb up as OPEC instituted cuts in production, Asian economies recovered and industrial production grew in China.

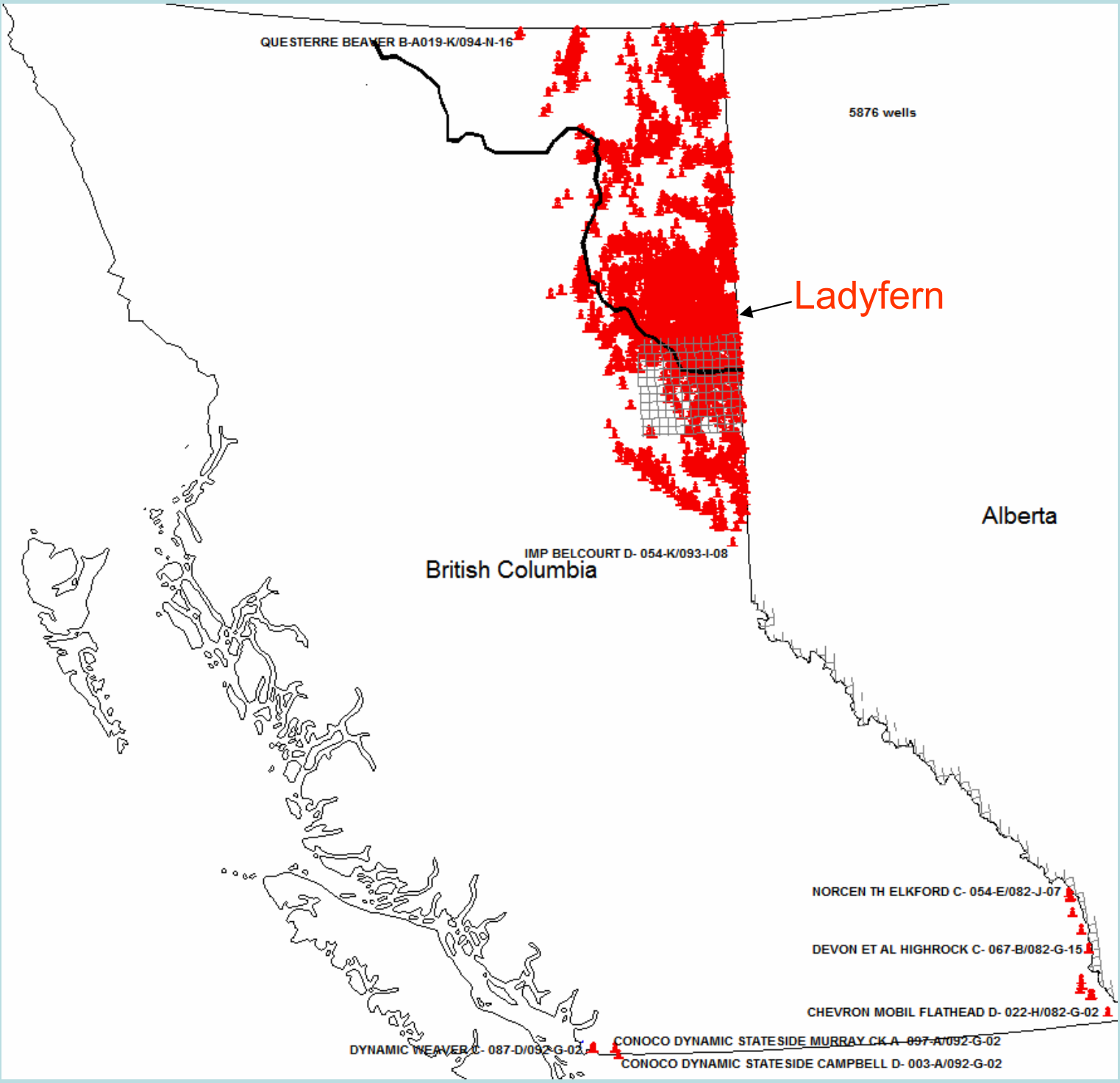
# 1990 – 2000 BC

Hydrothermal dolomite from the Pine Point mine, NWT
http://gsc.nrcan.gc.ca/mindep/photolib/mvt/pine/index_e.php

2000: The discovery of gas in hydrothermal dolomites in a remote part of BC – Ladyfern – leads to a mini-boom in exploration.

Emphasis was placed on oil rather than gas exploration

Many new fields were brought on-stream – most were close to existing producers




# Wells Drilled 1990 – 2000

5876 wells

BRITISH COLUMBIA

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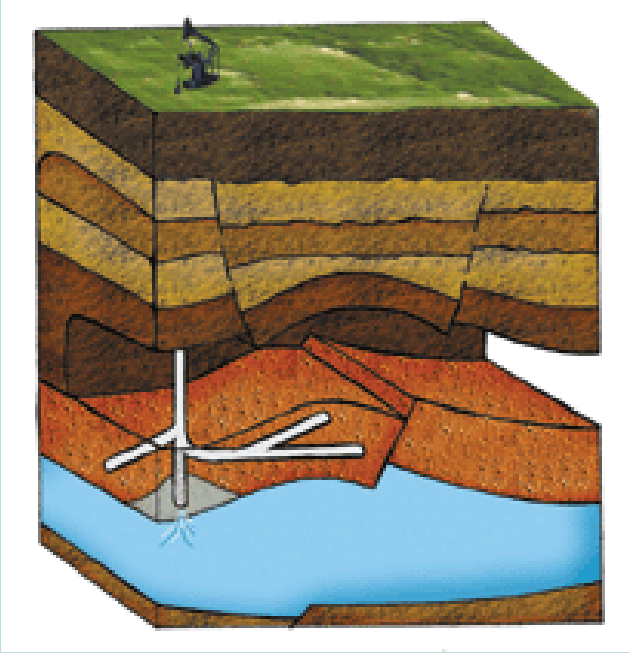
# 2000 – 2008 World

Calgary at the height of the first oil boom of the 21st century Courtesy of Calgary Downtown Association http://www.downtowncalgary.com/

**2001:** The suicide bombings of the World Trade Centre and Pentagon raised the profile for North American energy security ever higher. Increased investment flowed in BC and western Canada.

**2007:** Tightening supplies due to increasing demand combined with continuing tensions in the Middle East led to an oil price of almost $100/ barrel – close to the adjusted record set in 1979.

# 2000 – 2008 BC



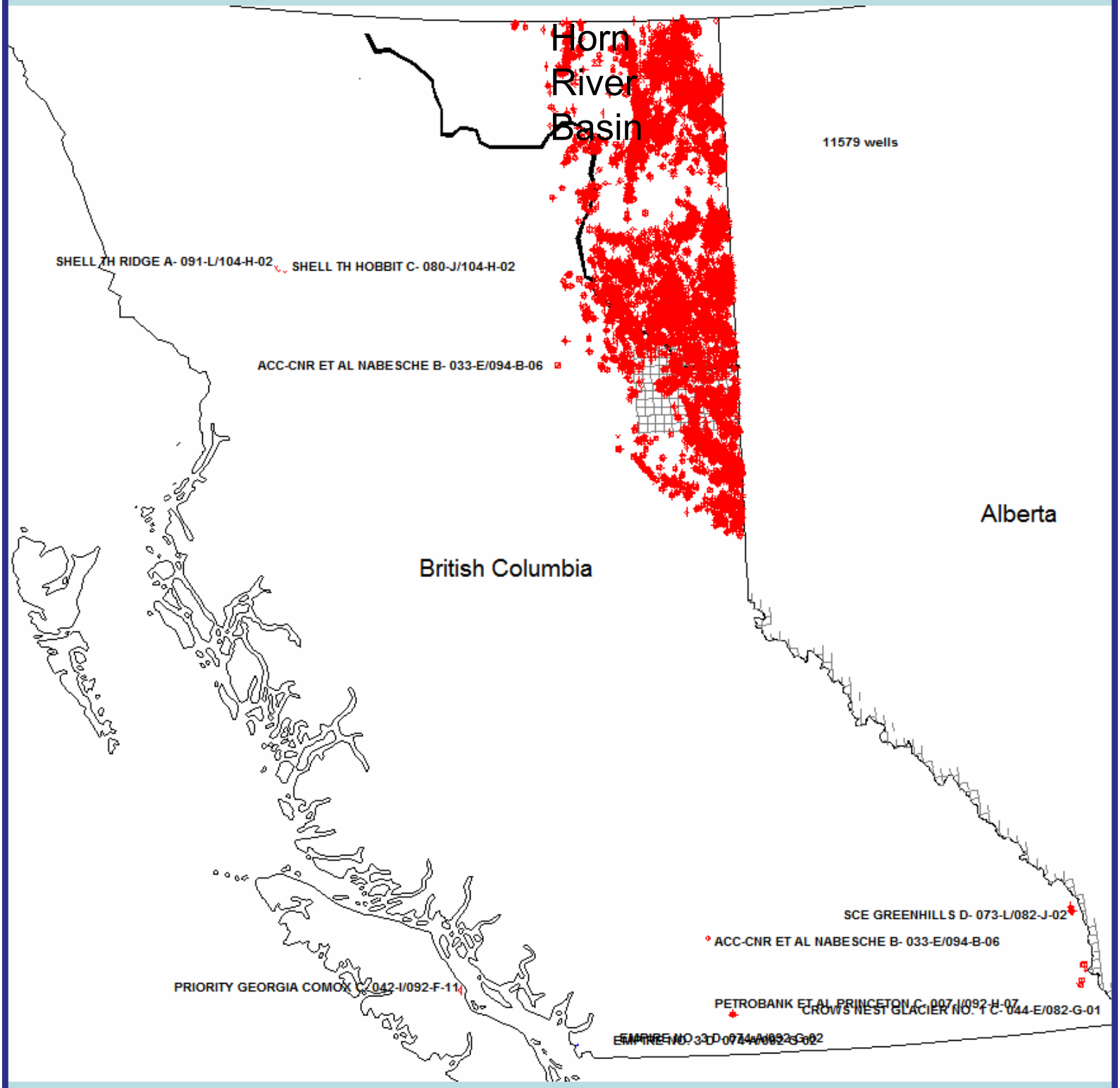
http://horizontaldrilling.org/

Gordon Campbell, current Premier of BC

**2007:** British Columbia set a new annual record for money raised in disposition of mineral rights. This is mainly due to new interest in shale gas in shale basins in the northernmost regions of the province. "Resource Plays" attract increasing attention in BC, Alberta and the western U.S. as conventional reserves run down and prove more difficult to replace.

**2008:** Interest in BC potential increases due to changes in royalty regimes on production in neighbouring Alberta. Bids on shale gas lands skyrocket.

**2008 - ?** Years of over-optimistic financial practices catches up with the world economy. Oil plummets from a high of $145 in July/08 to $31 in December. Exploration/development activity declines.




# Wells Drilled 2000 – 2007

11579 wells

BRITISH COLUMBIA

Ministry of
Energy, Mines and
Petroleum Resources

# SUMMARY OF BC PETROLEUM EXPLORATION

Petroleum exploration dates back to the early 1900's in the lower mainland

The first real discoveries were in the Peace River area in the 1920's

Exploration began early in the interior basins and offshore but has not yet found economic reserves, except for coalbed methane in the southeast

The Alaska Highway and major discoveries elsewhere such as Leduc accelerated exploration in the northeast in the 1940s and 1950s

Most big fields in BC were discovered in the 1950s and 1960s

Price ups and downs, influenced by world and local politics and events have influenced well counts

New technologies have made unconventional plays, such as shale gas in the Horn River area, economic