

# **AV The Canol Oil Shale Play Central Mackenzie Valley, Northwest Territories, Canada: Geoscience, Operations and Social License\***

**John Hogg<sup>1</sup>**

Search and Discovery Article #110223 (2015)\*\*

Posted September 7, 2015

\*Adapted from presentation at the AAPG DPA Playmaker, Calgary, Alberta, March 31, 2015

\*\*Datapages©2015 Serial rights given by author. For all other rights contact author directly.

<sup>1</sup>President, Skybattle Resources Ltd., Calgary, Alberta ([jrhogg@shaw.ca](mailto:jrhogg@shaw.ca))

## **Abstract**

The June 2011 federal land sale within the Central Mackenzie Valley saw 11 parcels, totaling almost 900,000 ha (2.2 million acres) awarded to five companies for a combined work commitment in excess of \$534 million Canadian Dollars.

Two Middle Devonian-aged shale intervals within this basin, the Canol and Bluefish shales, show significant potential for shale oil resource development. Geochemical, petrographic, and sedimentologic analysis of the subsurface and outcrop, combined with regional seismic interpretation, have allowed for a comprehensive evaluation of the exploration potential of these shales and for comparison to other shale formations currently being produced.

New wells have drilled, cored, and tested the shale intervals, and a large amount of new 2D and 3D seismic data has been acquired. With encouragement from drilling and testing programs, these world-class shale formations may hold an exciting future for the Central Mackenzie Valley and Canadian First Nation's communities.

There are many challenges associated with drilling in the Canadian arctic, including a complex and cumbersome regulatory regime, lack of infrastructure, and ongoing consultation to ensure Social License. If the play is proved successful, ongoing communication between government, regulators, industry, communities, and Canadian First Nations is required for the life of the project.

### **Reference Cited**

Enachescu, M.E., P.R. Price, J.R. Hogg, F. Kierulf, M.F.J. Cooper, and A.C. Springer, 2013, Geological, geochemical and geophysical characteristics of the Devonian oil shales in Central Mackenzie Valley, NWT, Canada: Search and Discovery Article #10559 (2013). Website accessed August 28, 2015,  
[http://www.searchanddiscovery.com/documents/2013/10559enachescu/ndx\\_enachescu.pdf](http://www.searchanddiscovery.com/documents/2013/10559enachescu/ndx_enachescu.pdf).

# **The Canol Oil Shale Play Central Mackenzie Valley, Northwest Territories, Canada: Geoscience, Operations and Social License**



**John Hogg. P.Geo  
President,  
Skybattle Resources**

**Playmaker Calgary**

**March 31, 2015**



# Presentation

**Introduction**

**Location and History**

**Geology**

**Geochemistry**

**Geophysics**

**NWT Oil and Gas**

- *Land Tenure System*
- *Project Descriptions*

**Project Overview**

**Social License**

**Summary**

**Acknowledgements**

M.E. Enachescu  
P. Price, F. Kierulf, M. Cooper,  
A. Springer, MGM Energy Corp

# Play Location

**Arctic Circle, NWT**  
**Devonian Canol Formation shale**  
**Source rock for the**  
**Norman Wells oilfield**

Discovered in 1920

Depth top reef 320m

Oil Column > 300m

Canol Pipeline 1943-45

Developed in 1980's

320 MMbbls produced

Now ~12,000 bopd



**Norman Wells**

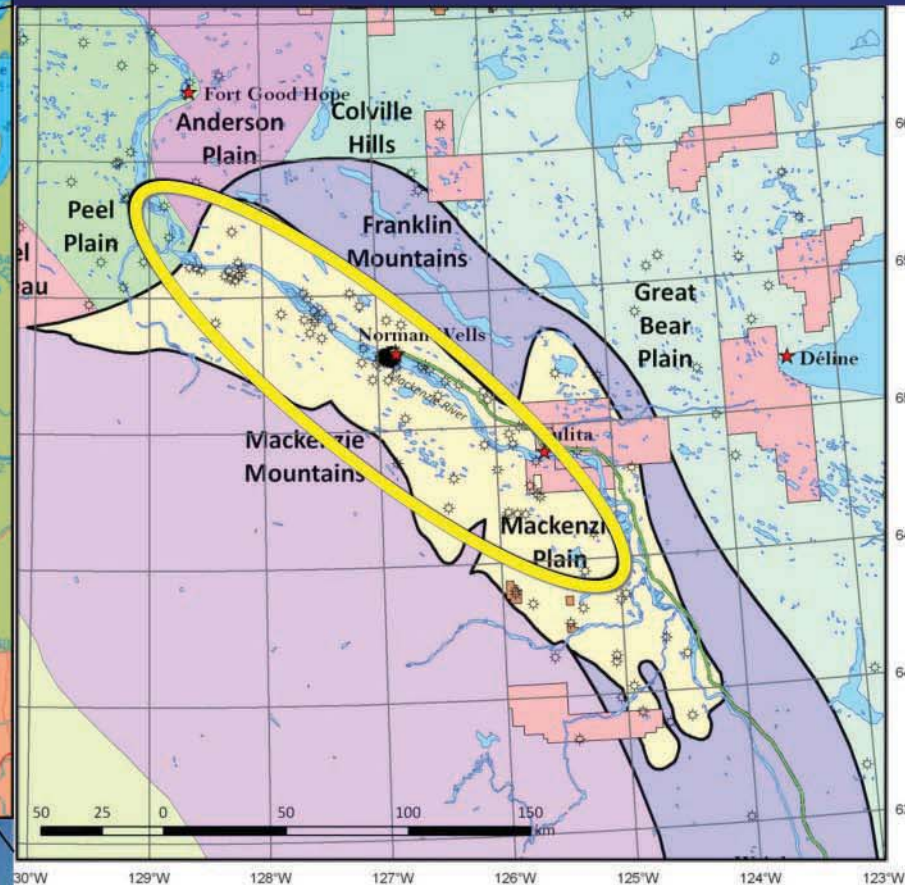


# Historic Petroleum Geology

- Conventional exploration failed to find additional reserves in reefs or structural plays after Norman Wells discovery in 1920
- 50+ wells over the course of 70 years looking for more conventional resources, with no new pools (*one Basin, one Discovery*)
- Since late 2000s focus on shale oil
  - Industry
  - Geological Survey of Canada
  - Northwest Territories Geoscience Office
- Stratigraphy is similar to lucrative Horn River play in NE British Columbia



# Northwest Territories Canol Shale Resource





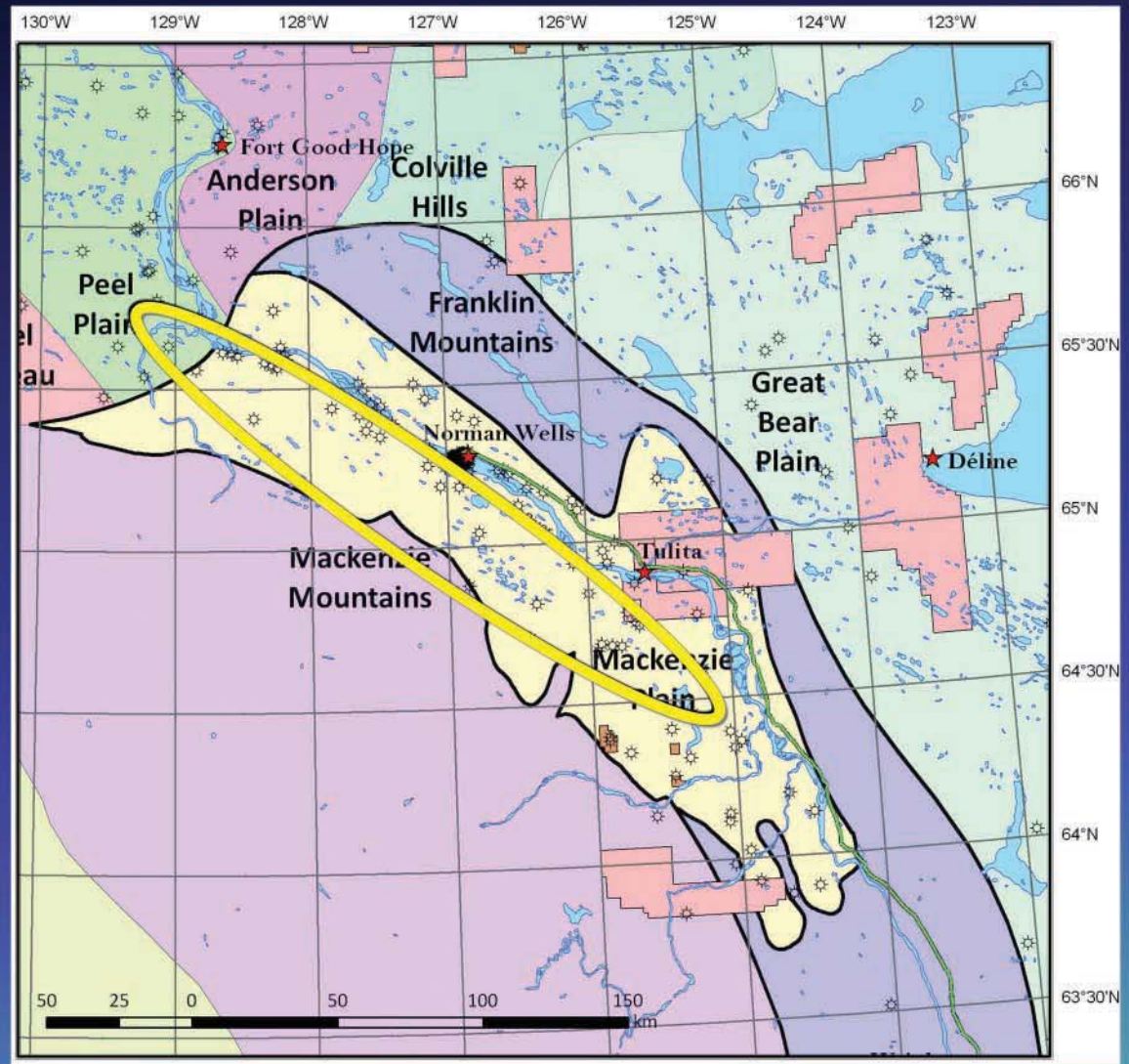
# Central Mackenzie Valley

Area of Canol Shale potential is the Yellow highlighted area

Potential Area ~70 km wide by 200 km long

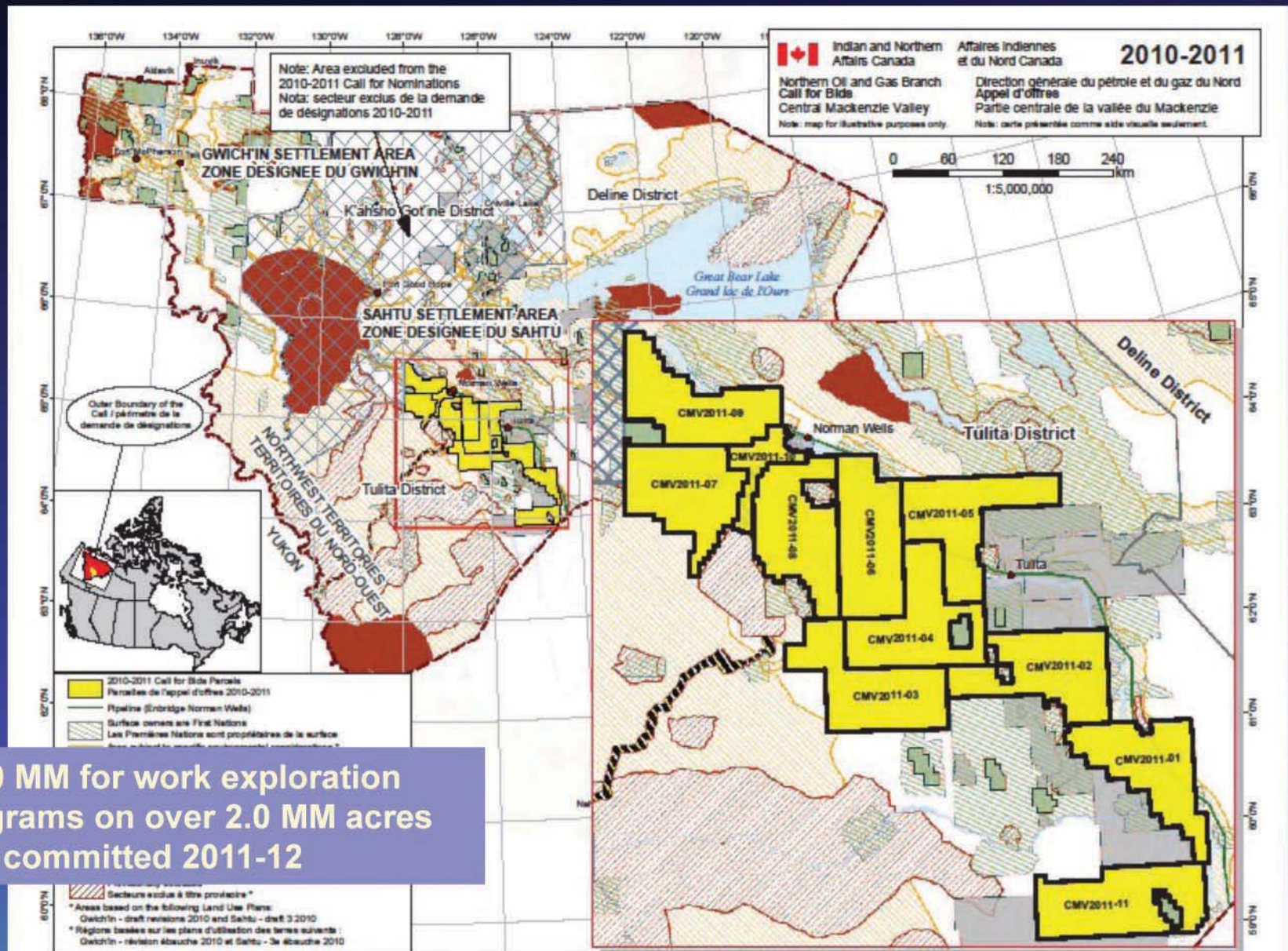
Shale exploration began in 2011

Data from forty-years of drilling through the zone was used in the shale resource assessment





# 2011 AANDC Landsale – Call for Bids





# The Land

**Oil Shale Basin**

**Mackenzie River**

**NWT Winter Road**

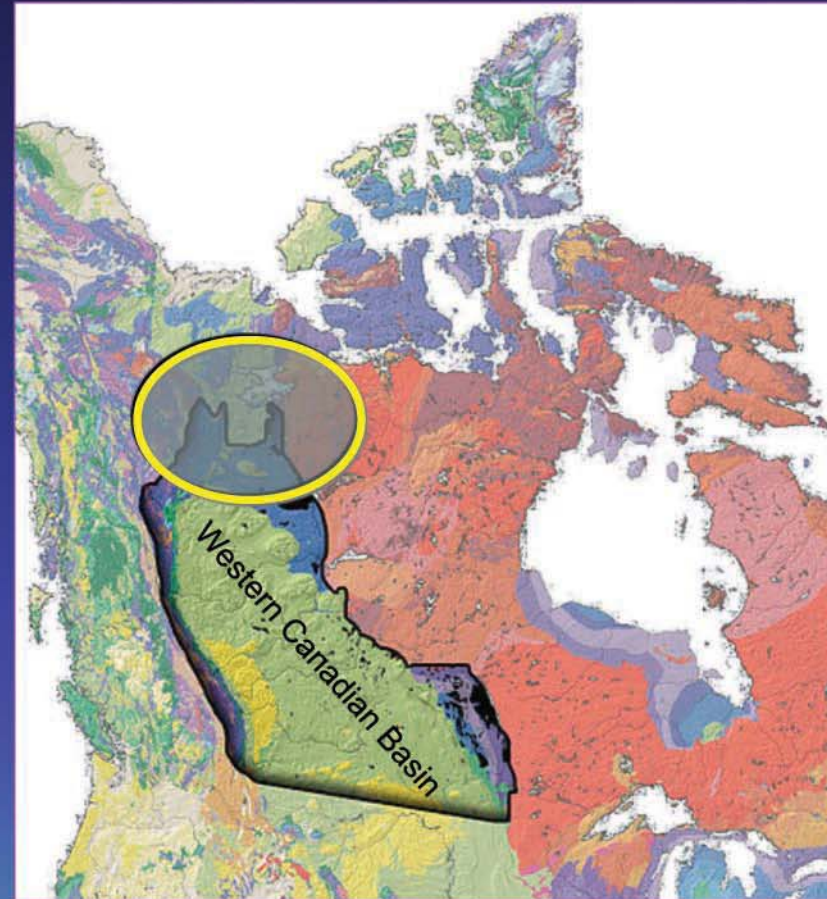
**Norman  
Wells  
Pipeline**





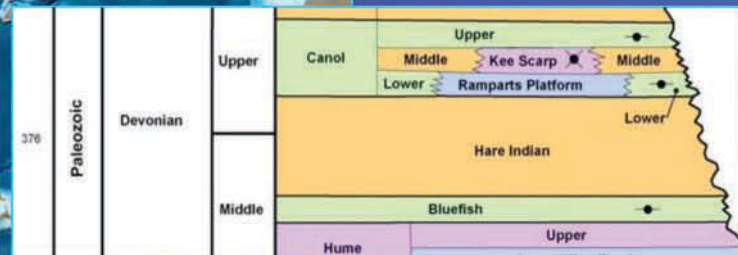
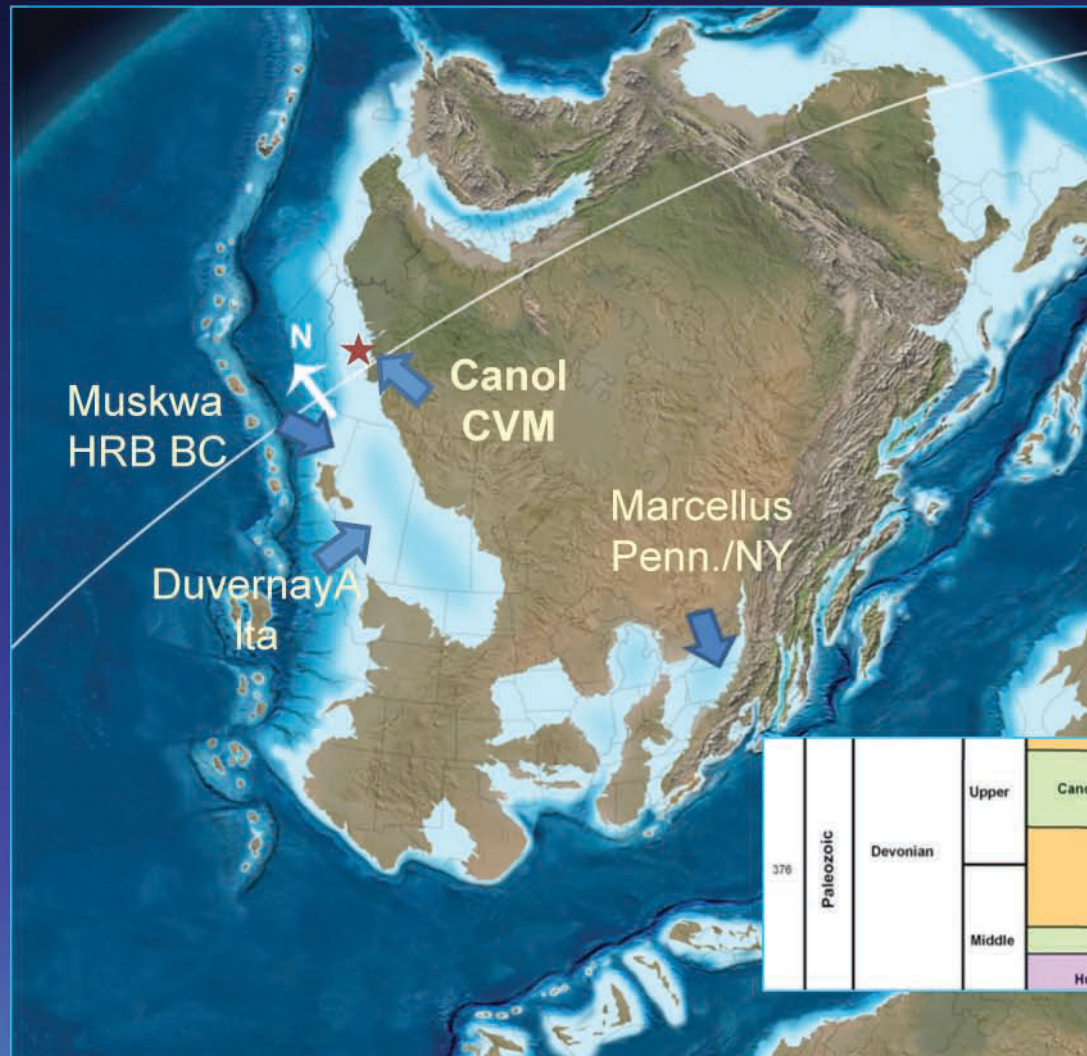
# Central Mackenzie Valley (CMV) Regional Geological Setting

- **Northern extension of the Western Canada Basin**
- **Paleozoic continental margin basin**
  - Platform/Reefal carbonates
  - Evaporites
  - Marine Clastics
- **Unconformably overlain by a Cretaceous foreland basin**
  - Clastics and Coals
- **Evolution includes repeated episodes of extension, transtension and compression**





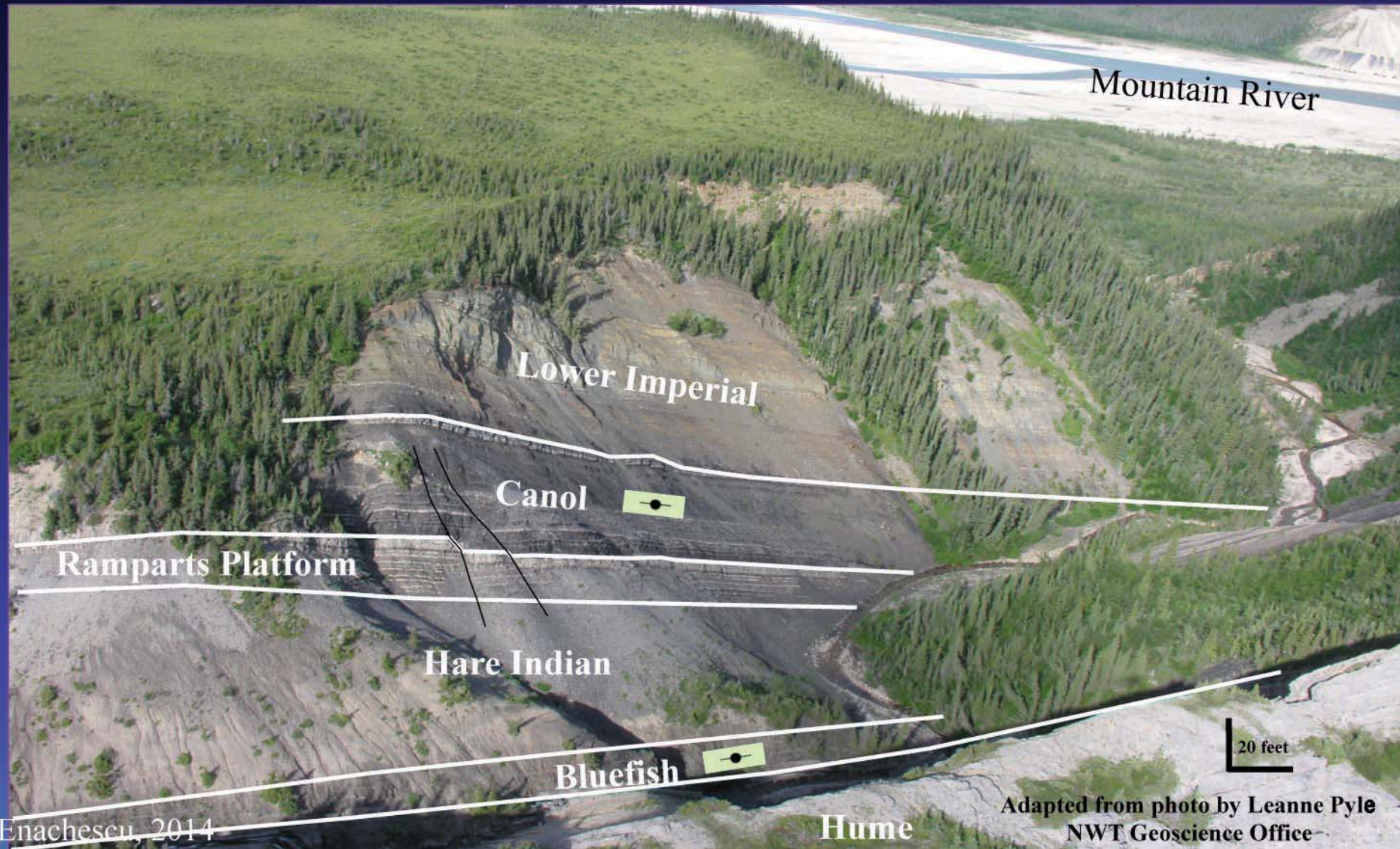
# Paleogeographic Setting Middle Devonian Time (385 Ma)



Map after Blakey, R.C. March 2011

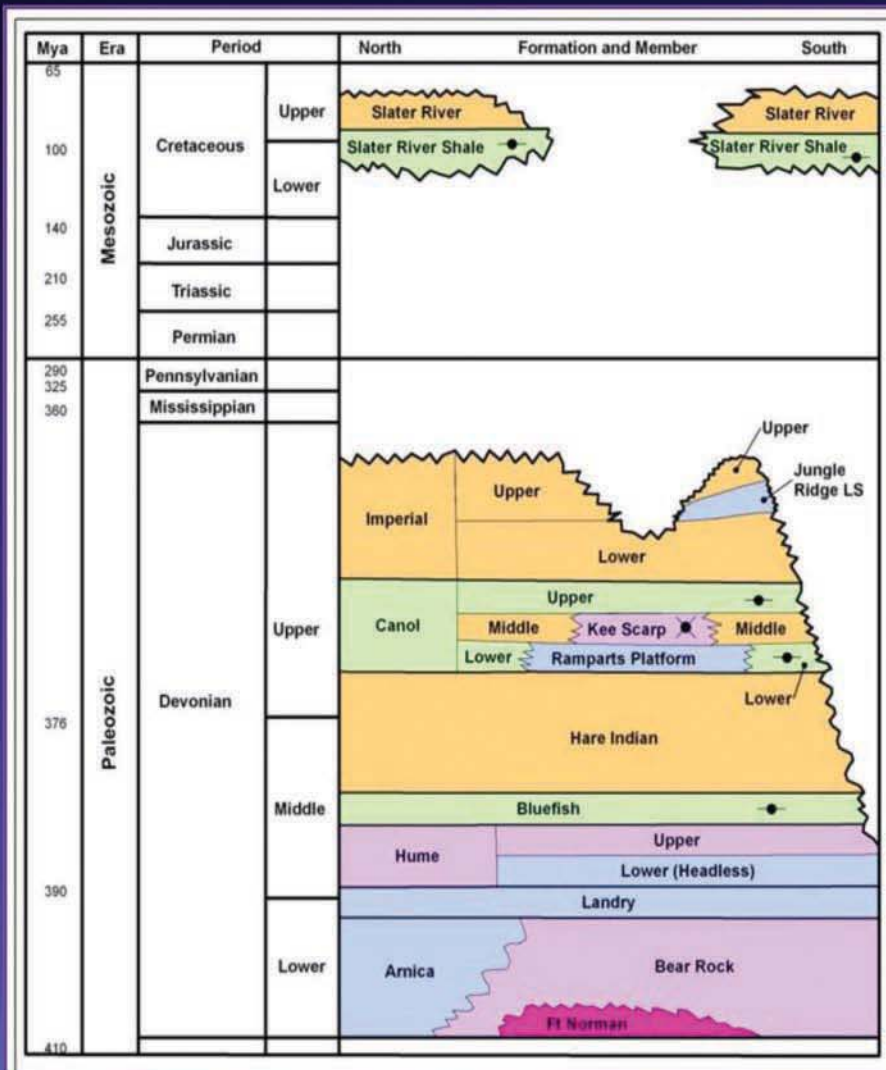


# Middle to Late Devonian Geology of the Central Mackenzie Valley

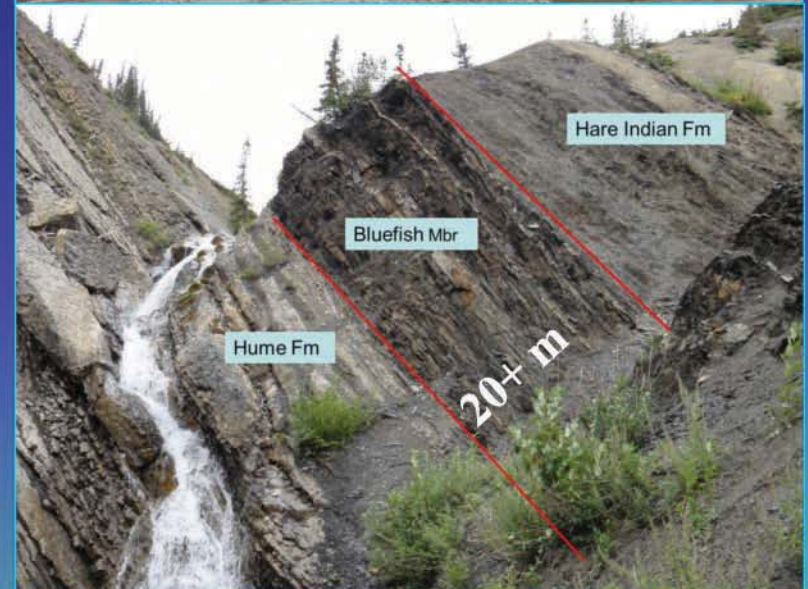




# Reef and Basinal Stratigraphy



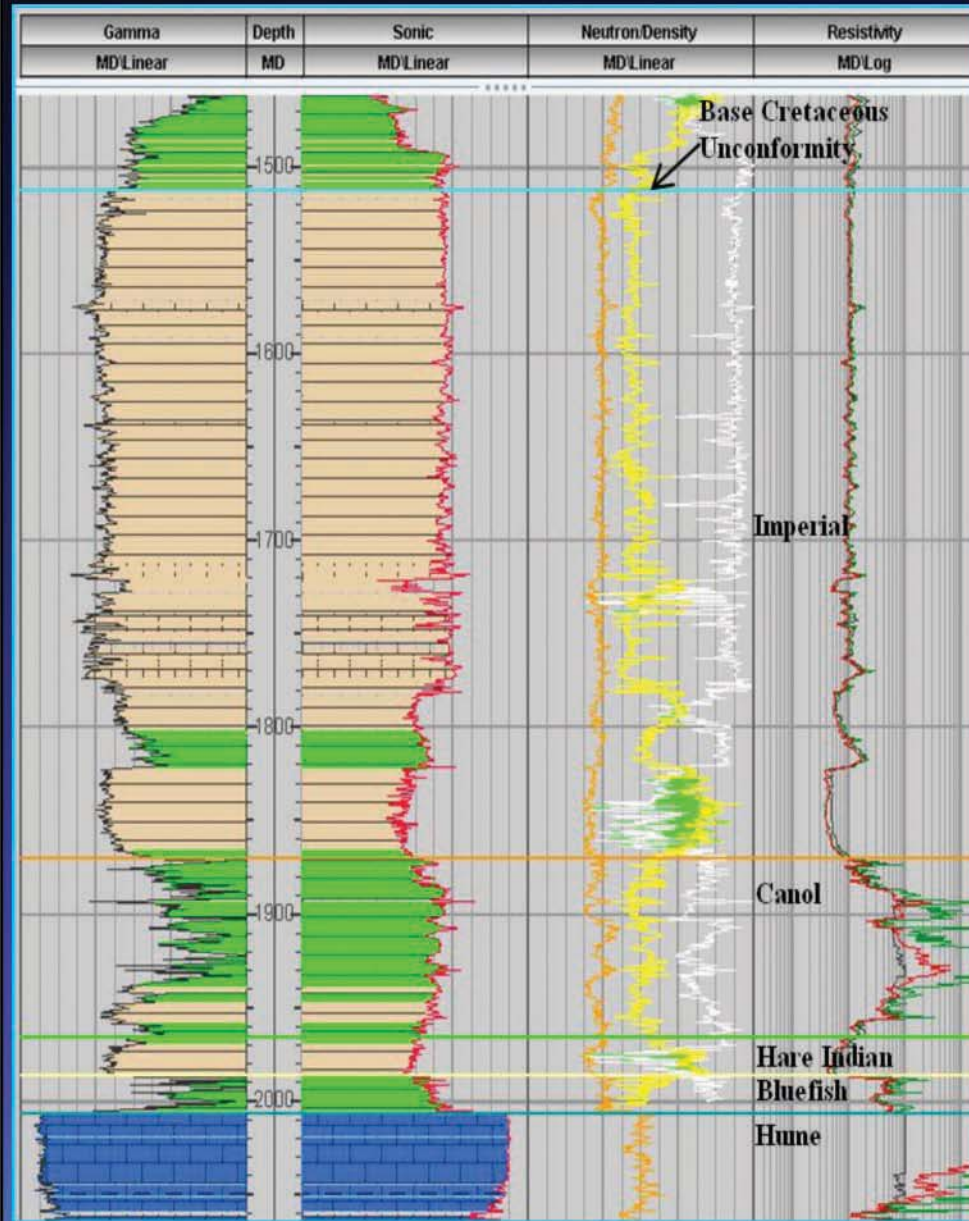
after Price et al., pers com



Photos: Paul R. Price



# Representative Log – Key Characteristics



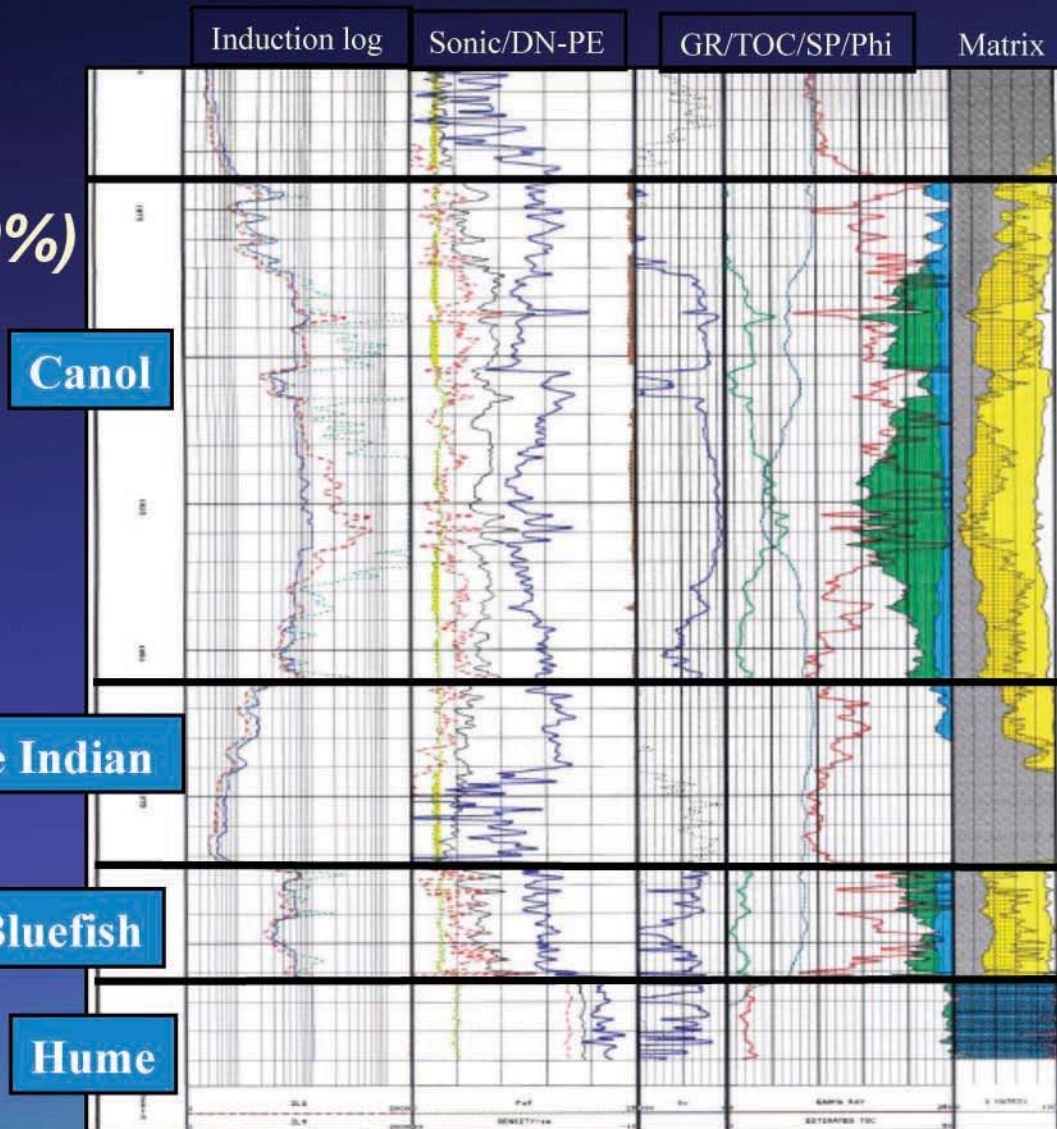
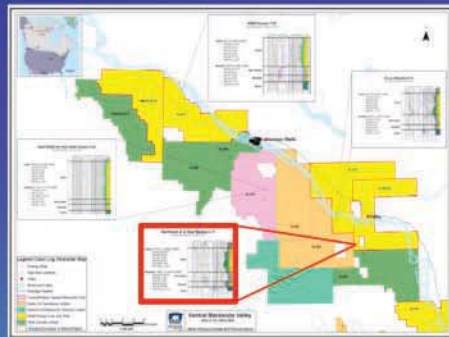
- Organic shale characterized by high gamma reading
- Hydrocarbon content indicated by high resistivity values
- Slightly higher seismic velocity and density due to increase silica content
- Average total porosity 13.9%
- Avg. TOC 4.9%
- TMax ~ 445



# Key Well - East Mackay I-77

## Canol Parameters (Cutoffs $\Phi_{iT} > 6\%$ , $S_w < 50\%$ ) (1870.2 to 1965.5mMD)

- Thickness 95.3m
- Net Pay 59.3m
- Avg  $\Phi_{iT}$  13.9%
- Avg  $S_w$  20.9%
- Avg VSh 21.9%
- Avg  $\text{TOC}_{\text{calc}}$  6.9%

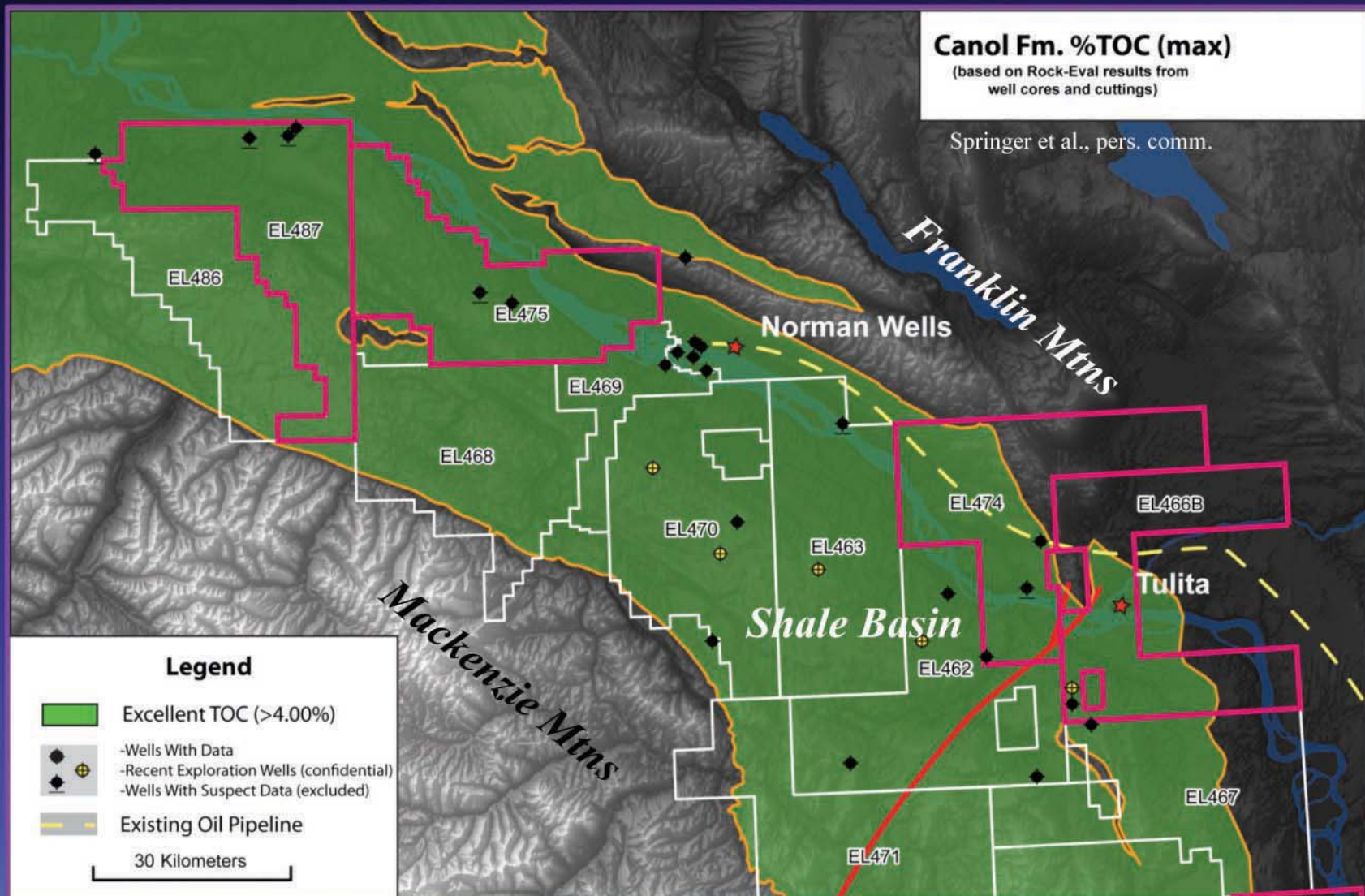




# Organic Geochemistry

- Performed work on outcrop samples, chips, well cores and cuttings
- Evaluation of source rock potential
  - Rock-Eval
  - Total Organic Carbon
  - Kerogen type
  - Thermal maturity
  - TAI
- Shale mineralogy/lithology (semi-quantitatively, using X-ray diffraction);
- Whole rock geochemistry

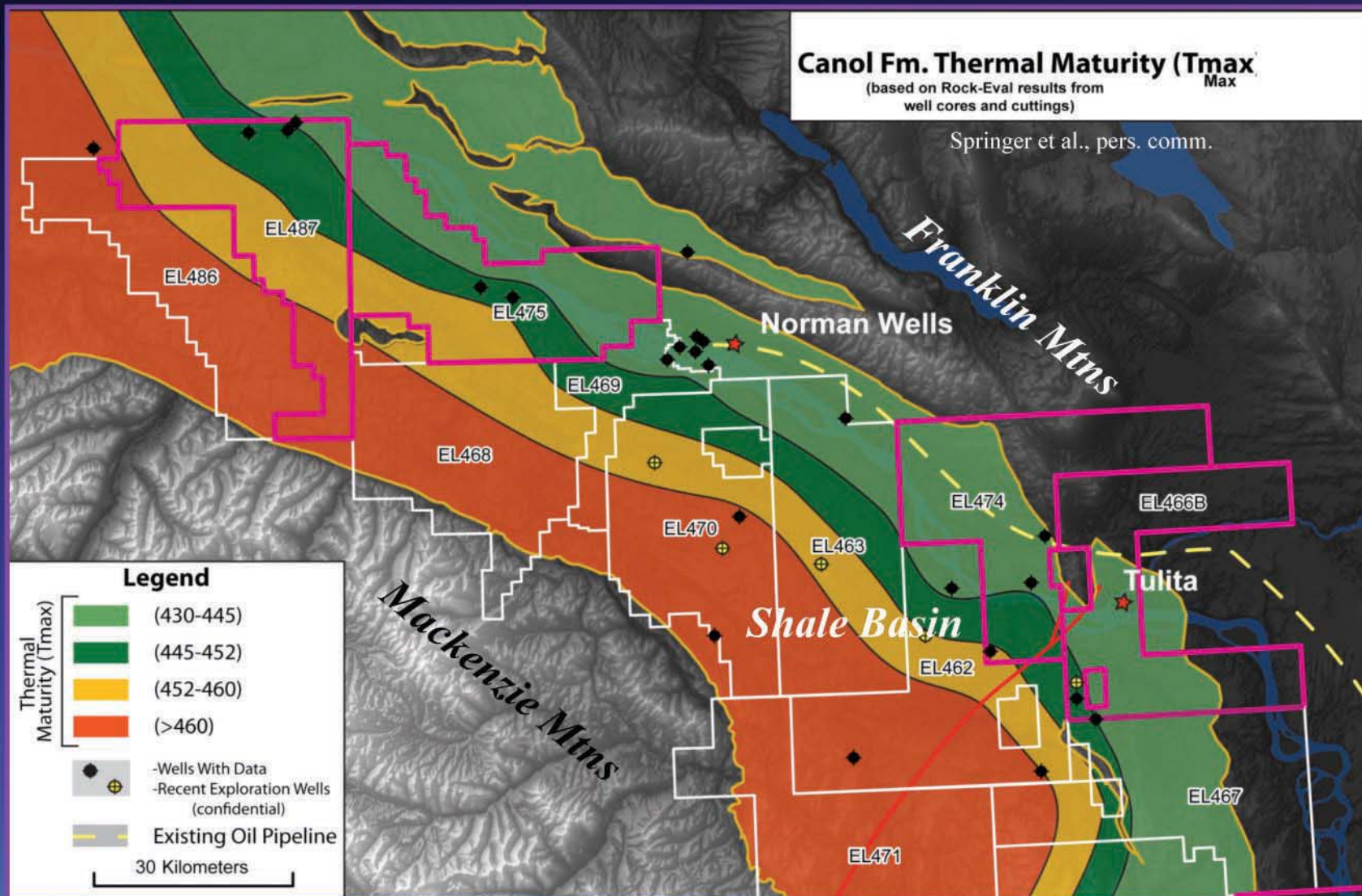
# Organic Geochemistry



Modified from Search and Discovery Article #10559; Enachescu et al., (2013)

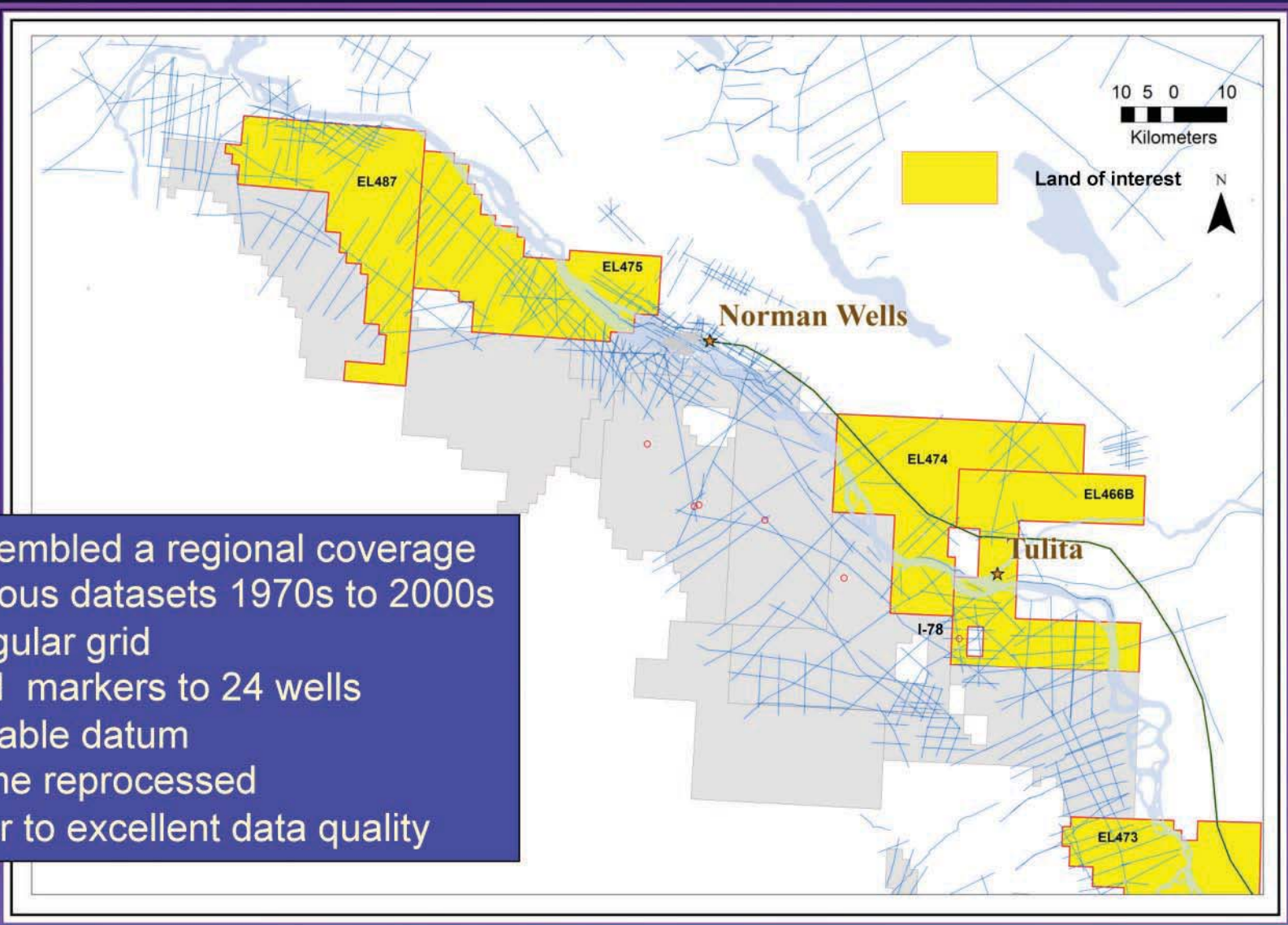


# Organic Geochemistry



Modified from Search and Discovery Article #10559; Enachescu et al., (2013)

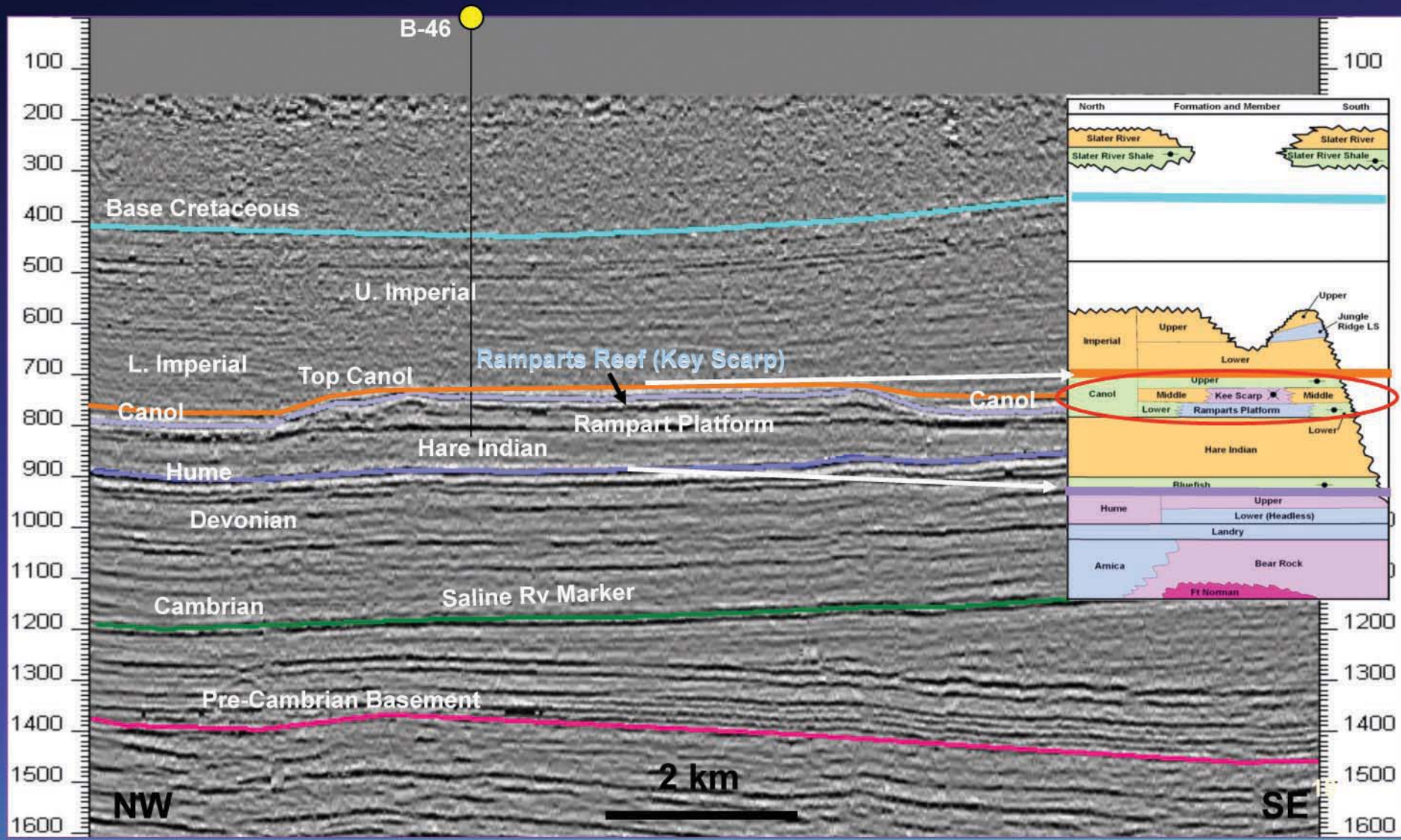
# Geophysics: Seismic Coverage



Assembled a regional coverage  
Various datasets 1970s to 2000s  
Irregular grid  
Tied markers to 24 wells  
Variable datum  
Some reprocessed  
Poor to excellent data quality

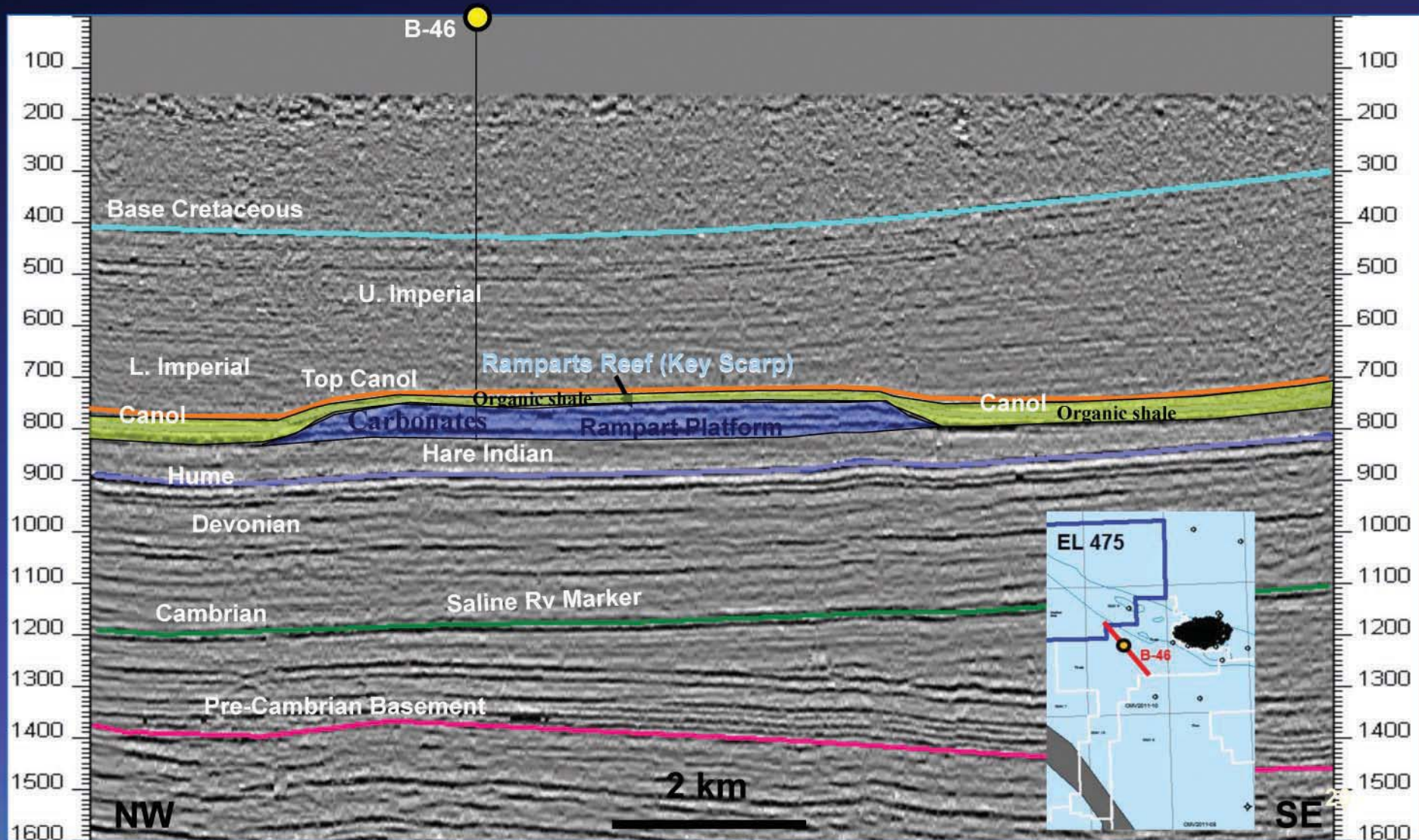


# Regional Geophysics Ramparts Reef and Shale Basin





# Regional Geophysics Ramparts Reef and Shale Basin





# NW-SE Devonian Cross-section

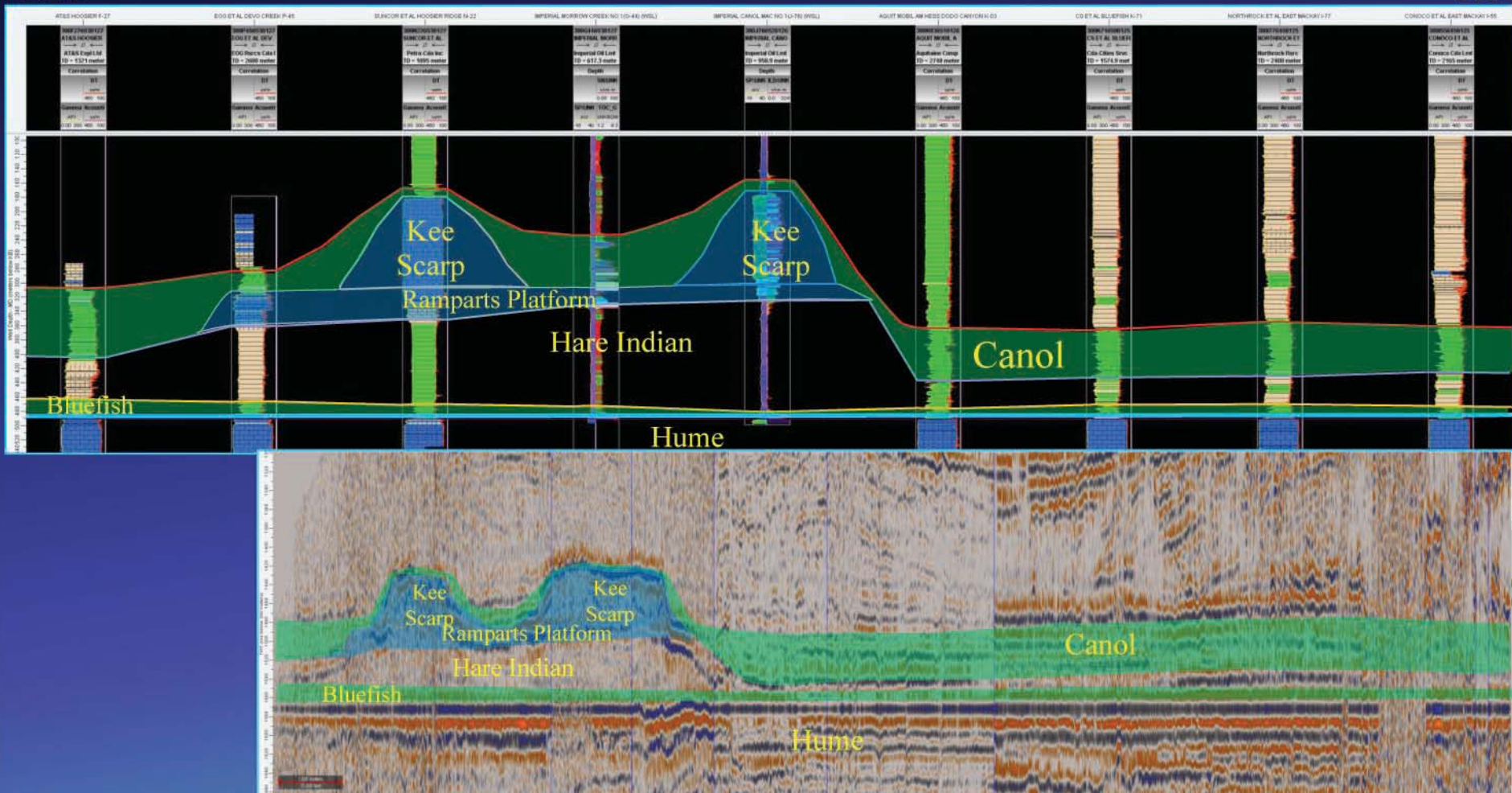
Hoosier Ridge

Norman Wells

East Mackay

NW

SE



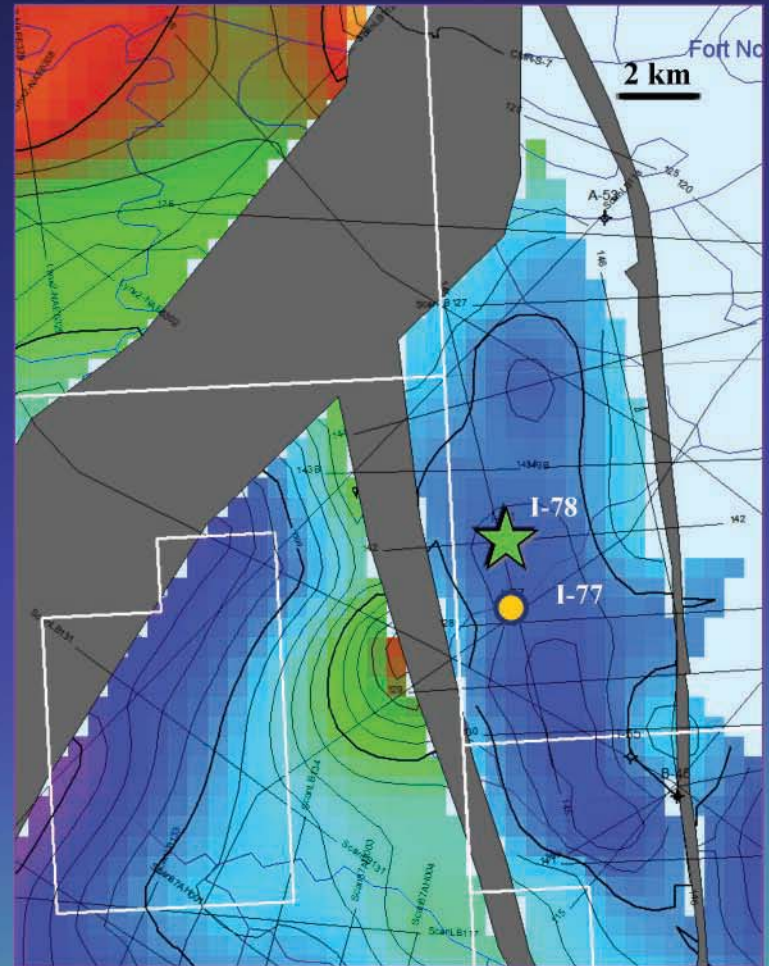
Modified from Search and Discovery Article #10559; Enachescu et al., (2013)



# Drilling: East MacKay I-78

## Why Drill I-78?

- First flow test in the basin
- Vertical well approved
- Deeper and thick Canol within fault bounded syncline
- Offset East MacKay I-77
- Intersection of seismic lines
- Good seismic data quality
- Coring and logging will allow further research of seismic, geo-mechanical and reservoir properties of Devonian shales



Map from Enachescu et al., (2013)



# Project Overview



# Regulatory Process in NWT

- It takes 9-12 months to secure approval to drill in the NWT, through a Project Description, PD, that is submitted to the Sahtu Land and Water Board, SLWB
- Multiple stakeholder consultation
- Review of the PD by 20+ GNWT and Federal Agencies
- Review of the PD by local Sahtu Boards, towns and hamlets
- Coordination of the PD is done by the SLWB
- Well design and HSE is the purview of the GNWT and NEB



# Community and Public Consultations

- Before submitting Project Description
  - Consultation with Communities
  - Consultation with NGO's
  - Consultation with Federal and Territorial Government Departments
  - Modify Project Description after receiving comments
- During the Project
  - Communities, Government and NGO's visits to lease
- After the completion of the project
  - Post-drill consultation with Communities, Government and NGO's

# Environmental Program

- Before submitting Project Description
  - Extensive Flora, Fauna and Surface Water Assessment of the area
  - Consultation for Traditional Knowledge, Archeological, First Nations special places
- During Drilling/Fracture Stimulation
  - Ongoing assessment of Wildlife and Environmental conditions by onsite wildlife monitors
  - Monitor groundwater wells
- After Leaving the Lease/Staging Area
  - Reporting on Flora & Fauna
  - Ongoing Monitoring of Groundwater wells
  - Additional testing of all surface waters
  - Lease and Staging Area post-drill inspection/reclamation
  - *All reporting is part of the public record*



# The Project

- Negotiate Access and Benefits Agreements with SLWB
- Acquire Land Use Permit and Water License
- Barge equipment/fuel to the staging area
- Goods and Services contracts for road and lease construction
- Build winter road and lease, construction begins Nov. 2012
- File Technical Applications are with the Regulator, NEB
- Drill three ~150m ground water wells on the lease
- Drill, core and evaluate by March the vertical shale oil exploration well
- Fracture Stimulate and flow test the well
- Off the land by March 31st



# Planning, Staging and Construction

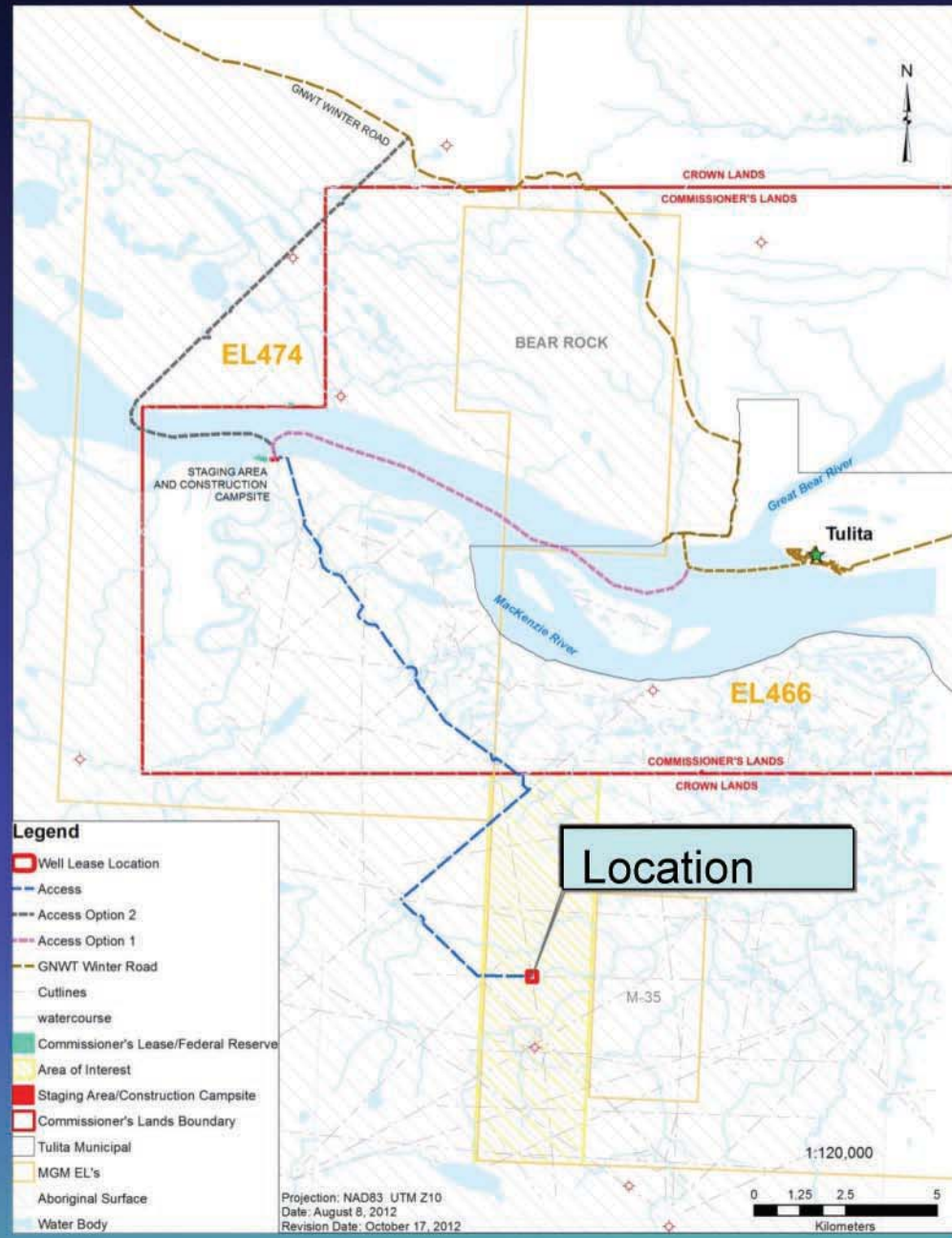




# East MacKay Project

## Project Activities:

- Staging
- Road/Lease Construction
  - Included 23 km of onshore road and
  - 13 km of ice road on the Mackenzie River
  - Lease construction was a 150x200 m exploration lease
  - Constructing a 100+ camp at the staging area
- Ground Water Wells (3)
- Vertical Exploration Well
  - Drilling to ~2000 m
  - Coring the Canol/Bluefish
  - Vertical Fracture Stimulation the Canol and Bluefish shales





# Staging using Mackenzie River





# Staging Fuel



# Road Construction

- Ice Road Construction
  - Flood all roads with 15-20 cm of water
  - Grade and Continue to maintain through the Project
- All roads were existing seismic lines
- Water used was from the Mackenzie River ~ 40,000 m<sup>3</sup>
  - 80% was used for roads
  - 15% lease/staging area
  - 5% Camp





# Pre-Construction



# Post-Construction





# Ground Water Wells



# Water Well Completion Test



Steady pumping rate = ~10 gpm for 24 hrs  
Total produced 14,500 gallons, 55m<sup>3</sup>



# **Water Well Water Results**

- **All of the results from our three water wells public**
- **Results show that the fresh water around our location at ~ 80-100 metres below the surface and is naturally a little high in Fluoride, Copper and Zinc**
- **There is no trace of hydrocarbons, before, during or after our drilling or stimulation operations**

# Exploration Drilling





# Data Acquisition

- Coring of Canol and Bluefish
- Full suite of conventional logs over the surface hole and spectral gamma
- Main hole had a full suite of logs plus additional logging runs for pressure data
- One third of the drilling costs were for evaluation, cores and logs

# Fracture Stimulation Operations

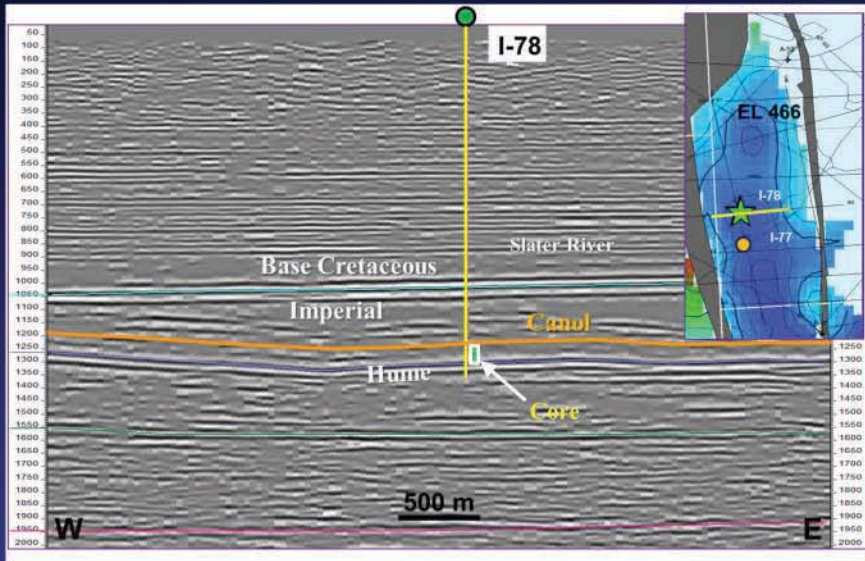




# Fracture Stimulation

- Fracture stimulated four zones:
  - One in the Bluefish
  - Three in the Canol
- Comingled the Canol production, very short timeframe to complete the task
- Objectives were to flow hydrocarbons in order to obtain a Significant Discovery License, not to determine commerciality
- All of the objectives were achieved

# Drilling Results: East Mackay I-78



Drilled to total depth 2001 m  
Seismically tops came in  $\pm 5$  m  
Cored Canol & Blue Fish  
Full suite of wire line logs  
including Dipole Sonic  
Fracture Stimulation of Canol  
and Bluefish using a clear  
mineral oil  
Confirmed presence of free  
hydrocarbons  
Shut-in for pressure build-up  
and re-tested  
A Significant Discovery  
Licence was awarded to  
partner companies by NEB



# Social License



# What is a Social License

- Industry, Government, Communities, First Nations (*when applicable*) and the Public working with a common goal of understanding past, future and ongoing projects
- For the Industry, this involves consultation, communication and *full public disclosure* of work programs
- For the Government, a Social License is to be an active participant in the Region *before* licenses are granted
- For the Communities a Social License is to work with Government and Industry on their Concerns over the project



# **Government Responsibility for Social License**

- **It is the duty of Government to ensure that baseline data is collected in exploration areas *before* exploration licenses are awarded**
- **This includes:**
  - Surface and Groundwater studies
  - Community potable well data
  - Regional Seismicity data
  - Regional planning for increased activity on rural infrastructure
- **Consultation with the affected Communities, Stakeholders and NGO's which includes discussion on what exploration and development will bring to the Region**
- **Actively listen and modify future land postings for specific concerns**

# **Industry Responsibility for Social License**

- **Once land is obtained by a company they must meet with both Government and Communities to discuss future programs, timelines and opportunities**
- **To actively listen to concerns of the Communities and Public and address areas of concern**
- **To report to the public and government on a timely basis**
- **To fully disclose environmental information to the public including all fracture stimulation fluids, chemicals and volumes, drilling mud chemicals and ensure a groundwater and surface monitoring program**



# **Communities Responsibility for Social License**

- To make themselves aware of the activity and an acknowledgement that the Oil and Gas Resource extracting is an Industrial activity**
- To understand that the Technical aspects of the program are being monitored by Professional Engineers, Geoscientists, Biologists and Hydrologists within the Government, who awarded the lands to the Industry**
- Recognize that the Industry and Government are committed to full disclosure of baseline and ongoing studies to the public before, during and after completion of the projects**

# What does the Industry need from Government for Resource Plays?

- **Clear regulatory path forward**
  - Know the rules before proceeding with exploration
  - Development planning will take years, the regulatory process can't change in the middle of planning
- **Communication with Stakeholders**
  - Communities need to know that with success there will be a need for pipelines for oil, gas and natural gas liquids to markets and additional roads and infrastructure improvements
  - Good quality environmental baseline data is acquired before exploration



# Summary

- The Canol shale is an example of a frontier basin play with little local infrastructure
- The Canol shale is like many frontier basins plays; Projects, not single wells, that require significant Project Management
- Social License is “best practice”
- Industry, Government and the Public need to be involved in planning the projects
- Industry must see a clear path forward from Exploration through Development



**Thanks**

