

# Status of the Uranium Resource in Québec

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**September 8, 2014**

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# PREAMBLE

- This presentation deals with the status of the uranium resource and the general conditions that govern the development of a mining project.
- This presentation was popularized and is designed for the general public. It remains compliant with all scientific standards, but the vocabulary and examples have been simplified.



# VOCABULARY RELATING TO MINERAL RESOURCES

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# WHAT IS THE BACKGROUND AND WHAT IS AN ANOMALY?

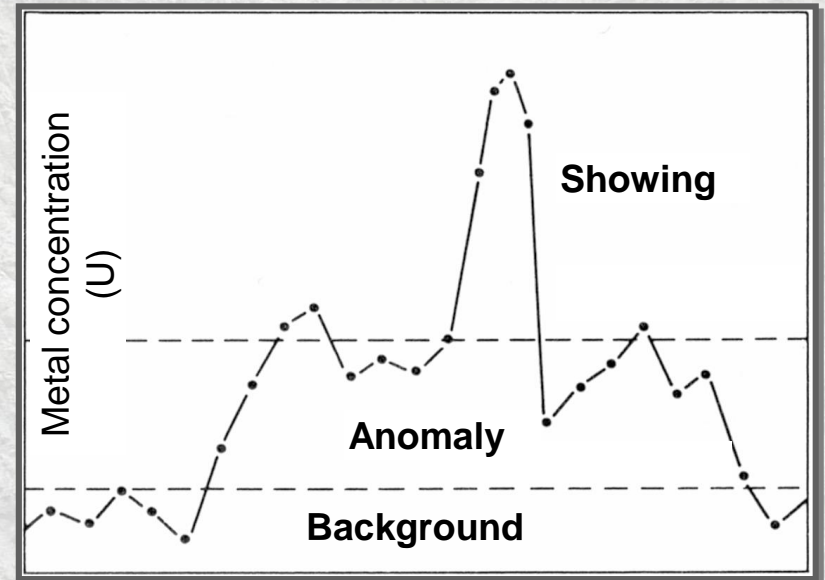
- **Background:**

Normal concentration of an element (U) in a given environment

- Earth's crust: ~ 2.8 ppm U

- **Anomaly:**

Concentration in a given setting of a natural element, higher or lower than the normal concentration (background)



Source: Beaudoin, G., 2012. Exploration Minérale, Manuel de cours, GGL-2608.



# WHAT IS A SHOWING?

- Presence of a metallic or mineral substance at a grade equal to or higher than a prescribed threshold
- **Uranium showing (MERN)**
  - Prescribed threshold  $\geq 425$  ppm U
  - $425 \text{ ppm U} = 0.05\% \text{ U}_3\text{O}_8$

Daniel Lake showing (Azimut Exploration)



Source: [www.azimut-exploration.com/fr-prop-daniellake.html](http://www.azimut-exploration.com/fr-prop-daniellake.html)



# WHAT IS A WORKED DEPOSIT, AN ORE DEPOSIT, AND ORE?

- **Worked deposit:**
  - Showing where the shape, continuity, and orientation of the mineralization have been determined through exploration work
  - Generally drilling and/or trenching
- **Ore deposit:**
  - Deposit where the tonnage and grade of the targeted substance have been assessed through exploration work
- **Ore:**
  - Mineral or mineral aggregate that may be mined, concentrated, and sold at a profit



# WHAT ARE RESOURCES, RESERVES, AND A MINE?

- **Mineral resources:**
  - Concentration of an inorganic material, including metals, that shows reasonable prospects for economic extraction
  - Subdivided into inferred, indicated, and measured resources, in order of increasing confidence
- **Mineral reserves:**
  - Economically mineable part of an indicated or measured mineral resource, as demonstrated by at least a preliminary feasibility study
  - Subdivided into probable and proven reserves, in order of increasing confidence
- **Mine:**
  - Industrial facility where an ore deposit is mined (open pit or underground mine)

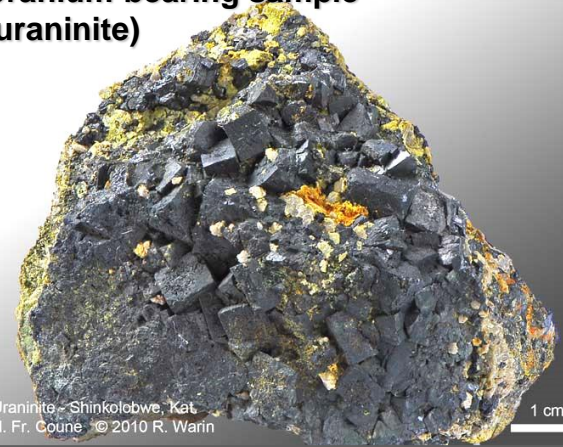


# WHAT IS GRADE?

- Proportion of a useful substance (U, Gold, Ni, Cu) in a sample:
  - Expressed as mass relative to total mass of sample
  - Expressed in % when the amount of substance is significant
  - Generally expressed in ppm (parts per million) when the amount of substance is lower
- **Uranium grade:**
  - Expressed as uranium oxide (%  $\text{U}_3\text{O}_8$ ) or in ppm U
  - $0.05\% \text{ U}_3\text{O}_8 = 425 \text{ ppm U}$

$0.01\% = 100 \text{ ppm} = 100 \text{ g/t}$   
 $1\% = 10,000 \text{ ppm} = 10,000 \text{ g/t}$

Uranium-bearing sample  
(uraninite)



Uraninite - Shinkolobwe, Kat.  
Coll. Fr. Coune - © 2010 R. Warin

Source: [www.agab.be/mineralogie/Katanga/images/uranite/uranite.html](http://www.agab.be/mineralogie/Katanga/images/uranite/uranite.html)

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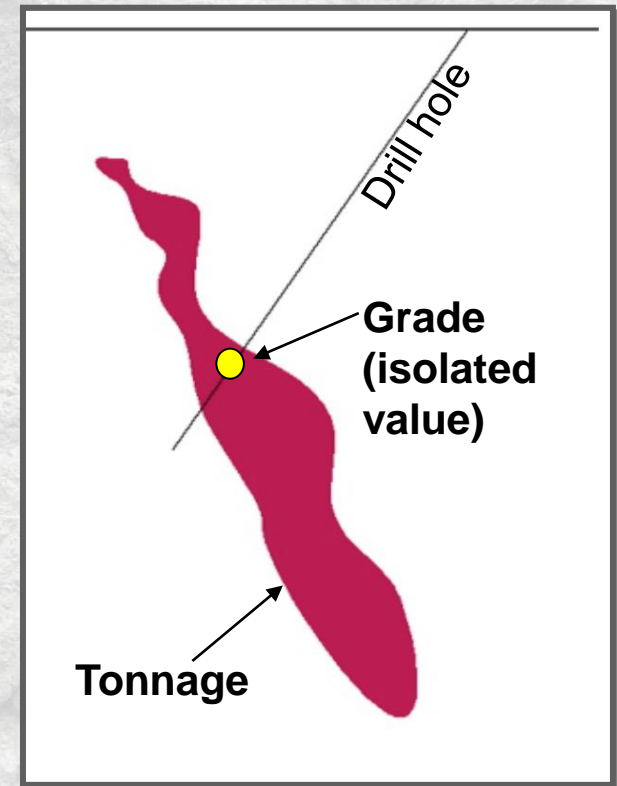


# WHAT IS TONNAGE?

- Total amount of ore expressed in tonnes (t) or in pounds (lb)
- Metric tonne (t):
  - International weight unit

**1 tonne = 1,000 kg = 2,204.6 pounds**

VERTICAL SECTION



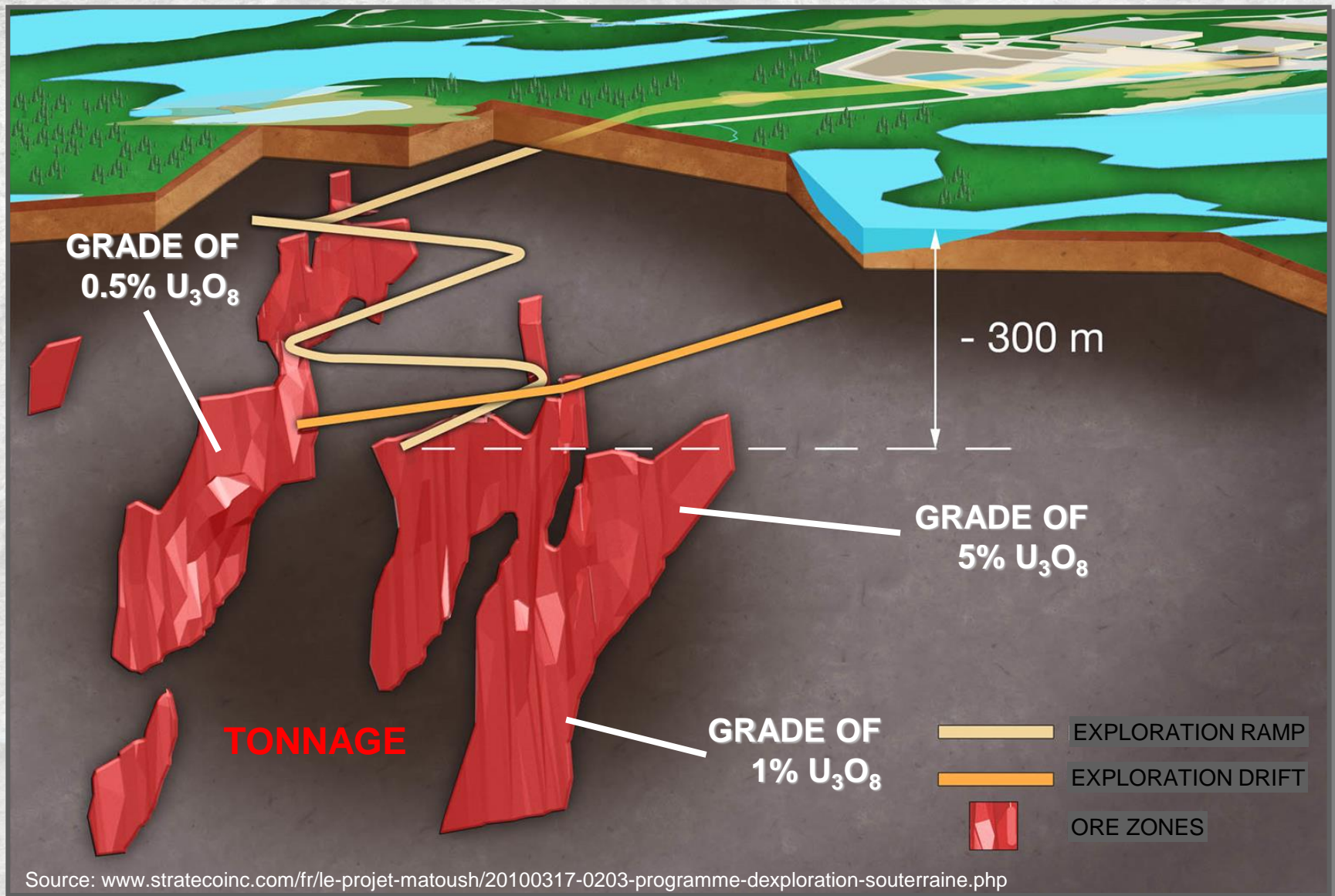
Source: Beaudoin, G., 2012. Exploration Minérale, Manuel de cours, GGL-2608.

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# TONNAGE AND GRADE OF AN ORE DEPOSIT





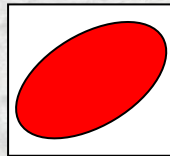
# WHAT IS AN ECONOMIC DEPOSIT?

- $\text{Grade} \times \text{Tonnage} = \text{Quantity} \times \text{Price} - \text{Production costs}$   
= Economic deposit or = Non-economic deposit
- Grade and tonnage are inextricable and must be taken into account together to determine if an ore deposit is economic or not
- Depends on a variety of factors (grade, tonnage, price of substance, production costs, infrastructure, etc.)

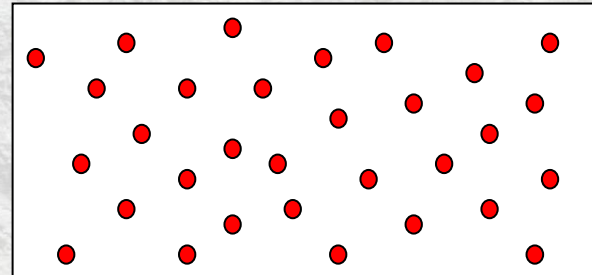
**Economic deposit:**

\$\$\$\$

=



or



**High grade x  
Low tonnage**

**Low grade x  
High tonnage**

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# GEOLOGICAL SETTINGS WHERE URANIUM IS FOUND IN QUÉBEC

- **Deposits associated with sedimentary basins**
  - Baie-James (Monts Otish)
- **Deposits associated with granitic rocks**
  - Côte-Nord, Hautes-Laurentides



Source: [www.lithotheque.site.ac-strasbourg.fr/pres-de-chez-vous/centre\\_alsace/sainte-odile/mont-sainte-odile-fiche-professeur](http://www.lithotheque.site.ac-strasbourg.fr/pres-de-chez-vous/centre_alsace/sainte-odile/mont-sainte-odile-fiche-professeur)



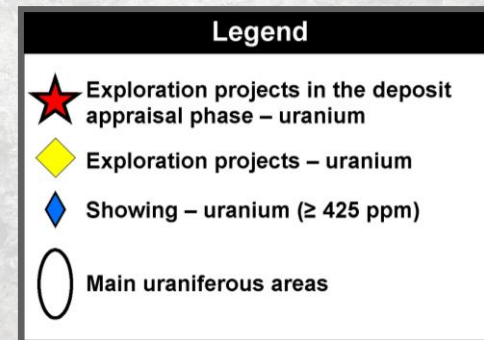
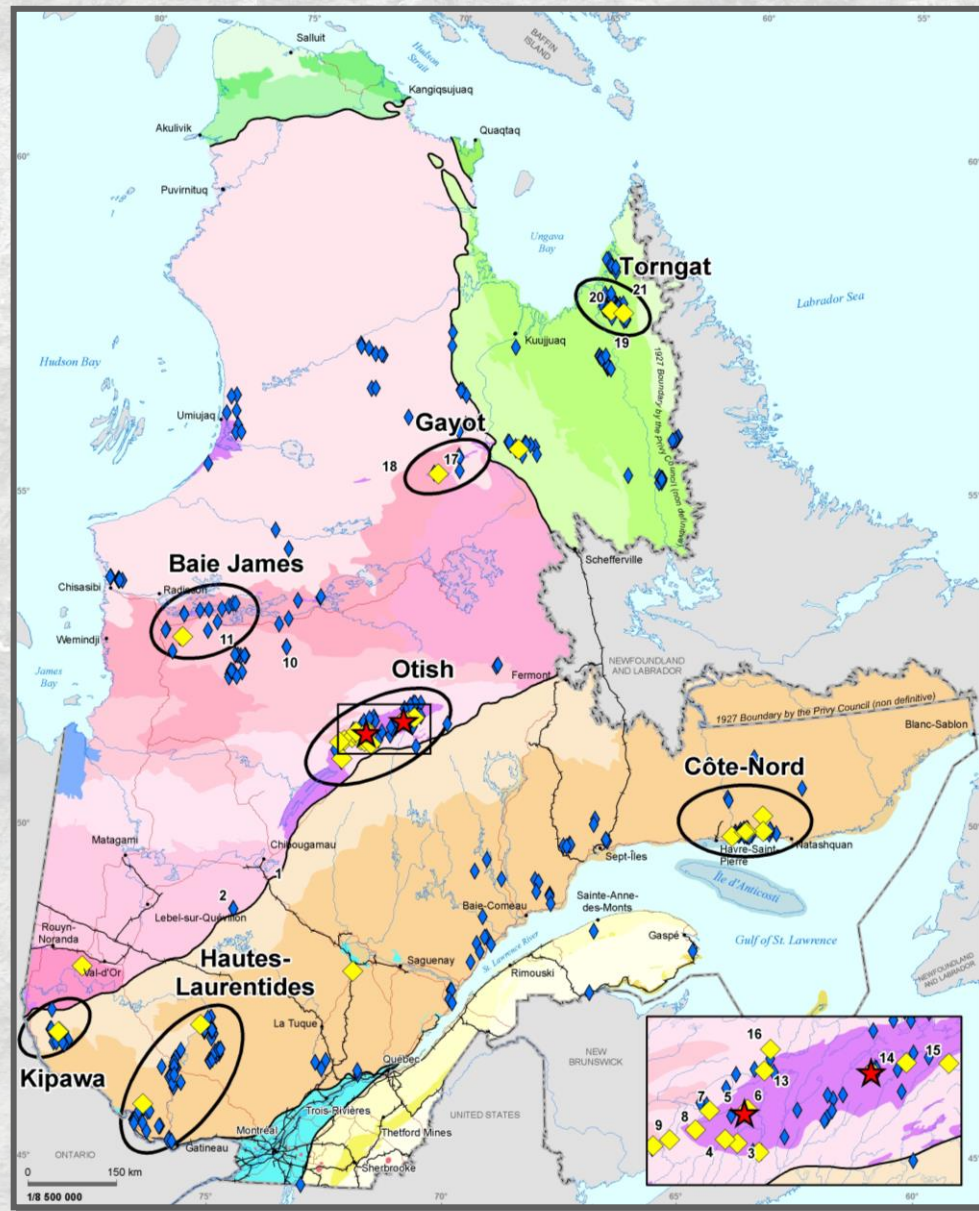
Source: [geology.com/rocks/granite.shtml](http://geology.com/rocks/granite.shtml)

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# URANIUM POTENTIAL IN QUÉBEC



Source: MERN

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# QUÉBEC'S POSITION ON THE WORLD STAGE

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# Exploration projects in Québec compared with uranium mines around the world

Location	Ore deposit	Grade (% U <sub>3</sub> O <sub>8</sub> )	Tonnage (Mt)	Tonnes U
<b>QUÉBEC</b> <i>(Indicated Resources)</i>	<b>Matoush<sup>1</sup></b>	<b>0.95</b>	<b>0.59</b>	<b>4,753</b>
	<b>L (Lavoie)<sup>2</sup></b>	<b>0.45</b>	<b>0.39</b>	<b>1,488</b>
	<b>North Shore<sup>3</sup></b>	<b>0.014</b>	<b>21.5</b>	<b>2,552</b>
<b>CANADA (Sask.)</b> <i>(Total Reserves)</i>	<b>Cigar Lake<sup>4</sup></b>	<b>18.3</b>	<b>1.64</b>	<b>254,502</b>
	<b>McArthur<sup>4</sup></b>	<b>15.76</b>	<b>1.04</b>	<b>138,991</b>
<b>NAMIBIA</b> <i>(Total Reserves)</i>	<b>Rössing<sup>5</sup></b>	<b>0.03</b>	<b>149</b>	<b>40,159</b>
<b>AUSTRALIA</b> <i>(Total Reserves)</i>	<b>Olympic Dam<sup>6</sup></b>	<b>0.057</b>	<b>552</b>	<b>266,815</b>

Sources: <sup>1</sup> www.stratecoinc.com (2012), <sup>2</sup> DV 2013-01, <sup>3</sup> www.sedar.com (2011), <sup>4</sup> www.cameco.com (2013), <sup>5</sup> www.rossing.com (2013), <sup>6</sup> www.mining-technology.com/projects/olympic-dam/ (2011)

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# KNOWN URANIUM RESOURCES

	Tonnes U	% world
Australia	1,673,000	31
Kazakhstan	651,000	12
<b>Canada</b>	<b>485,000</b>	<b>9</b>
Russia	480,000	9
South Africa	295,000	5.5
Namibia	284,000	5
Brazil	279,000	5
Niger	272,000	5
United States	207,000	4
China	171,000	3
Jordan	112,000	2
Uzbekistan	111,000	2
Ukraine	105,000	2
India	80,000	1.5
Mongolia	49,000	1
Others	150,000	3
Québec*	8,800	<0.2
World Total	5,404,000	100

\* Estimated by MERN

Source: [www.world-nuclear.org](http://www.world-nuclear.org) as at August 18, 2014, public data from 2009

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# URANIUM EXPLORATION PROJECTS IN QUÉBEC

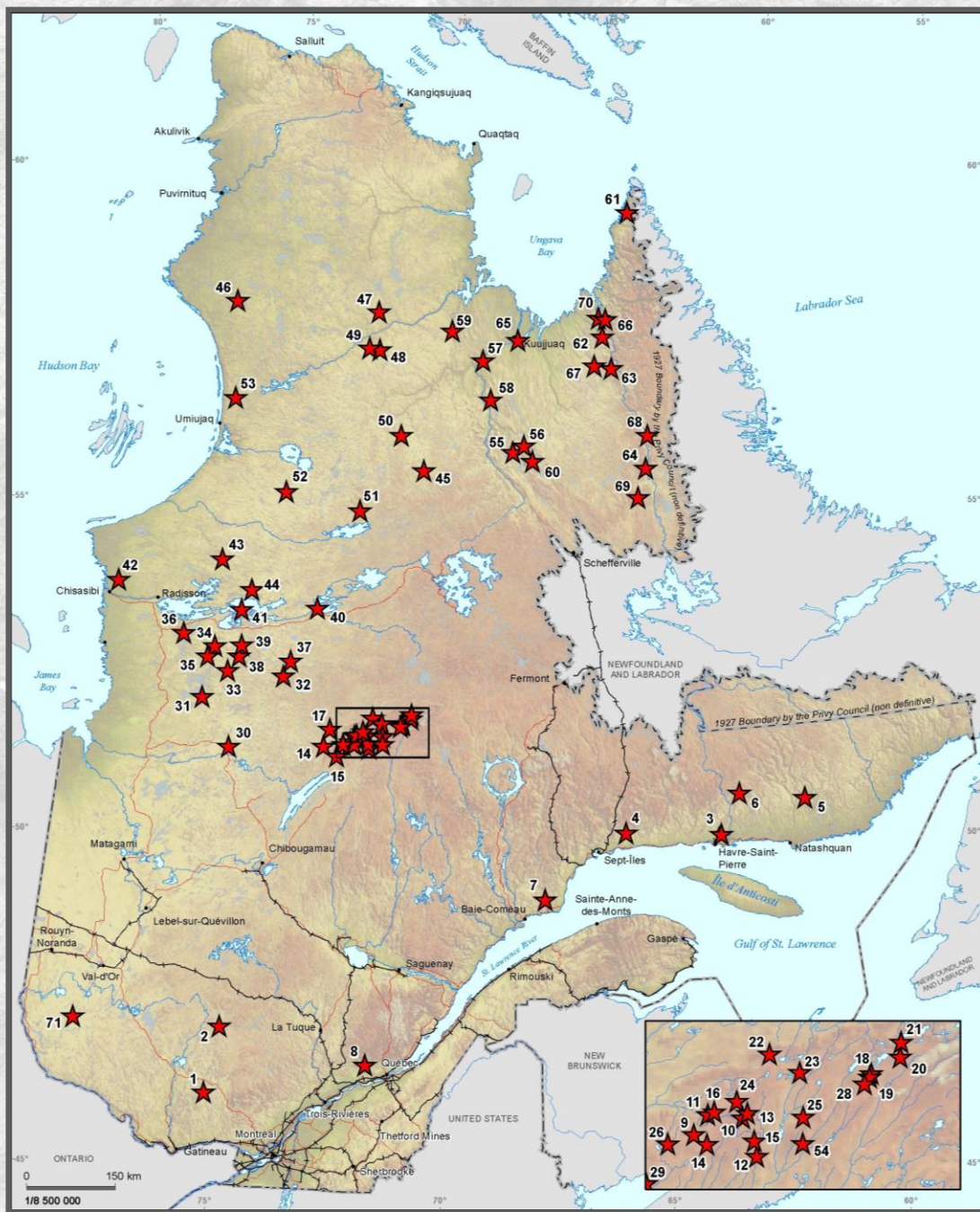
EVOLUTION SINCE 2008

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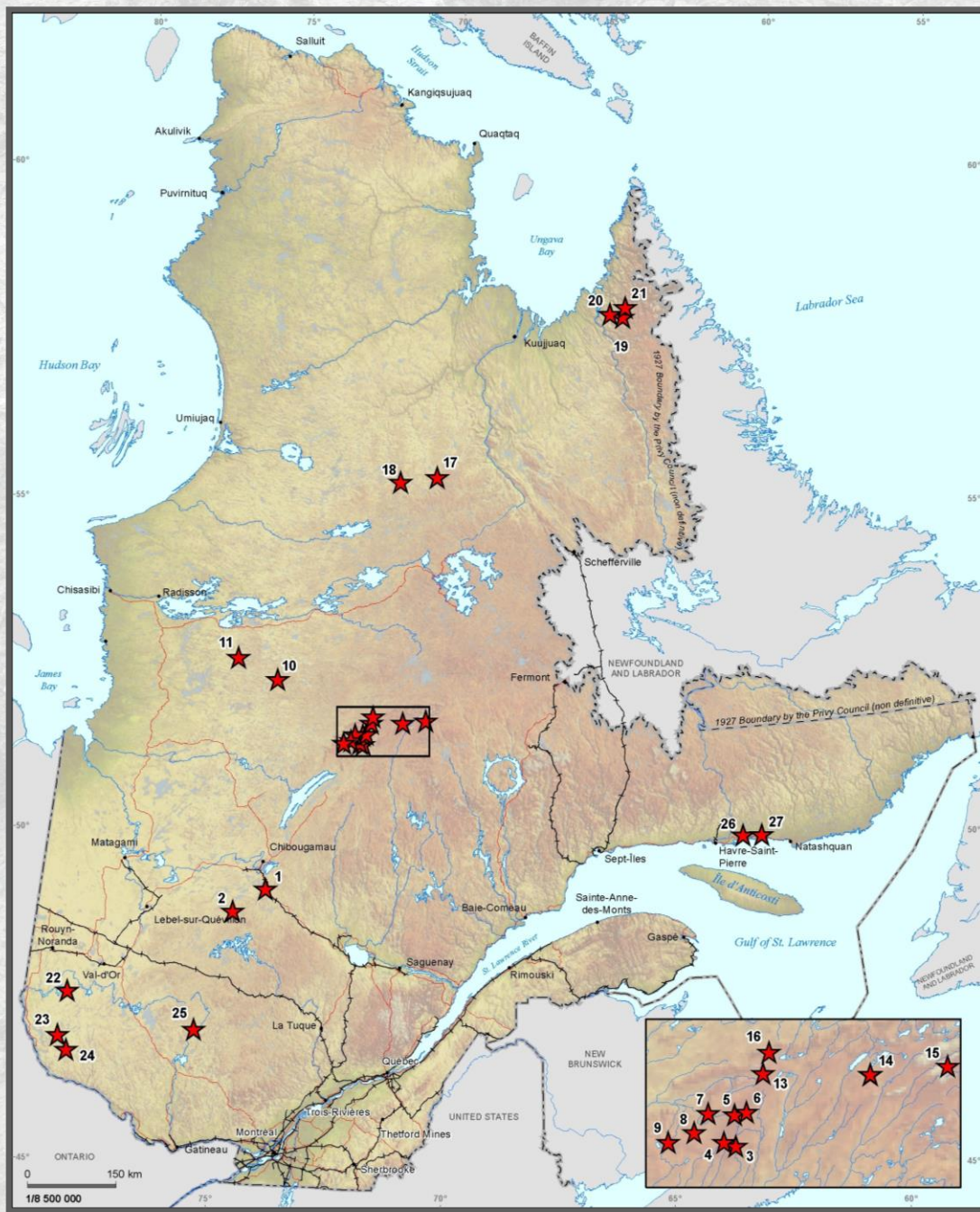
# 70 exploration projects in 2008



Source: MERN, Sigéom, DV 2009-01



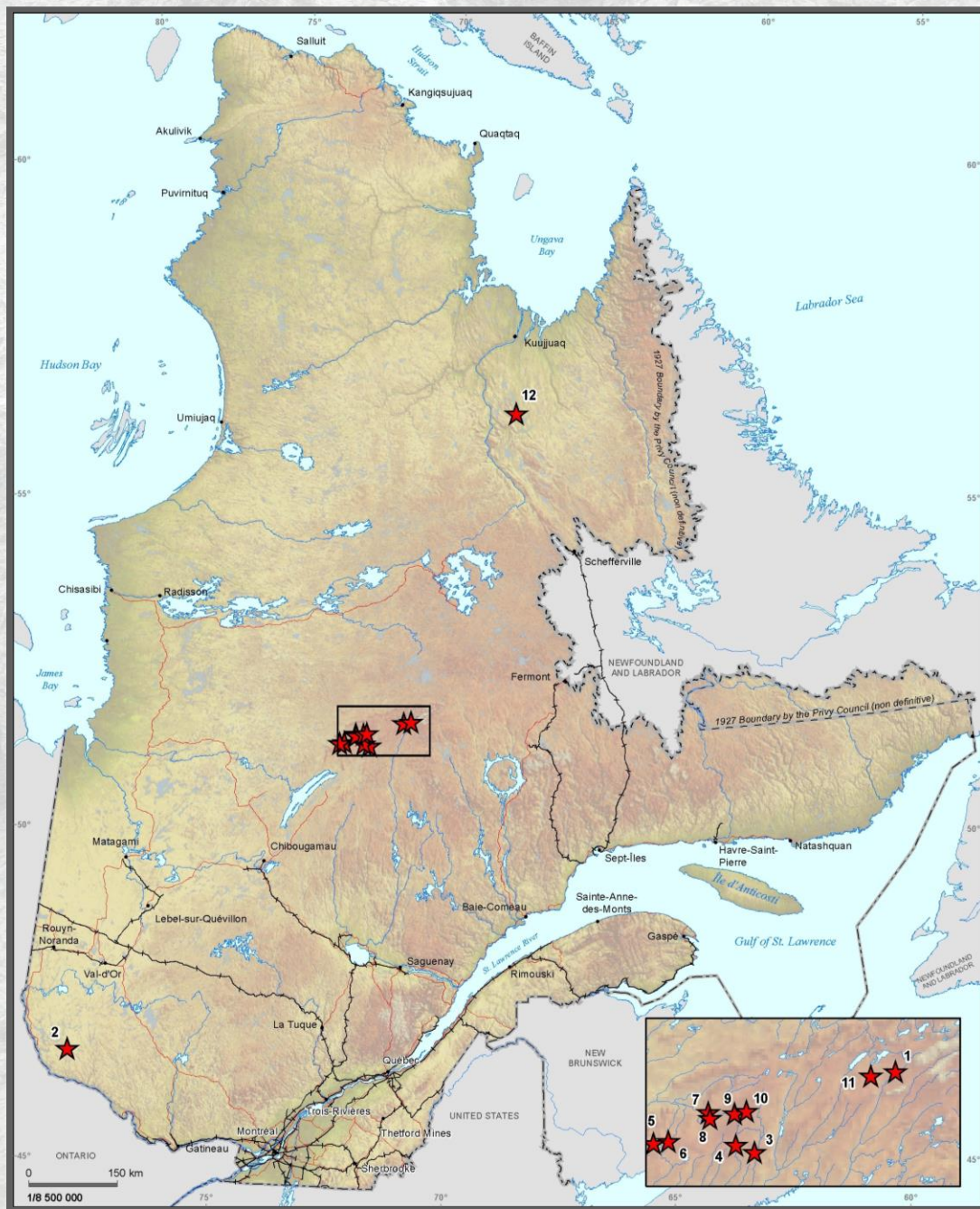
# 27 exploration projects in 2010



Source: MERN, Sigéom, DV 2011-01



# 12 exploration projects in 2012

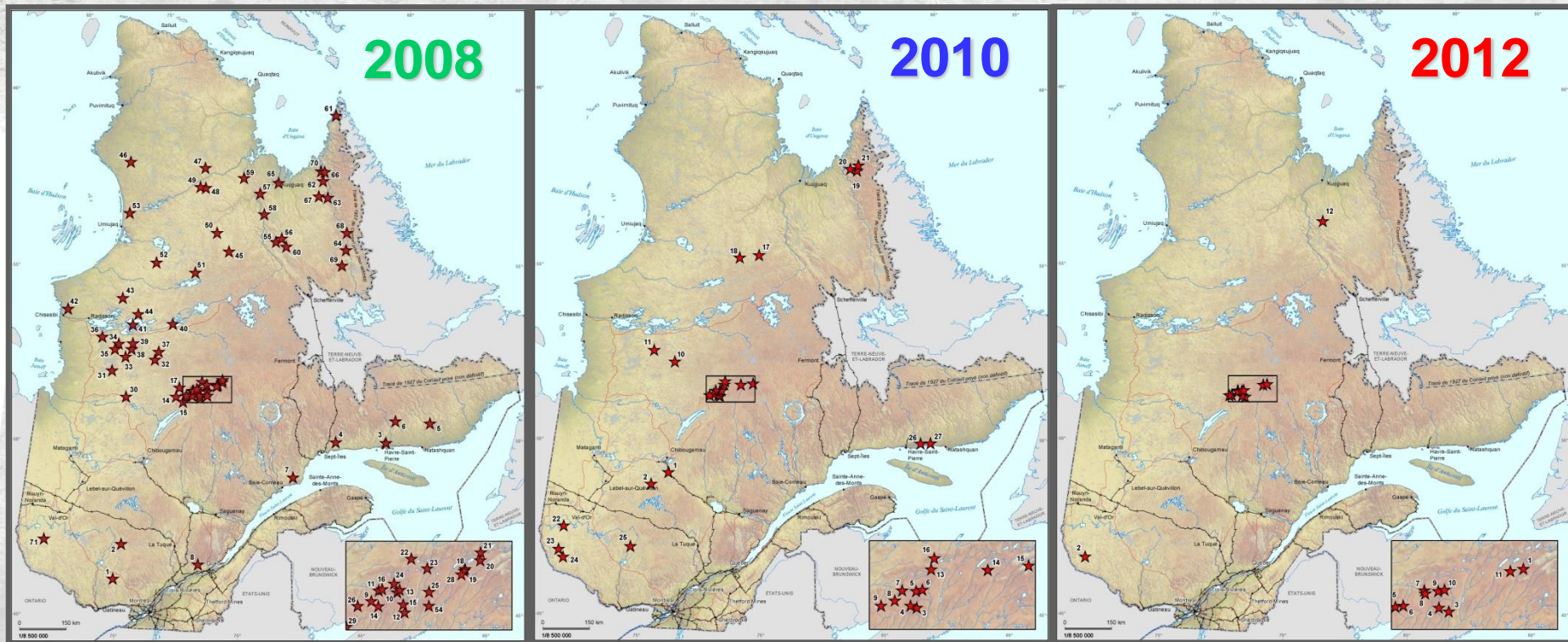


Source: MERN, Sigéom, DV 2013-01





# Evolution of uranium projects since 2008




Source: [http://www.cameco.com/investors/markets/uranium\\_price/spot\\_price\\_5yr\\_history/](http://www.cameco.com/investors/markets/uranium_price/spot_price_5yr_history/)



# MINERAL DEVELOPMENT PROCESS

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# FROM THE ORE DEPOSIT TO THE MINE

## Mineral Development Process



The result of each step of the mineral development process is key to move on to the next step

Exploration		Deposit Appraisal						
Resources	Inferred resources	Measured and indicated resources	Proven and probable reserves		Corporate decision and search for financing	Construction	Mining operations (variable duration)	Rehabilitation (during and after the end of operations)
Metallurgical testing	Laboratory testing	Laboratory testing	Step-by-step pilot-scale testing	Closed-circuit pilot-scale testing				
	A few pieces	A few kilograms	A few tonnes	Several tonnes				
Technical report (43-101)		Preliminary scoping study	Prefeasibility study	Feasibility study				
Economics		Cost at ± 25-30%	Cost at ± 15-20%	Cost at ± 15%				
Environment		Baseline study	Impact study	C.A. application				
Social		Information sessions, consultations, public hearings			Monitoring committee			




# FROM THE ORE DEPOSIT TO THE MINE

- Conduct required consultations throughout the process
- Establish mineral reserves (mineable at a profit)
- Perform metallurgical testing to confirm the extraction process for targeted metals
- Establish operational and production parameters, marketed products, sales prices, markets
- Determine infrastructure needs (power, transportation, etc.) depending on the site
- Determine the social and environmental impacts and solutions to implement
- Assess the economics of the project (final phase)
- Establish a financial arrangement for the project and secure financing (strategic partnership)
- Obtain authorizations:
  - Environmental impact study (BAPE)
  - Economic scoping study on processing
- Create a monitoring committee



# DEVELOPMENT FACTORS

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# DEVELOPMENT FACTORS

- Economic deposit: grade and tonnage
- Access to capital
- Access to infrastructure:
  - Roads, railway and port facilities, water and power supply
  - Camp and airfield (in some cases)
- Jobs, goods and services providers
- Requirements facilitating social acceptability of projects
- Known, clear, and stable regulations
- Tax incentives:
  - Tax credit for exploration, deposit appraisal and mine development
  - Tax credit for processing of natural resources
- Royalties to the State, taxes, duties, and economic benefits



# MINING TAX REGIME - A FAIR RETURN FOR QUEBECERS

Companies that mine ore in Québec are required to pay mining tax

For fiscal years starting after January 1<sup>st</sup>, 2014, companies pay **the greater** of:

- **Minimum mining tax:**

- Based on the output value at the mine shaft head
- May not be less than 10% of the gross value of annual output
- Rate: 1% on the first \$80M; 4% on the rest

or

- **Mining tax on annual profit:**

- Progressive rate ranging from 16% to 28%
- Based on the profit margin


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# PROCESSING OF URANIUM FROM QUÉBEC

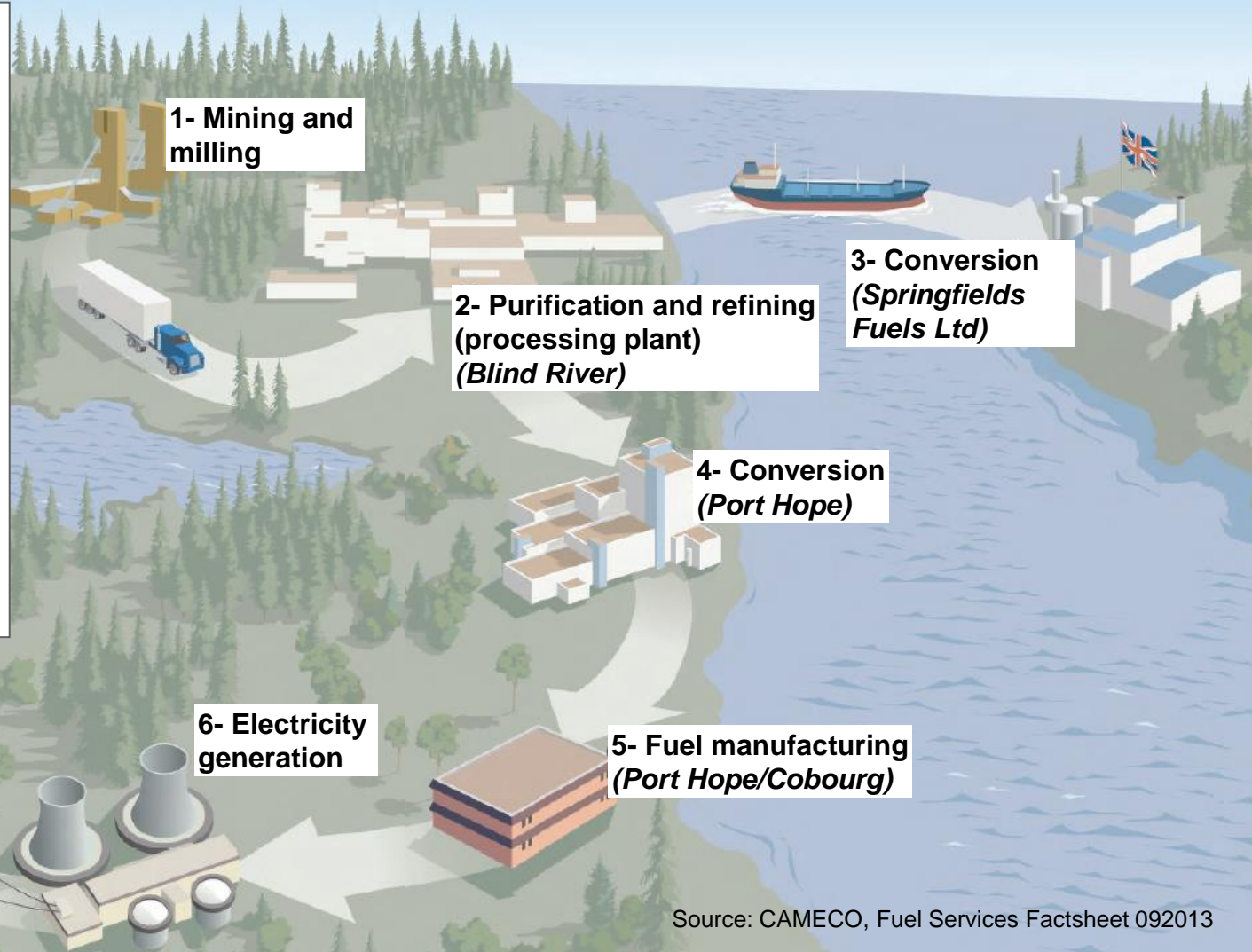
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# URANIUM PRODUCTION CHAIN

- 1- Mining and milling  
( $\text{U}_3\text{O}_8$  - yellowcake)
- 2- Purification and refining  
(processing plant)  
( $\text{U}_3\text{O}_8$  into  $\text{UO}_3$ )
- 3- Conversion  
( $\text{UO}_3$  into  $\text{UF}_6$ )
- 4- Conversion  
( $\text{UO}_3$  into  $\text{UO}_2$ )
- 5- Fuel manufacturing
- 6- Electricity generation  
(nuclear power plant)





# URANIUM PRODUCTION CHAIN

	Mine site			Refinery	Conversion	Manufacturing
Activities	Mining	Processing	Hydrometallurgy	Purification, refining		Shaping
	Crushing, milling, concentration		Dissolution Precipitation	$U_3O_8$ into $UO_3$	$UO_3$ in $UO_2$ $UO_3$ in $UF_6$	$UO_2$
Products	$U_3O_8$ (yellowcake)			$UO_3$	$UO_2$ $UF_6$	Fuel pellets
If project is in Québec	YES			NO		

## In Québec:

- Uranium mining projects would proceed with concentration of uranium into “yellowcake”
- This “yellowcake” would be shipped outside of Québec for refining

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- [web.cim.org/standards](http://web.cim.org/standards)



# EXTRA SLIDES

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# WHAT IS AN EXPLORATION PROJECT?

- **Exploration project:**

All of the exploration activities (prospecting, mapping, geochemical and geophysical surveys, trenching, drilling, sampling) that a person or an organization conducts or intends to conduct with the aim of discovering an ore deposit.

- **Exploration project at the deposit appraisal phase:**

All of the activities (drilling, bulk sampling, data acquisition for project engineering, risk analysis, market study, pilot tests, etc.) that a person or an organization conducts or intends to conduct with the aim of appraising and developing an ore deposit.

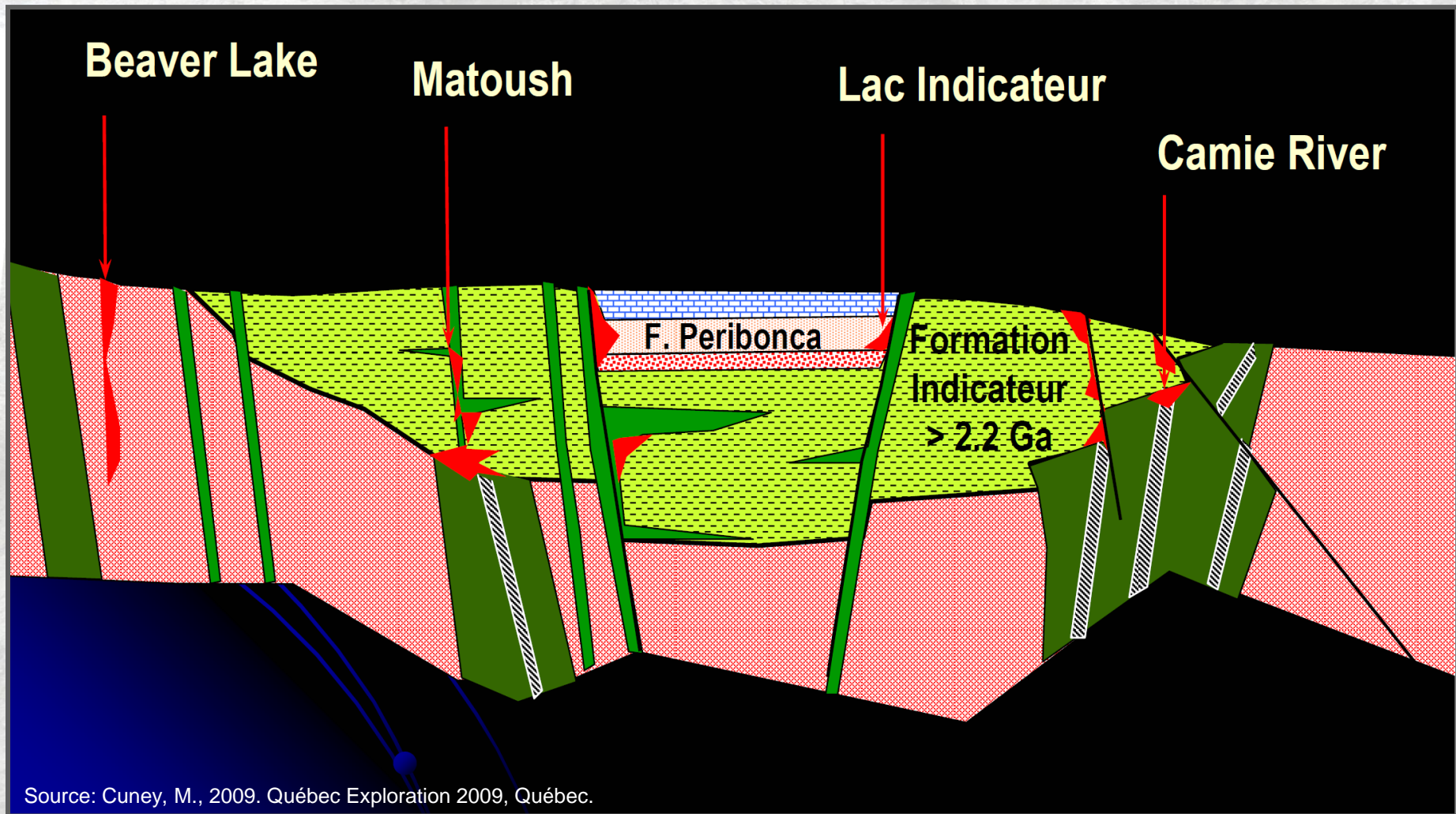


# GEOLOGICAL SETTINGS WHERE URANIUM CAN BE FOUND

- Unconformities
- Pegmatites
- Uraniferous placers
- Sandstones
- Granitoids
- Volcanic rocks
- Uranium veins in shear zones
- Olympic Dam

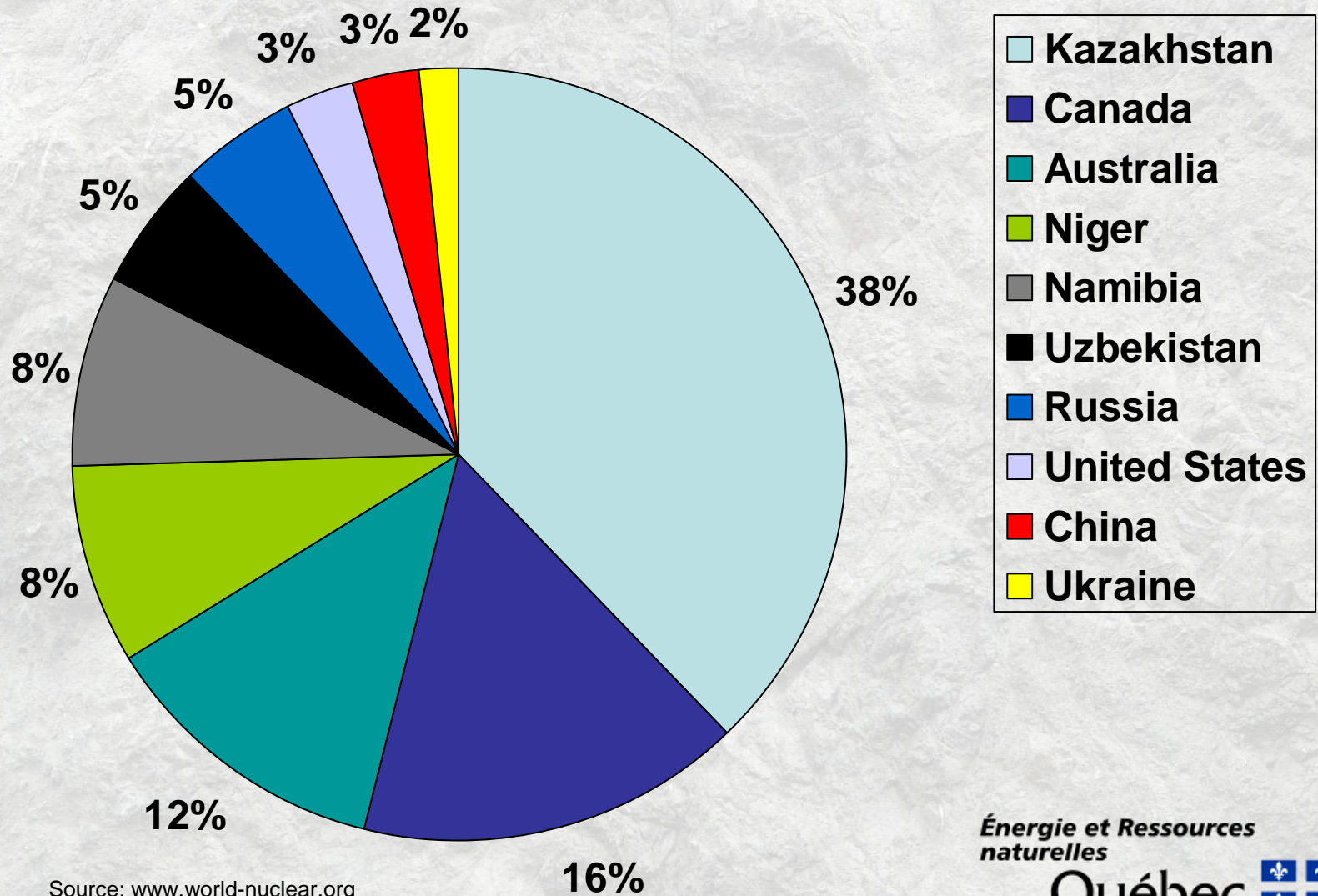


# URANIUM DEPOSITS ASSOCIATED WITH SEDIMENTARY ROCKS





# WORLD URANIUM PRODUCTION IN 2012



Source: [www.world-nuclear.org](http://www.world-nuclear.org)

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