CRITICAL METALS POTENTIAL OF POLYMETALLIC INTRUSION-RELATED MINERALIZATION FROM THE APPALACHIAN QUÉBEC-MAINE BORDER AREA

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SOUTHERN QUEBEC IS A HIGH-POTENTIAL REGION FOR THE DISCOVERY OF STRATEGIC MINERALS AND CRITICAL METALS.

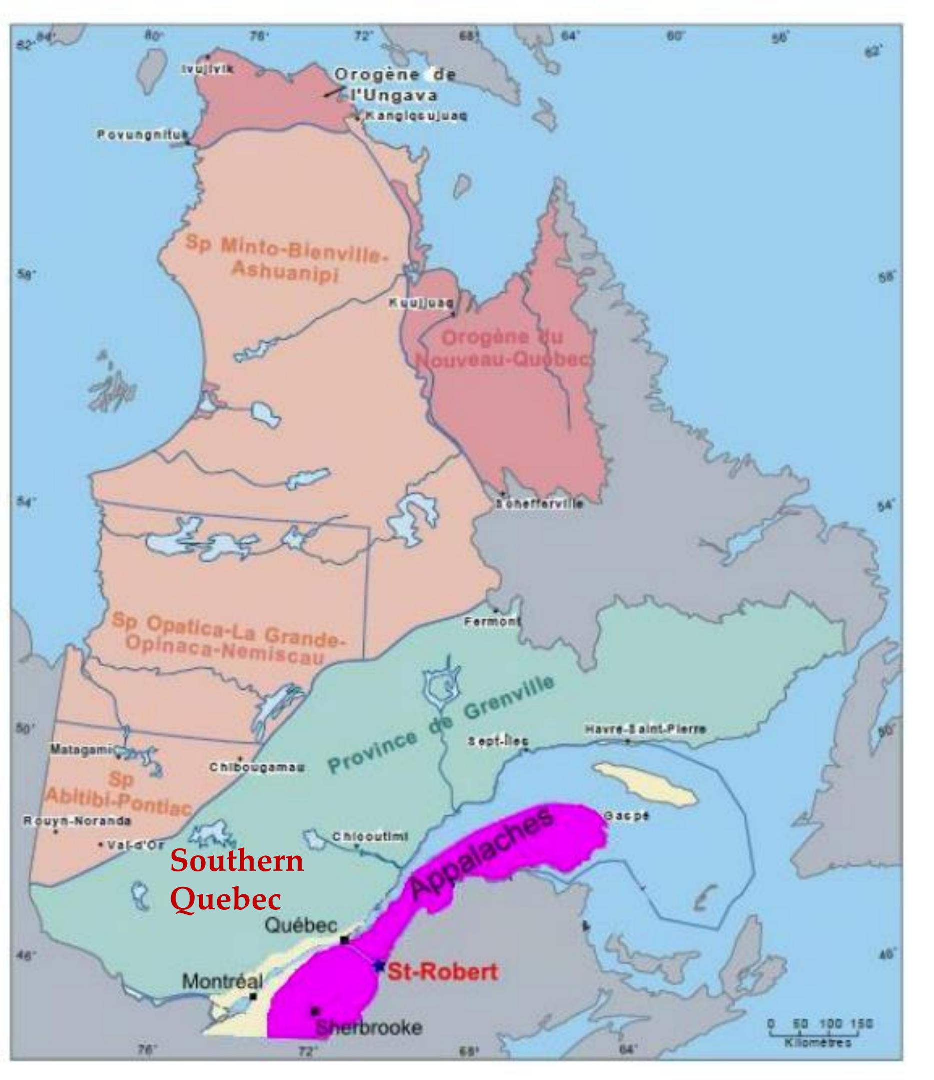
-With the exception of the old St-Robert mine area, the region is relatively underexplored for these metals, but the geology contains most of the components needed to form deposits.

-Economic exploitation of these critical metals is possible because of the polymetallic nature of the mineralization.

This presentation highlights the geological and metallogenic potential of Quebec's Appalachians in the border region between Quebec and Maine (USA).

The mineralizations of interest in this region are closely associated with Devonian intrusions, and exploration targets are mainly located in the Siluro-Devonian Appalachian formations.

The St-Robert Bellarmin area is prioritized due to the polymetallic nature of the granophile mineralized zones, which allow for the production of concentrates rich in Pb-Ag, Zn and critical metals such as W and Bi. The same area has gold potential to be developed.



The high-potential porphyry mineralization sector is located in southern Quebec, more specifically the near the Quebec-Maine (USA) border.

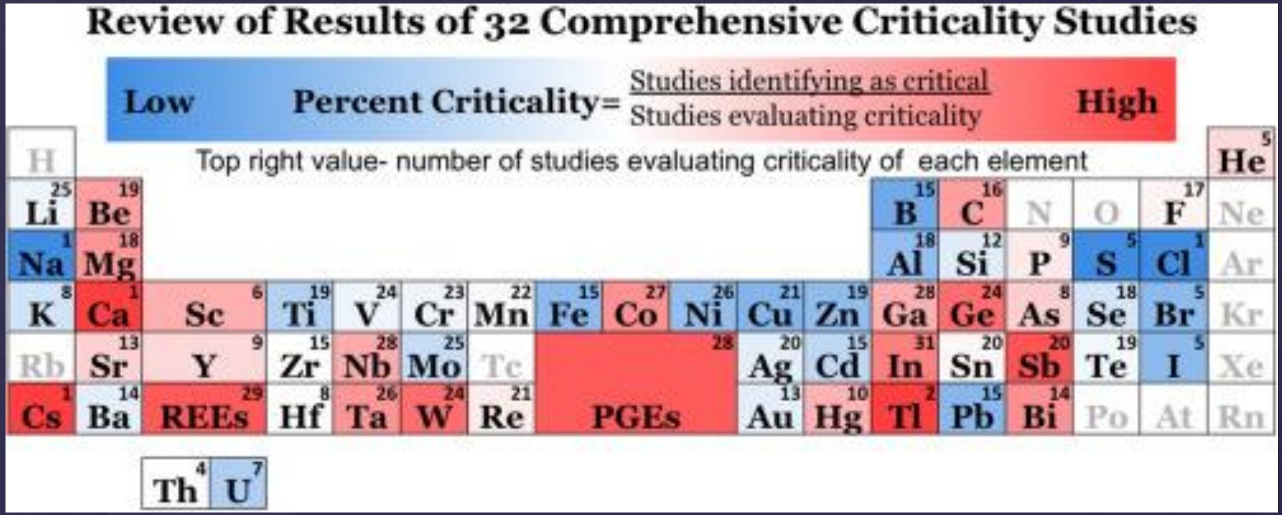
Porphyry-related granophile mineralizations (and associated quartz veins) are most often polymetallic in nature. At St-Robert Bellarmin, these mineralizations are Pb-Ag-Zn-W-Bi.

The presence of strategic metals and minerals in these Devonian mineralized systems is of interest to industry and governments.

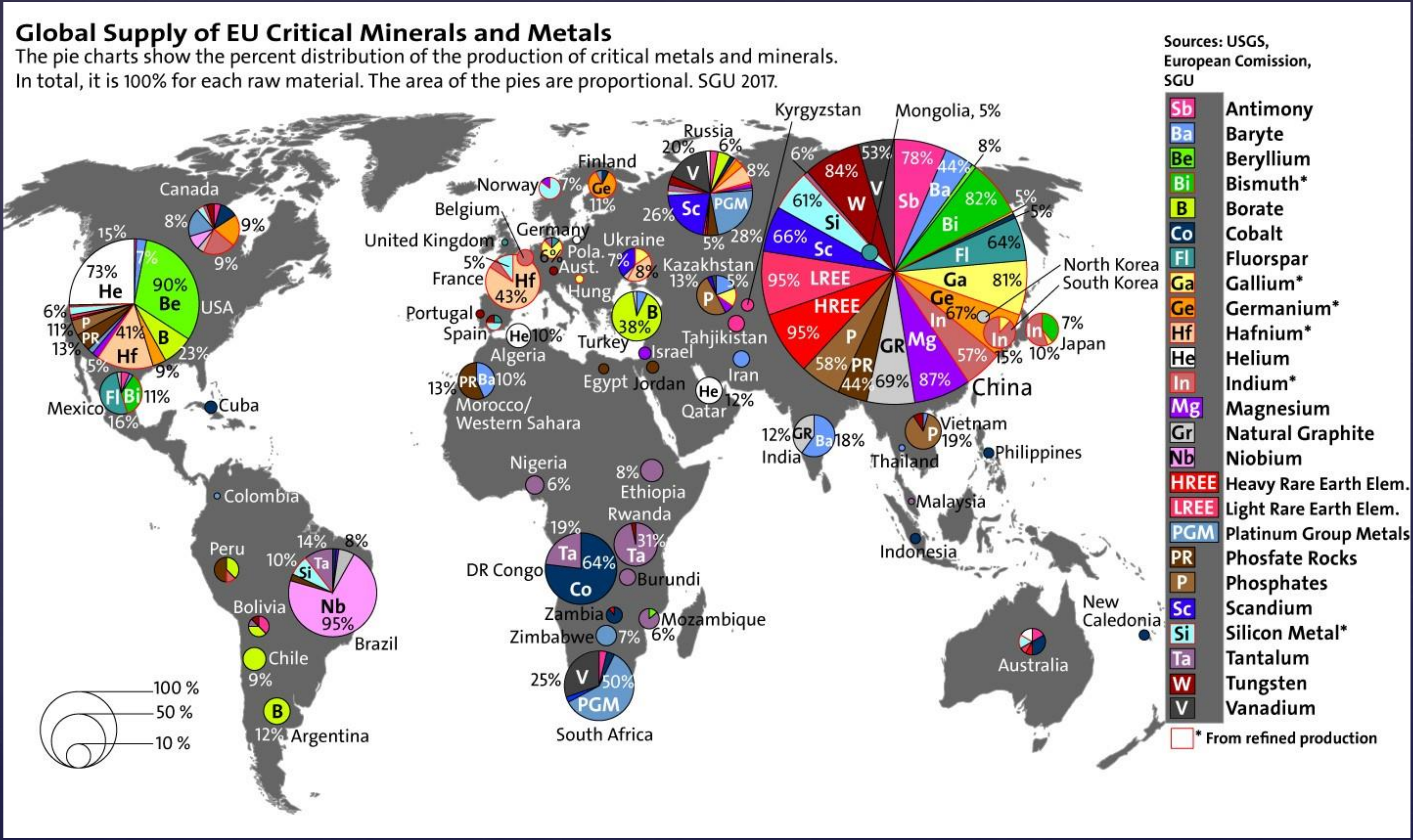
The St-Robert-St-Theophile area also has strong gold potential (e.g. Bella fault).

Potential in the southern Appalachians of Quebec

Canada's critical mineral list



Hayes and McCullough, 2018: Resources Policy 59 (2018) 192–199


Global Supply of EU Critical Minerals and Metals
The pie charts show the percent distribution of the production of critical metals and minerals.
In total, it is 100% for each raw material. The area of the pies are proportional. SGU 2017.
Sources: USGS, European Comission, SGU
Sb Antimony
Ba Baryte
Be Beryllium
Bi Bismuth*
B Borate
Co Cobalt
Fl Fluorspar
Ga Gallium*
Ge Germanium*
Hf Hafnium*
He Helium
In Indium*
Mg Magnesium
Gr Natural Graphite
Nb Niobium
HREE Heavy Rare Earth Elem.
LREE Light Rare Earth Elem.
PGM Platinum Group Metals
PR Phosfate Rocks
P Phosphates
Sc Scandium
Si Silicon Metal*
Ta Tantalum
W Tungsten
V Vanadium
* From refined production
100 %
50 %
10 %
Canada 8% 9% 9%
USA 15% 73% He 90% Be 7% 6% 11% 13% P PR 41% Hf B 23% 9% 5%
Mexico Fl Bi 11% 16%
Cuba
Colombia
Peru
Bolivia
Chile 9%
B 12% Argentina
Brazil 14% 8% 10% Si Ta Nb 95%
Norway 7%
Finland Ge 11%
Belgium
United Kingdom
Germany 6%
Pola.
Aust.
Hung.
France 5% Hf 43%
Portugal
Spain
He 10% Algeria
Morocco/ Western Sahara 13% PR Ba 10%
Ukraine 7% 8%
Turkey B 38%
Israel
Egypt
Jordan
Qatar He 12%
Iran
Nigeria 6%
Ethiopia 8%
Rwanda 31% Ta
DR Congo 19% Ta 64% Co
Burundi
Zambia
Mozambique 6%
Zimbabwe 7%
South Africa 25% V 50% PGM
Russia 20% 6% 8% V Sc PGM 26% 5% 28%
Kazakhstan 13% 5% P
Tahjikistan
Kyrgyzstan
Mongolia, 5%
China 6% 84% W 53% V 78% Sb 44% Ba 8% 82% Bi 5% 5% 64% Fl 61% Si 66% Sc 95% LREE 95% HREE Ga 81% Ge 67% In 58% P 44% PR GR 69% Mg 87% 57%
North Korea
South Korea 15%
Japan In 7% 10%
India 12% GR Ba 18%
Vietnam P 19%
Thailand
Philippines
Malaysia
Indonesia
Australia
New Caledonia

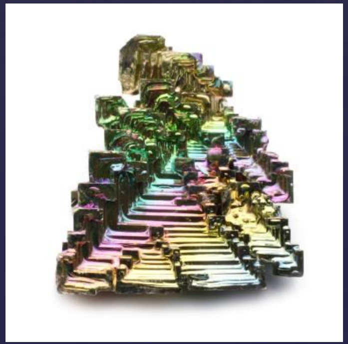
Minerals Absolutely Critical to U.S. Security

Critical Minerals List

NET IMPORT RELIANCE

Mineral	Net import reliance	Use	Mineral	Net import reliance	Use
BERYLLIUM	14%	*Alloying agent in aerospace and defense*	TITANIUM	91%	*White pigment, metal alloys*
MAGNESIUM	47%	*Furnace linings for manufacturing steel*	POTASH	92%	*Fertilizer*
GERMANIUM	50%*	*Fiber optics, night vision applications*	BISMUTH	96%	*Used in medical and atomic research*
LITHIUM	50%*	*Batteries*	VANADIUM	100%	*Used for titanium alloys*
TUNGSTEN	50%*	*Used in wear-resistant metals*	CESIUM	100%	*Used in research and development*
ZIRCONIUM	50%*	*High-temperature ceramics production*	FLUORSPAR	100%	*Aluminum manufacturing, gasoline, uranium fuel*
ALUMINUM	61%	*Used in almost all sectors of the economy*	GALLIUM	100%	*Integrated circuits, optical devices (e.g. LEDs)*
PLATINUM-GROUP METALS	68%†	*Catalytic agents*	GRAPHITE	100%	*Lubricants, batteries, fuel cells*
CHROMIUM	69%	*Stainless steel, other alloys*	INDIUM	100%	*LCD screens*
COBALT	72%	*Rechargeable batteries, superalloys*	MANGANESE	100%	*Steelmaking*
TIN	75%	*Coatings and alloys for steel*	NIOBIUM	100%	*Steel alloys*
BARITE	75%*	*Cement and petroleum industries*	RARE EARTHS	100%	*Batteries, electronics*
TELLURIUM	75%*	*Steelmaking, solar cells*	RUBIDIUM	100%	*Research and development in electronics*
RHENIUM	80%	*Lead-free gasoline, superalloys*	SCANDIUM	100%	*Alloys, fuel cells*
ANTIMONY	85%	*Batteries, flame retardants*	STRONTIUM	100%	*Pyrotechnics, ceramic magnets*
TITANIUM	91%	*White pigment, metal alloys*	TANTALUM	100%	*Electronic components (e.g. capacitors)*

Scheelite



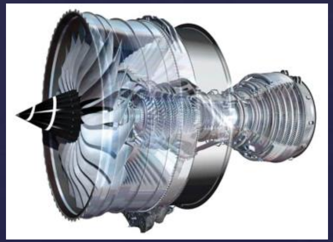
Bismuth

Tungsten (W)

Production of hard metals
Specialist steels

high strength, hardness, heat tolerance, and wear and corrosive resistance

-cutting tools for mining and machining metals
-tamping dies and hot rollers in steel mills
-turbine blades
-rocket nozzles
-space vehicle reentry shields,
-exhaust gas assemblies,
-industrial furnaces,
-armour-piercing ammunition,
-bearings.



-radiation shielding
-high voltage switches
-electrodes
-circuit breakers.
-incandescent light bulb filaments,
-x-ray and cathode-ray tubes heating elements

Tungsten (W)

Chemical industry

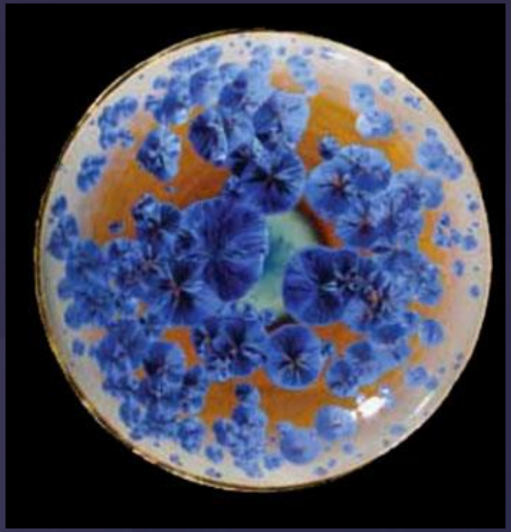
-Ceramic glazes

-Enamels

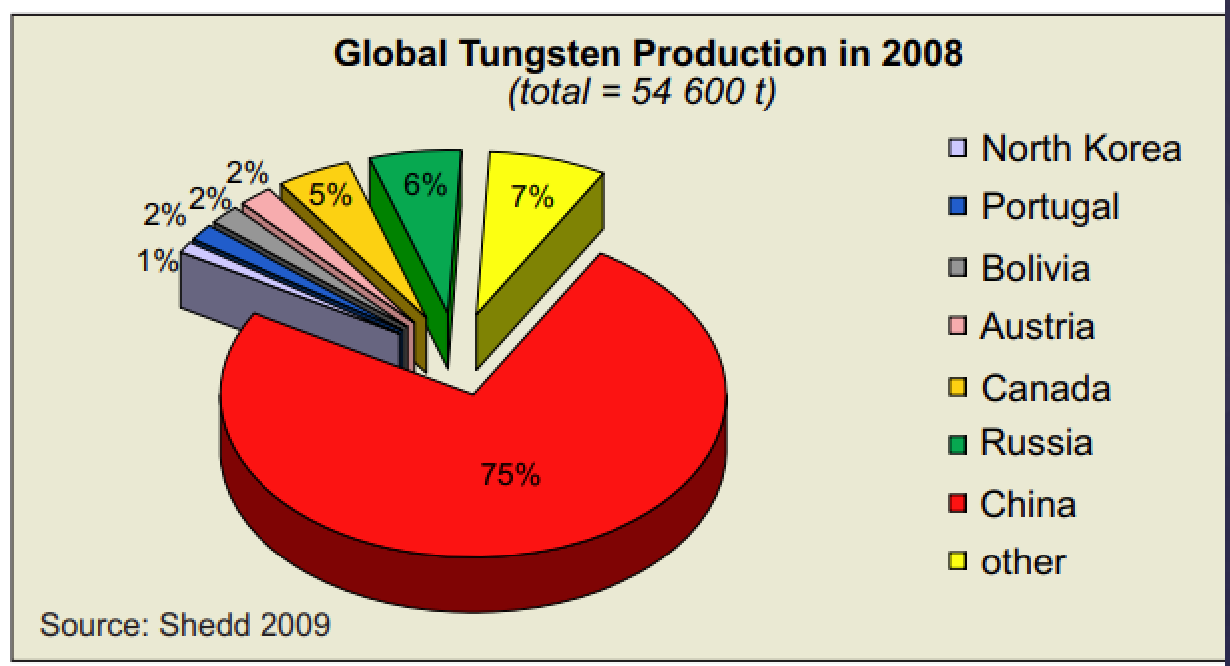
-White pigments in paint

-Fireproofing of textiles

-Production of semiconductor circuits



Tungsten (W)



During the past several years, China has become the world's largest tungsten consumer because of rapid industrialization; therefore, export of the metal is now **limited**

Bismuth (Bi)

Bismuth is used in:

-Pigments

-Medical applications

-Cosmetics

-Industrial catalyst

-Metallurgical industry

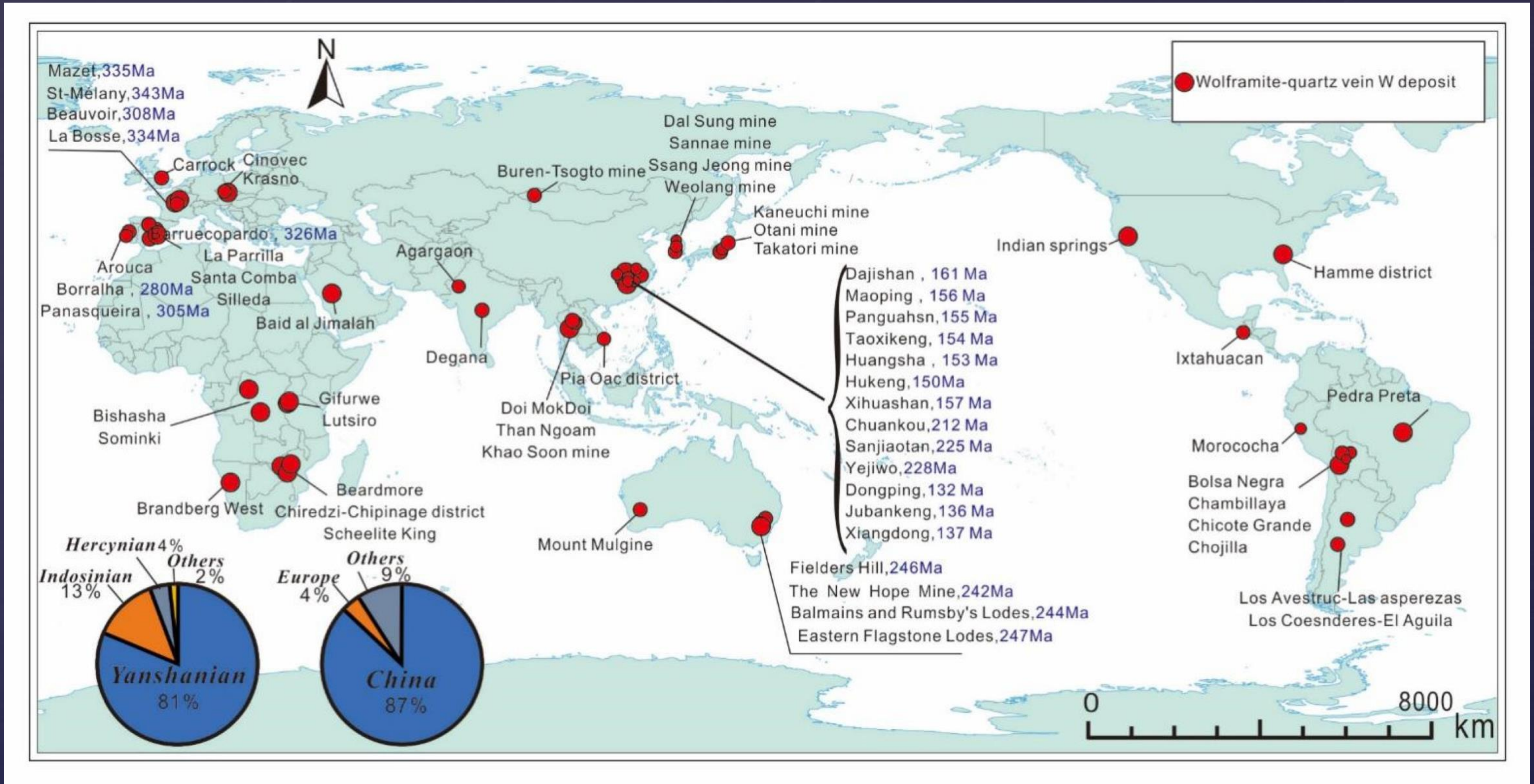
-Alloys and solder

-Electronics (infrared spectroscopy, semiconductors)

-Research and development

-Spectroscopy (x-ray and gamma-ray detectors, laser)

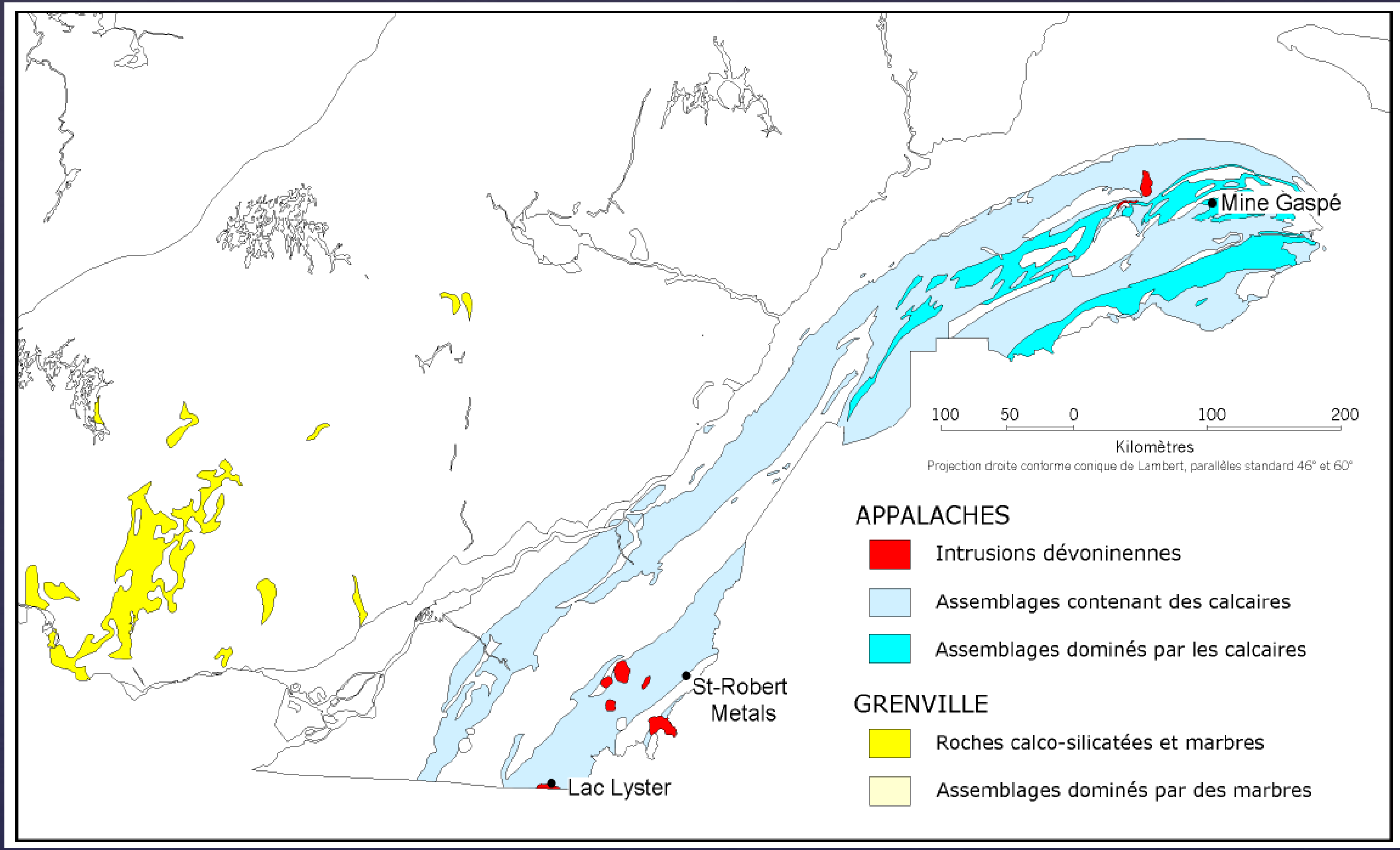
WORLD DISTRIBUTION OF WOLFRAMITE-QUARTZ VEIN W DEPOSIT



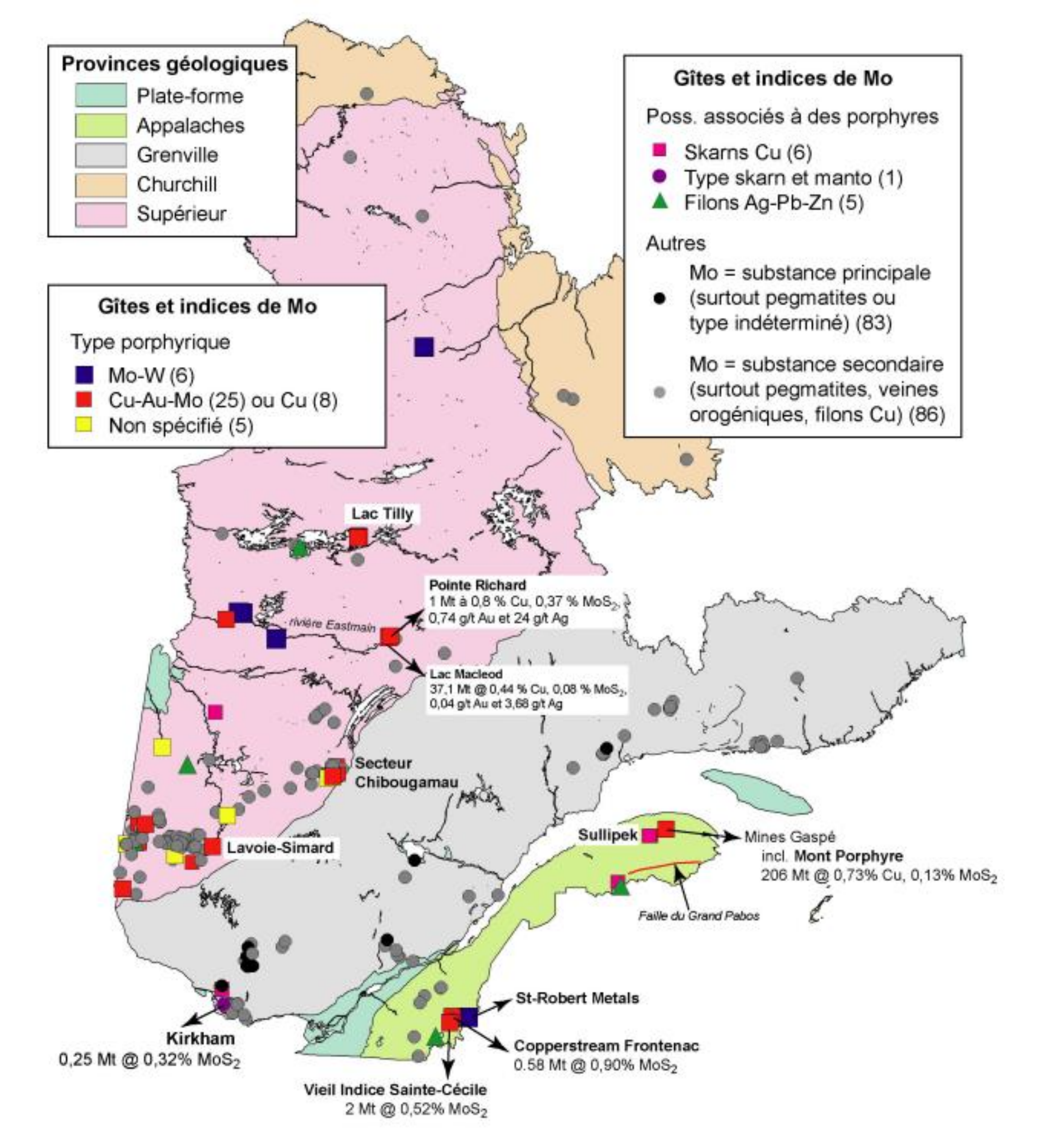
Ni et al., 2022; Minerals **2022**, *12(2), 237*

Critical minerals in the Quebec-Maine Frontier area of the Appalachian Belt

Location of areas in Québec with Devonian instrusions



Source: https://www.sidex.ca/wp-content/uploads/2022/03/Explorer-pour-le-tungste%CC%80ne-au-Que%CC%81bec.pdf



Source: https://www.sidex.ca/wp-content/uploads/2022/03/Explorer-pour-le-molybde%CC%80ne-au-Que%CC%81bec.pdf

In southern Quebec, the high-potential areas for tungsten are the same as those for molybdenum.

Although the presence of tungsten has been recognized for decades, the mining industry has never developed this market. Especially since, from the early 1980s, the market was dominated by China and the value of the ore (WO_3) was low.

In southern Quebec, scheelite ($CaWO_4$) is closely associated with polymetallic vein mineralization rich enough in metals to be mined. Regardless of the market price of WO_3, it would be possible to mine these mineralizations based on the prices of Ag, Pb, Zn and Bi, as well as Au.

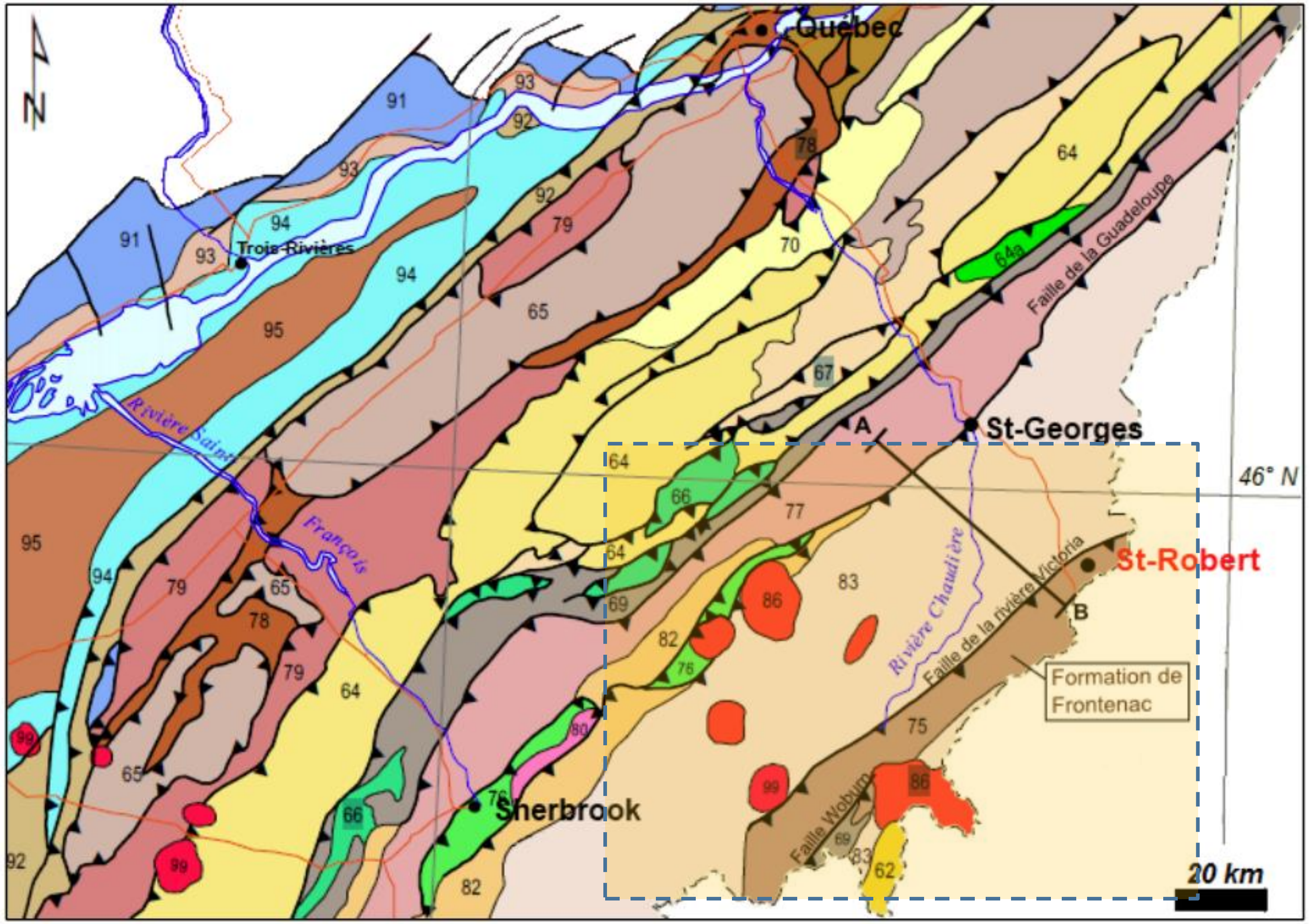


Figure 2.9 : Carte géologique des Appalaches de la région de St-Robert et légende. Modifiée de la carte géologique du Québec du MRNF, 2002. Les numéros 88 à 92 représentent les membres de la plate-forme du St-Laurent. La droite A-B représente le tracé de la coupe géologique présentée sur la figure 2.10.

Geology of the Appalachians south of Quebec City and north of the Quebec-Maine border

Devonian intrusive pluton are shown in red.

W, Bi and Mo mineralisations are reported in the MRN database (SIGEOM)

NW-SE geological section showing Precambrian basement, the St. Lawrence Platform and the Appalachian formations, including the Precambrian Chain Lakes massif to the south.

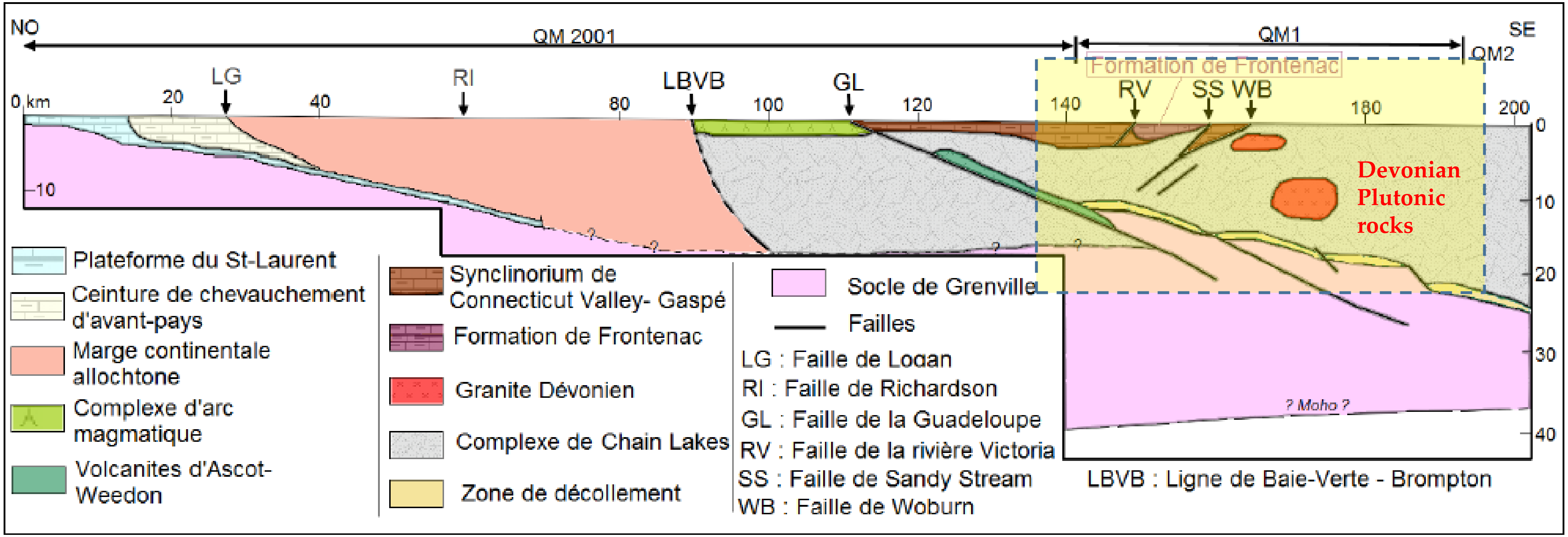
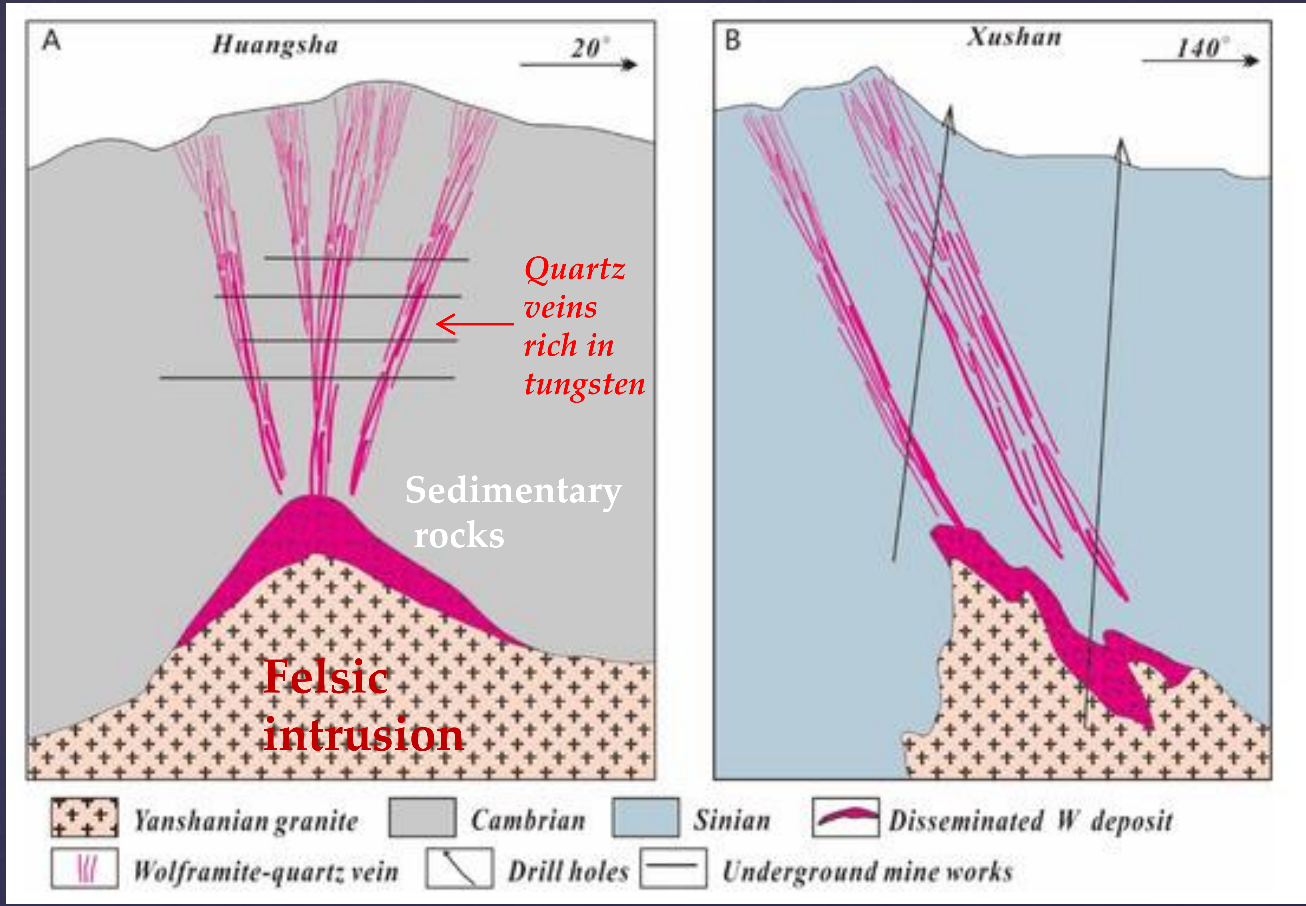


Figure 6.66 : Coupe géologique issue de l'interprétation des profils sismiques effectués par l'USGS et Ressources Naturelles Canada. La localisation du profil est située figure 6.65. Modifiée de Spencer et al. (1989).



Exploration strategy for tungsten

-Detect highly differentiated igneous masses (geophysics)

-Locate plutons overlain by sedimentary rock cover (geophysics, geology)

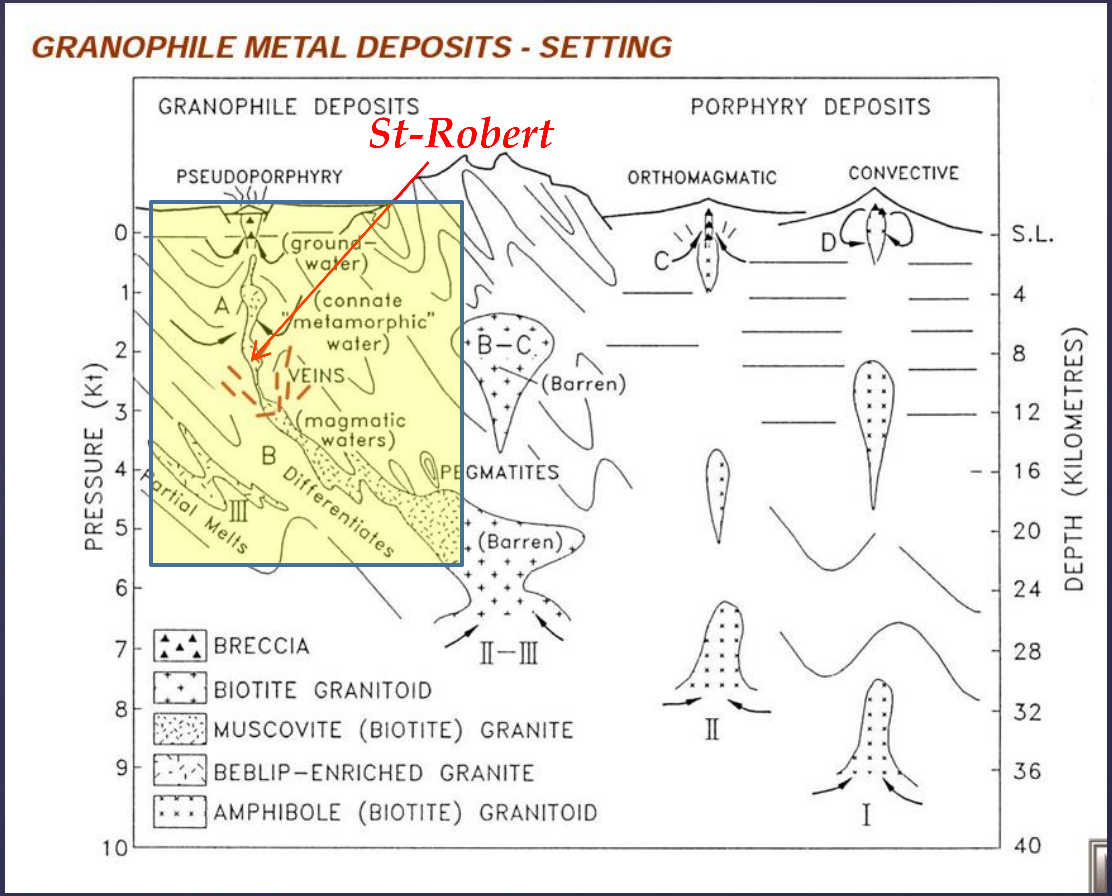
-Locate magmatism related to continental subduction

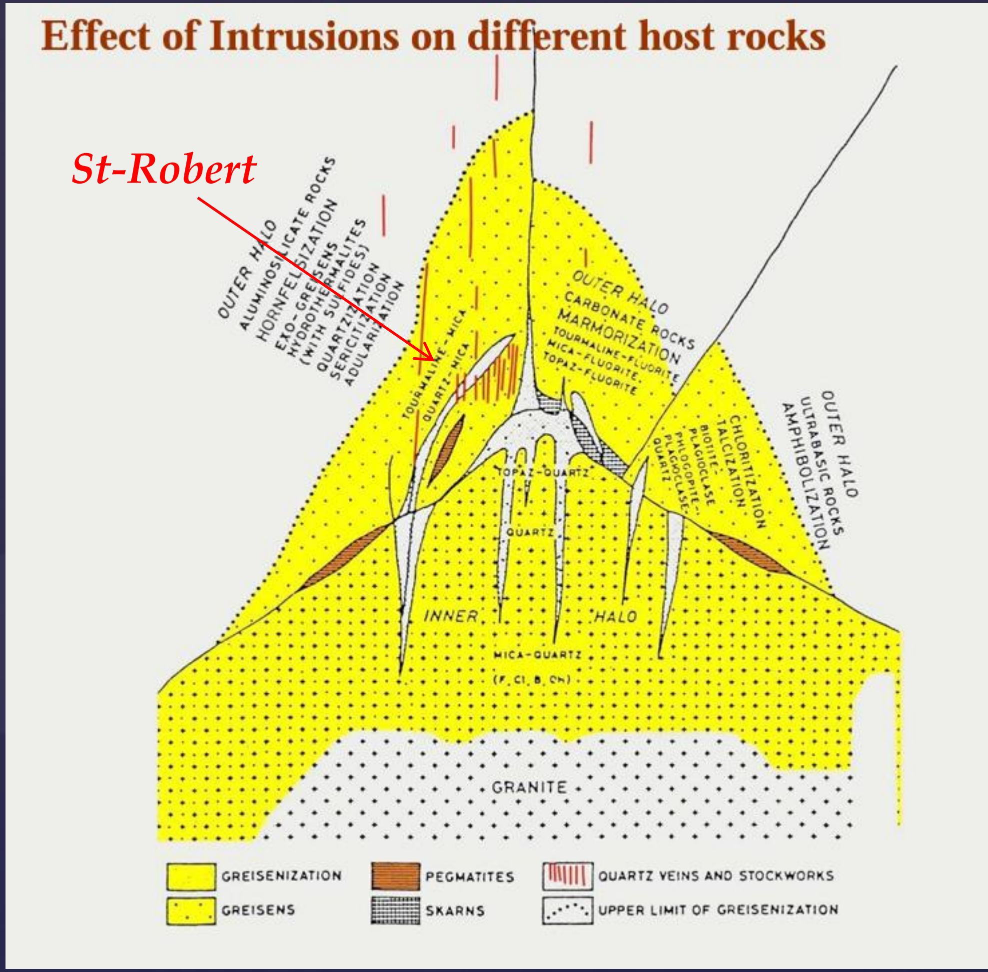
-If scheelite-rich quartz veins are present, look for wolframite zones closer to the intrusion (at depth) …..

-If calcium-rich rocks are present near the pluton, skarn-type mineralization is a major target possibility ….

-Scheelite can also be REE-rich ….

EXPLORATION FOR INTRUSION-RELATED GRANOPHILE METAL DEPOSITS





Source: mines-prospector-matty-mitchell-virtual-metallic-mineral-deposits-of-nl-part-5-granite-hosted.pdf

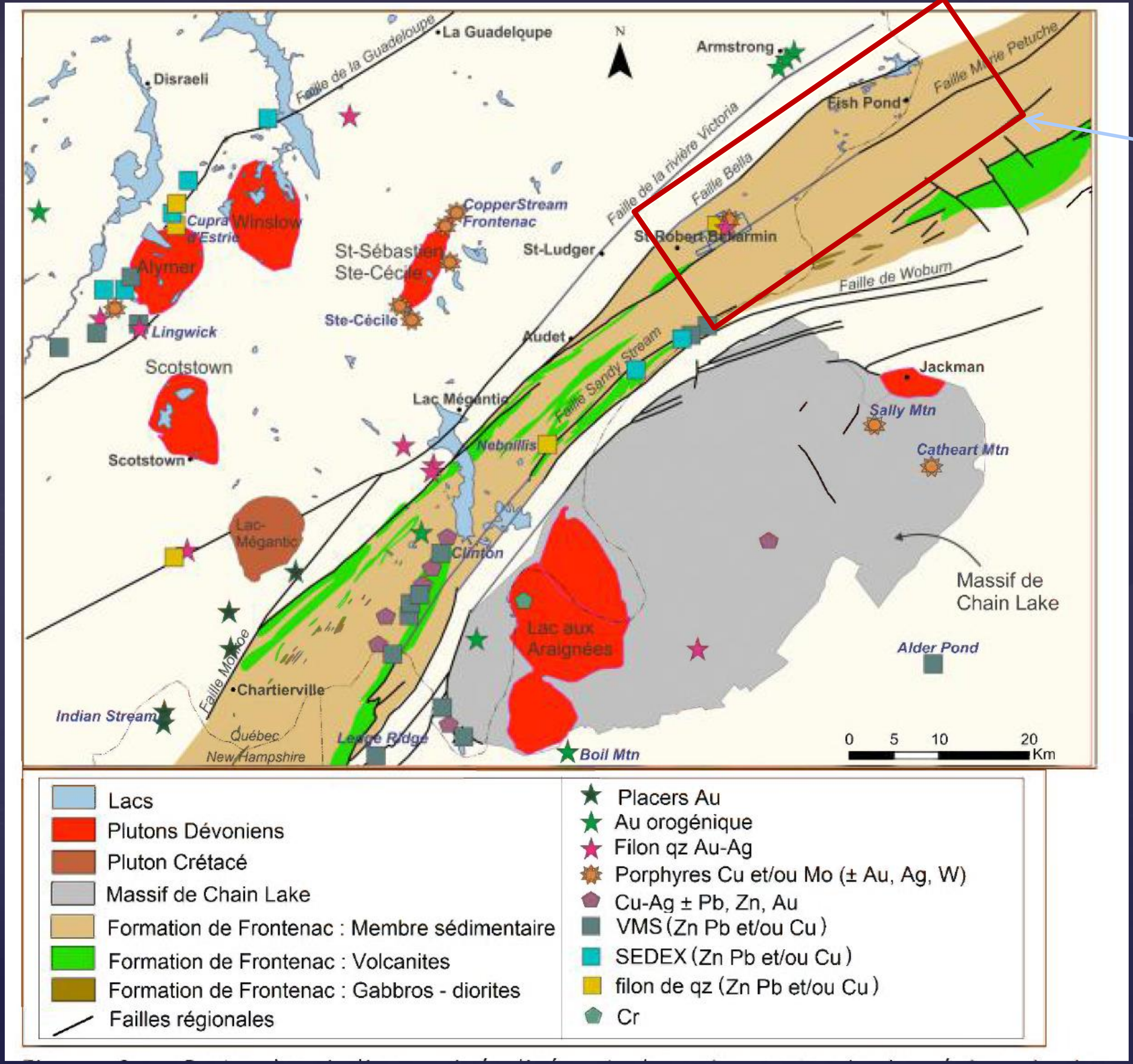
In the St-Robert-Bellarmin area, the rocks of the Frontenac Formation have also been affected by the emplacement of **deep intrusions** and granophile pseudo-**porphyry mineralizations** (former St-Robert Metals mine).

-This metallogenic context is favourable to the emplacement of polymetallic mineralisations (**W**, Pb, Ag, Zn, **Bi** and **Mo)**.

-W, Bi and Mo are considered as critical metals for the industry and governments

-Other elements such as rare earths can be present as substitutes in scheelite (no data for St-Robert)

Exploration sector of Leopard Lake Gold Corp



Modified from **Athurion (2013)**

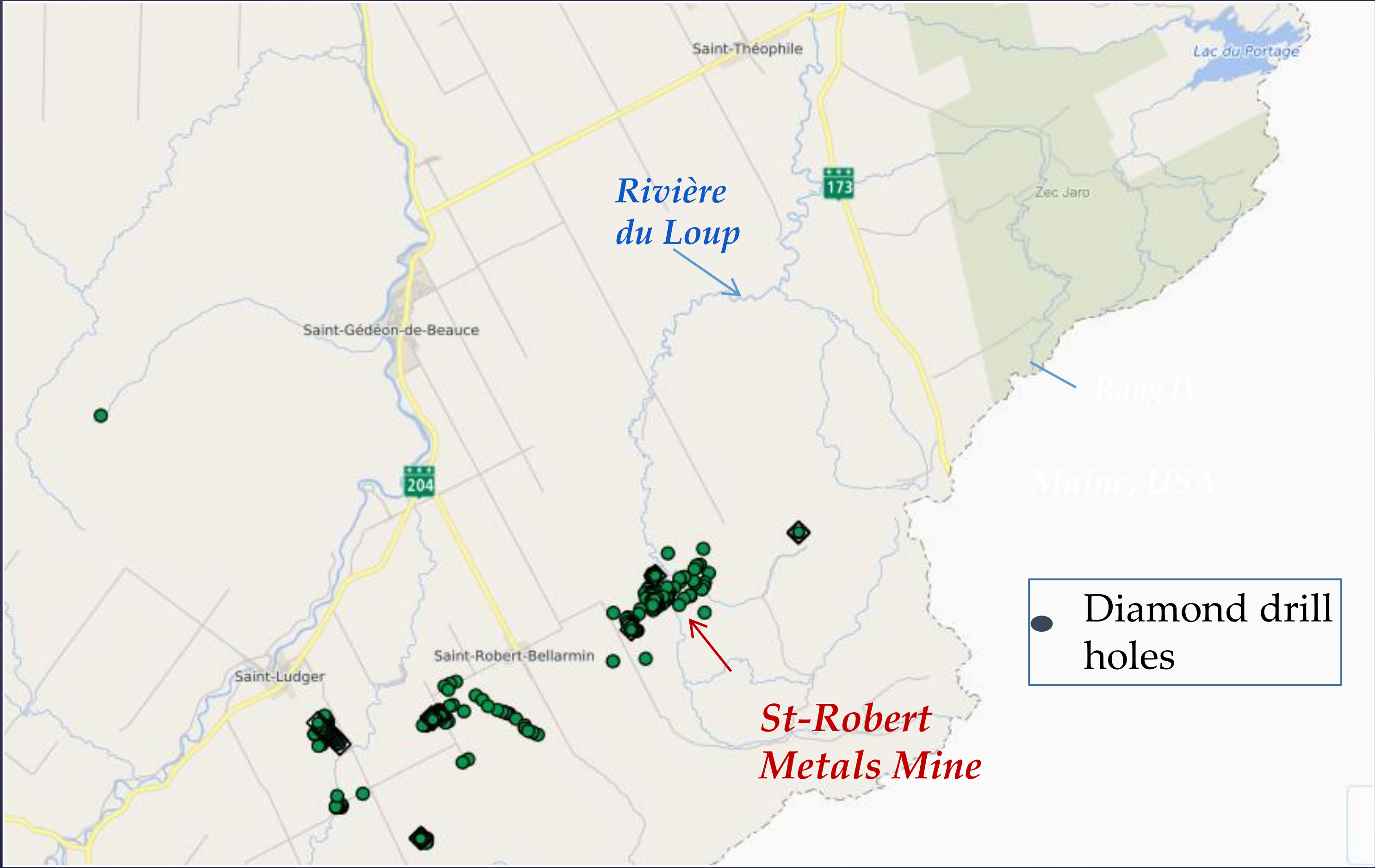
-A very large part of the area is unexplored

-Restricted access to Domtar territory (private forest properties)

-In this region of Quebec, for a long time, underground rights belonged to surface owners.

LEOPARD LAKE GOLD CORP.

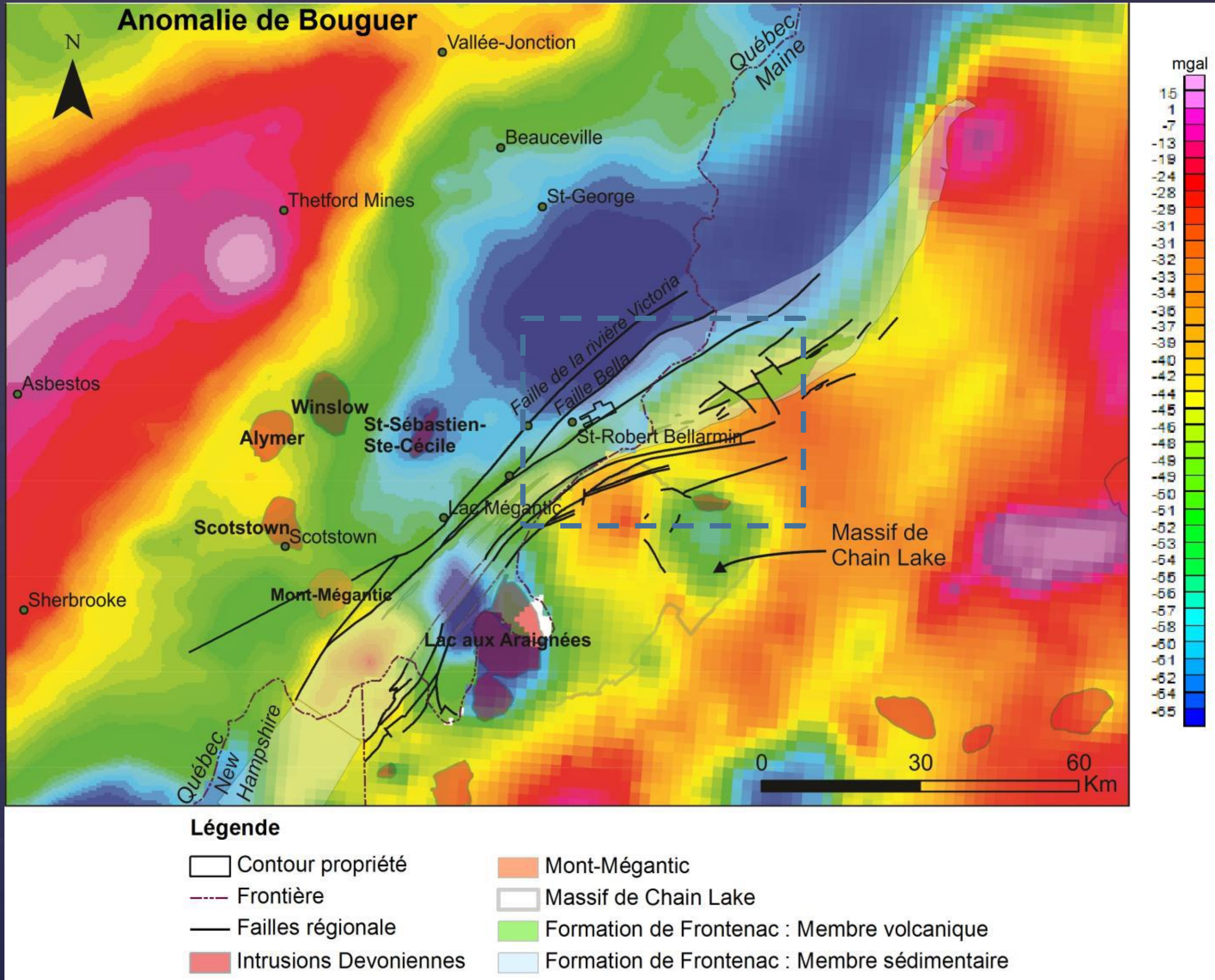
DISTRIBUTION OF DIAMOND DRILL HOLES



Source: MERN-SIGÉOM (sept 2022)

-THE ABSENCE OF DRILLING EAST AND NORTHEAST OF THE ST-ROBERT MINE IS A GOOD INDICATION OF UNEXPLORED TERRITORY FOR MINERAL RESOURCES.

-THIS TERRITORY CORRESPONDS, FOR THE MOST PART, TO THE DOMTAR PRIVATE FOREST LANDS.

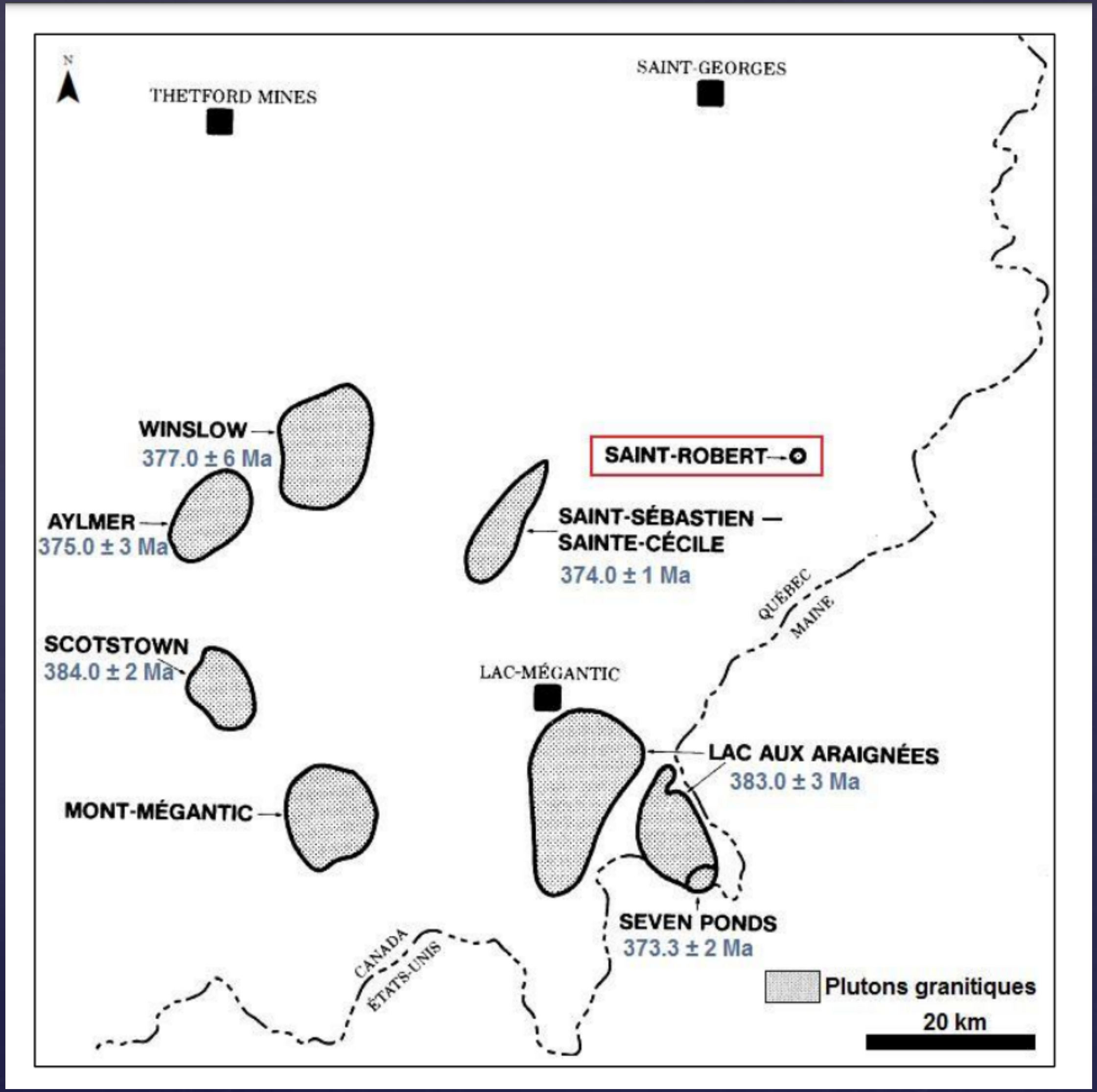


Regional gravity map centered on the St-Robert area.

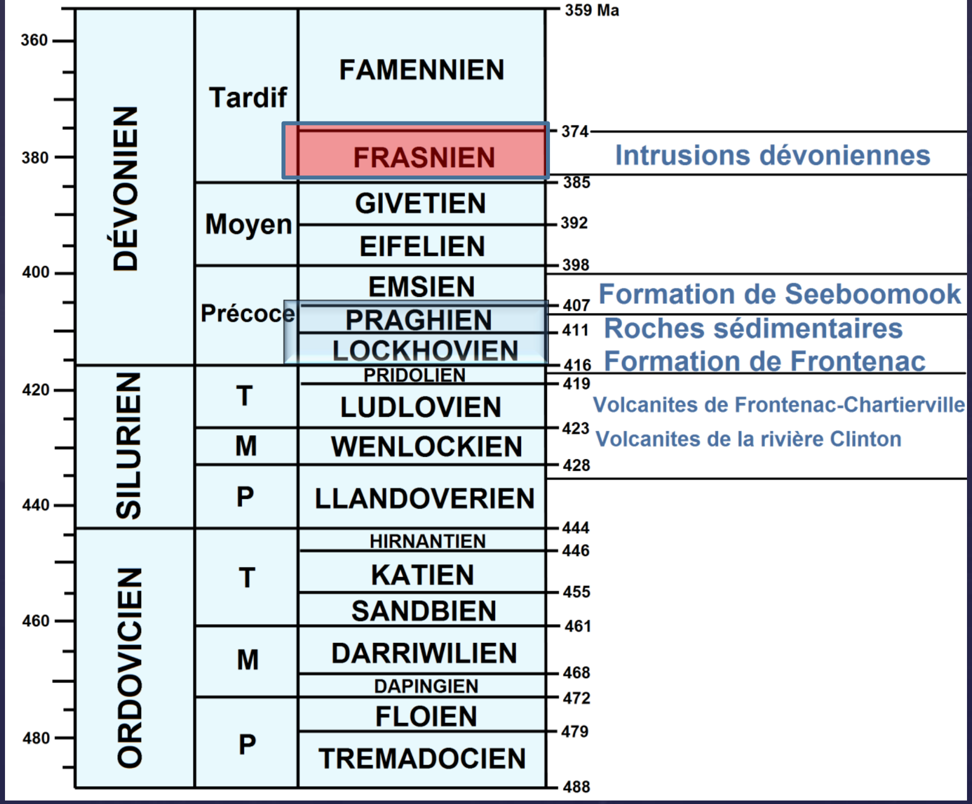
The main faults in the region are indicated on the map.

The St-Robert mine area is located in a major tectonic transition zone.

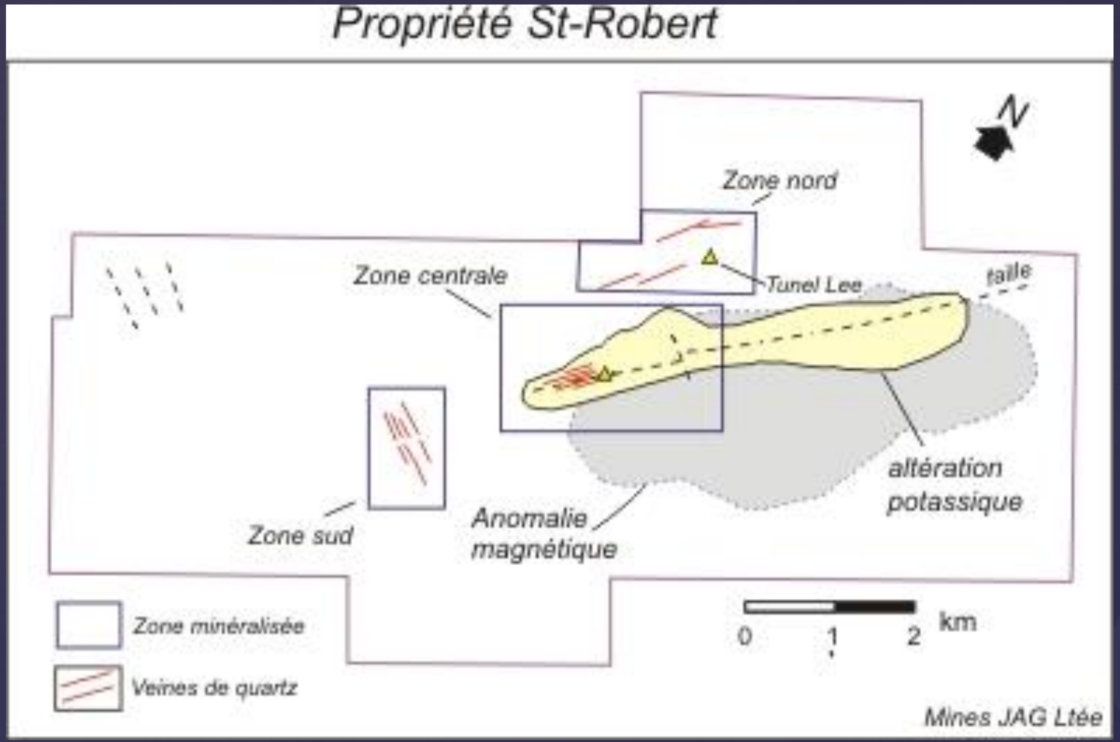
LOCATION OF THE MAIN DEVONIAN INTRUSION IN SOUTHERN BEAUCE AREA (QC)



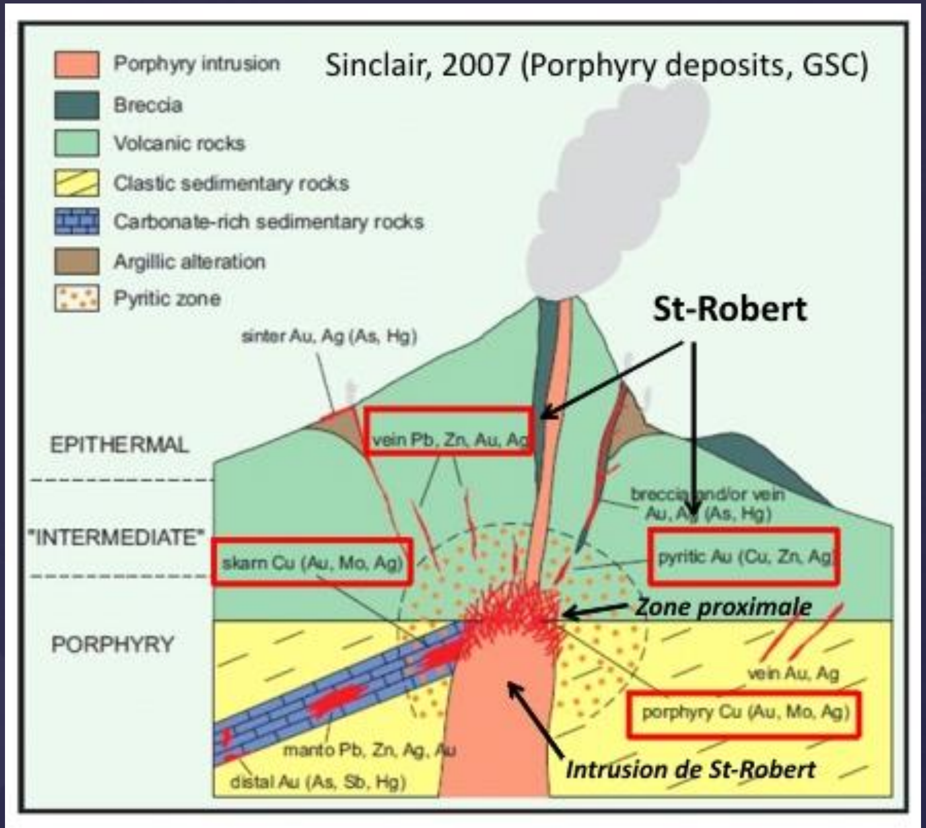
Stratigraphical column



LOCAL GEOLOGY AND METALLOGENY



Simplified geology of the St-Robert property. The magnetic anomaly is interpreted as associated with the presence of a relatively shallow magnetic intrusive mass. The main mineralized quartz veins are shown in red.

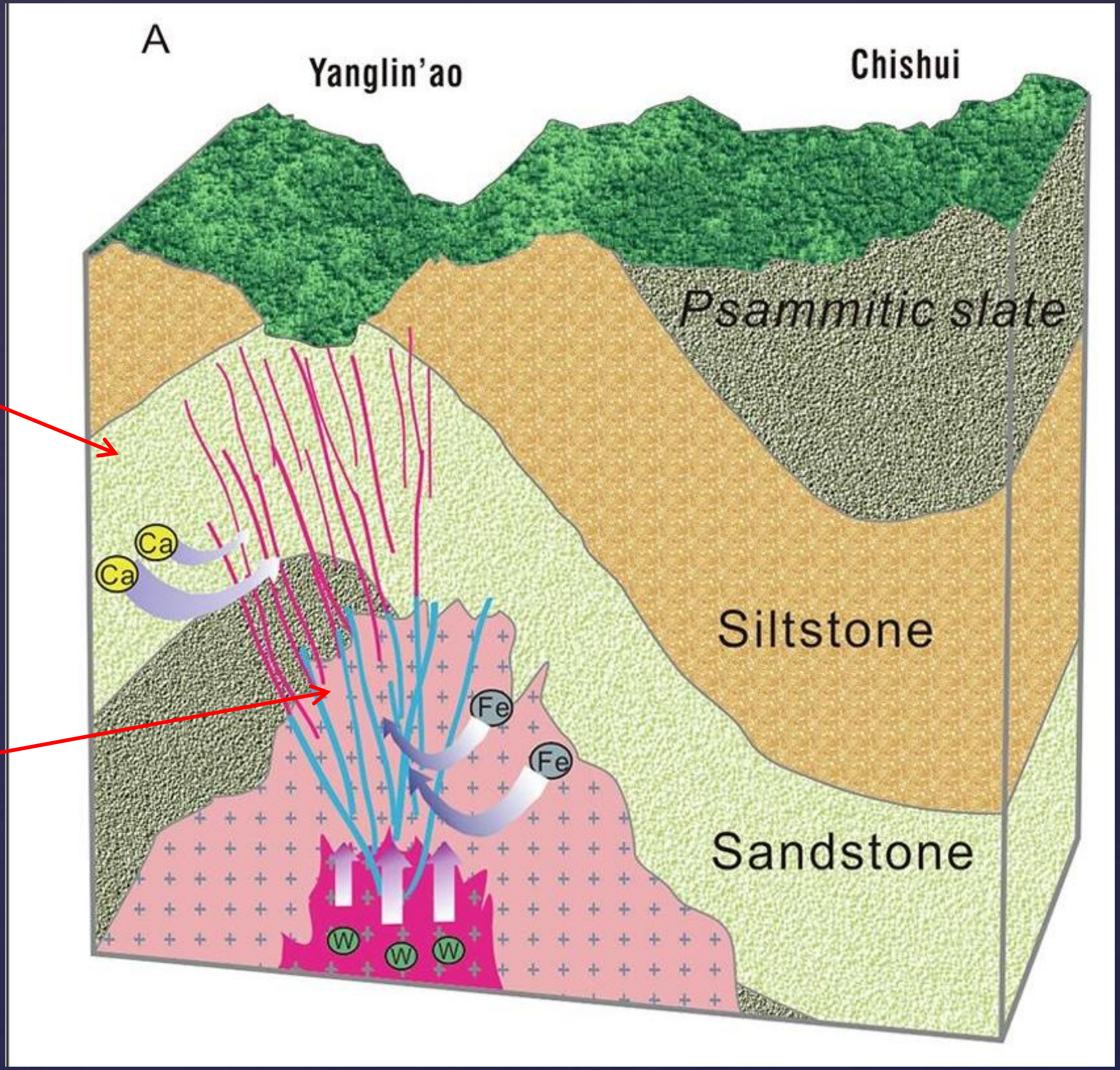


Simplified geological model of a porphyry deposit associated with a felsic intrusion. Note the presence of **proximal mineralization** near the pluton and **distal vein mineralization** in the crustal rocks above the intrusive mass. Figure from Sinclair (2007).

EXPLORATION MODEL FOR THE ST-ROBERT AREA

Polymetallic quartz veins with scheelite (W) South zones, Central and North zones.

Deeper sectors to explore (2023-+). Deep mineralized zone may contain wolframite (W) and possibly Cu , Mo or Sn.



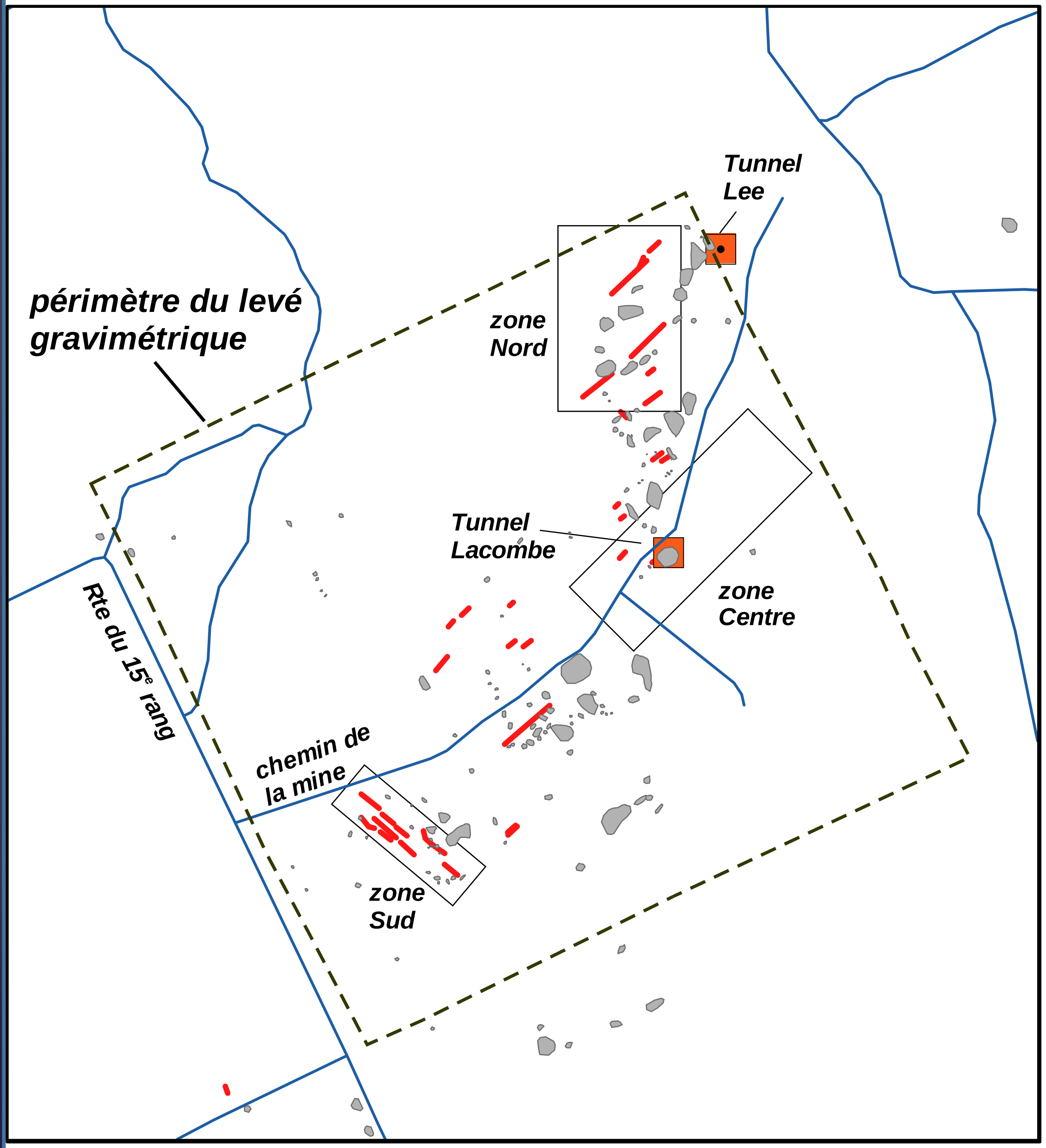
Li et al., 2022; Ore Geology Reviews Volume 142, March 2022

Mineral potential of the St-Robert property area

In 1958, the engineer Lacombe carried out a resource calculation on the property. Based on the results of drilling and underground workings, he determined that for the **first 180 meters** (600 feet) **of depth**, the three mineralized zones (***South, Centre and North***) contained **895,107 tons** of proven ore and **2,167,002 tons of probable ore**.

Given the long timeframe of these calculations and the less stringent quality control standards of the time, the tonnages calculated by Lacombe (1958) must be considered as *historical resources*. To establish true reserve calculations, new drilling campaigns will be required.

Zones minéralisées et veines



Location of South, Central and North mineralized zones and main polymetallic quartz veins (in red) on the St-Robert property.

Location of the main rock outcrops is shown on the map.

SUMMARY TABLE OF **HISTORICAL RESOURCES** CALCULATED BY LACOMBE (1958)

Tableau 7.1 : Tableau récapitulatif des ressources historiques calculées par Lacombe (1958). La zone Centre correspond aux corps minéralisés 2, 3 et 4. La zone Sud correspond au corps minéralisé 1 et la zone Nord aux corps minéralisés 5 a et 5b.

Corps minéralisés	1	2	3	4	5a	5b
Tonnage (T) prouvé	147 764	110 506	139 333	129 024	317 280	51 200
Teneur du minerai	Au = ? Ag = 4,4 oz/t Pb = 1,5 % Bi = 0,159 % WO_3 = 0,128 %	Au = 0,002 oz/t Ag = 6,7 oz/t Pb = 1,37 % Bi = 0,15 % WO_3 = 0.15 %	Au = 0,40 oz/t Ag = 1,10 oz/t	WO_3 = 0,60 %	WO3 = 0,59 %	Ag = 0,80 oz/t Pb = 16,20 % Bi = 0,18 % WO_3 = ?
Longueur de l'amas (m)	232	226	168	293	146	390
Largeur de l'amas (m)	35	24	76	55	11	0,30
Extension verticale connue de l'amas (m)	97	107	58	43	46	152
Tonnage (T) probable	206 869	280 000	253 333	215 040	1 211 760	-

South Zone	Central Zone	North Zone

HISTORICAL RESOURCES AND ORE VALUE ASSESSMENT BASED ON METAL PRICES IN 2023

Projet St-Robert : Estimation de ressources historiques selon Lacombe (1958), valeurs tirées d'Athurion (2013)

Prix des métaux 2023	USD		
Pb:	2189	USD / MT	*tonnes métriques*
Ag:	24,23	USD/Troy oz	*Once Troy*
WO3:	325	USD / MT	
Bi:	8128	USD/MT	
Zn:	2474	USD/MT	

	Pb	**Ag**	**WO3**	**Bi**	***Zn****	**tonnage****	**tonnage*****	**Pb**	**Ag**	**WO3**	**Bi**	***Zn****	**total USD / MT**	**total Cdn/ MT**	**Tonne*Conc**
	%	Troy oz/ton	%	%	%			$	$	$	$				
Zone 1	1,5	4,4	0,128	0,159	***0,658***	147764	206869	***32,84***	***106,61***	***0,03***	***12,92***	16,28	168,678	232,78	34 395 829 $
Zone 2	1,37	6,7	0,15	0,15	***0,601***	110506	280000	***29,99***	***162,34***	***0,04***	***12,19***	14,87	219,424	302,81	33 461 835 $
Zone 3	0	1,1	0	0	***0,000***	139333	253333	***0,00***	***26,65***	***0,00***	***0,00***	0,00	26,653	36,78	5 124 827 $
Zone 4	0	0	0,6	0	***0,000***	129024	215040	***0,00***	***0,00***	***0,15***	***0,00***	0,00	0,145	0,20	25 885 $
Zone 5a	0	0	0,59	0	***0,000***	317280	1211760	***0,00***	***0,00***	***0,14***	***0,00***	0,00	0,143	0,20	62 593 $
Zone 5b	16,2	0,8	0	0,18	***7,105***	51200	nd	***354,62***	***19,38***	***0,00***	***14,63***	175,78	564,417	778,89	39 879 420 $

895107 ** ressources historiques prouvées

2 167 002 *** ressources historiques probables

*** ratio Pb/Zn (campagne JAG 1983)** ***2,28***

Total **113** millions de dollars Cdn *pour ressources historiques prouvées*

Total **143** millions de dollars Cdn pour ressources historiques probables

*Note: Les concentrations en Zn ne sont pas rapportées dans les calculs de Lacombe (1958).
Pour fin de modélisation préliminaire , les données manquantes sont estimées pour un rapport Pb/Zn de 2,28.
Pour une estimation rigoureuse de la valeur du minerai, ces valeurs deront être mesurées à partir de nouveaux sondages

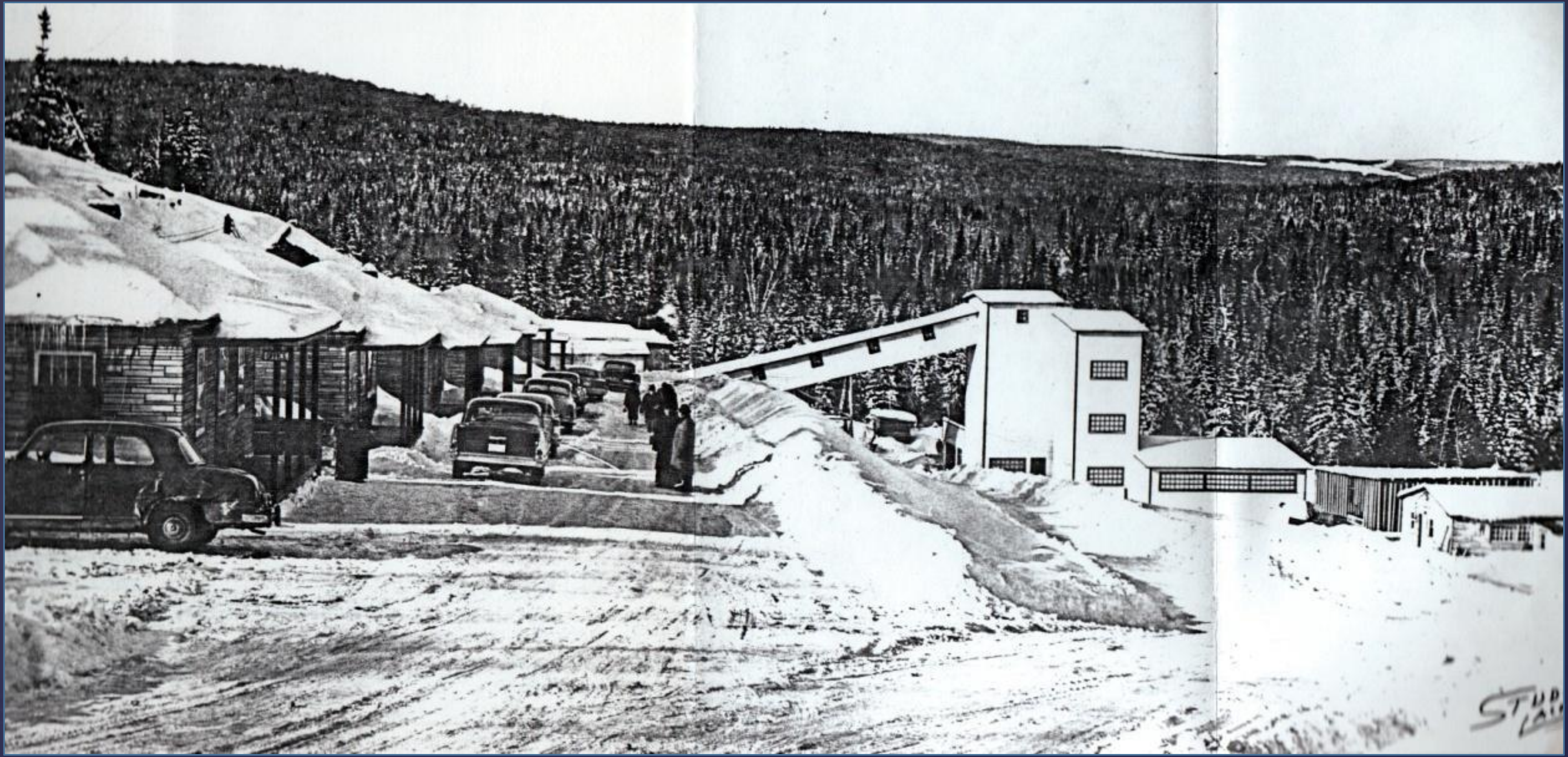
	Longueur	***Largeur***	***Profondeur***
Zone 1	232	35	97
Zone 2	226	24	107
Zone 3	168	76	58
Zone 4	293	55	43
Zone 5a	146	11	46
Zone 5b	390	0,3	152

In **1958**, twelve barrels of concentrate were produced. These concentrates were sent to Germany. The first shipment of **5.4 tons** contained:

60% Pb,
350 - 400 oz/t Ag,
0.1 - 0.5 oz/t Au
4 to 5% Bi.

At that time, the St. Robert ore concentrate worth **$197.46 / t**. Recovery was in the order of **83% for Pb**, **87% for silver**, **81% for gold** and **67% for bismuth** (Frédéric, 1983).

However, in October 1958, due to a lack of financial resources, the company stop the mining operation. In all, only **1,000 tonnes** of ore were processed at the St-Robert Metals mill.



St-Robert Metals Corp. mine site in 1957. Picture taken from Frédéric (1983).

Quartz vein mineralizations

Mineralization on the St-Robert property is polymetallic. They occur mainly in **quartz veins** and **enclosing rocks** in the **Central**, **South** and **North zones**, but also in certain **porphyry dykes** and **fractures**. In order of abundance, the minerals present on the property are **pyrite** (FeS_2), **galena** (often silver-bearing) (PbS), **scheelite** ($CaWO_4$), **cosalite** ($Pb_2Bi_2S_5$), **sphalerite** (ZnS), molybdenite (MoS_2) and **chalcopyrite** ($CuFeS_2$).

Two types of mineralized veins can be found on the property: **subvertical veins** and later **subhorizontal veins**. The latter are far fewer in number and much narrower (< 10 cm) than the subvertical veins. They are found mainly in the **Central zone**, where they contain a lot of pyrite and scheelite. They were mainly observed in the Lee and Lacombe tunnels, and intersect the subvertical veins in all zones. Subvertical veins are observed in all zones of the property.

FIELD OBSERVATIONS

Polymetallic quartz veins (South Zone)

Pictures form Athurion (2013)

Polymetallic quartz veins (Central Zone)

POLYMETALLIC QUARTZ VEIN AND SULPHIDE MINERALISATIONS

igure 3.21 : À gauche : Veine subhorizontale, zone Sud. À droite : Veine de quartz minéralisée en alène argentifère, pyrite, sphalérite, scheelite et chalcopyrite de la zone Centre. Échantillon SR10 ecelant 1280 ppm d'Ag et 2,5 % de W.

Pictures form Athurion (2013)

Scheelite mineralization

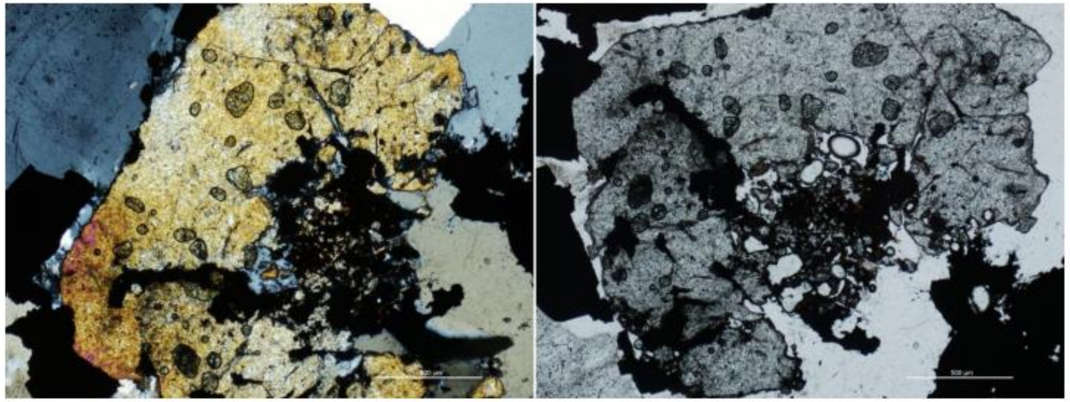


Figure 3.24 : Scheelite de l'échantillon SR10 en lumière transmise polarisée analysée (gauche) et en lumière polarisée non analysée (droite). La barre d'échelle correspond à 500 µm.

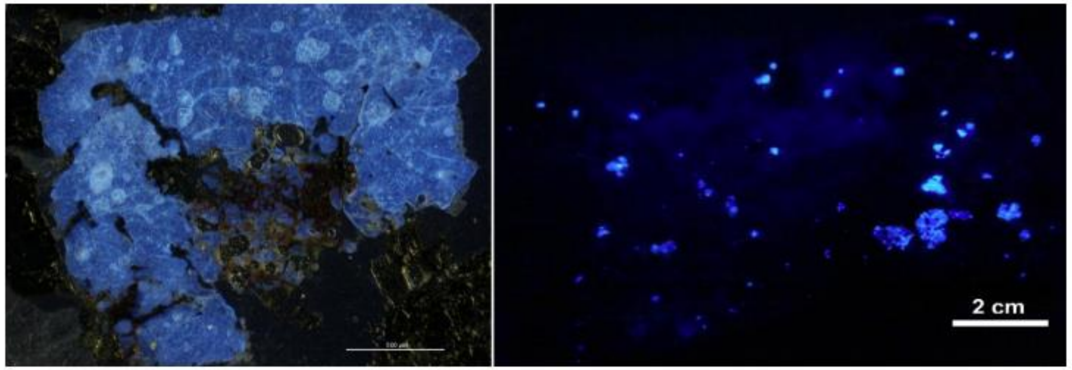
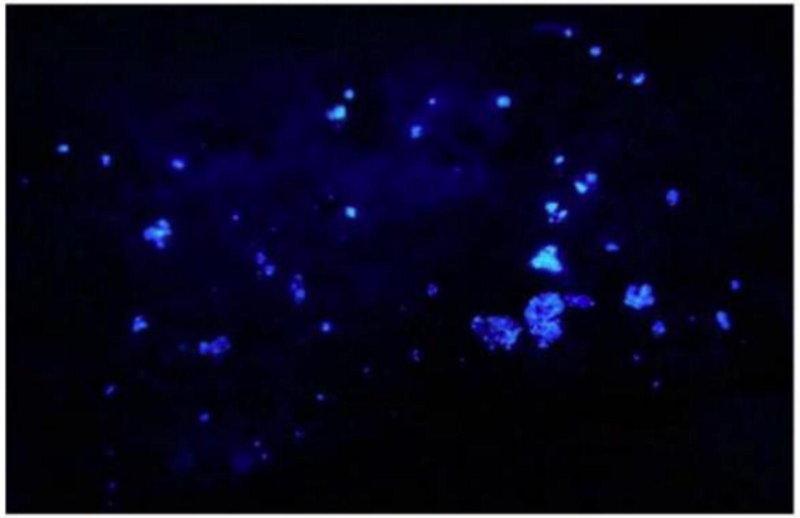


Figure 3.25 : À gauche : Scheelite de l'échantillon SR10 au microscope polarisant avec une lumière fluorescente. La barre d'échelle correspond à 500 µm. À droite : photographie d'une roche issue d'un dyke quartzo-feldspathique minéralisé.

Pictures form Athurion (2013)

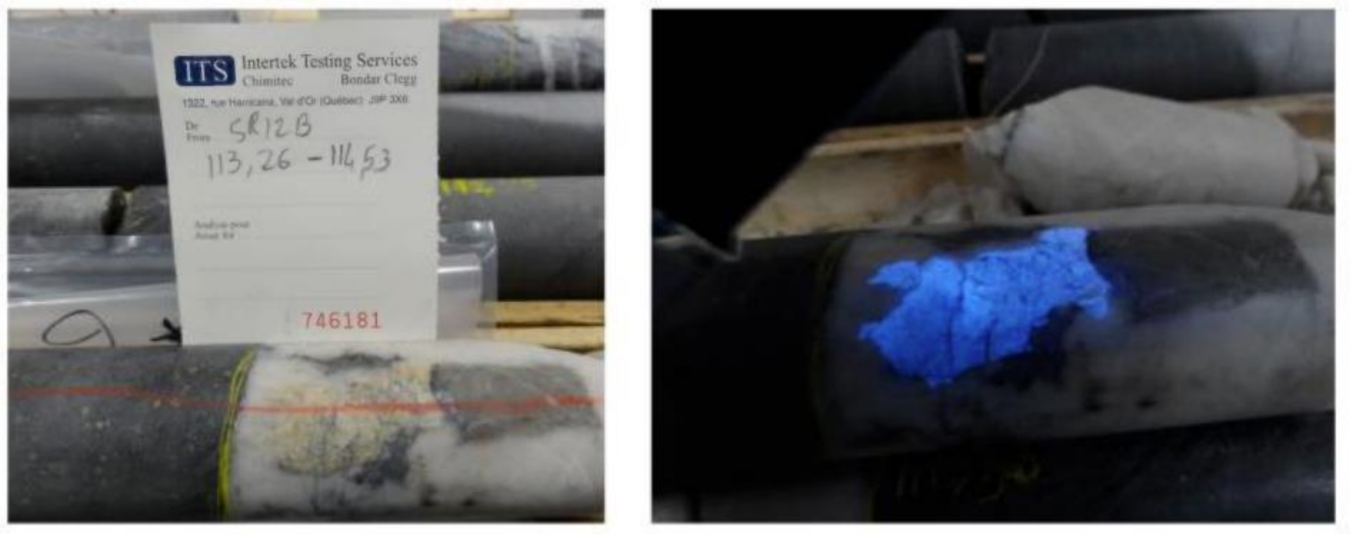
Altered porphyric dyke

Photographie 3 : Roche intrusive SR01



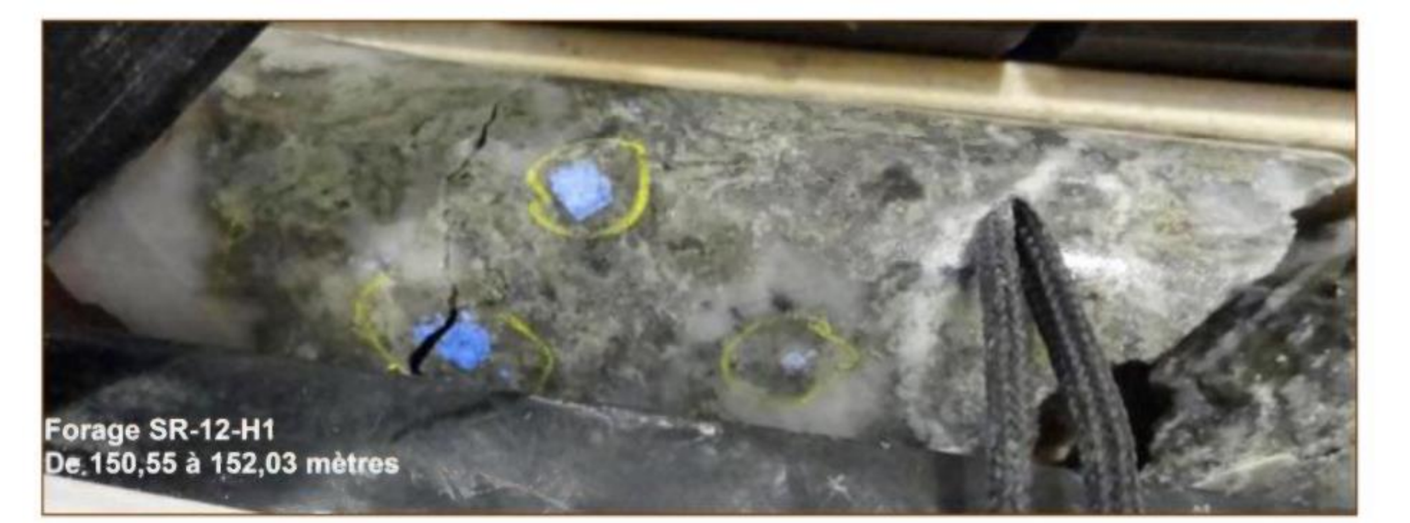
Photographie 4 : Échantillon minéralisé en Scheelite - lumière fluorescente

Scheelite mineralization in the South mineralized Zone



Quartz vein containing scheelite (2 cm crystals) in borehole SR-12b

Scheelite mineralization in the Central mineralized Zone



Quartz vein and breccia containing scheelite in borehole SR-12-H1

St-Robert Metal's Cosalite needles

1.25 mm

Cosalite: $Pb_2Bi_2S_5$

Local geology and geophysics

Magnetic map (magnetic porphyric intrusive)

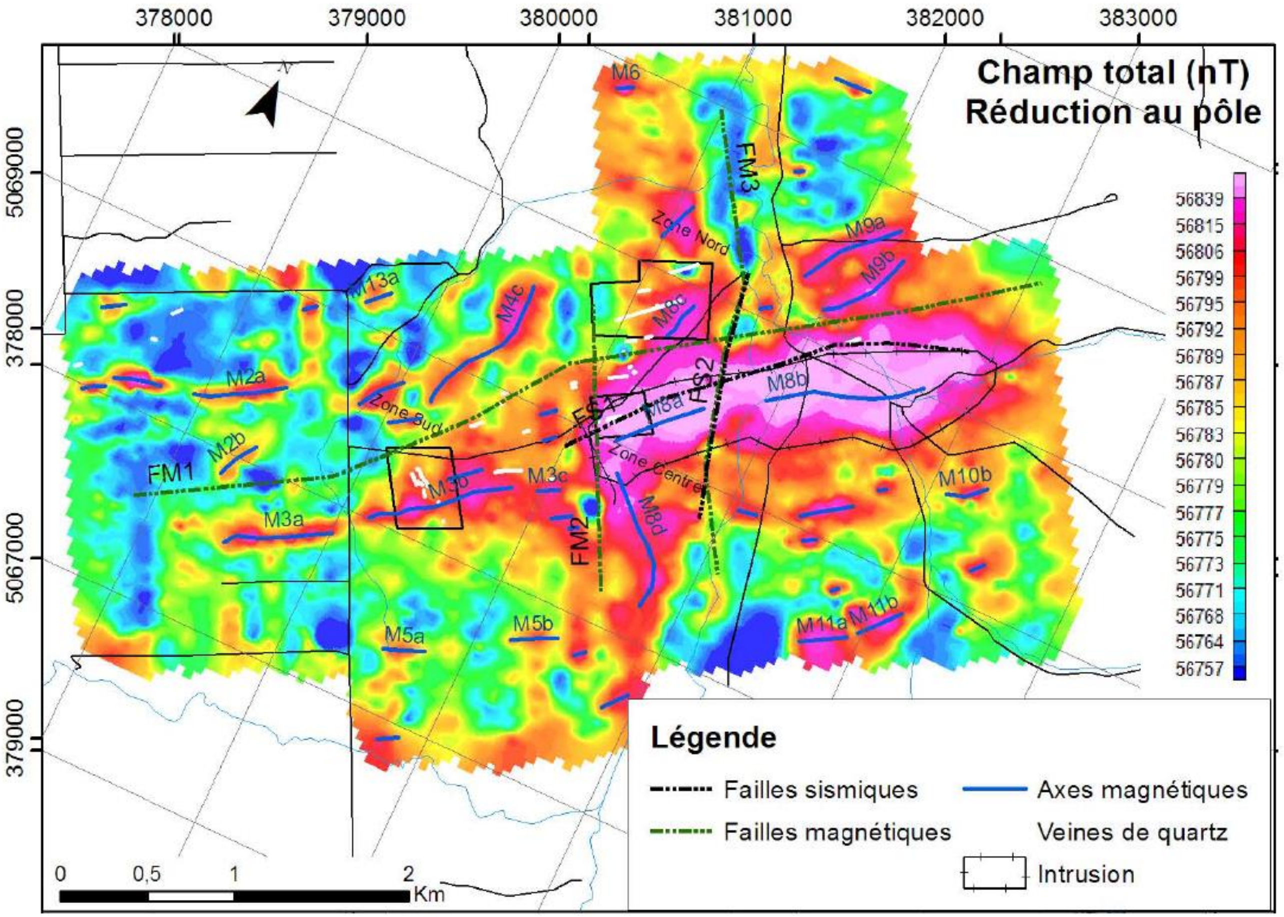
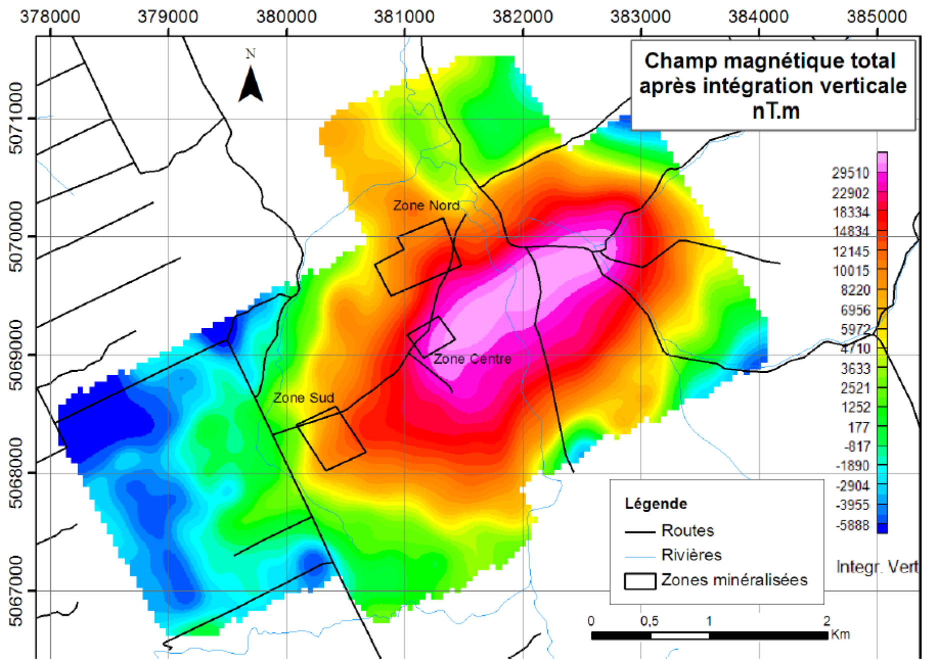


Figure 6.8 : Carte d'interpolation par krigeage des données du champ magnétique total (après réduction au pôle). Projet St-Robert, INRS-ETE. Modifiée de Koita (2011). Le tracé des *failles magnétiques* est issu de la carte de la dérivée verticale première du champ magnétique total.



Magnetic porphyric intrusive and South, Central and North mineralized zones

Tungsten :

Assays performed on numerous drill holes on the St-Robert property have often considered only gold, and occasionally silver or tungsten. These analyses were carried out only on mineralized quartz veins, and very rarely on enclosing rocks. Scheelite is mainly found in porphyry dykes, as demonstrated by the presence of a dyke containing 0.6% WO_3 in the Lacombe tunnel and the "new discovery" in the North Zone, which contains up to 14% WO_3. In fact, tungsten has been sought more often in the Central Zone than in the North Zone, whereas it appears to be present in greater quantities in the North Zone. It would therefore be necessary to study this zone in greater detail.

In the other zones, tungsten is present sporadically and could be an interesting by-product. The relatively high tungsten concentrations obtained in the past, combined with the high concentrations observed in the 2013 drilling campaign and channel sampling, lead us to believe that tungsten could be one of the property's main commodities.

Tungsten deposits often contain grades of around 0.1 to 0.3% WO_3 , with tonnages ranging from a thousand to a million tons. For example, the Mount Pleasant deposit in New Brunswick has a tonnage of 50,000 tons of W ore at a grade of only 0.21%.

Bismuth (Bi):

Very few holes were drilled in the northern zone due to access difficulties. We did, however, observe very good Bi concentrations during channel sampling in this zone. In North America, Bismuth is a fairly rare element, often present in small quantities. The St-Robert property may also have bismuth potential. It is present in interesting concentrations (0.01 to 0.89%) in the North Zone.

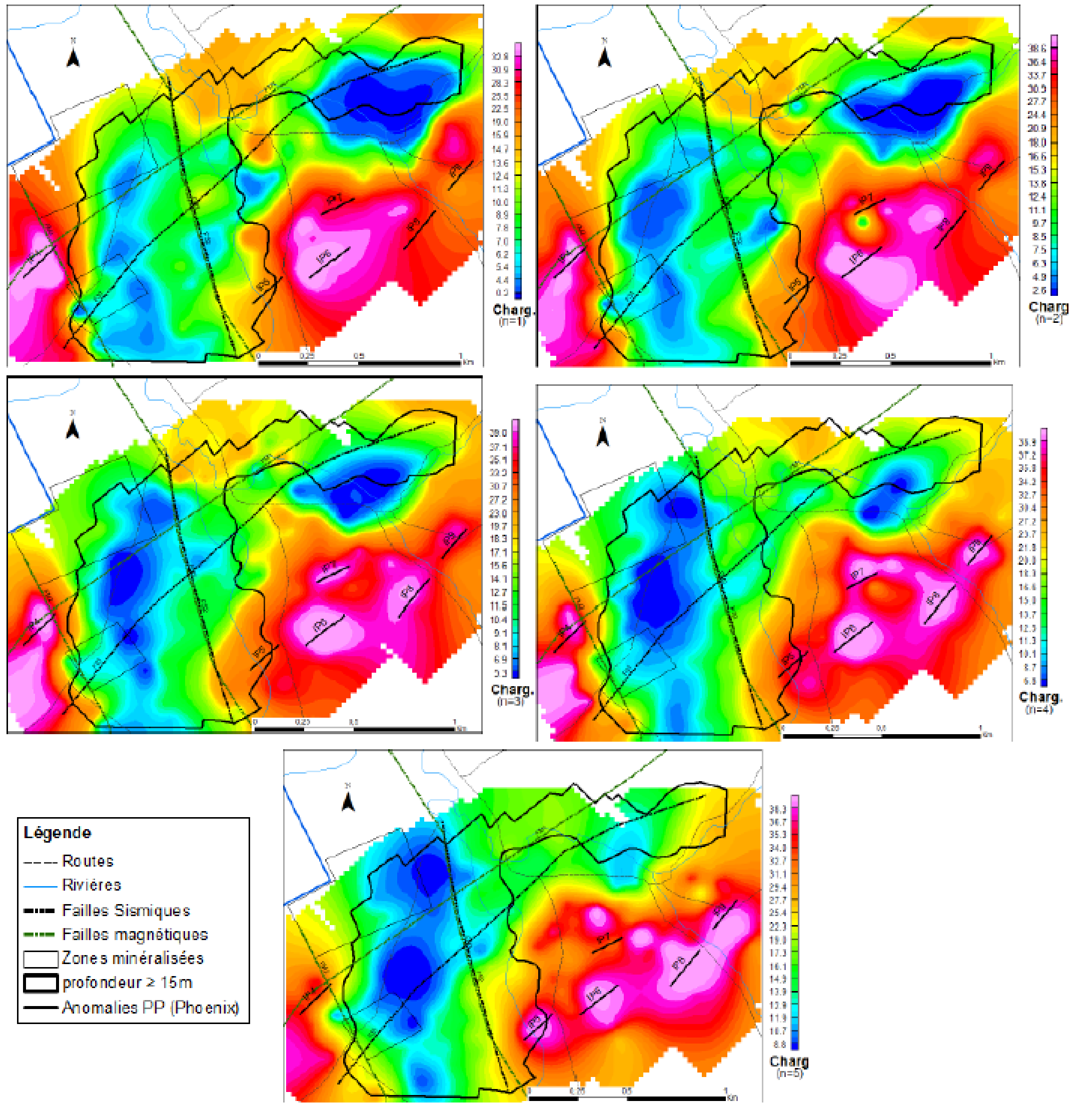
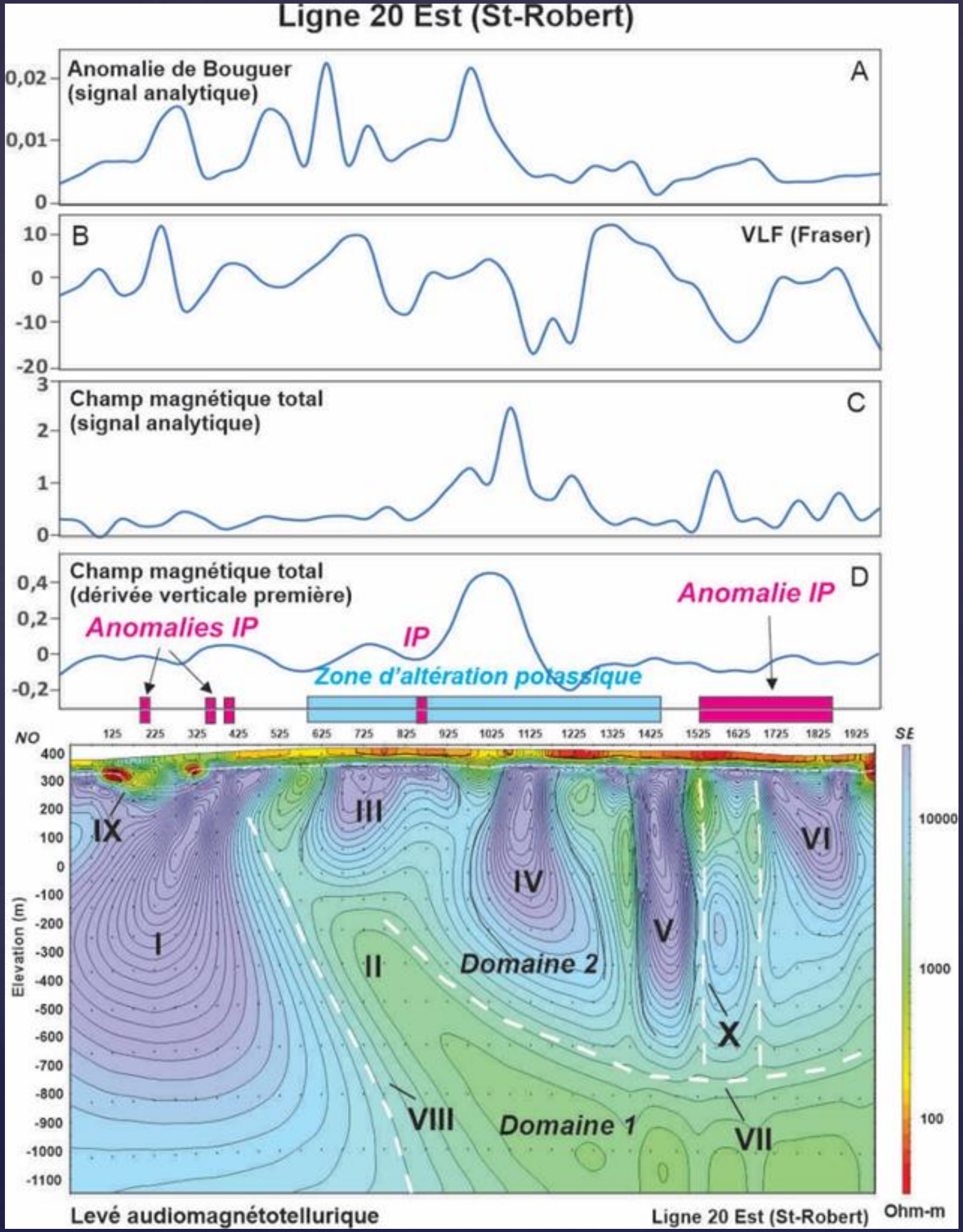


Figure 6.37 : Cartes des valeurs de chargeabilité pour n=1, 2, 3, 4 et 5. Données provenant du levé de Phoenix Geophysics inc.

Electrical chargeability anomalies observed during the induced polarization survey by Phoenix Geophysics Inc. Maps for different dipoles (depths) indicate the presence of zones potentially rich in disseminated sulfides.

These anomalies, located on Domtar's properties, will need to be drilled.



2D inversion model of line 20-East (St-Robert property). Variation curves for the Bouguer anomaly (analytical signal), the total magnetic field, VLF data (Fraser filtered data) and first vertical derivative of the total magnetic field, are shown above the audiomagnetotelluric section.

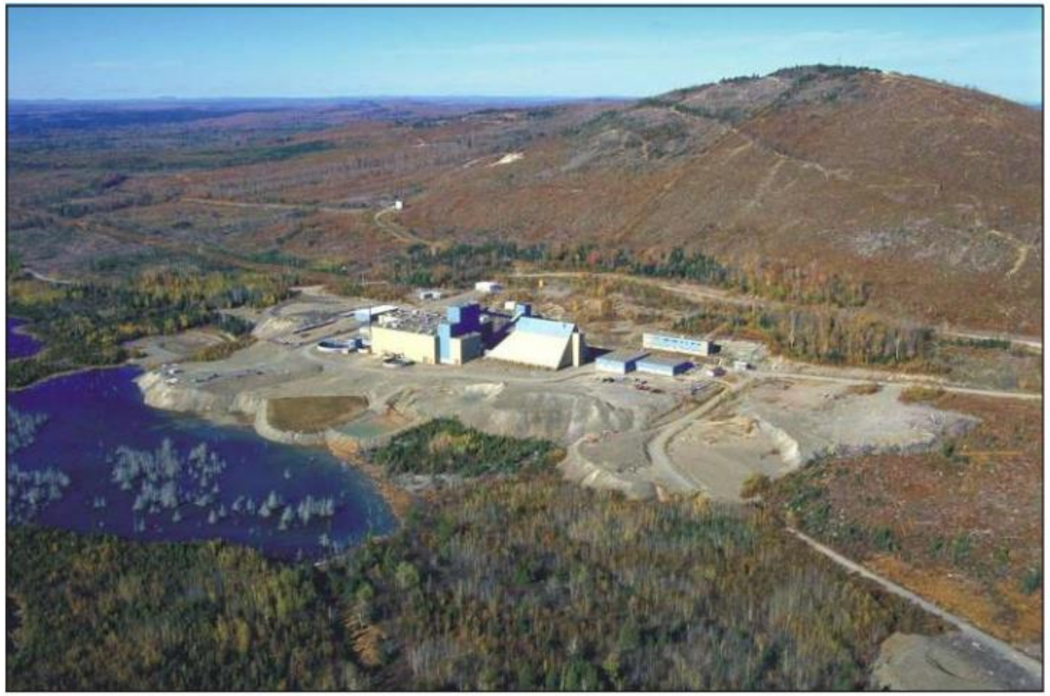


Figure 2. Aerial view of the Mount Pleasant mine site.

Sisson Brook and Mount Pleasant are considered to have economically viable reserves of tungsten and associated metals.

Modèle géologique simplifié d’un gisement porphyrique associé à une masse intrusive. Notez la présence de minéralisations proximales près du pluton et de minéralisations filoniennes distale dans les roches crustales situées au-dessus de la masse intrusive. Figure titrée de **Sinclair (2007)**.

Gold in the southern Beauce region ?

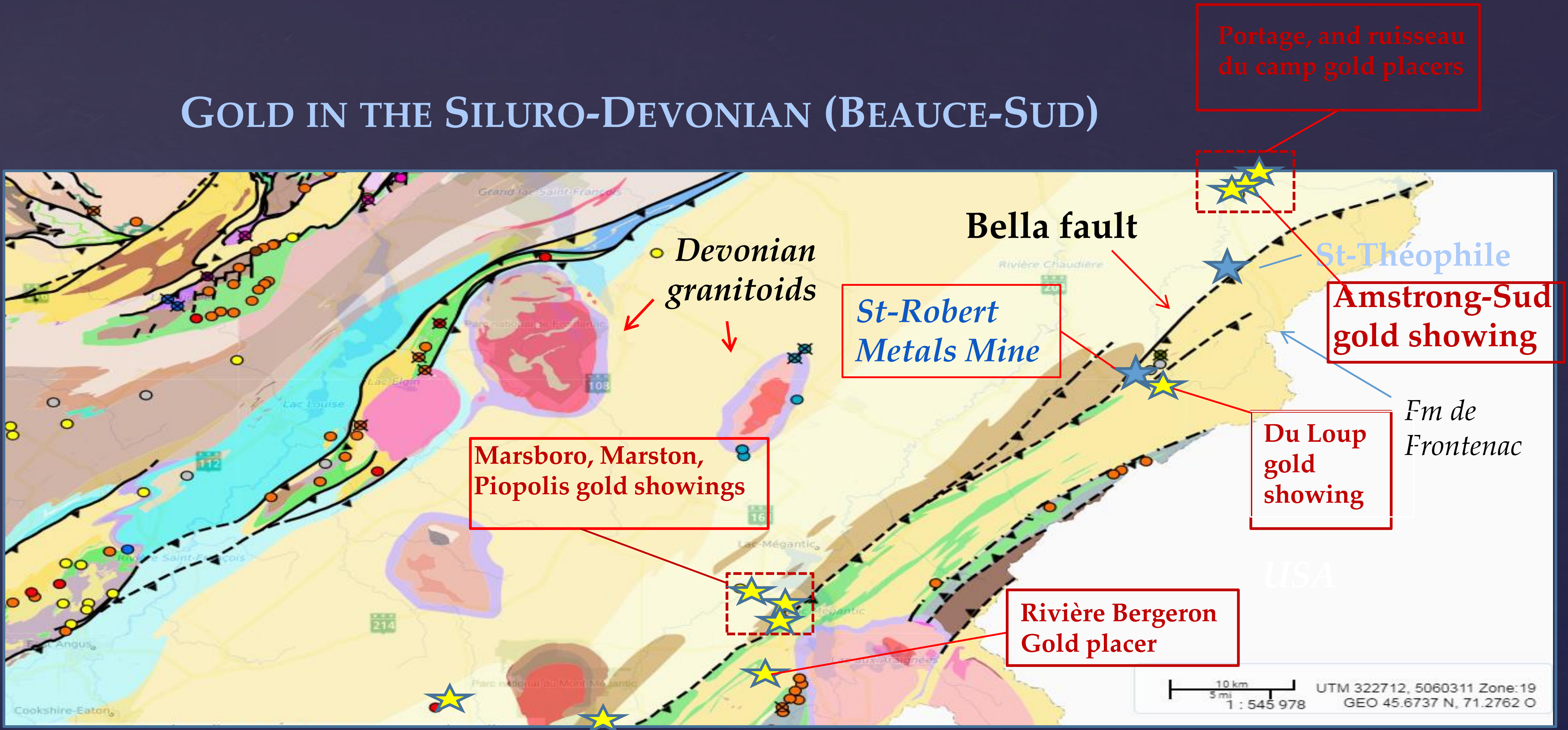
The **Frontenac Formation**, as well as other Siluro-Devonian formations in the region, contain numerous gold-bearing mineralizations, as evidenced by the **Marsboro, Marston, Piopolis, du Loup** and **Armstrong** gold showings (in bedrock). Highly significant gold concentrations have also been reported in the area of the former St-Robert Metals Mine. These showings demonstrate that gold emplacement mechanisms were active in the region.

Other **surface evidence**, such as the **Rivière Bergeron**, **Portage** and **Ruisseau du Camp** placers are further evidence of a favourable gold context for gold exploration.

The **Bella fault**, and certain associated structures, appear to control the spatial distribution of gold regionally.

This fault crosses the **Leopard Lake Gold Corp** property in the Beauce region and should be systematically prospected for gold.

GOLD IN THE SILURO-DEVONIAN (BEAUCE-SUD)



Source des données: MERN SIGÉOM sept 2022)

Conceptual exploration model for gold-in-rock exploration

Favourable regional geological unit: Frontenac Fm

Favourable structures: Bella fault and other sub-parallel faults, anticlinal folds

Other favourable geological context: System of porphyry-realted granophile hydrothermal systems

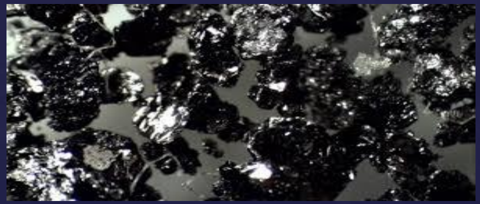
Geological context favourable to the presence of orogenic gold deposits in the Frontenac Formation

-Primary and/or diagenetic sulphides in the Frontenac Fm
(e.g. Domtar quarry 1)

-> Local source of metals such as As and Au available to form deposits

Metal-binding organic matter (O.M.): Over time, this organic matter was transformed into graphite by regional metamorphism (presence of graphite in the mudslates of the Frontenac Fm).

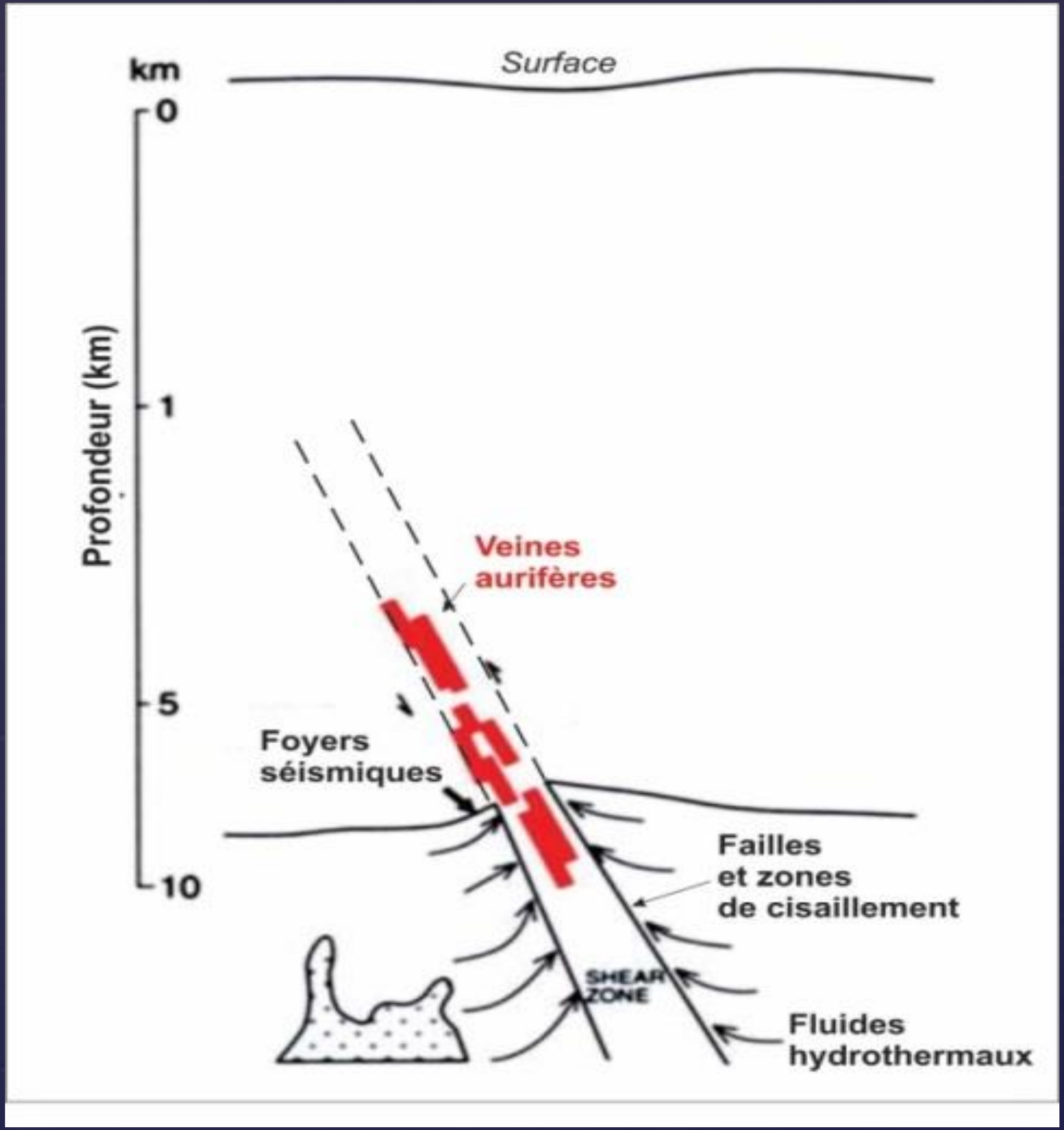
-> The presence of O.M.. could favours the reduction of hydrothermal fluids and therefore the precipitation of gold (for early mineralisations).



-The presence of **primary or diagenetic sulfides** in volcano-sedimentary or sedimentary units (and **early metal enrichment**) is an important step in the process of forming later metal deposits such as orogenic gold deposits.

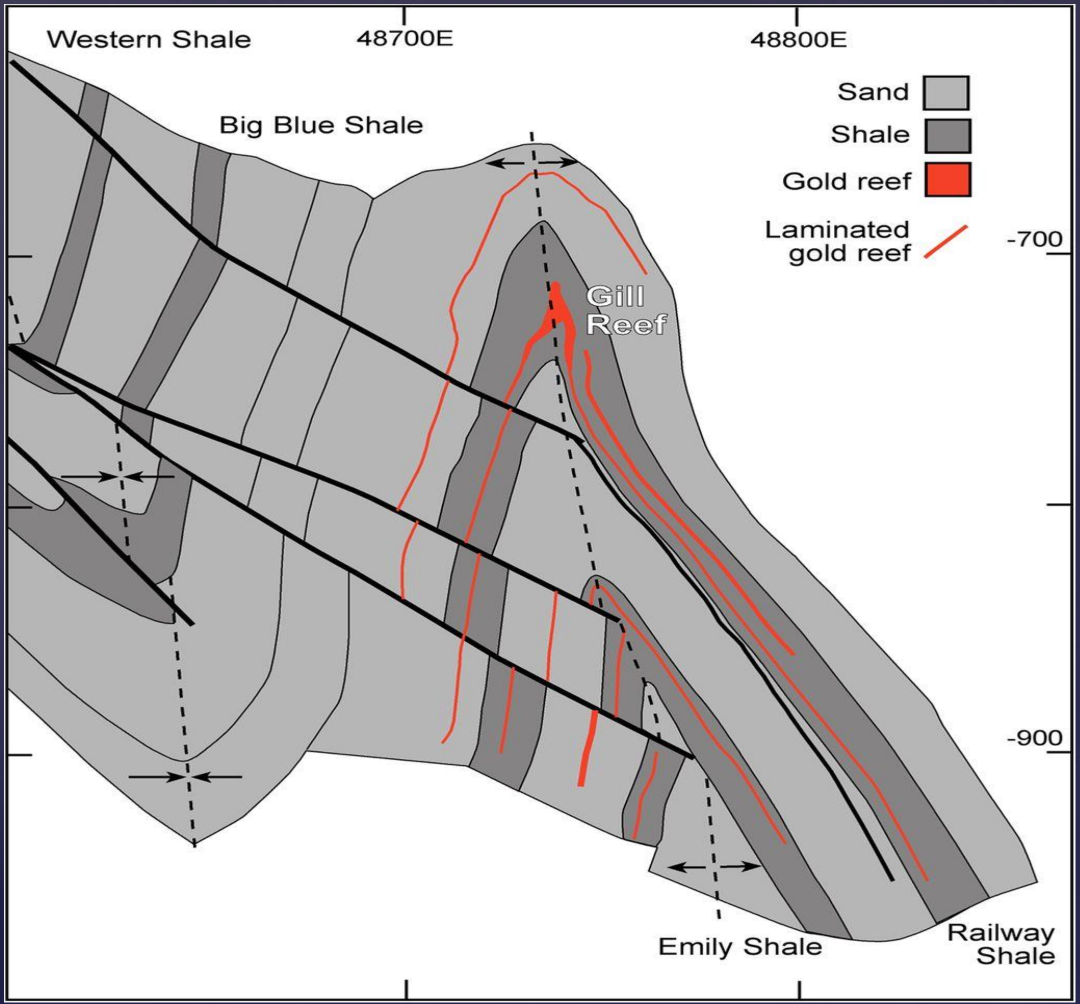
-These early metals need to be leached, concentrated and transported into more permeable structures (e.g. faults), enabling hydrothermal fluids to be transferred to structural traps (ex. folds) or formation traps (porous rocks, faulting-related porosity).

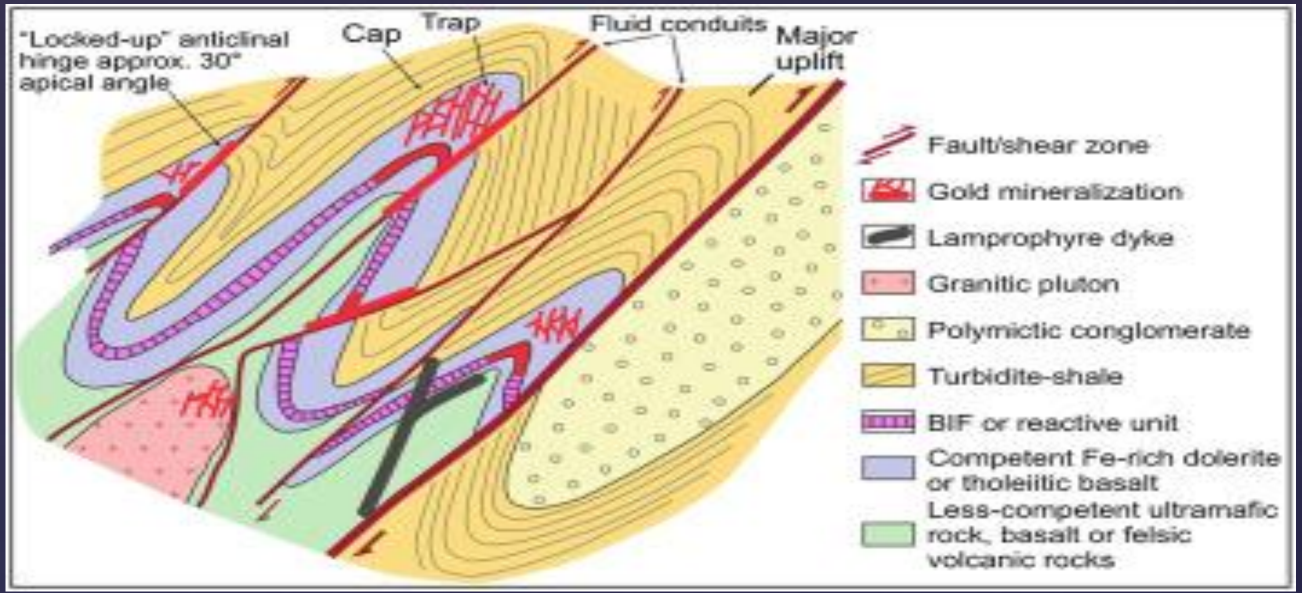
-In the search for gold in Appalachian rocks, the exploration effort should take into account geophysical detection to locate very deep gold-bearing structures, which are often not exposed at surface (Quaternary overburden).



Porosity and permeability of antiform folds

" Saddle Reef "





The Saddle Reef gold deposit model is probably the most appropriate for orogenic-gold exploration in the Soutern Beauce area.

Geological observations (2022)

-The sedimentary rocks of the Frontenac Formation were affected by deformation related to the Acadian orogeny.

-These deformations are responsible for the folding of rocks and the formation of faults and other structural discontinuities favourable to the focused transport of gold by orogenic hydrothermal fluids.

-Mapping of Domtar's # 1 quarry (located in the Rivière du Loup area) clearly shows the Acadian structures and the presence of sulphide-rich mudslates.

Folds, faults and sulphide mineralization. Aggregate quarry #1 (Domtar).

Les concentrés économiques de tungstène doivent contenir 65% de WO3 dans un concentré de wolframite et 60% de * Dans ce texte, sauf indication contraire, les quantités sont exprimées en tonnes métriques. - 2 - WO3 dans un concentré de scheelite. Dans certains pays, le concentré de scheelite doit contenir une teneur plus élevée, soit 70% de WO3. Le scheelite pure, quant à elle, renferme 80.6% de WO3.

les principales mines du monde occidental sont des gîtes du type skarn alors que les réserves chinoises sont constituées par des gîtes filoniens à quartz-wolframite (Burnol et al., 1978).

Tungsten is usually mined underground. Scheelite and/or wolframite are frequently located in narrow veins which are slightly inclined and often widen with the depth. Open pit mines exist but are rare. Tungsten mines are relatively small and rarely produce more than 2000t of ore per day. Mining methods for tungsten ore are not at all exceptional and usually are adapted to the geology of the ore deposit. Most tungsten ores contain less than 1.5% WO_3 and frequently only a few tenths of a percent. On the other hand, ore concentrates traded internationally require 65-75% WO_3. Therefore, a very high amount of gangue material must be separated. This is why ore dressing plants are always located in close proximity to the mine to save transportation costs. The ore is first crushed and milled to liberate the tungsten mineral crystals. Scheelite ore can be concentrated by gravimetric methods, often combined with froth flotation, whilst wolframite ore can be concentrated by gravity (spirals, cones, tables), sometimes in combination with magnetic separation

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