Laurentian University
Université Laurentienne
HARQUAIL School of Earth Sciences
École des sciences de la Terre
METAL EARTH
Unlocking the earth's mineral wealth.

# Who You Will Hear From:

| | |
|---|---|
| **David Harquail** | President and CEO<br>Franco-Nevada Corporation<br>Chairman of the World Gold Council |
| **Pierre Zundel** | Interim President (2017-2019)<br>Laurentian University |
| **Ross Sherlock** | Director, MERC<br>Research Chair in Exploration Targeting<br>Harquail School of Earth Sciences |

“Greater Sudbury has the best ore body and the largest concentration of expertise in mining supply, products and services in the world.

We want to be associated with Laurentian University because it’s undoubtedly the go-to university for mineral exploration and mining in Canada."

- Ned Goodman

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ÉCOLE DE GÉNIE

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GOODMAN SCHOOL OF MINES
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McEWEN ÉCOLE D'ARCHITECTURE
SCHOOL OF ARCHITECTURE

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HARQUAIL SCHOOL OF EARTH SCIENCES
ÉCOLE DES SCIENCES DE LA TERRE

LaurentianUniversity
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GOODMAN
SCHOOL OF MINES
ÉCOLE DES MINES

GOODMAN

GOODMAN

# A Centre for Geological Research

**Ministry of Northern Development and Mines**

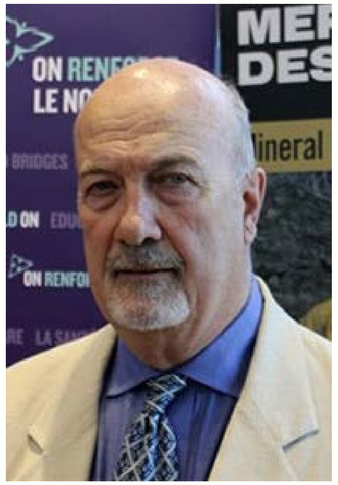
- Ontario Geological Survey (OGS)
- Ontario Geoscience Laboratories
- John B. Gammon Geoscience Library
- Ring of Fire Secretariat

**Laurentian University**

- Centre for Excellence in Mining Innovation (CEMI)
- Mining Innovation, Rehabilitation and Applied Research Corporation (MIRARCO)
- **Harquail School of Earth Sciences**
  - **Mineral Exploration Research Centre (MERC)**
  - **NSERC-CMIC Exploration Footprints Secretariat**
  - **CFREF-FedNor-NOHFC Metal Earth Secretariat**

**Willet Green Miller Centre**

# Award-winning Mineral Exploration Research Team



**Harold Gibson**

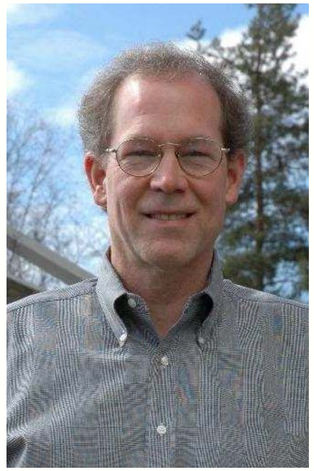
**Professor of Economic Geology**
**Metal Earth Director**
William Harvey Gross Medal
Barlow Memorial Medal
Duncan Derry Medal

**Ross Sherlock**

**Professor of Economic Geology**
**Director of MERC**
**Research Chair in Exploration Targeting**
William Harvey Gross Medal

**Daniel Kontak**

**Professor of Ore Deposit Geology**
Gesner Medal
Peacock Medal
Duncan Derry Medal



**Michael Lesher**

**Professor of Economic Geology**
**Research Chair in Mineral Exploration**
**Director NSERC-CMIC Footprints Network**
Duncan Derry Medal

**Jeremy Richards**

**Professor of Economic Geology**
**Tier I Canada Research Chair in Metallogeny**
W.W. Hutchison Medal
William Harvey Gross Medal
Society of Economic Geologists, Silver Medal

**Richard Smith**

**Professor of Exploration Geophysics**
**NSERC Industrial Research Chair in Exploration Geophysics**
Barlow Memorial Medal

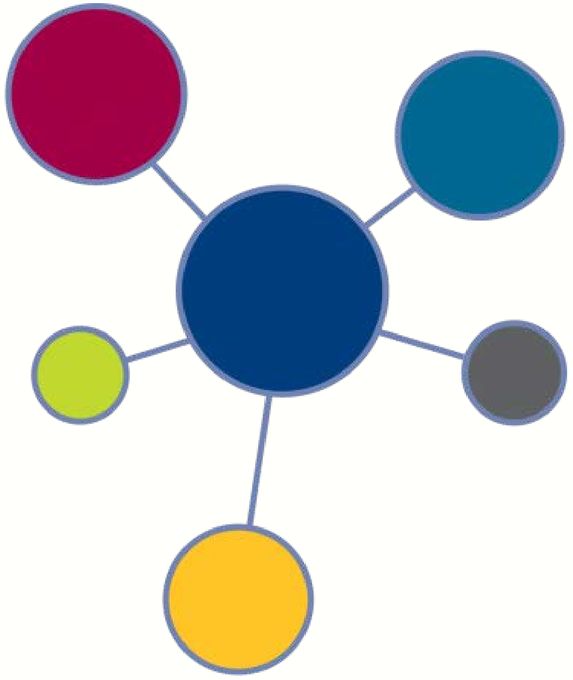
# The Harquail School of Earth Sciences Team

# Pierre Zundel

Interim President (2017-2019)
Laurentian University

LaurentianUniversity
UniversitéLaurentienne

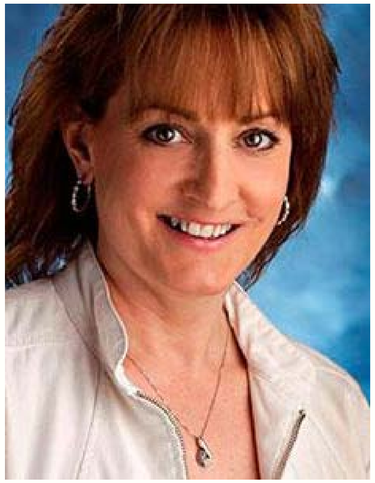
# Imagine.
# Connect.
# Share.



C-GKRS

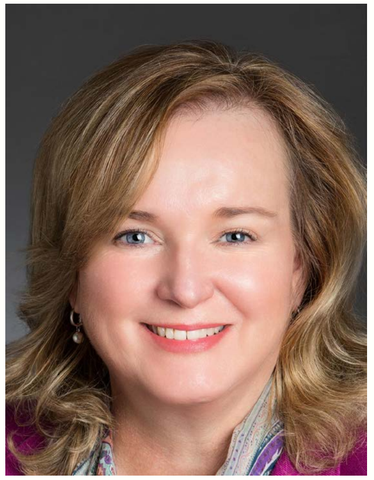
# Industry Leaders Among our Alumni

**Paul Rollinson**
B.Sc. Geology
CEO and President
**Kinross Gold Corporation**



**Samantha Espley**
M.Sc., Engineering
General Manager - Mining & Mineral Processing Technical Excellence Centre
**Vale, Ontario Operations**

**Bryan Coates**
B.Comm.
President
**Osisko Mining Corporation**

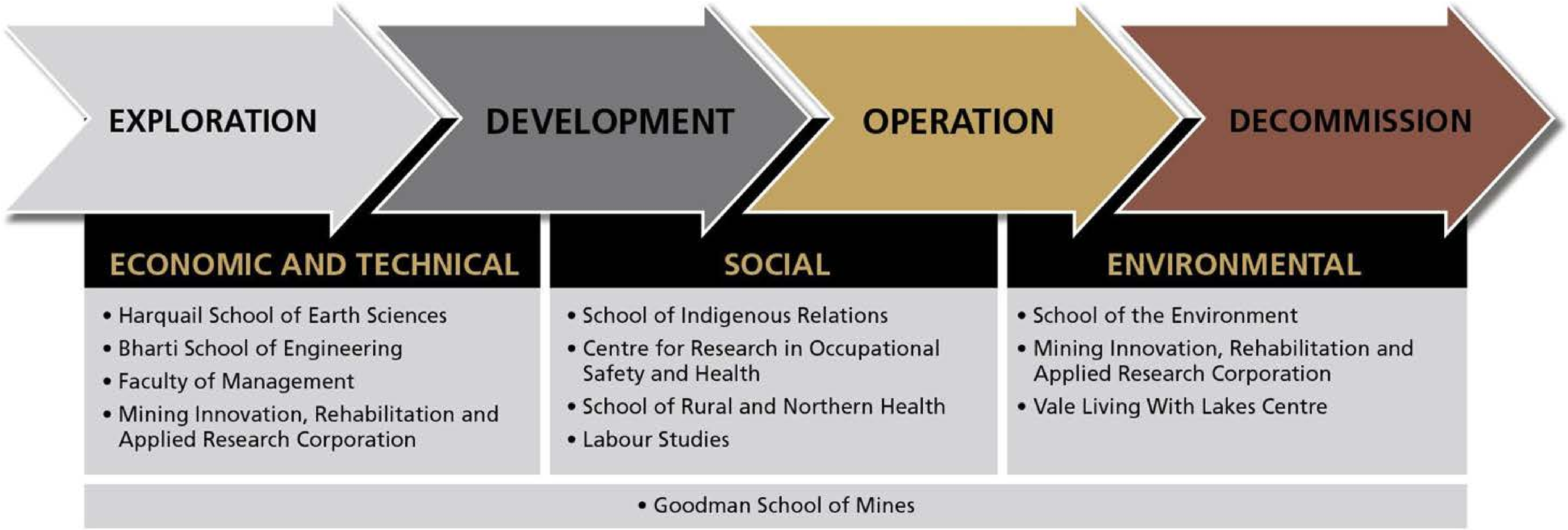


**Marcia Smith**
BA
Senior Vice President, Sustainability and External Affairs
**Teck Resources Limited**

**Robert A. Archer**
B.Sc., Geology
President and CEO
**Great Panther Silver Ltd.**

**Kristan Straub**
B.Sc., Geology
Vice-President
**Glencore Mine, Raglan**

# Canada's Leading University for Mining Research and Education



# Building Scientific Capacity

Recent hire of 5 new faculty with mineral exploration and/or Precambrian geology expertise

**Jeremy Richards**

Tier I CRC in Metallogeny

**Ross Sherlock**

Research Chair in Exploration Targeting

**Mostafa Naghizadeh**

Exploration Seismic Geophysics

**Stephane Perrouty**

Precambrian Geology

**Leonardo Feltrin**

Exploration Data Analytics

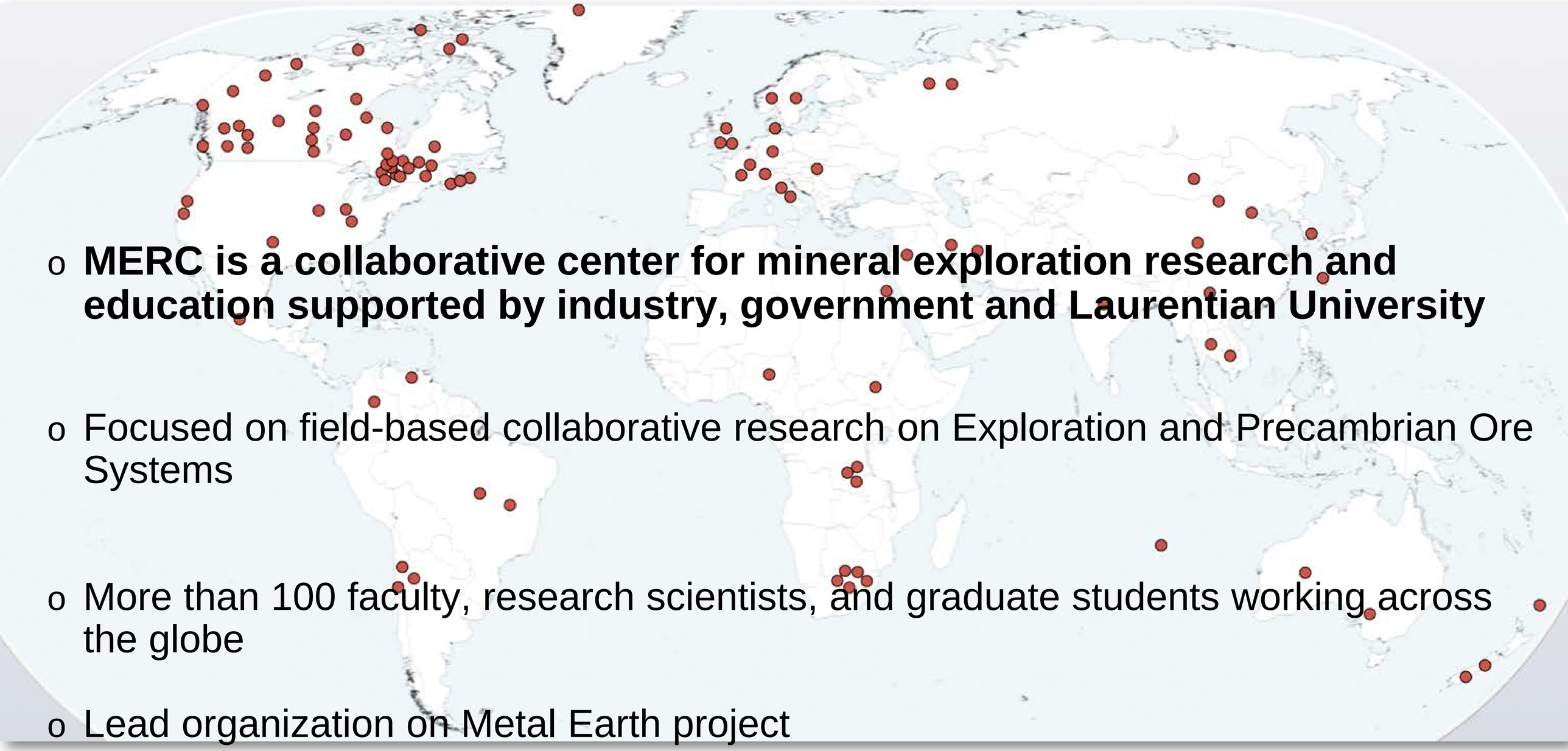
**Interviewing**

Exploration Geochemist

# Mineral Exploration Research Center (MERC) and it's Metal Earth Project

**Ross Sherlock**
Director, MERC

# Mineral Exploration Research Centre (MERC)



- **MERC is a collaborative center for mineral exploration research and education supported by industry, government and Laurentian University**
- Focused on field-based collaborative research on Exploration and Precambrian Ore Systems
- More than 100 faculty, research scientists, and graduate students working across the globe
- Lead organization on Metal Earth project

# MERC Foundation Members

Laurentian University Université Laurentienne
HARQUAIL SCHOOL OF EARTH SCIENCES ÉCOLE DES SCIENCES DE LA TERRE

BARRICK

KL | KIRKLAND LAKE GOLD

125 ANNIVERSARY Est. 1891
ONTARIO GEOLOGICAL SURVEY

Laurentian University Université Laurentienne
GOODMAN SCHOOL OF MINES ÉCOLE DES MINES

# MERC Tier 1 Members

DETOUR GOLD

GOLDCORP

IAMGOLD

KINROSS

IVANHOE MINES
NEW HORIZONS

Teck

# MERC Tier 2 Members

SUDBURY INTEGRATED NICKEL OPERATIONS
A GLENCORE COMPANY

KGHM
POLSKA MIEDŹ

NORTHERN SUPERIOR RESOURCES

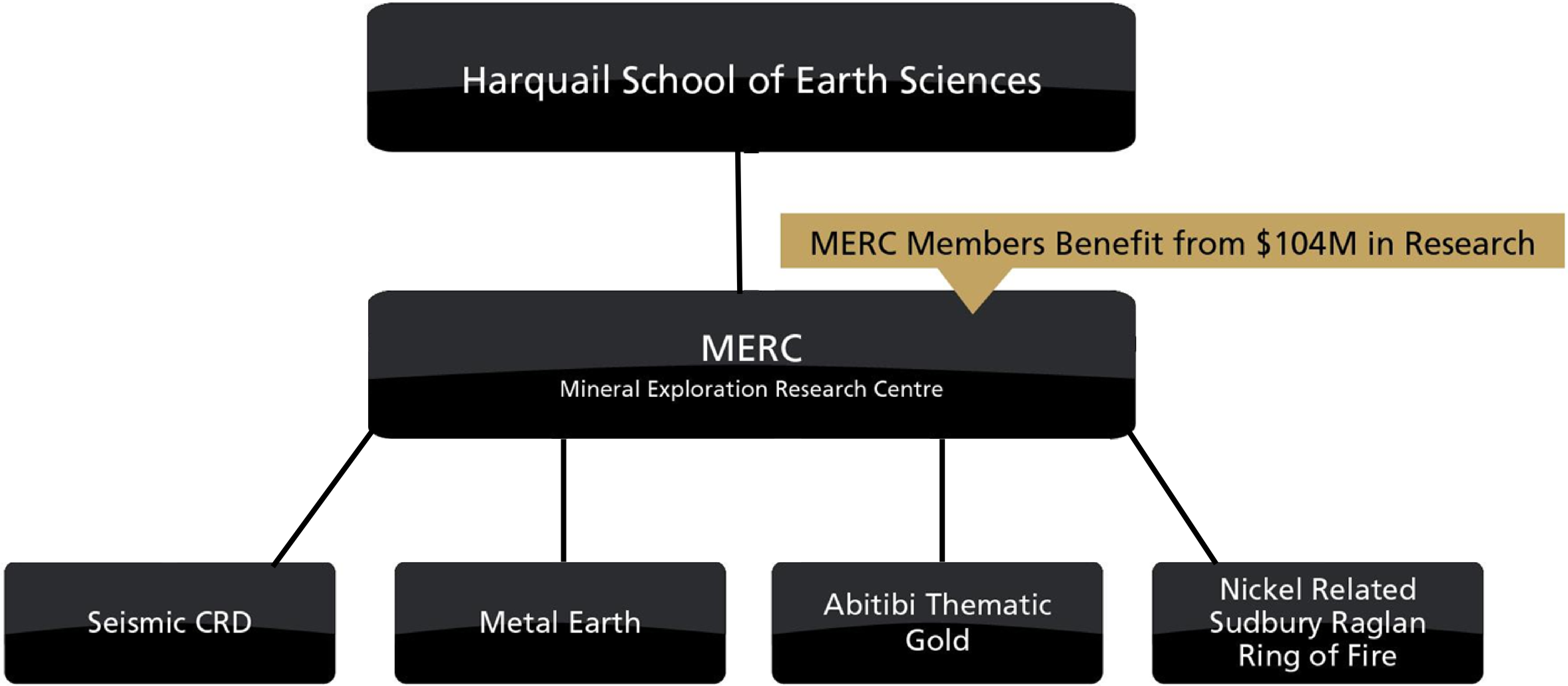
PELANGIO

VALE

McEWEN MINING
NYSE MUX TSX

FIRST COBALT

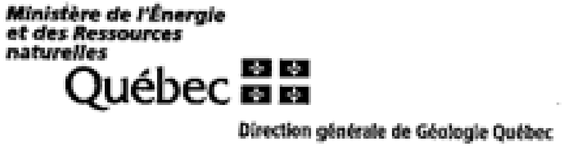
Taseko

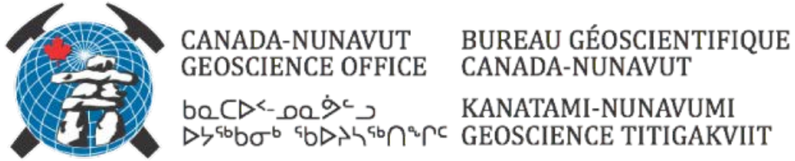

Harquail School of Earth Sciences
MERC Members Benefit from $104M in Research
MERC
Mineral Exploration Research Centre
Seismic CRD
Metal Earth
Abitibi Thematic Gold
Nickel Related Sudbury Raglan Ring of Fire

# Metal Earth

- **METAL EARTH** is a **MERC** led collaborative research project focused on metal endowment in the Precambrian shield
- **THE GOAL** is to improve the science for targeting and finding new orebodies
- Fully-funded seven-year $104M applied R&D initiative.
- **Canada FIRST** Research Excellence Fund (CFREF) - project started in summer 2017

# Metal Earth Partners





# Metal Earth

- **FUNDAMENTAL SCIENCE:**
  Transform our understanding of Earth's early evolution and the processes that govern differential metal endowment

- **Applied Innovation and Commercialization Component:**
  Make Canada a global leader in mineral exploration research through open source delivery of new knowledge and the development of transformative technologies targeted at increasing exploration success

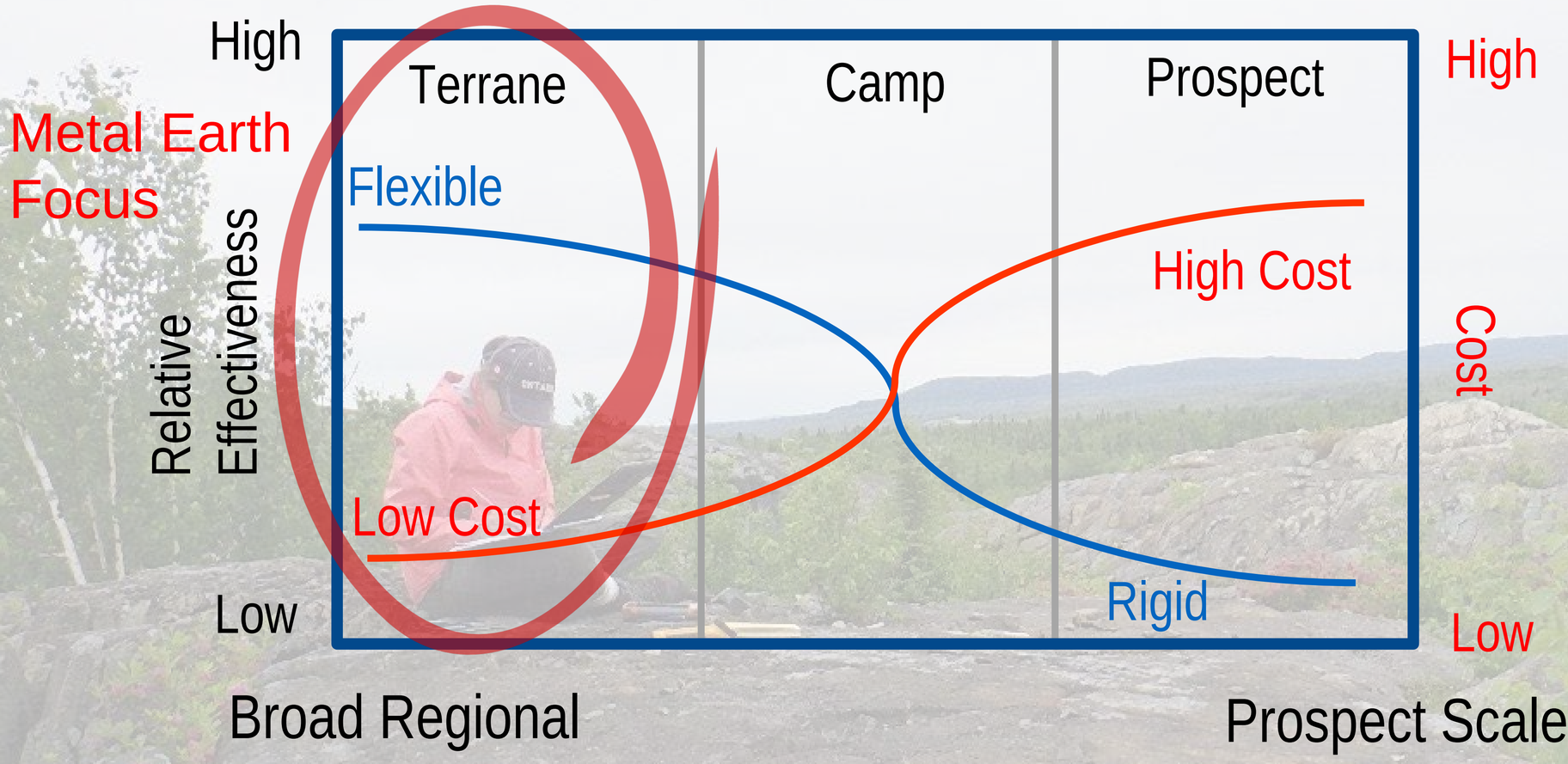
# Metal Earth Goals Are To :

- **Improve** the science for targeting and finding new orebodies

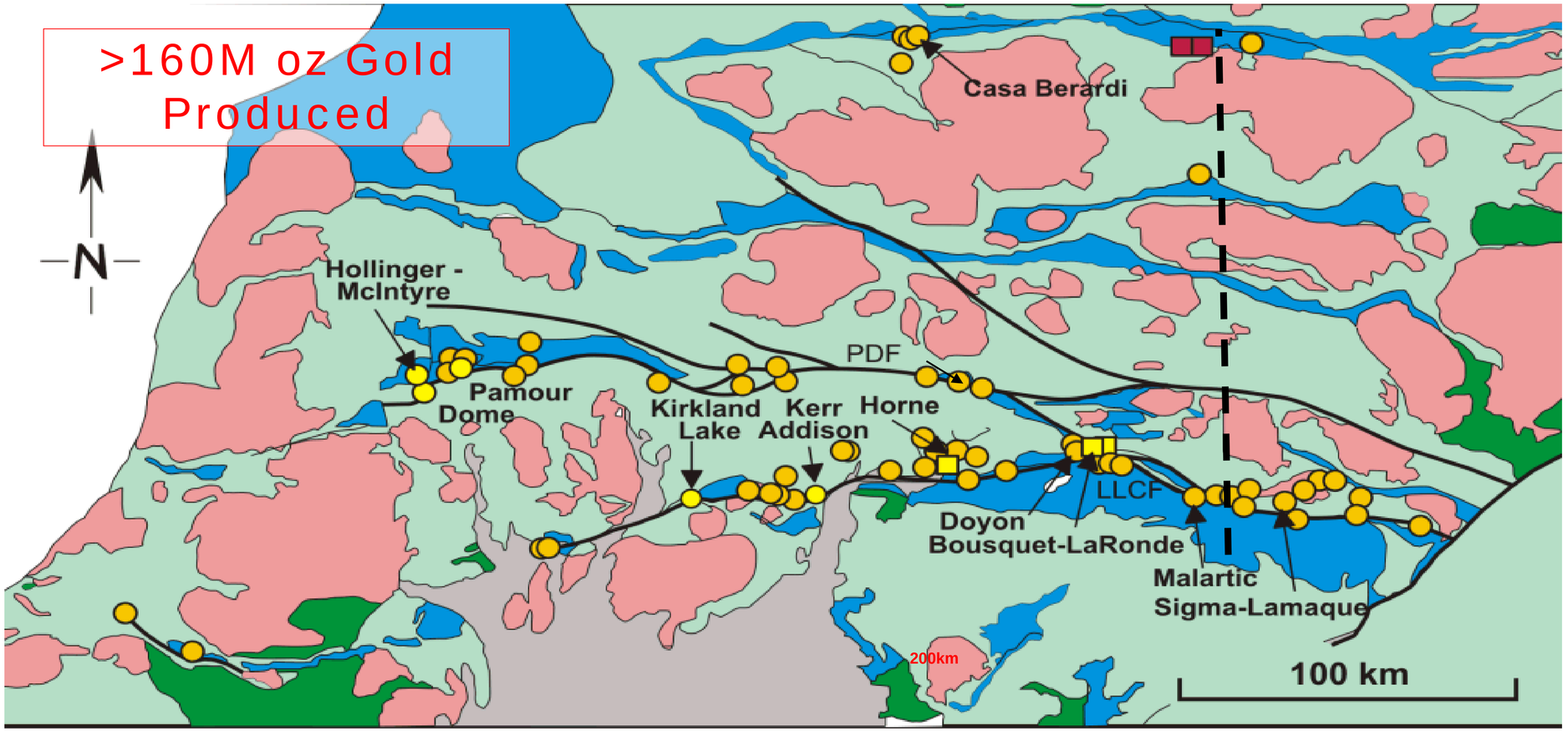
- **Improve** training of quality young geoscientists for the industry

# Exploration is about finding deposits

## Proper area selection reduces risk

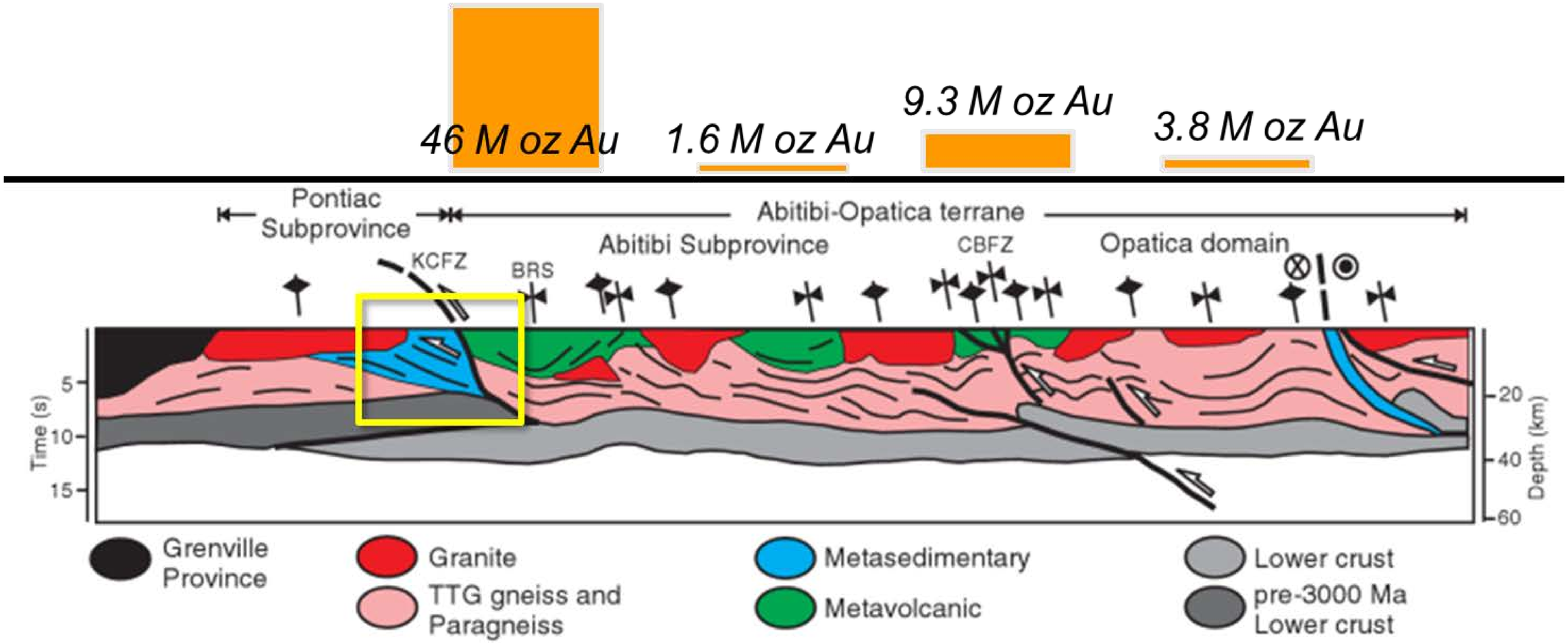


# Metal Endowment in the Abitibi




Dubé & Gosselin, 2007

# Metal Endowment in the Abitibi



# Metal Earth is Building Scientific Capacity

**People:**

Five new faculty

- 35 post-doctoral research associates
- 9 technical support positions
- 30 Ph.D., 40 M.Sc., 105 B.Sc. Students

- Pragmatic field based research
- Mentored by MERC & HES including
  - Harold Gibson
  - Bruno Lafrance
  - John Ayer
  - Phil Thurston

# Metal Earth Strategy

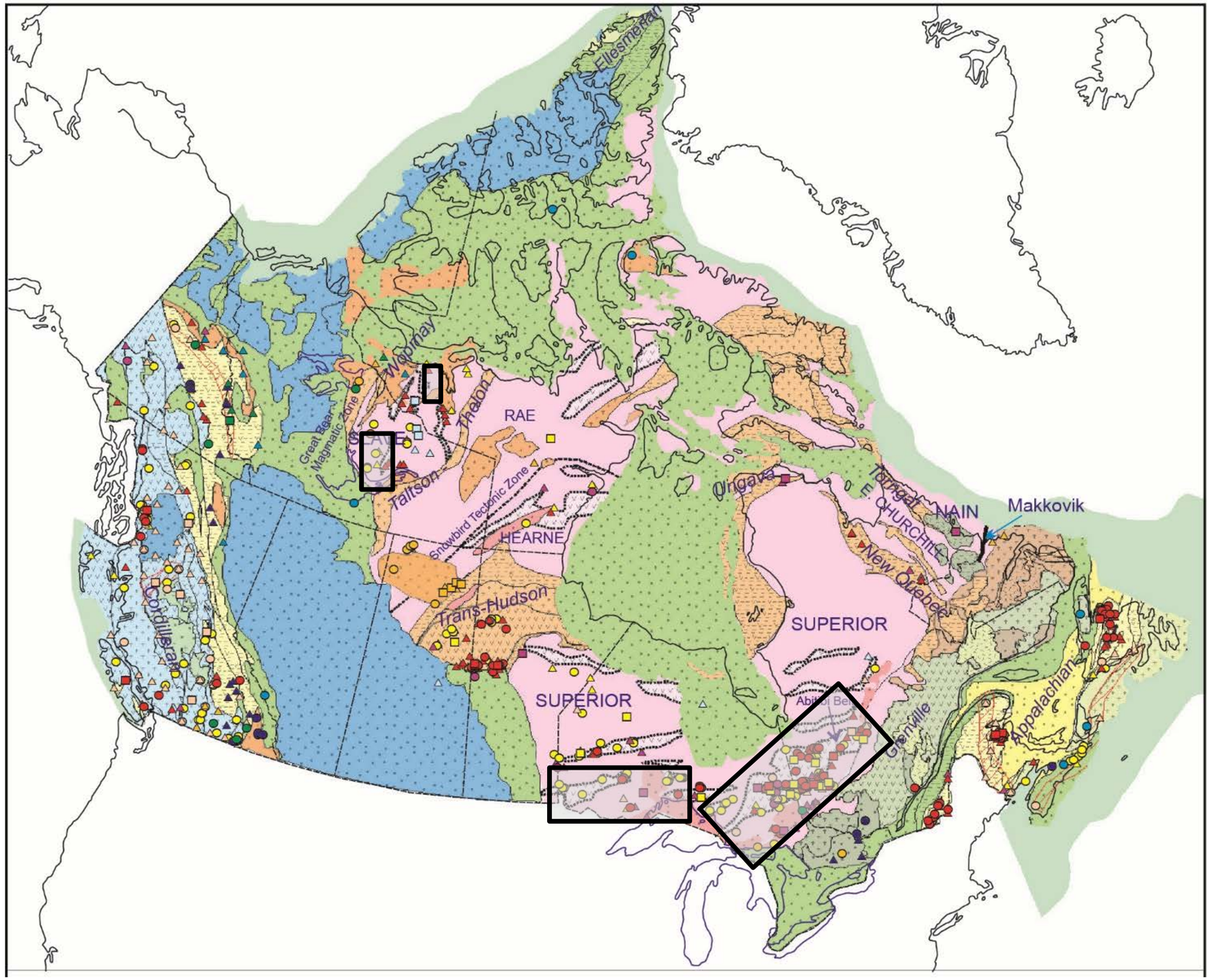
- Focus on Archean greenstone belts, which represent 60% of Earth history and almost 50% of Canada’s metal wealth
- Resolve ore system-scale controls at craton - greenstone belt - district - deposit scales
- Image ore and non-ore systems at full crust-mantle scale
- Develop transformative 3D-4D data integration, analysis, and visualization tools that will aid discovery of new districts and new deposits

# Metal Earth

## 4 Integrated Activities:

1. Craton Scale Research
2. Transect Scale Research
3. Thematic Research
4. Data Analytics

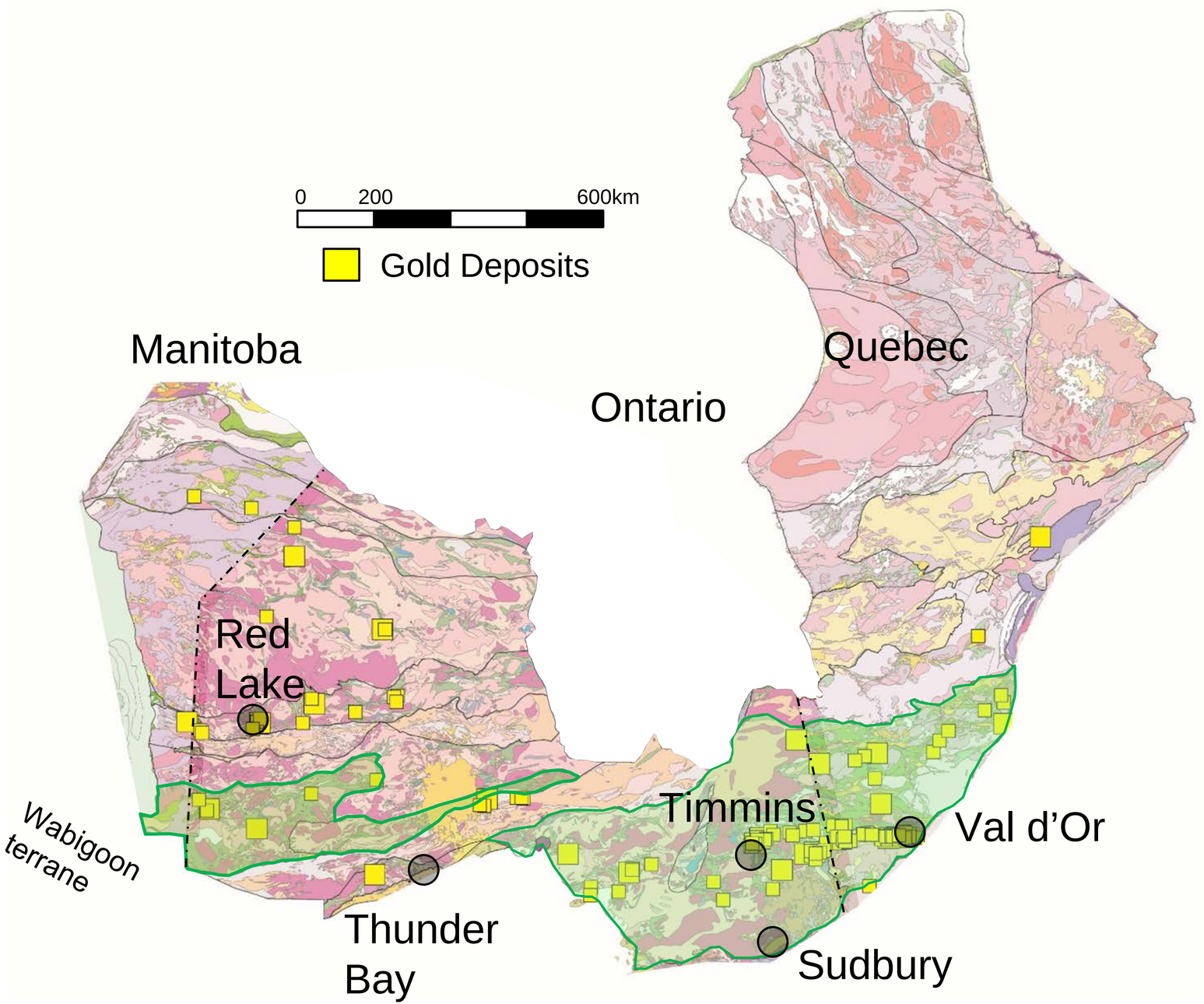
Initiate in 2018



# Metal Earth

## Craton Scale
## Superior - Slave Provinces
## 2017-2022

- Geologic compilation at 1:1M scale of the Superior
- Compilation of regional geophysical data (Esi Eshaghi PDF)
- New understanding of 3D and 4D craton architecture using isotopic mapping techniques (David Mole, Jeff Marsh PDFs)



# Metal Earth

## Transect Scale 2017-2021

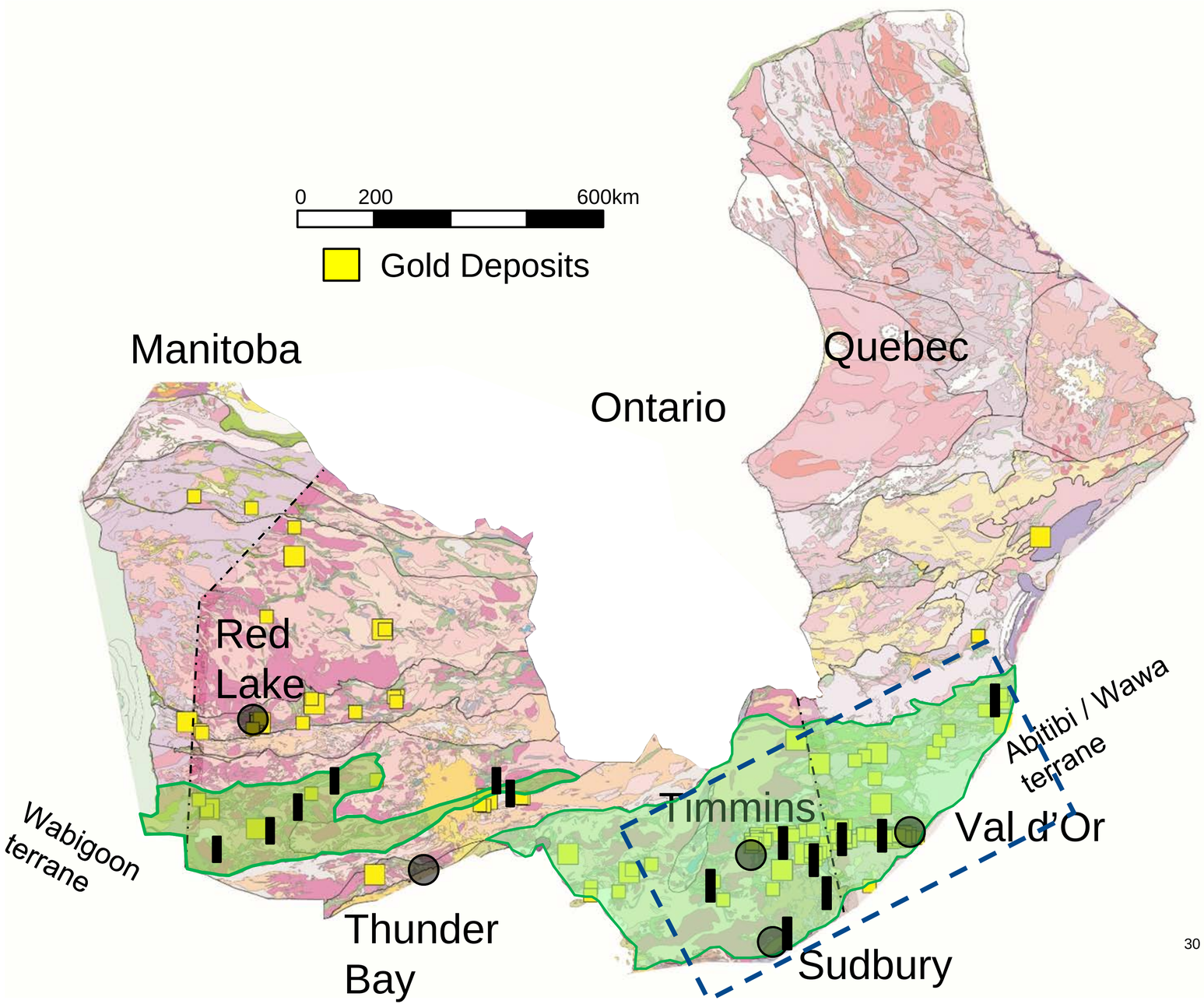
Southern Abitibi
+ Chibougamau

Sudbury - Cobalt

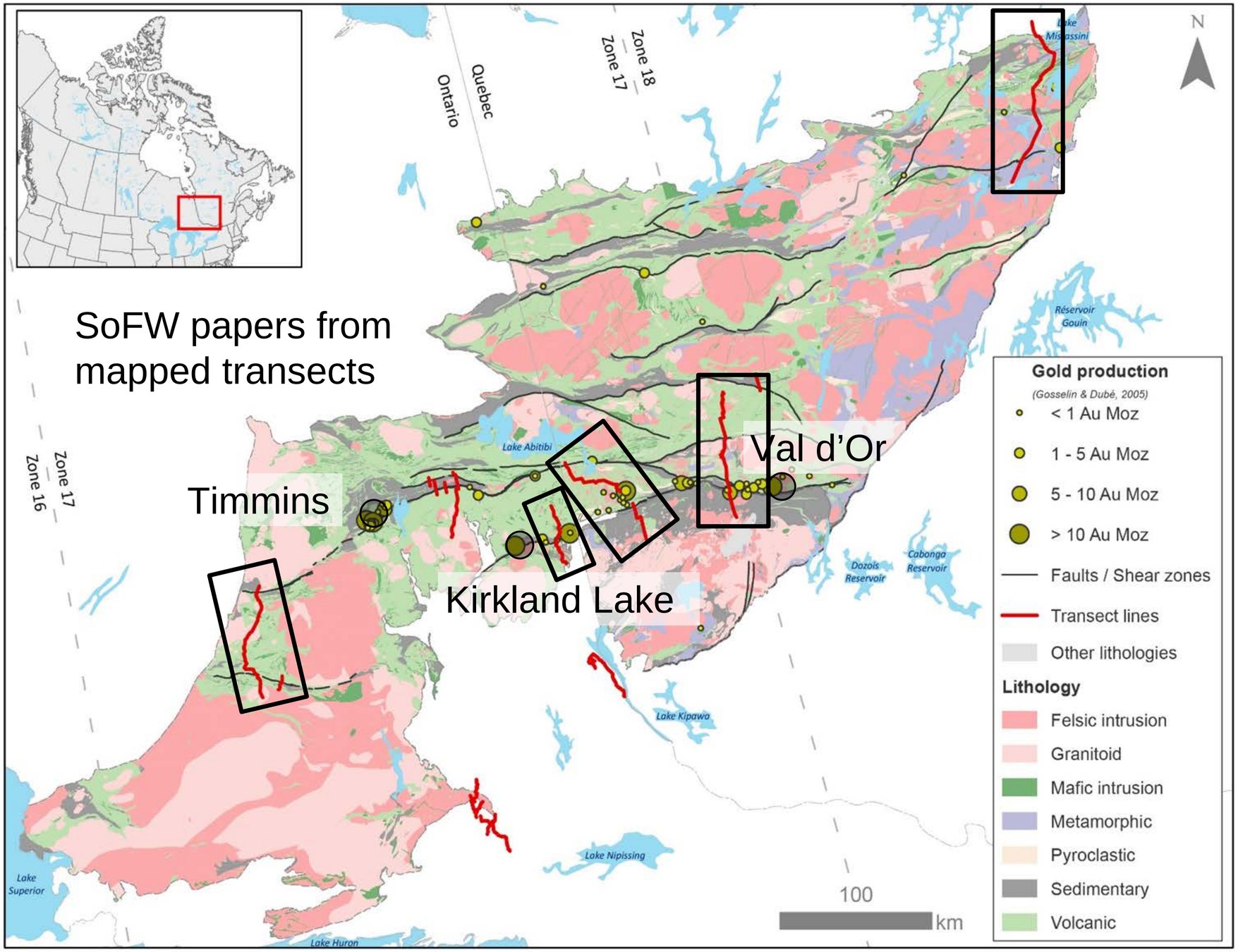
Wabigoon
- Geraldton
- Atikokan
- Dryden
- Fort Francis

**Seismic Survey ~1,069 km across the Superior**

Considering endowed and less endowed areas with same level of consideration



# Crustal Scale Slices Across Various Belts



# Metal Earth Seismic Surveys

**KM1**

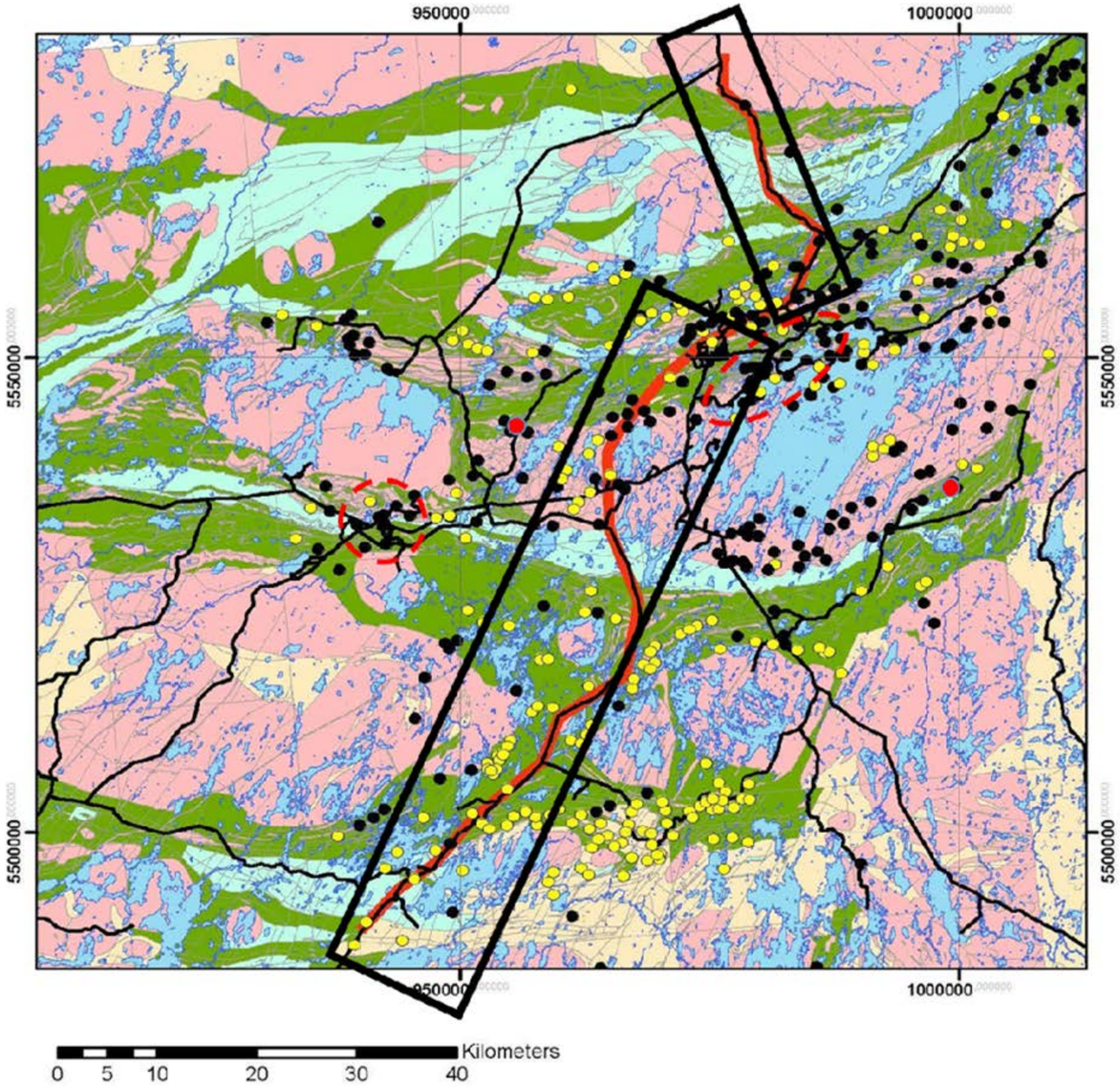
**August 4th, Chibougamou**

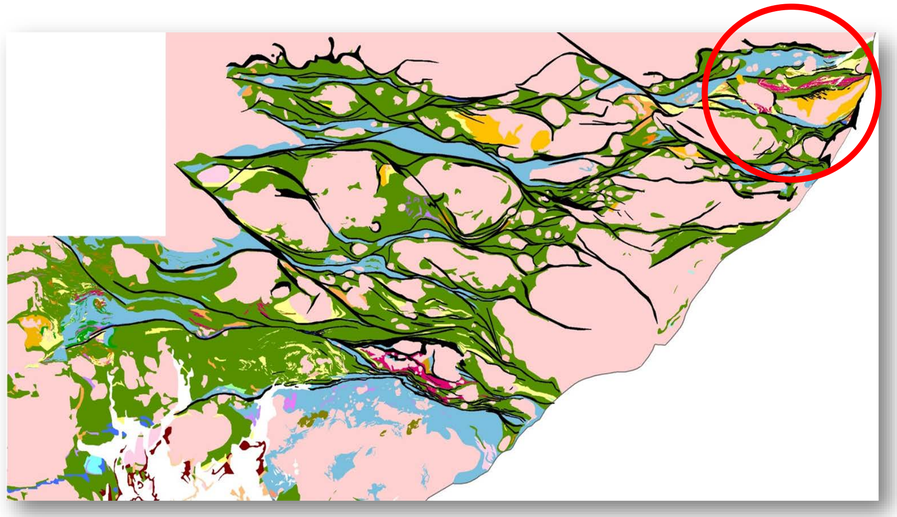
Link to

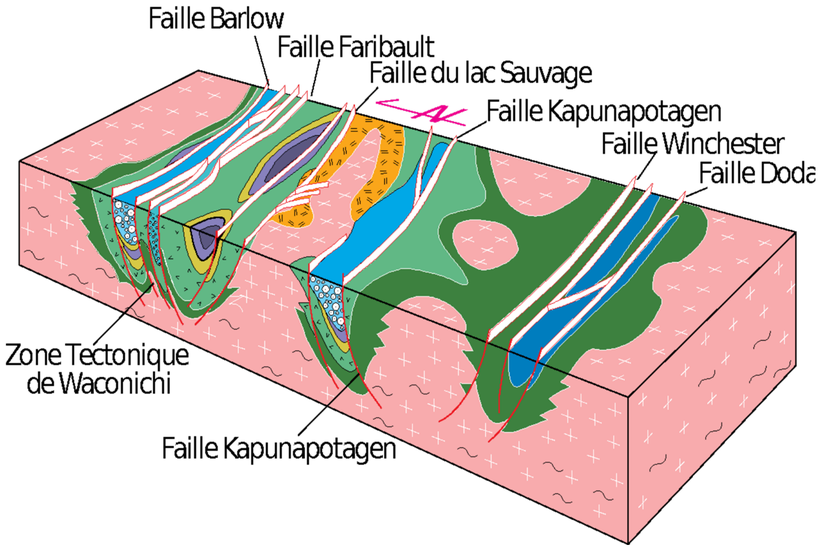
Seismic Video

# Transect Scale Research

## Chibougamau District Seismic Transect

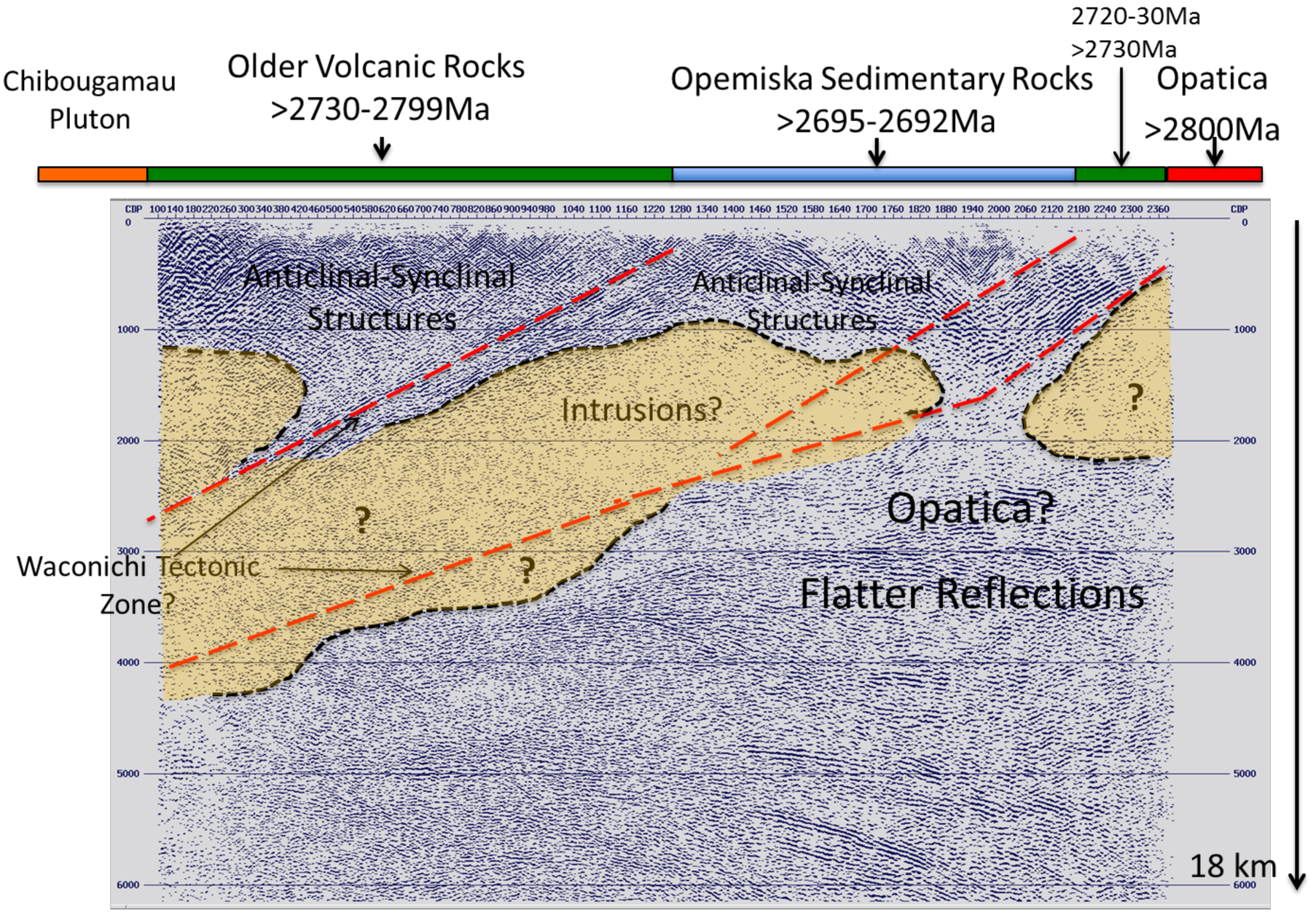





From Daigneault, 1991

# Preliminary - North-Northwest Seismic Profile



# Data Analytics & Thematic Research

**Data Analytics research** will **transform** existing data integration, analysis and interpretive tools to predict metal endowment and guide exploration.

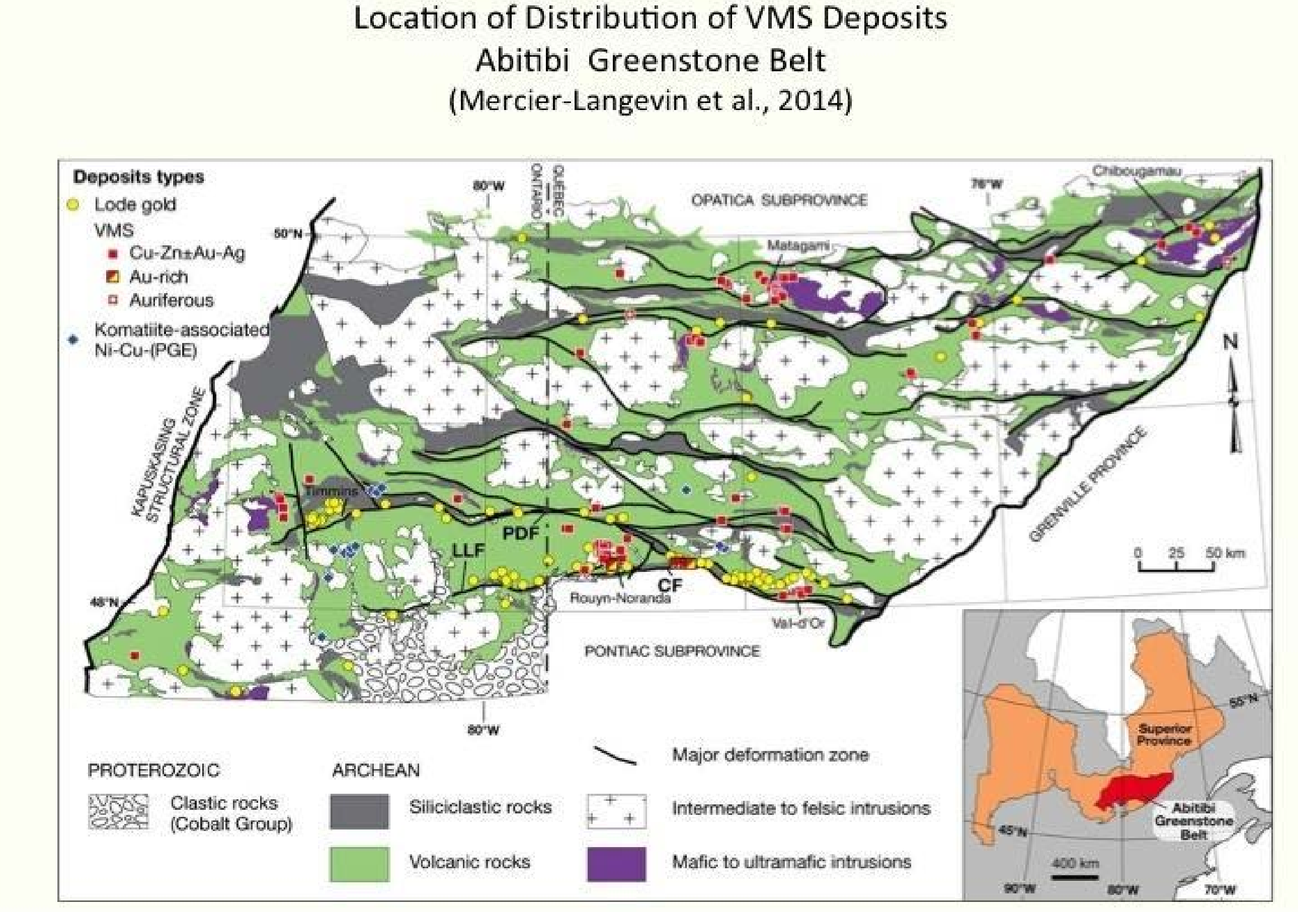
Data integrated, analyzed, interrogated and visualized using a goCAD Common Earth Model

Partnership with MIRA Geosciences and CEMI Mining Data Control Control Centre at SNOLAB
Evaluate potential Artificial Intelligence partners e.g. IBM

Commercial exploration targeting products starting Year 2019

**Initiate in 2018**

**Thematic research** from craton- to deposit-scales will address specific processes or questions on metal endowment and exploration
**Initiate in 2018**



# Metal Earth - Goals and Deliverables

| Goal | Delivered |
|---|---|
| Initiated Geophysics and Geochron compilations (Craton activity) | ✓ |
| Delivered $5.5M seismic survey (Transect Activity) | ✓ |
| Contract for $1.0M MT survey awarded (Transect Activity) | ✓ |
| Transect Mapping, fieldwork 2017,<br>10 graduate and 13 undergraduate students, 3 research associates | ✓ |
| Inaugural field workshop on transect geology, 55 participants | ✓ |
| New website for delivery of data, reports, and presentations | ✓ |

# Metal Earth - Goals and Deliverables

| Target Date: Next 18 Months |
| --- |
| Superior Craton geophysical compilation – Targeting Tool |
| Geophysical Map for Abitibi |
| Superior Craton Geochronology database and map |
| PDAC Short Course |
| First benchmark report |
| Transect work in the Wabigoon |
| Thematic work revolving around metal endowment |
| |

# Metal Earth - Goals and Deliverables

| Target Date: 3 - 5 years |
| --- |
| Full crustal sections through endowed and lesser endowed greenstone belts in the Superior |
| Initiate Transect scale work in the Slave |
| First protocols for geoscience data collection, integration and interpretation and commercialization |
| Annual field workshops |

Important dissemination of data

# MERC - Metal Earth Events

## 2018

PDAC Short Course (March)

*An assessment of Precambrian gold deposit models from deep to shallow crustal levels*

PDAC **Student Minerals Colloquium** (March)

MERC Modular Course **Exploration for Magmatic Ore Deposits**. (April)

MERC **Greenstone Gold and Base Metal Mapping Course (**May 6-12)

Resources for Future Generations (RFG) session, Vancouver (June)

MERC Modular Course **Mineral Exploration in Volcanic Terrains. Contact** (August)

**Annual Metal Earth Field Workshops** (Abitibi and Wabigoon; late August)

**Abitibi Exploration Research Symposium** associated with the Northeastern Ontario Mines and Minerals symposium in Kirkland Lake (October)

# Benefits of MERC Membership

- Be part of $104 million Metal Earth project funded by 3rd parties
- Learn results first-hand, as they develop
- Advise and collaborate to improve outcomes
- Opportunity to coordinate programs or share field mobilization costs
- Ongoing MERC research, reports, workshops, courses, maps and databases

# Conclusion:

MERC with its METAL EARTH project is leading a major collaborative effort to improve the science for targeting and finding new orebodies

THANK YOU  to MERC members for your support!

If you are not a part - **CONSIDER JOINING!**

LaurentianUniversity
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École des sciences de la Terre
MERC
Mineral Exploration Research Centre
METAL EARTH