

## Crustal variations in metal endowed vs. less endowed areas of the Abitibi greenstone belts: Insights from the Matheson and Swayze transects

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Canada



## Metal Earth Project

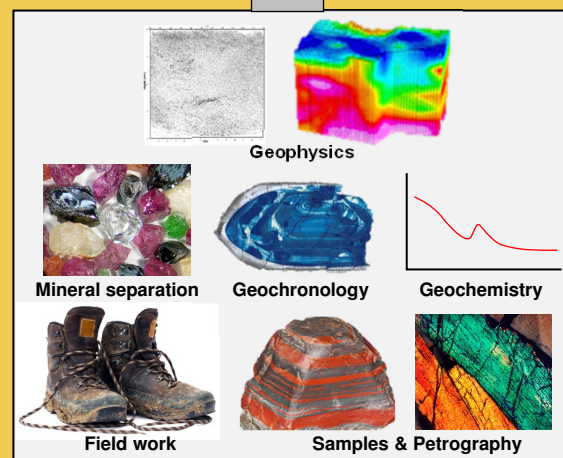
**To improve our understanding on the processes that control differential metal endowment**

Main focus: Superior craton and metal endowed and less endowed Archean greenstone belts

Resolve ore systems at multiple scales (craton – belt – district – deposit)

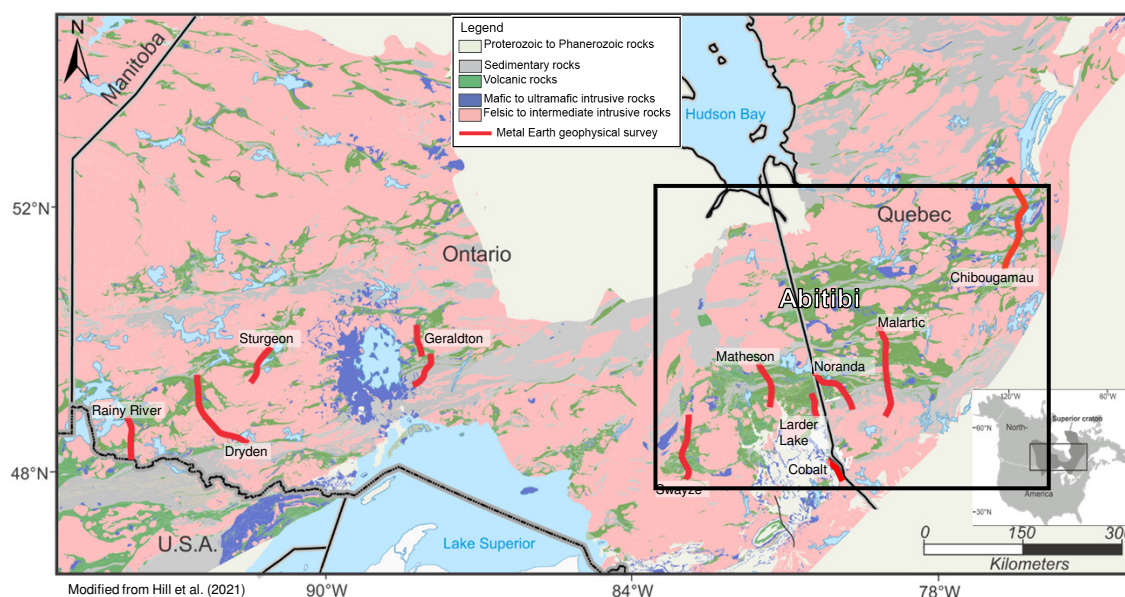
- Crustal/Mantle variations in endowed – less endowed areas
- Fluid/magma/heat pathways
- Fluid and metal sources
- Archean tectonics and metallogeny

Ore system processes

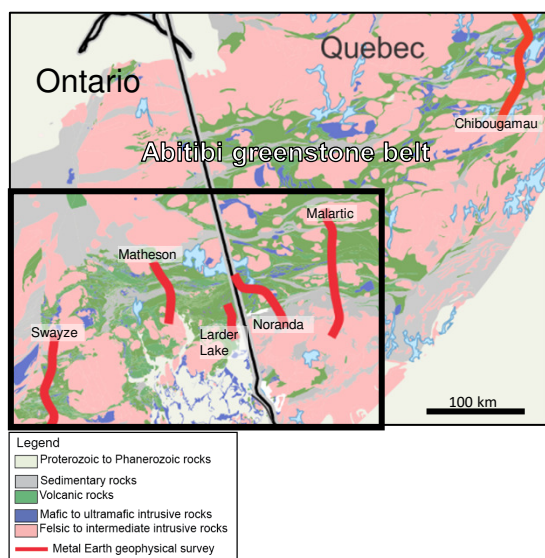


Compilation of geoscience data

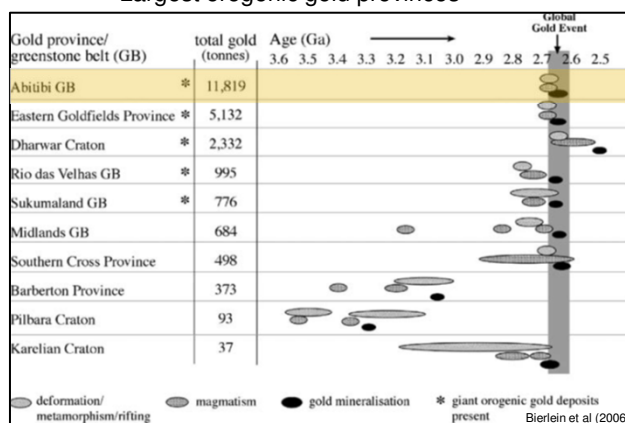
## Transect-scale research – Superior craton



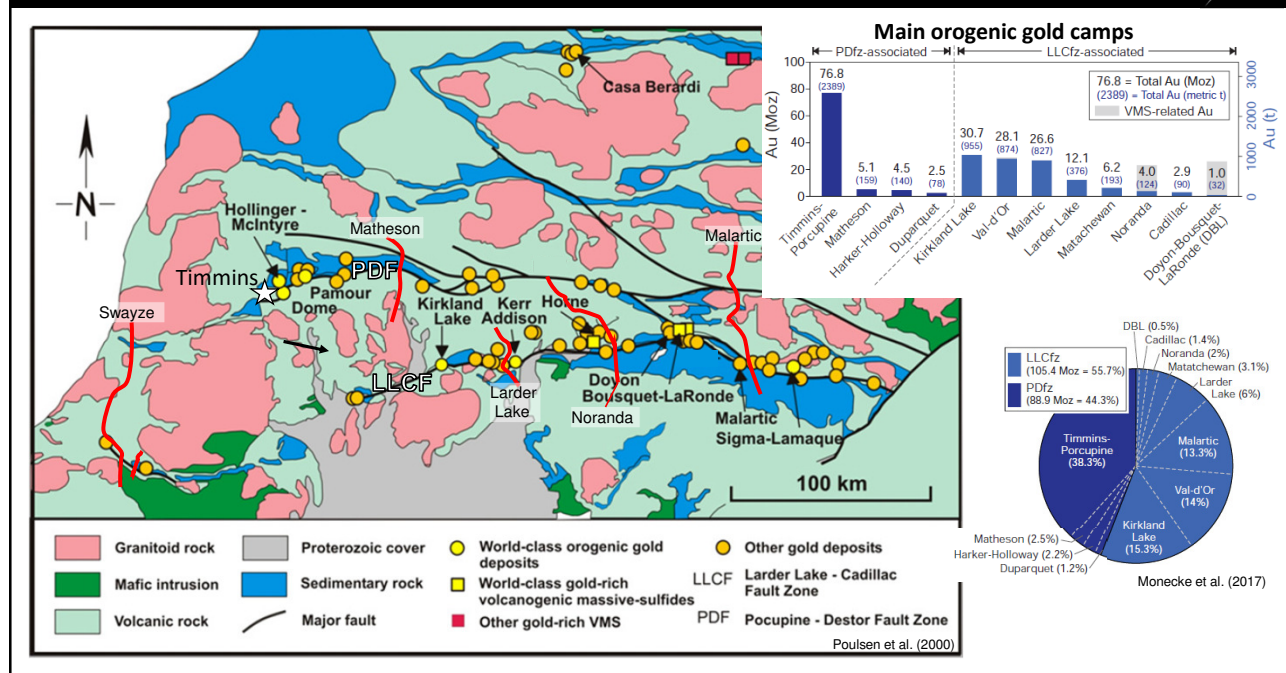
## Transect-scale research – Abitibi greenstone belt and orogenic gold



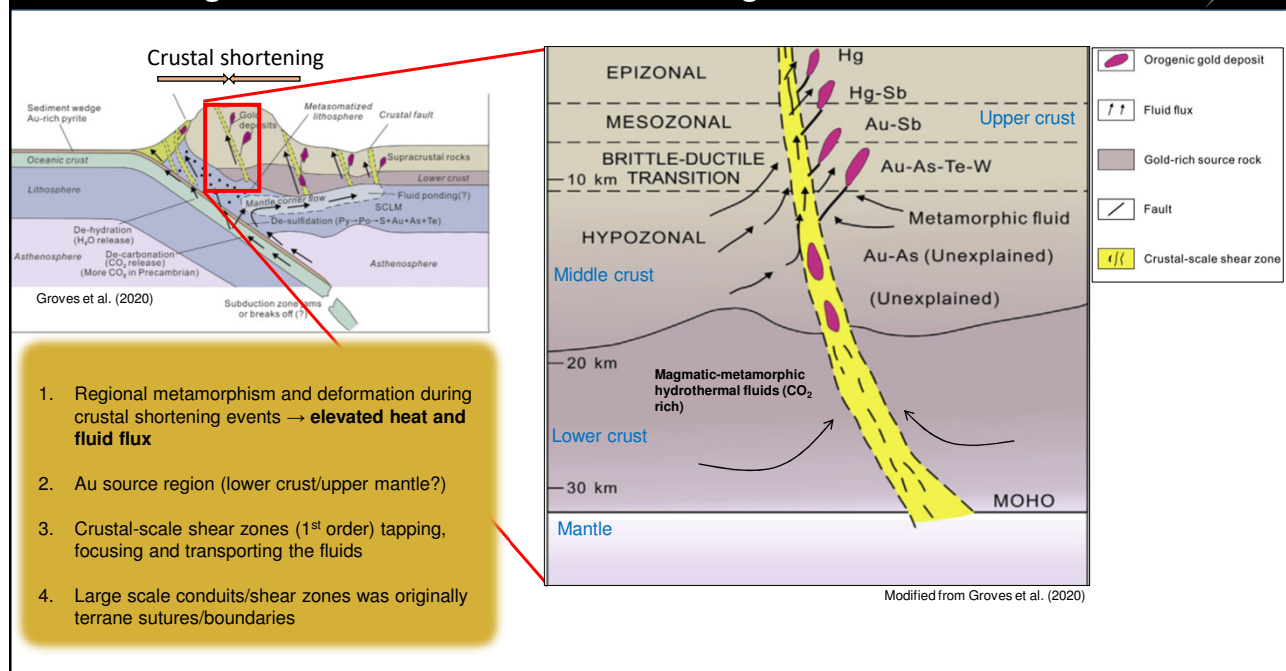
### Largest orogenic gold provinces



## Transect scale research – Abitibi greenstone belt and orogenic gold

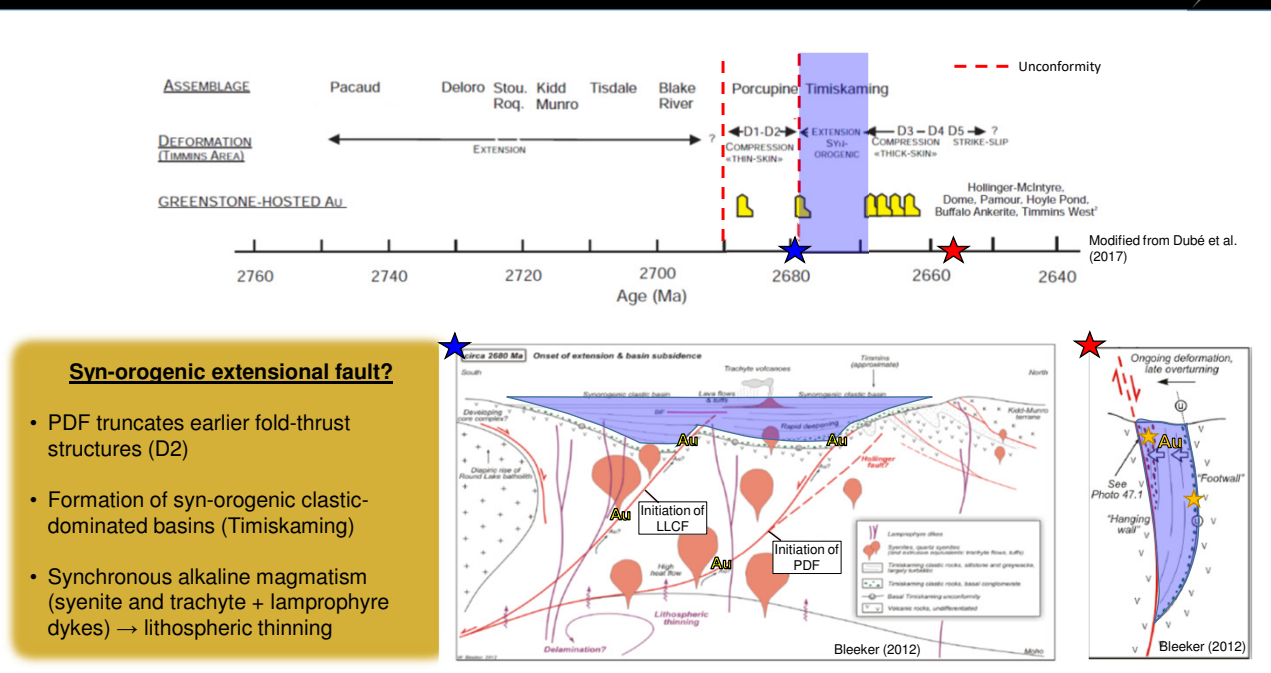


## General orogenic Au model – Crustal shortening

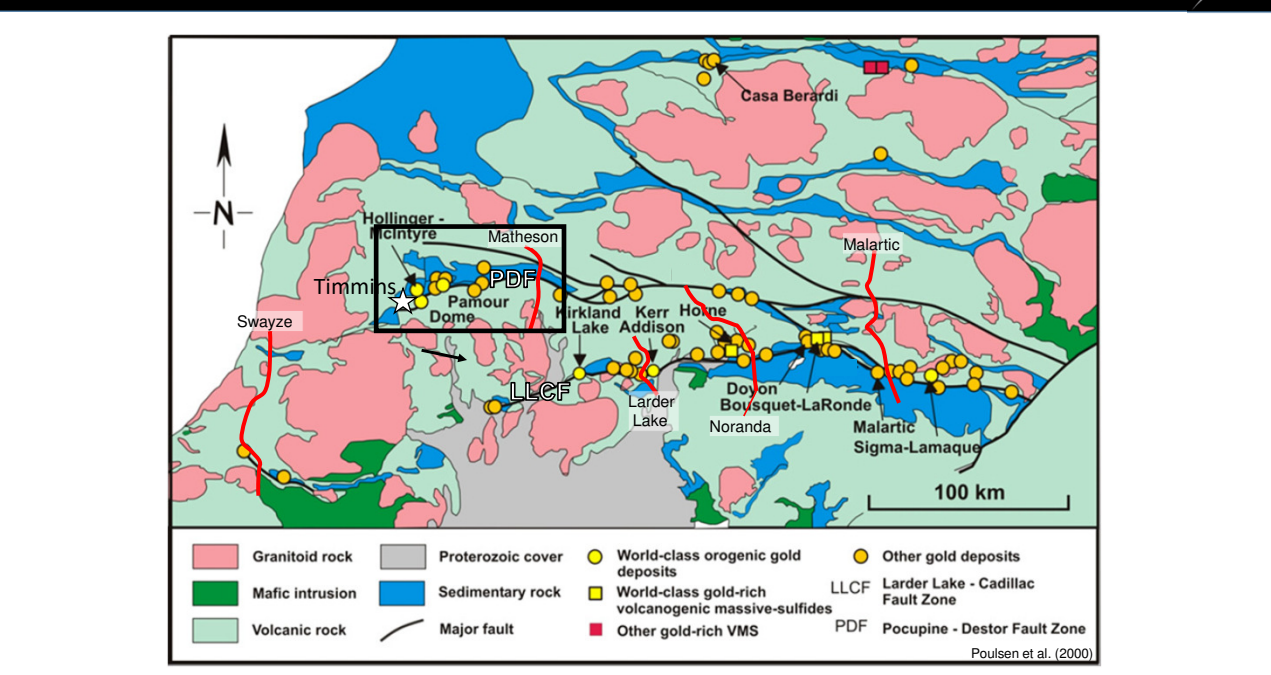


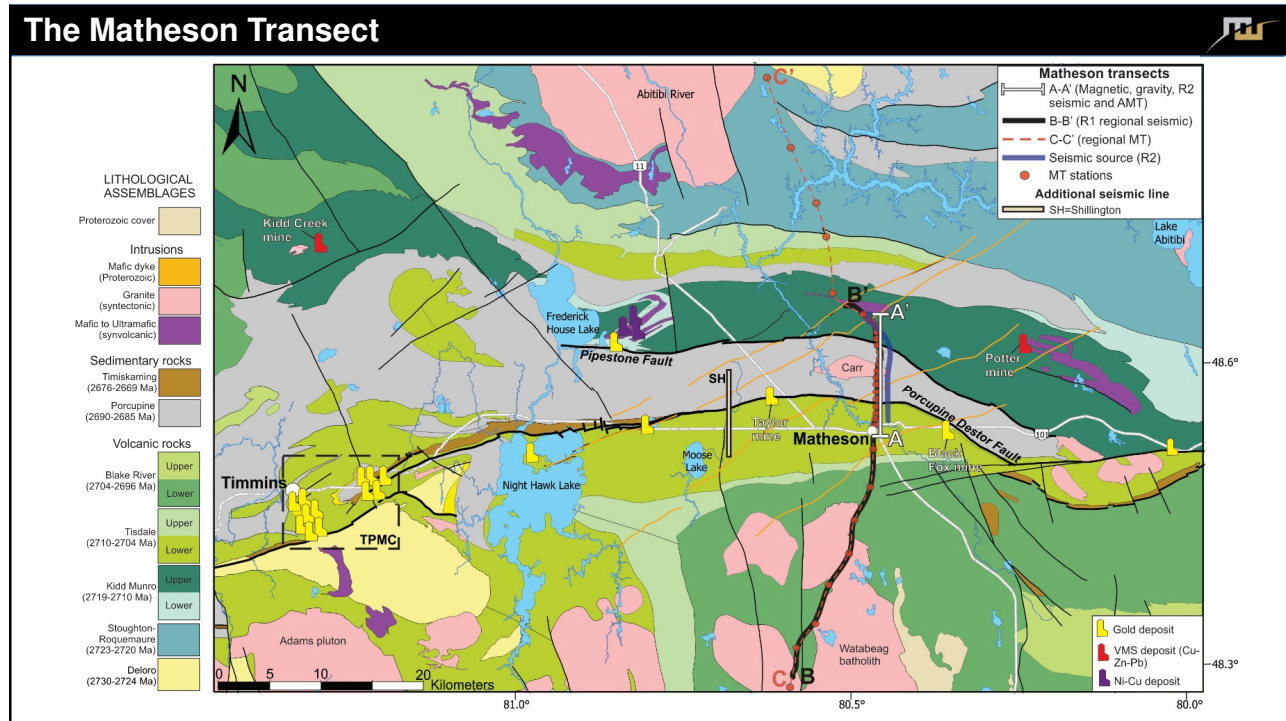


## Abitibi model – Extension?



## The Matheson Transect





### The Matheson Transect - Goals

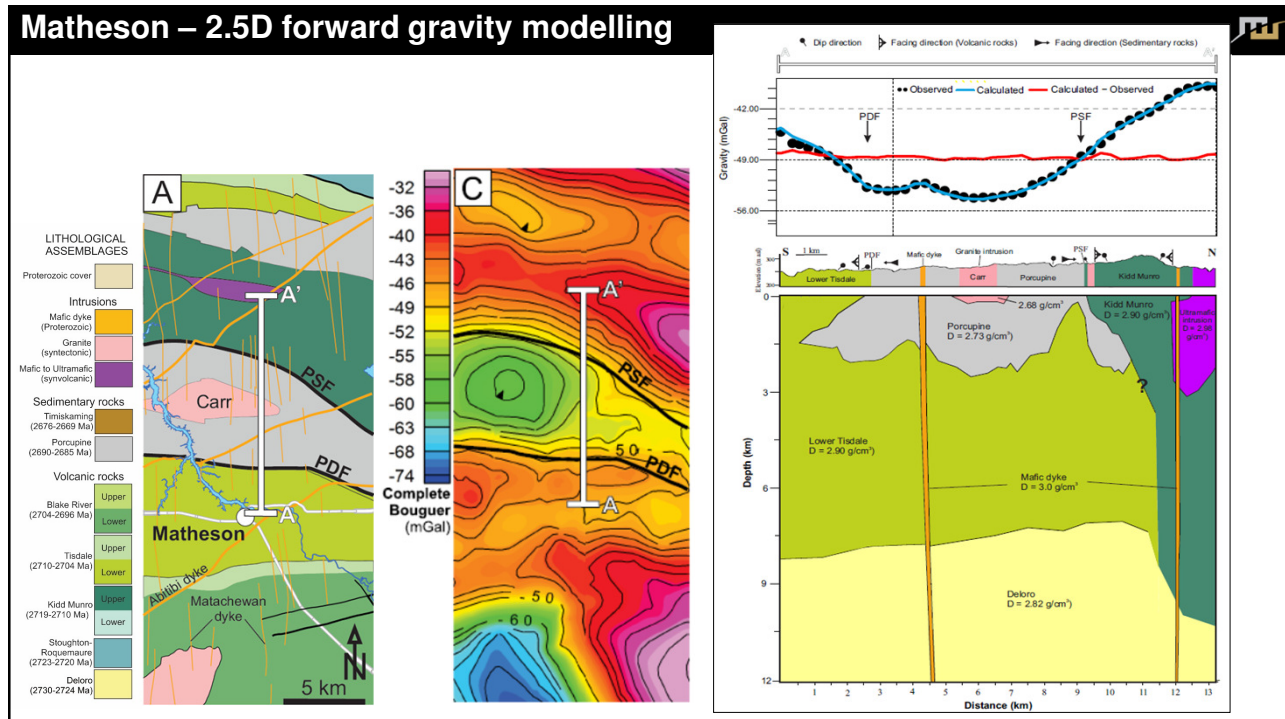
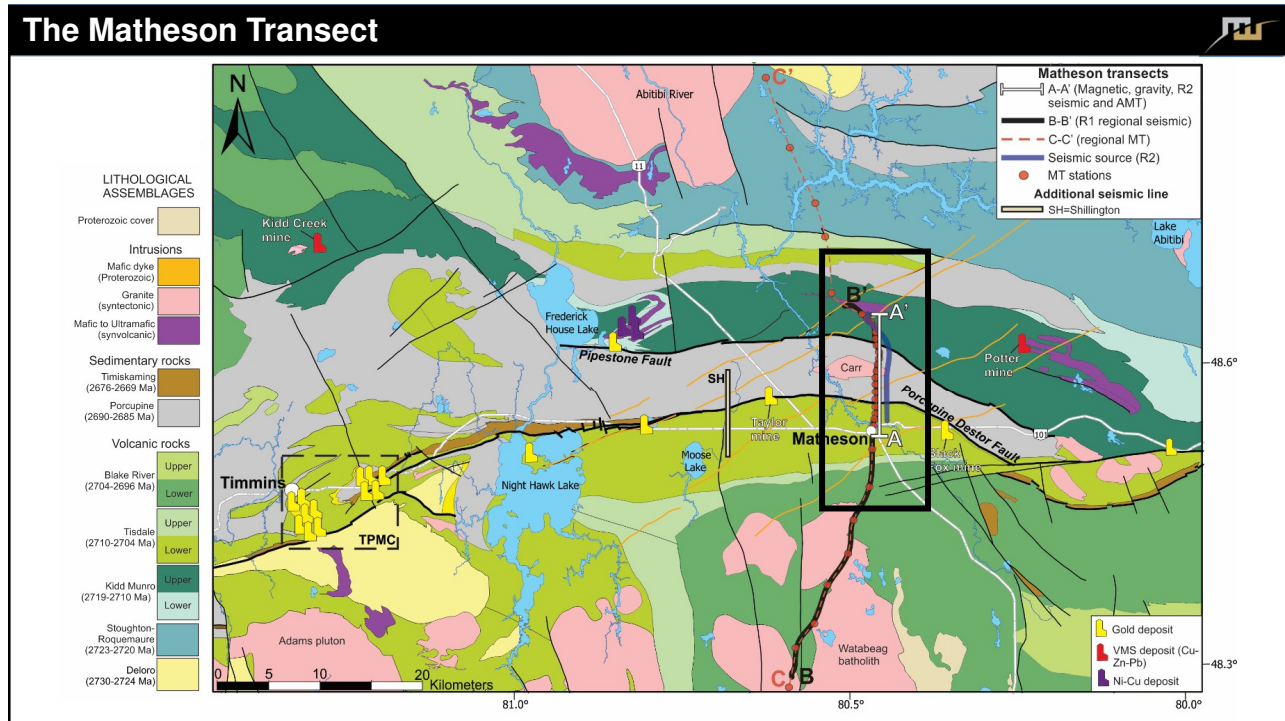
**Crustal geology** – Modelling key greenstone belt assemblages and fault geometry by integrating surface geology, gravity, MT and high resolution seismic

Assess the **metallogenic fingerprints** of the Matheson transect including characterizing potential deep-seated mineralizing fault systems

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Economic Geology, v. XXX, no. XX, pp. X-X

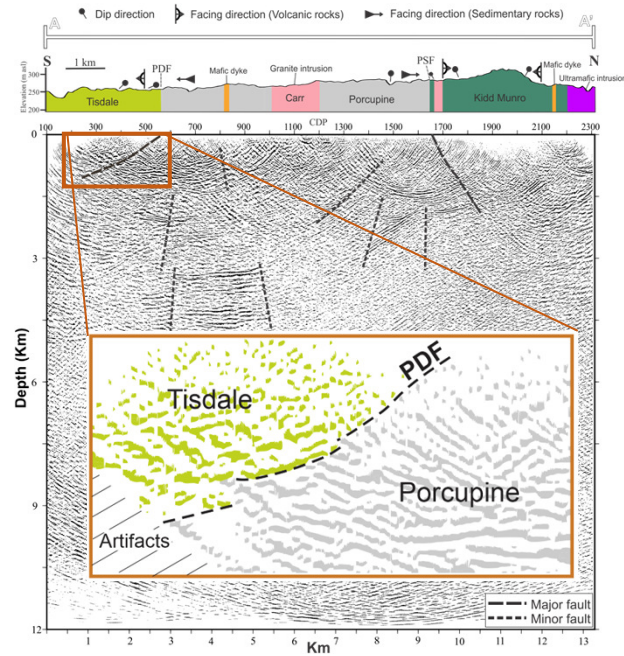
Crustal-Scale Geology and Fault Geometry Along the Gold-Endowed Matheson Transect of the Abitibi Greenstone Belt

Rasmus Hangaard,<sup>1,3</sup> Fabiano Della Justina,<sup>1</sup> Eric Roots,<sup>1,2</sup> Saeid Cheraghi,<sup>1</sup> Rajesh Vayavur,<sup>1</sup> Graham Hill,<sup>3</sup> David Snyder,<sup>1</sup> John Ayer,<sup>1</sup> Mostafa Naghizadeh,<sup>1</sup> and Richard Smith<sup>1</sup>

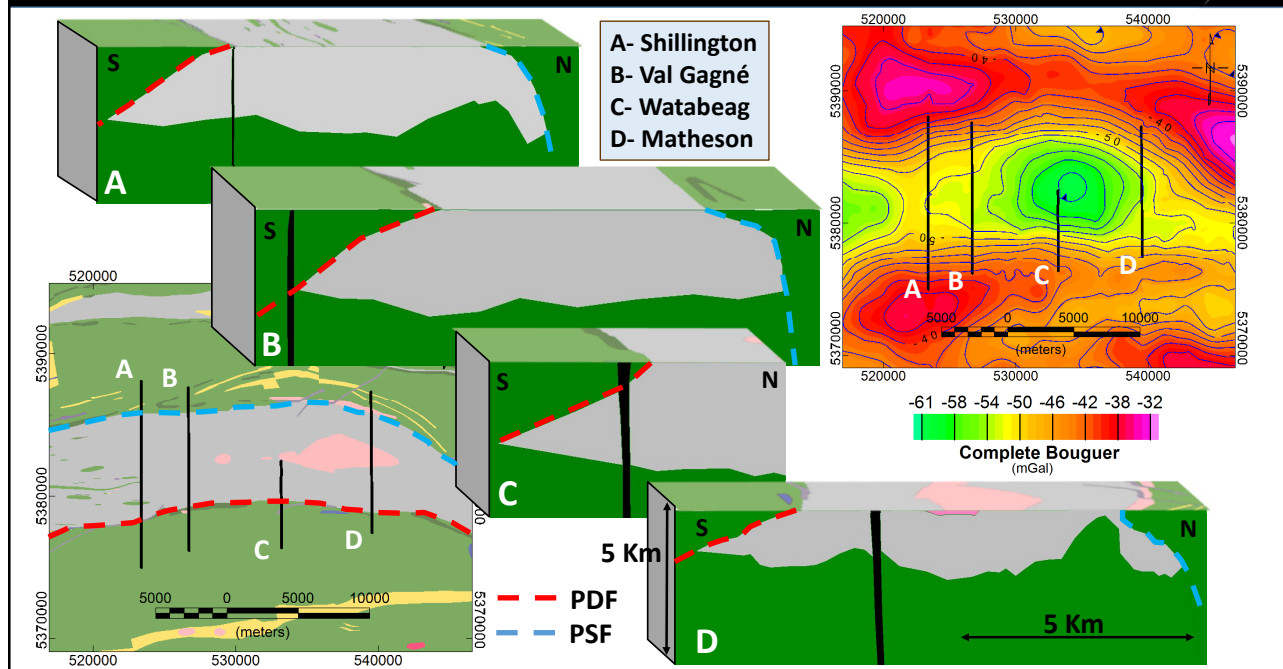




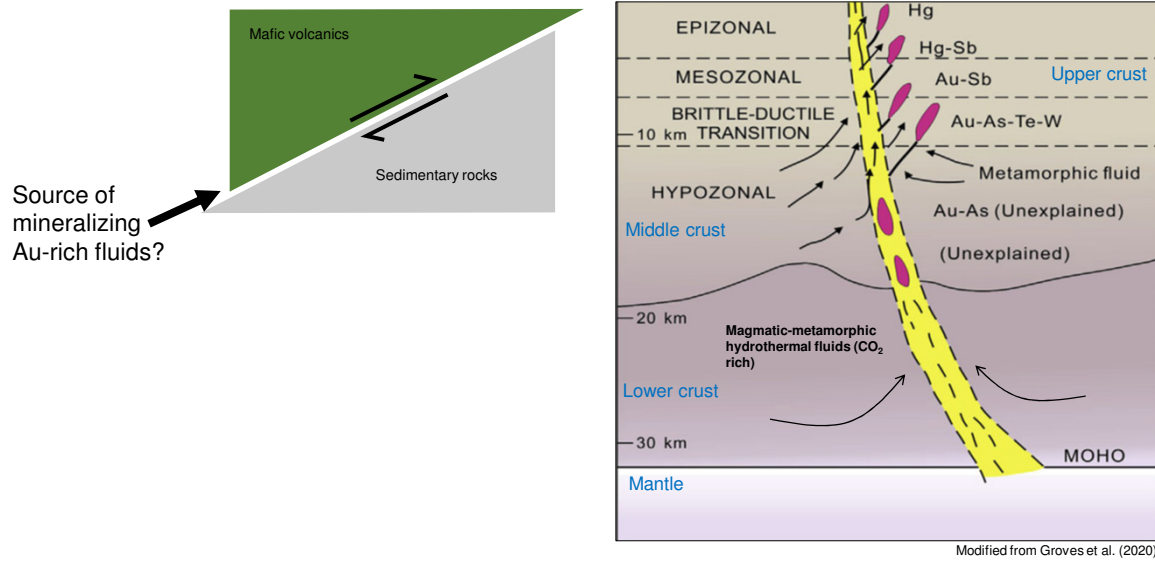
## Matheson – High resolution seismic



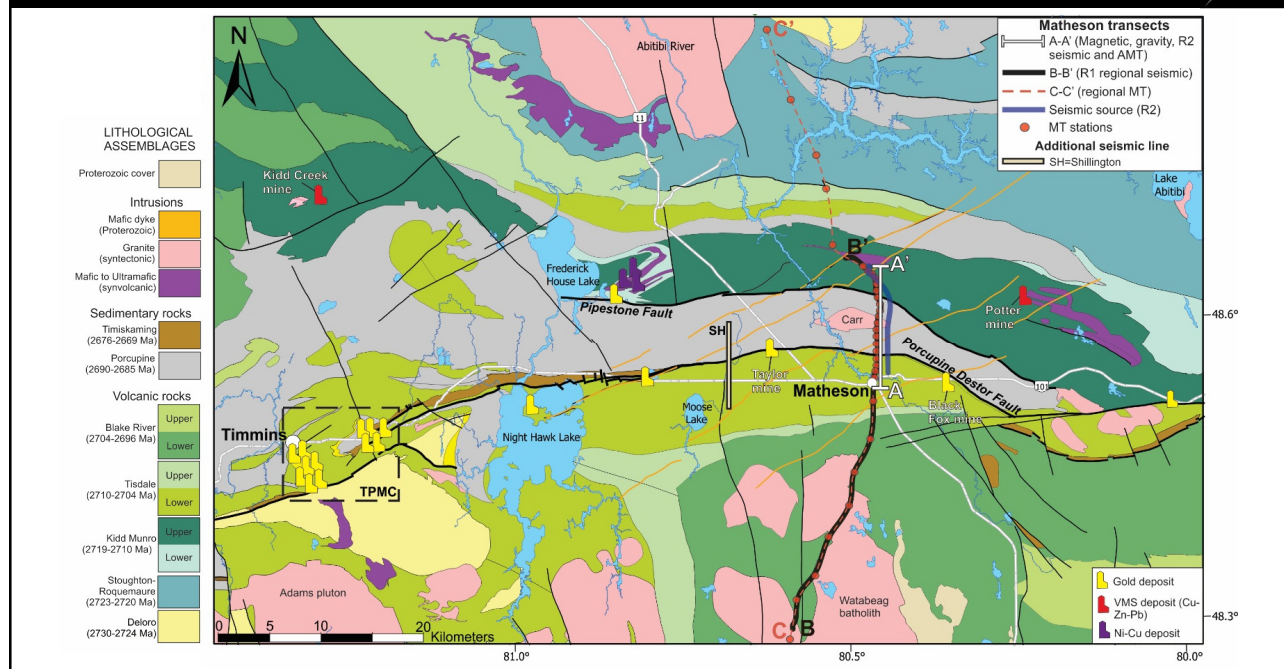
## Regional variations in the PDF geometry



## PDF - A shallow dipping thrust fault

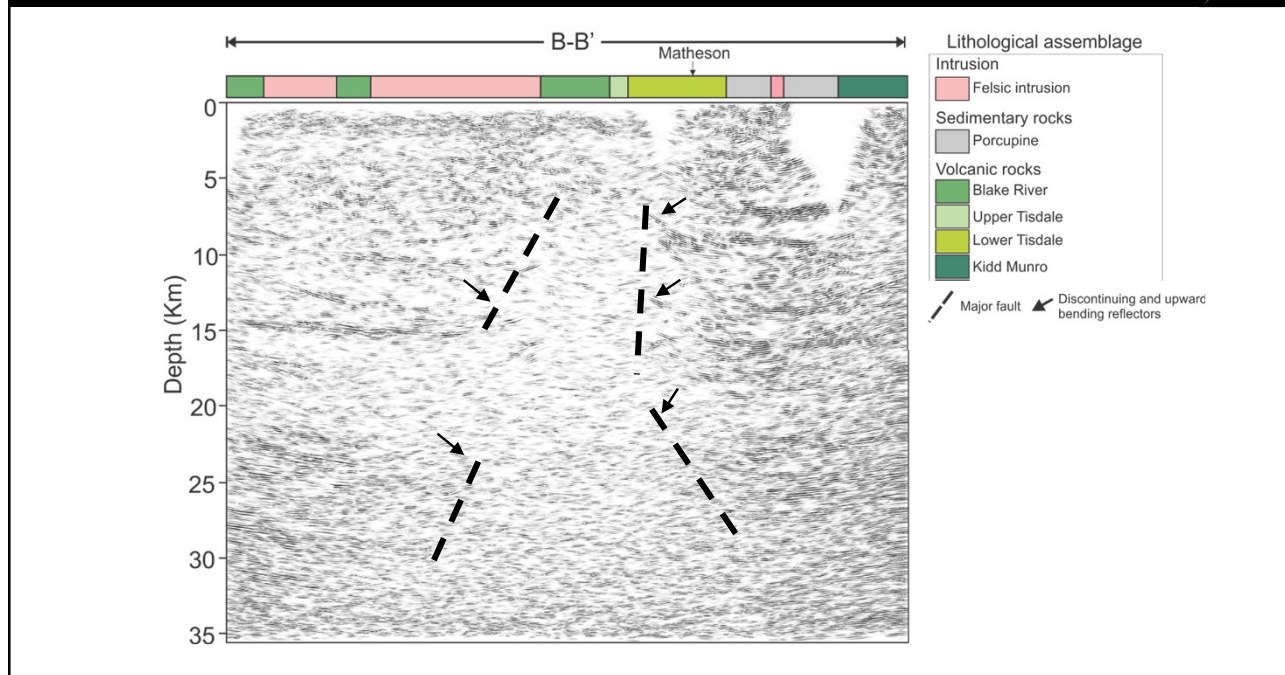


## The Matheson Transect

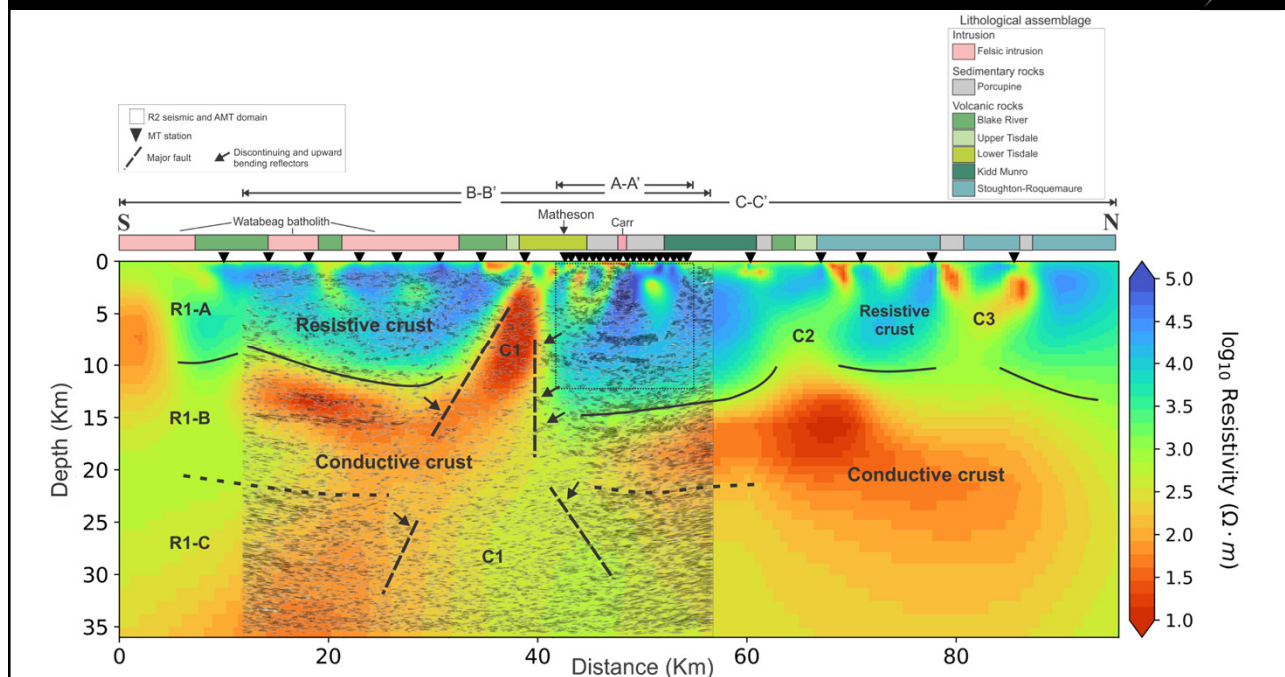




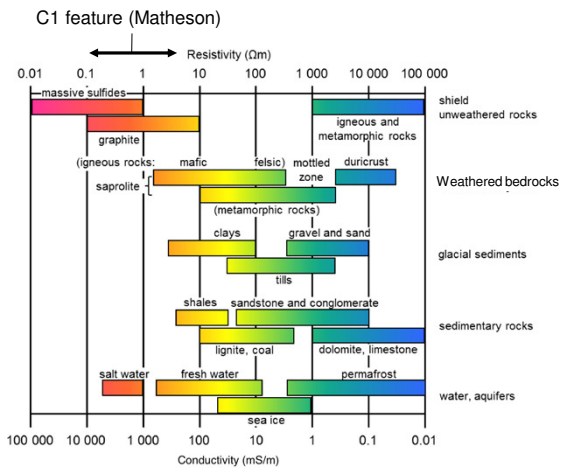
## Matheson - Full crustal seismic



## Matheson - Full crustal seismic and MT



## Source of low resistivity in Archean crust



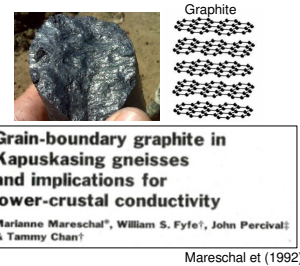
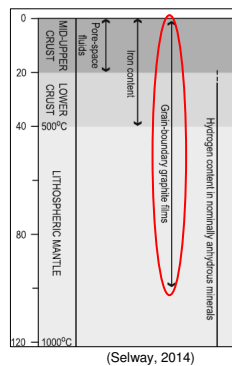
- Water/brines/melts?
- Sulfides?
- Graphite?

### Metamorphic graphite formation:

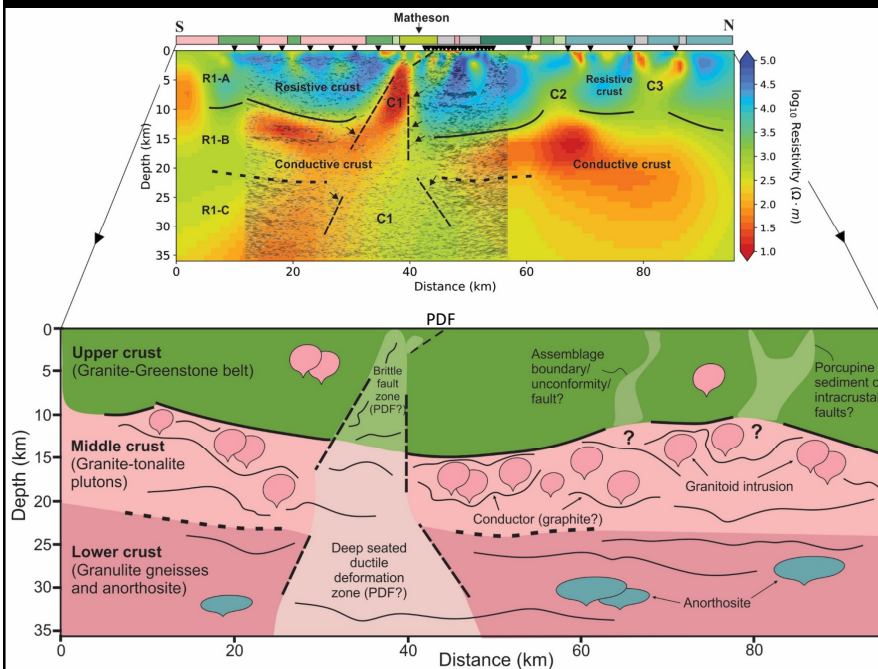
Fluid-deposited graphite from carbon-bearing fluids such as  $CO_2$ ,  $CH_4$ , and CO or mixtures of these. (\*Mantle derived magmas + metamorphic derived fluids are  $CO_2$ -rich)

Stable to mantle depths

Grain boundary graphite films (5-50 nm) → **solid** and **interconnected** conductive phase (Mareschal et al. (1992).



## Matheson - Full crustal geology

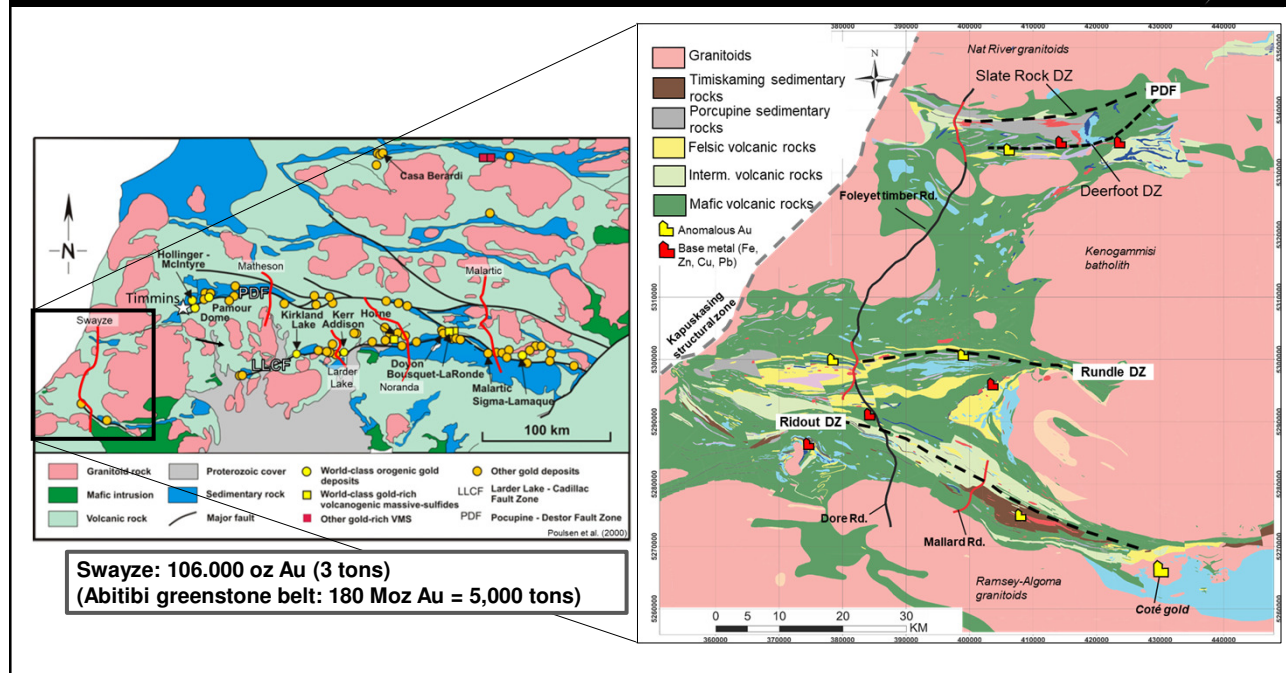


- Does the C1 feature represent a regional first order crustal-scale fault?
- Is it part of the PDF and how are the PDF in Matheson linked to the C1 feature?
- Is the shallow dipping thrust fault at Matheson, and in the region, a second (or higher?) order structure of the PDF?
- Did the deep-rooted C1 feature focused and transported hydrothermal fluids into the PDF in Matheson?

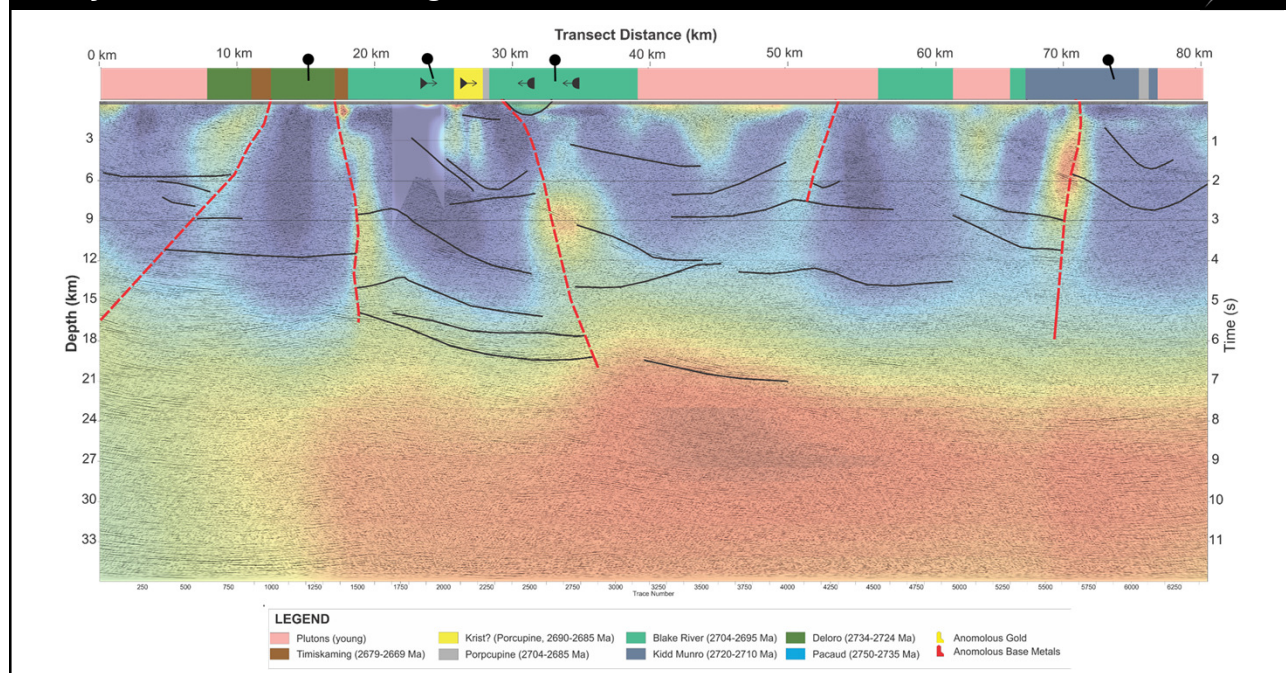
Graphitization: a by-product of late-stage thermal events following craton stabilization?



## Swayze – A less-endowed greenstone belt?

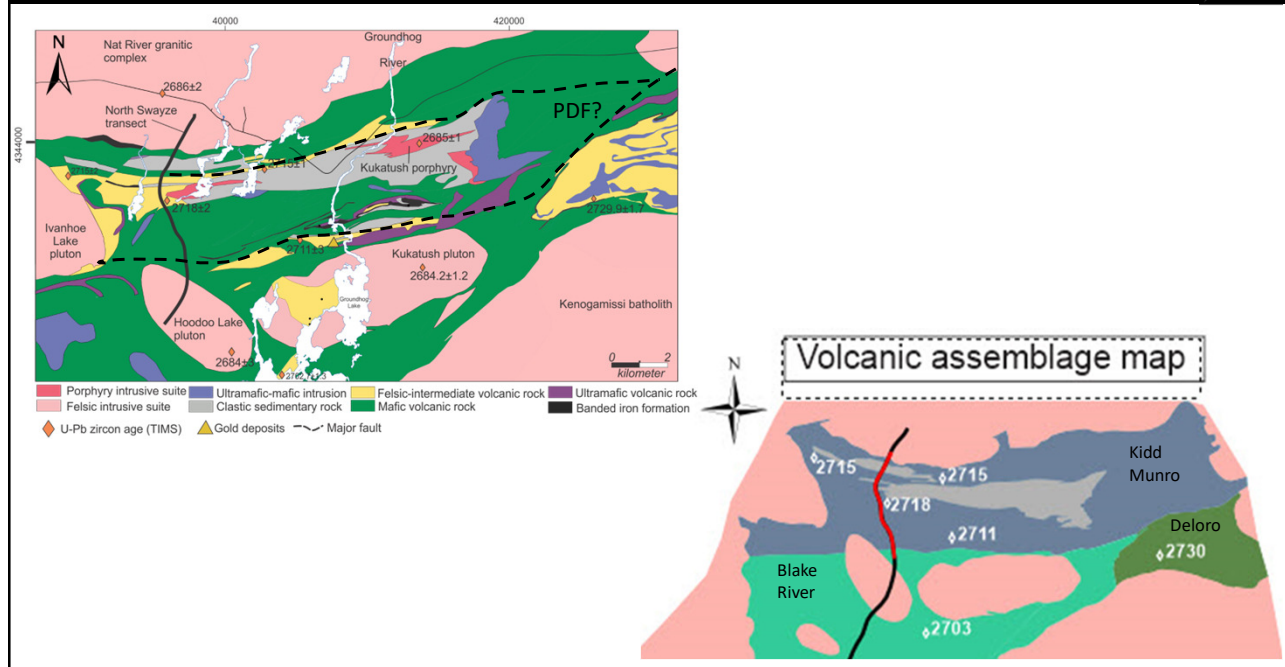


## Swayze – A less-endowed greenstone belt?

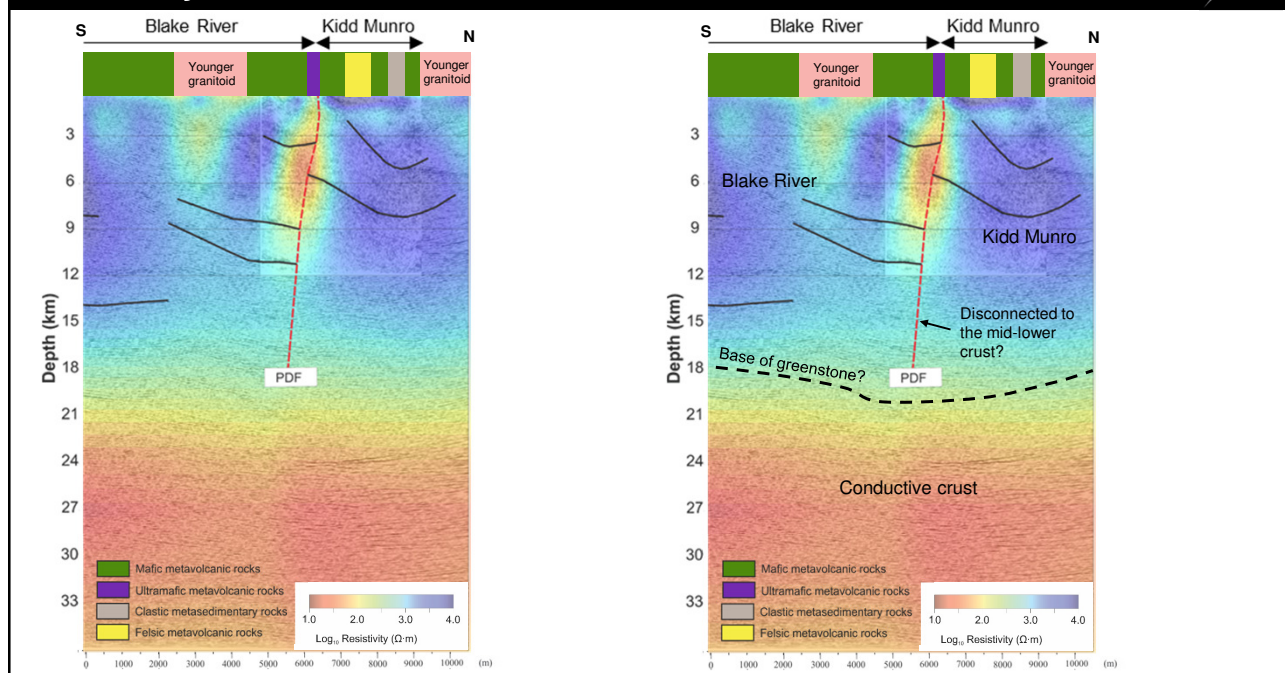




## North Swayze geology and the PDF



## North Swayze and the PDF in a crustal scale context



## Crustal variations between Matheson and Swayze - Summary

- Neither PSF nor Slate Rock deformation zone have a crustal conductive corridor at the Porcupine/Kidd Munro contact, suggesting these faults are less endowed crustal structures than the Porcupine Destor Fault zone
- Porcupine Destor Fault Zone in the north Swayze is located between Blake River and Kidd Munro mafic volcanics and it is **spatial unrelated** with the Porcupine sedimentary basin
- Secondary thrust faults (splays) as seen in Matheson but not Swayze is key for channelizing and concentrating Au-rich fluids?
- Deep seated primary crustal structure is not well developed in Swayze where it is disconnected to the mid-lower crust





# METAL EARTH

A new Canadian research initiative funded by  
Canada First Research Excellence Fund.









