

Diversité des gisements d'or des ceintures de roches vertes et implications pour l'exploration


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Xplor | Montréal | 29 Octobre 2024

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Contenu




- **Mise en contexte**
 - Distribution de l'or
 - Évolution des ceintures
- **Diversité de style de minéralisation**
 - Modèles descriptifs
- **4 exemples de différents styles**
 - Parmi un spectre
- **Contrôles et guides d'exploration**
 - Régional au local
- **Place de l'or dans l'évolution**
- Points importants

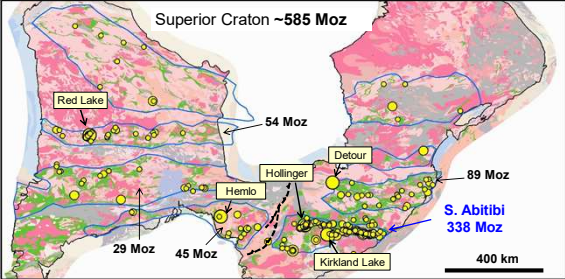
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L'or dans le Supérieur (et autres cratons!)




- Gisements des domaines spécifiques
 - +300 km long, 50-75 km large
 - Ceintures de roches vertes
- Distribution hétérogène
- 1 domaine domine le budget aurifère
 - Abitibi Sud = 60% de l'or
- **Qu'y a-t-il de spécial??**
 - Préservation = un des facteurs



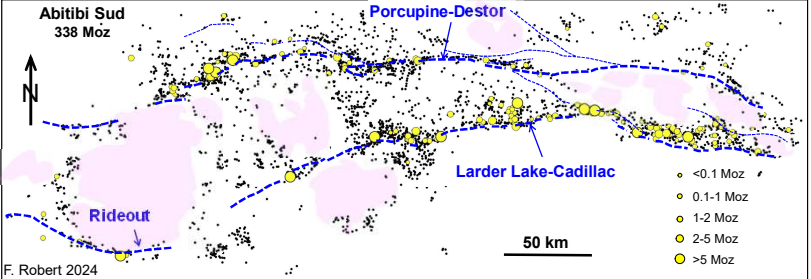
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L'or dans les ceintures




- **Indices et petits gisements**
 - Distribution vaste
 - Sauf batholithes granitiques
- **Gisements importants:**
 - Localisés: près des failles régionales
 - Regroupés (camps)



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Chronologie structurale


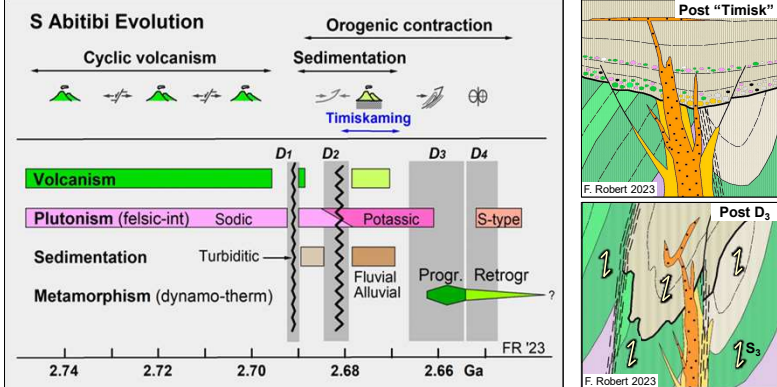


	Structures	Regime
D ₄	<ul style="list-style-type: none"> Crenulation cleavage Asymmetric folds Strike-slip shears 	Transcurrent deformation
D ₃	<ul style="list-style-type: none"> Steep fabrics (S, L) Reverse shears Tight to isoclinal folds (upright) 	"Thick-skin" shortening
	Angular unconf. - Coarse clastics	<i>Uplift and erosion</i>
D ₂	<ul style="list-style-type: none"> Folds (inclined to recumbent) Thrust faults 	"Thin-skin" shortening
	<i>Disconformity - Fine clastics</i>	<i>Uplift and erosion</i>
D ₁	<ul style="list-style-type: none"> Tilted units and early folds Syn-volcanic faults 	<ul style="list-style-type: none"> Initial shortening? Extension?

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Évolution géologique

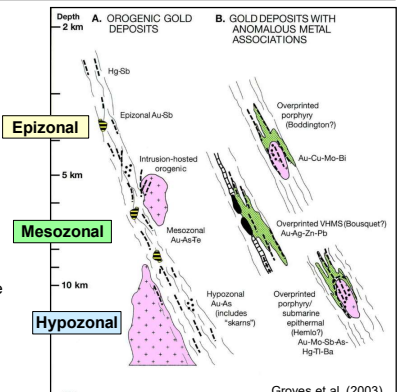
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Modèle orogénique et variations



- Définition originale**
 - Veines quartz-carbonate tardives
 - Régime compressif
 - Schiste vert et ductile-cassant
 - Mais... étendue à toute la croûte
- Variations observées**
 - Profondeur et grade métamorphique
 - Gisements "atypiques"
- Divergences**
 - Critères orogénique vs autres
 - Timing vs déformation et métamorphisme
- Meilleure approche**
 - Cas-par-cas
 - Emphase sur modèles descriptifs



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Diversité de style




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Diversité d'altération

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- Ankérite-séricite (veines)
 - Carbonates zonés
 - Biotite @ amphibolite inf.
- Albite-carbonate +/- hem-anh-ba (diss-stockw)
- Kspar-ser-carb (diss-stckw)
- Qz-ser-py (filons riches en sulfures)
- Diversité de fluides!**

Hollinger, Abitibi
Hemlo, Wawa
Windfall, Abitibi

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Diversité de timing

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Kanowna Belle, WA (A. Ross)
Or visible
5 mm

Hemlo, Wawa
1 cm

Giant, Yellowknife
1 cm

First Canadian, Val d'Or

Doyon, Bousquet
1 cm

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Modèles géologiques proposés

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- Groupes avec attributs récurrents
- 3 modèles dans un continuum

Filons orogéniques

- Veines qz-cb; failles inverses, plis, unités compétentes

Épizonaux assoc. Intrusions

- Zones disséminées & stockworks
- Veines et brèches épizonales

SMV aurifères

- Lentilles sulfures massifs
- Filons riches en sulfures

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Veines quartz-carbonate (orogéniques)

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- Caractéristiques**
 - Veines qz-cb et sulfures des épontes
 - Carb-ser-py alteration
 - Cisaillements inverses, plis, unités compétentes
 - Schiste vert à amphibolite inf. (brittle-ductile)
- Setting**
 - Régime en contraction (D_3 et D_2 ?)
 - Profondeur crustale: moyenne à faible

Perron, Abitibi
Lupin, Slave
Qz vein

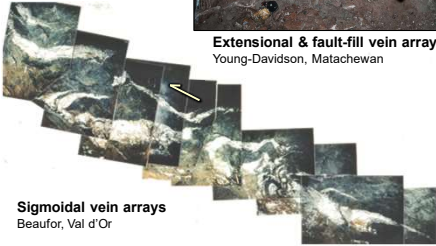
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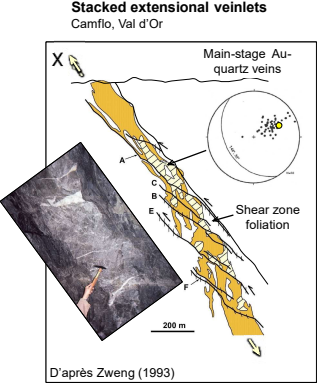
Autres géométries courantes

Extensional & fault-fill vein arrays
Young-Davidson, Matachewan



Sigmoidal vein arrays
Beaufor, Val d'Or



Stacked extensional veinlets
Camflo, Val d'Or

Main-stage Au-quartz veins


Shear zone foliation

D'après Zweng (1993)

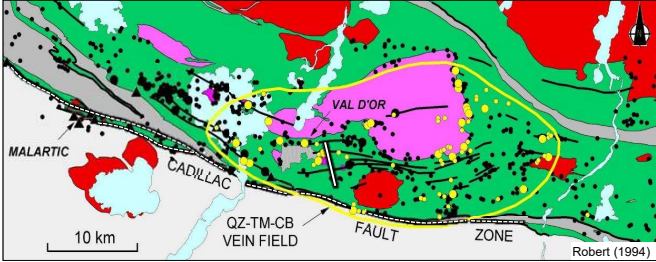
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Champs filoniens Val d'Or



- **Veines qz-tm-cb**
 - Cisaillement 3^{ème} ordre
 - Veines laminées et d'extension
 - Dans intrusions compétentes
 - Syn/tardi D₃, pré-D₄
- **Veines qz-cb**
 - Cisaillements 2^{ème} ordre
 - Veines laminées et brèches
 - Recoupées par dykes
 - Pré-Timiskaming à début D₃



MALARTIC CADILLAC VAL D'OR QZ-TM-CB VEIN FIELD FAULT ZONE

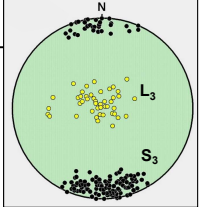
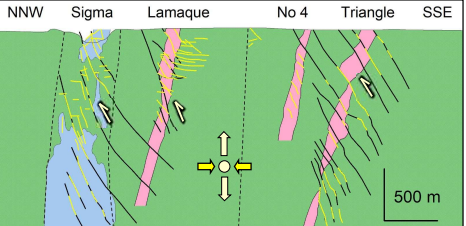
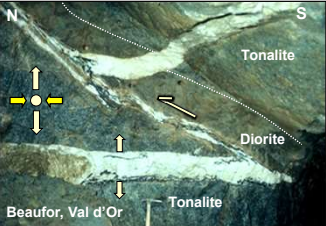
10 km Robert (1994)

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Veines à qz-tm-cb

- Champ filonien +/- homogène
 - Hydrothermal et structural
- Timing
 - Recoupe toutes intrusions
 - Post-Timiskaming
- Régime compressif
 - Contraction N-S
 - Allongement vertical
- Cohérent avec S₃ et L₃
- **Syn- D₃**

Beaufor, Val d'Or


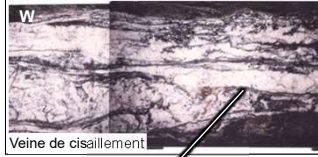
Tonalite Diorite Tonalite

500 m

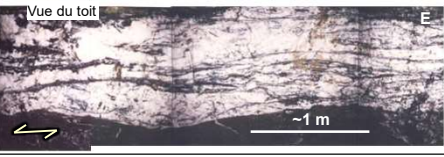
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Caractéristiques structurales

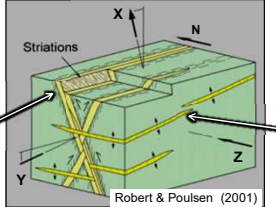



Veine de cisaillement



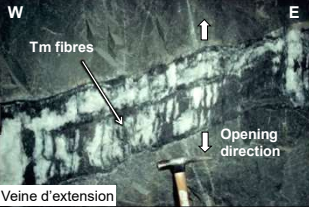
Vue du toit

~1 m



Striations

Robert & Poulsen (2001)



Tm fibres

Veine d'extension

Opening direction

Glissement inverse(-obl)

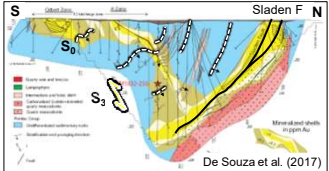


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Relations structurales

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- Mineralization in
 - D₃ structures (F₃ axial planes)
 - Along folded intrusion contacts
 - Cut by flat extensional veins
- Timing: early D₃

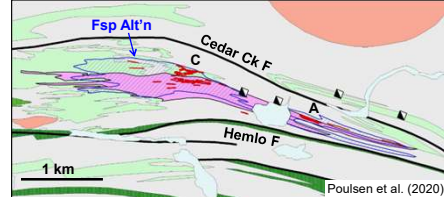



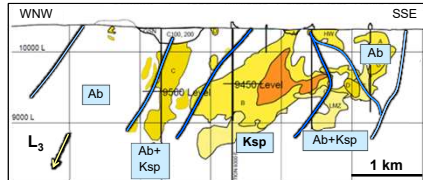
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Hemlo, Wawa (26.5 Moz @ 4.6 g/t)

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- Setting
 - Around QFP in sedimentary rocks
 - High strain, amphibolite-grade
- Mineralization
 - Veinlet, dissem., banded py-mo
 - Feldspar → ser-carb
 - Ba, V, As, Sb, Hg, Te
 - Oxidized fluid

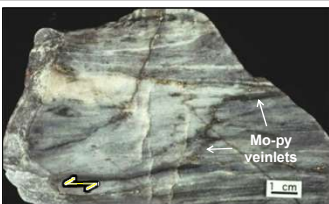
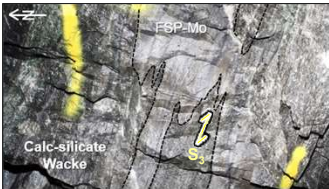
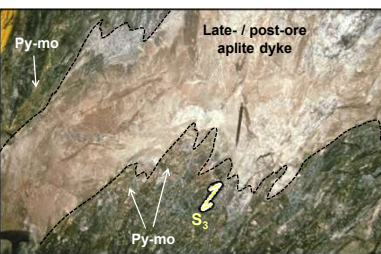
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Relations structurales

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- Mineralization is deformed
 - Transposed by S₃
 - Cut by barren dykes overprinted by S₃
 - Cut by orogenic veins
- Timing: pre-D₃

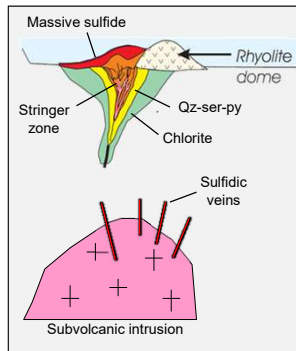
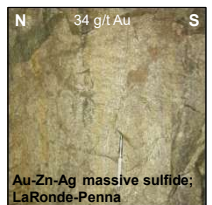

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SMV aurifères

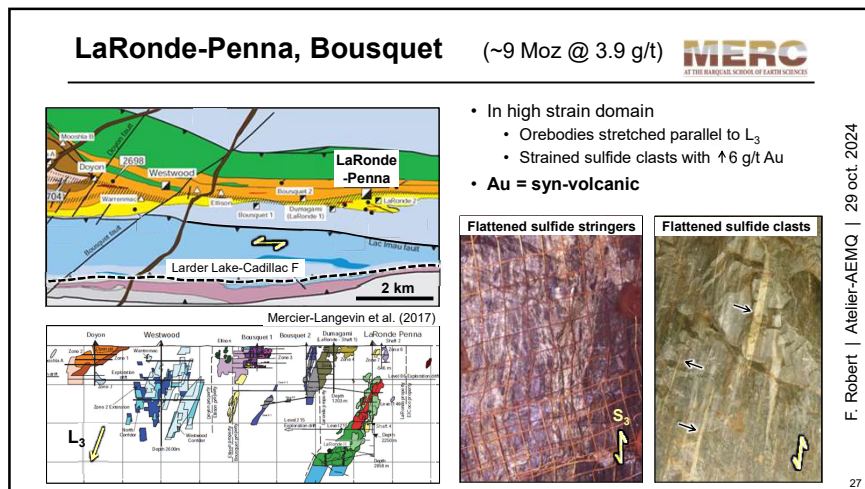
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- Mineralization
 - Sulfide lenses & stringers zone
 - Quartz-ser-pyr → chlorite
 - Ag, Cu, Zn, Pb +/- Te, Sb
- Setting
 - Top of cycle; felsic domes & volcanoclastics
 - Near subvolcanic intrusion

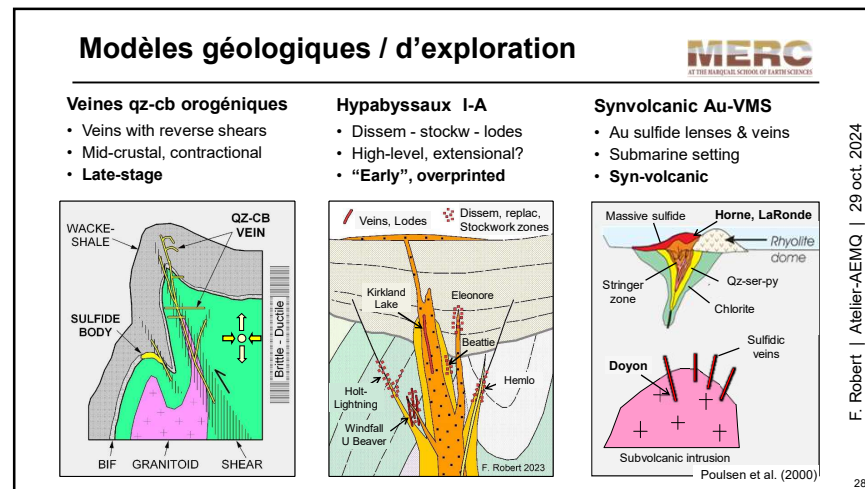




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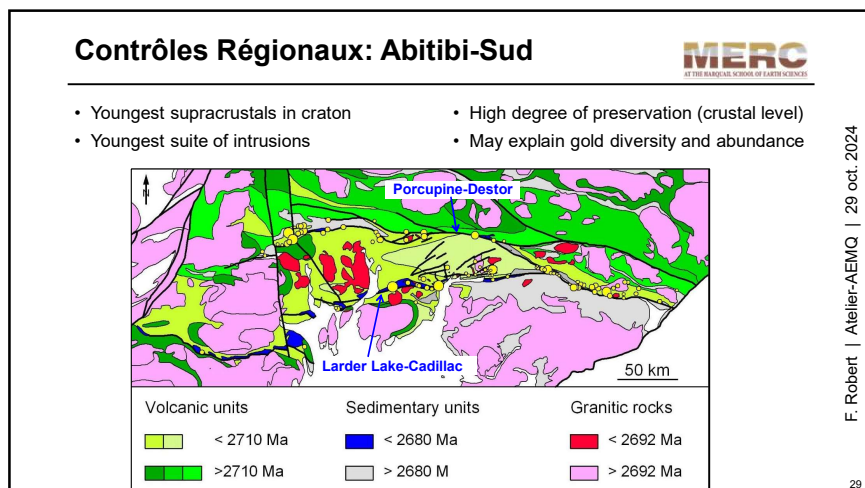
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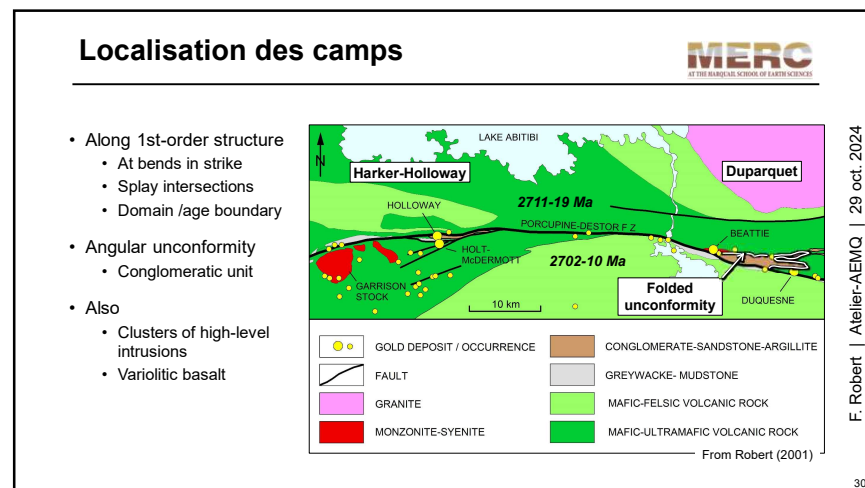
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Caractéristiques des camps

- Along 1st-order structure
- Anticlinal dome structure
 - 2 sets of folds
 - Offset by PDFZ
- Angular unconformity
 - Conglomeratic unit
 - Deposits proximal to unconformity
- Also
 - Cluster of high-level porphyries
 - Variolitic basalt
 - Extensive carbonate alteration

Legend:
 Conglom-arenite, BIF, Greywacke-mudstone, Volcaniclastic, Intermediate-felsic, Mafic / variolitic, Ultramafic-mafic, Felsic porphyry

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Contrôles stratigraphiques

- Deposit distribution**
 - In upper part of column
 - Near top of M-UM sequence
 - Near unconformity
 - Especially angular
 - In favorable hosts
 - Variolitic basalt
 - BIF in some camps
- Significance**
 - Importance of preservation
 - Unconformities
 - Favorable depth of erosion
 - Time of tectonic shift

Legend:
 Sedimentary rocks: Conglomerate-arenite, BIF, Greywacke-mudstone
 Volcanic rocks: Intermediate-felsic, Mafic (variolitic), Ultramafic

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Localisation des gisements

- Coincidence spatiale:
 - Structures et lithologies favorables
 - Selon le modèle choisi

Structural associations

- Shear zones & faults (contacts)
- Competent units in soft rocks
- Fold hinges and anticlines

Lithologic associations

- Fe-rich mafic rocks
- Iron formation
- Stocks & dykes (porphyries)

Favorable settings and Exploration guides

Modified from Groves et al. (1990)

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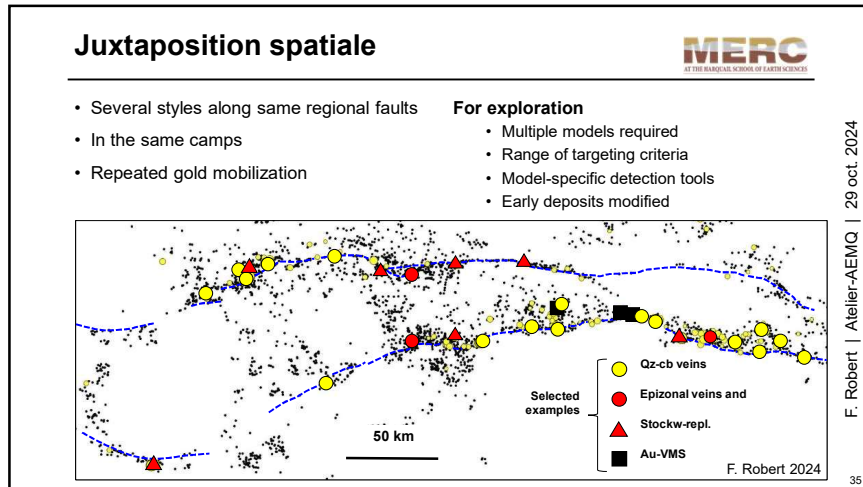
Place de l'or dans l'évolution

- Age of deposits**
 - Many well constrained
 - Multiple Au events
 - Over 90 my
- Diversity not a surprise**
 - Au-VMS
 - Epizonal intrusion-associated
 - Epizonal lodes
 - Mesozonal qz-cb veins
- What's orogenic?**
 - All from D₁ to D₄?
 - Only D₃ to D₄?
 - Many pre-metamorphic

S Abitibi Evolution Timeline:
 2.74 Ga (C) to 2.66 Ga (CM, QTC). Events include Volcanism, Plutonism (felsic-int), Sedimentation (Turbiditic, Fluvial Alluvial), and Metamorphism (dynamo-therm). Orogenic contraction phases D₁, D₂, D₃, D₄ are marked.

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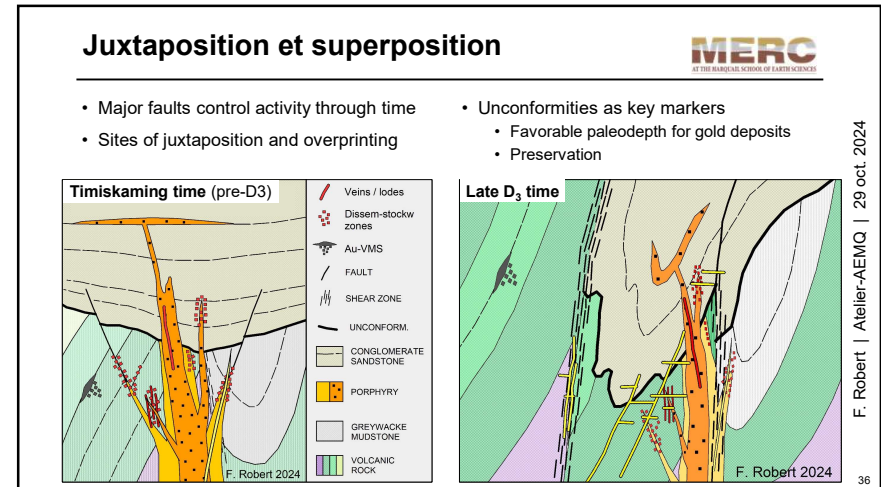
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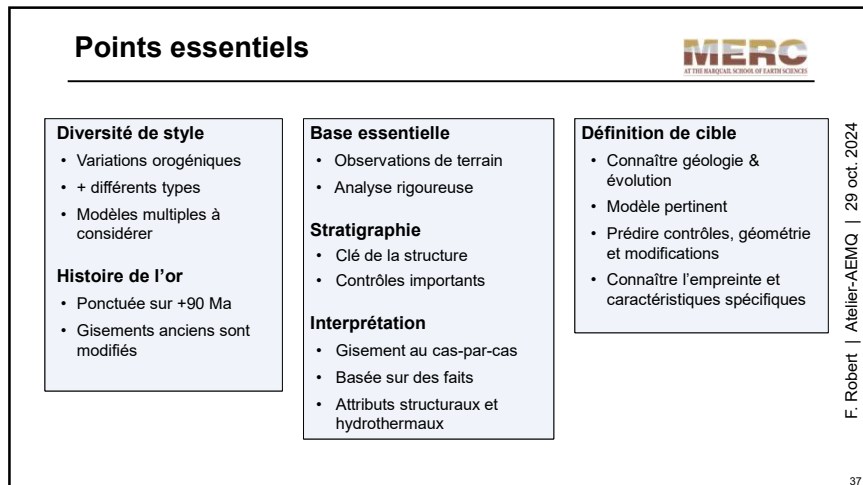
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