



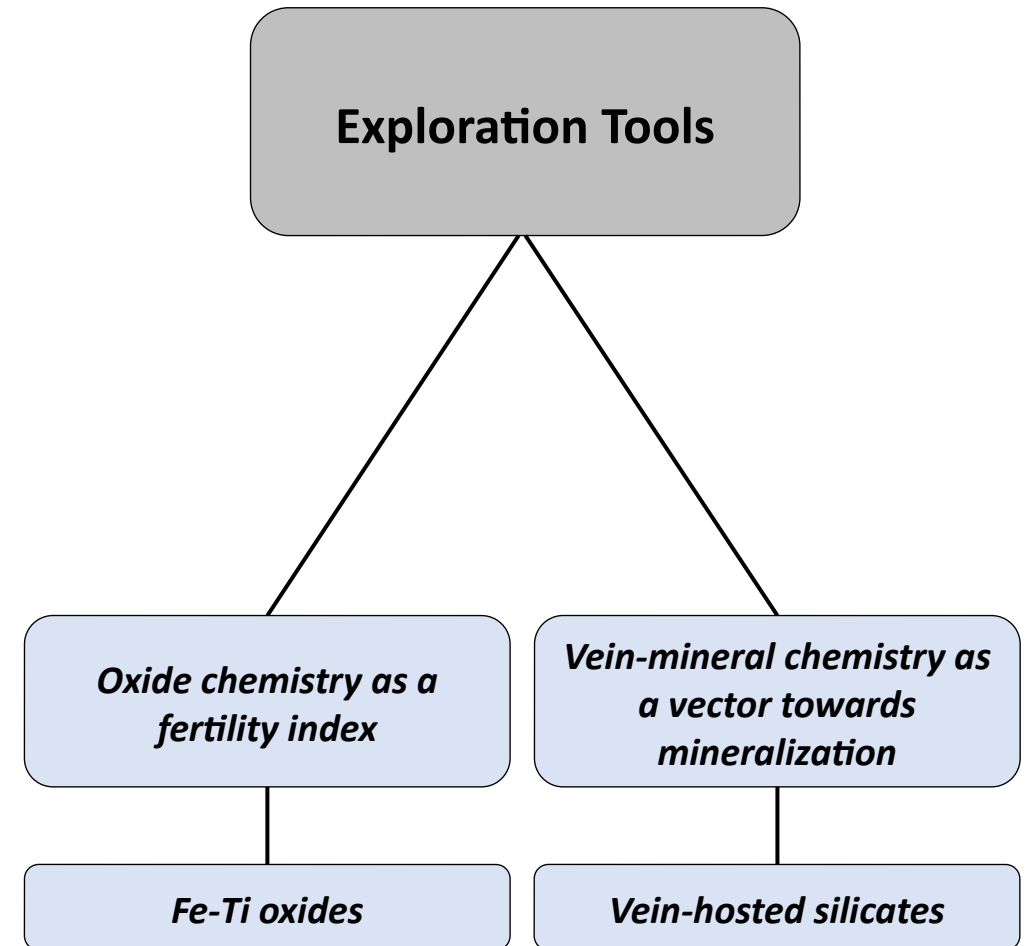
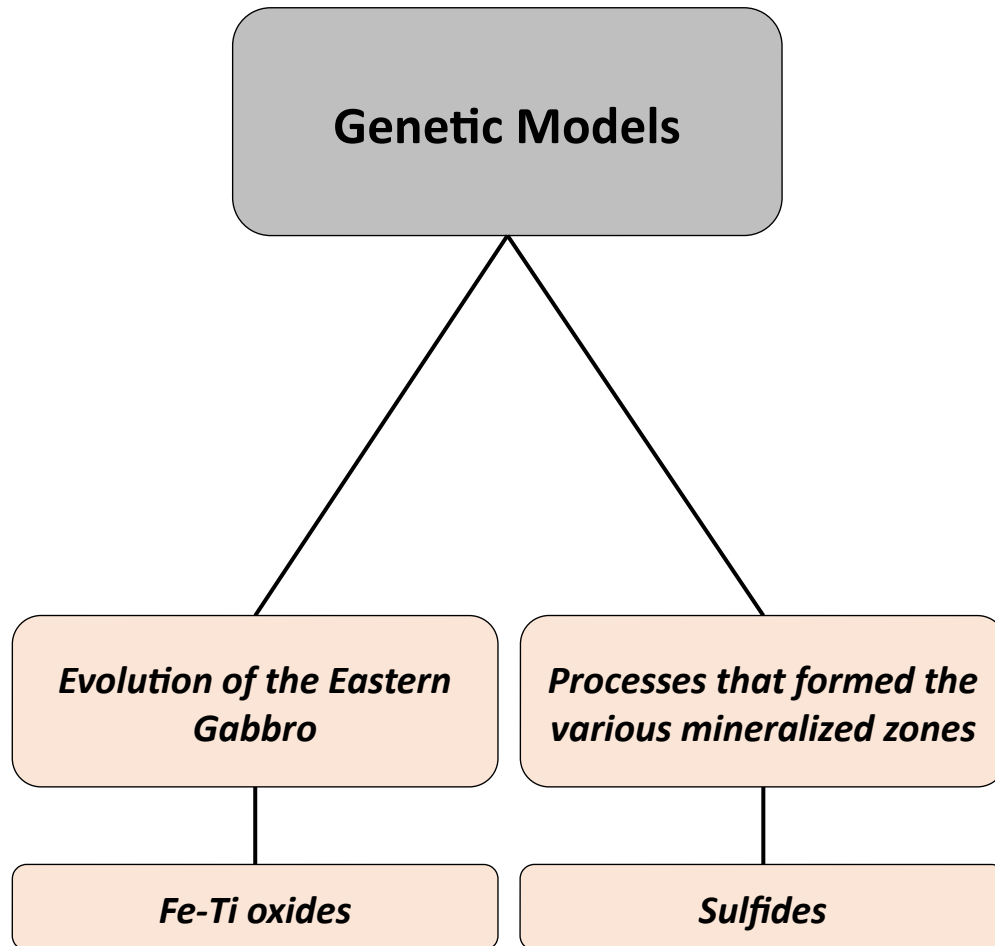
# Applications of mineral chemistry to petrogenesis and exploration in conduit-type Cu-PGE deposits

**Matthew Brzozowski**

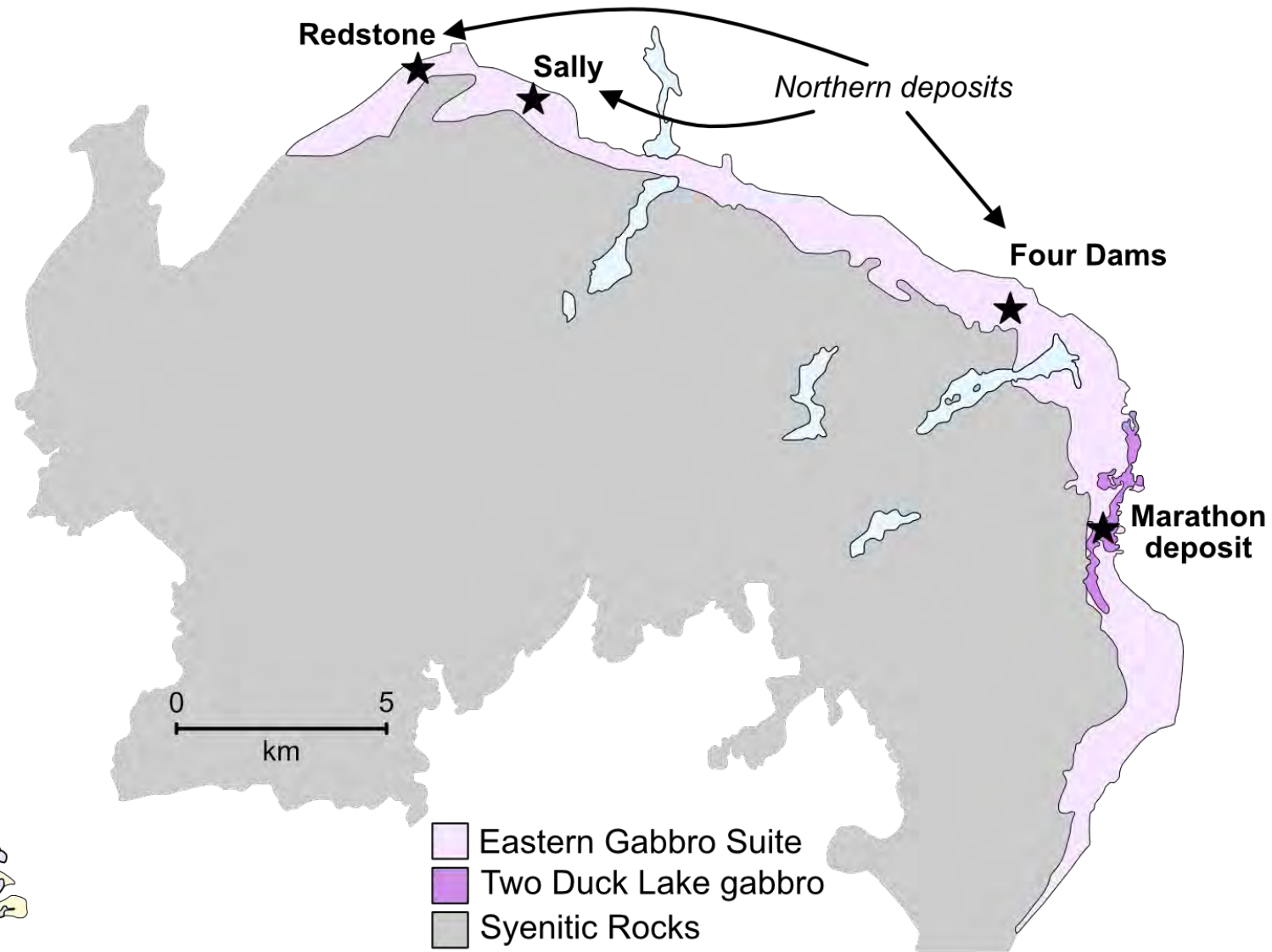
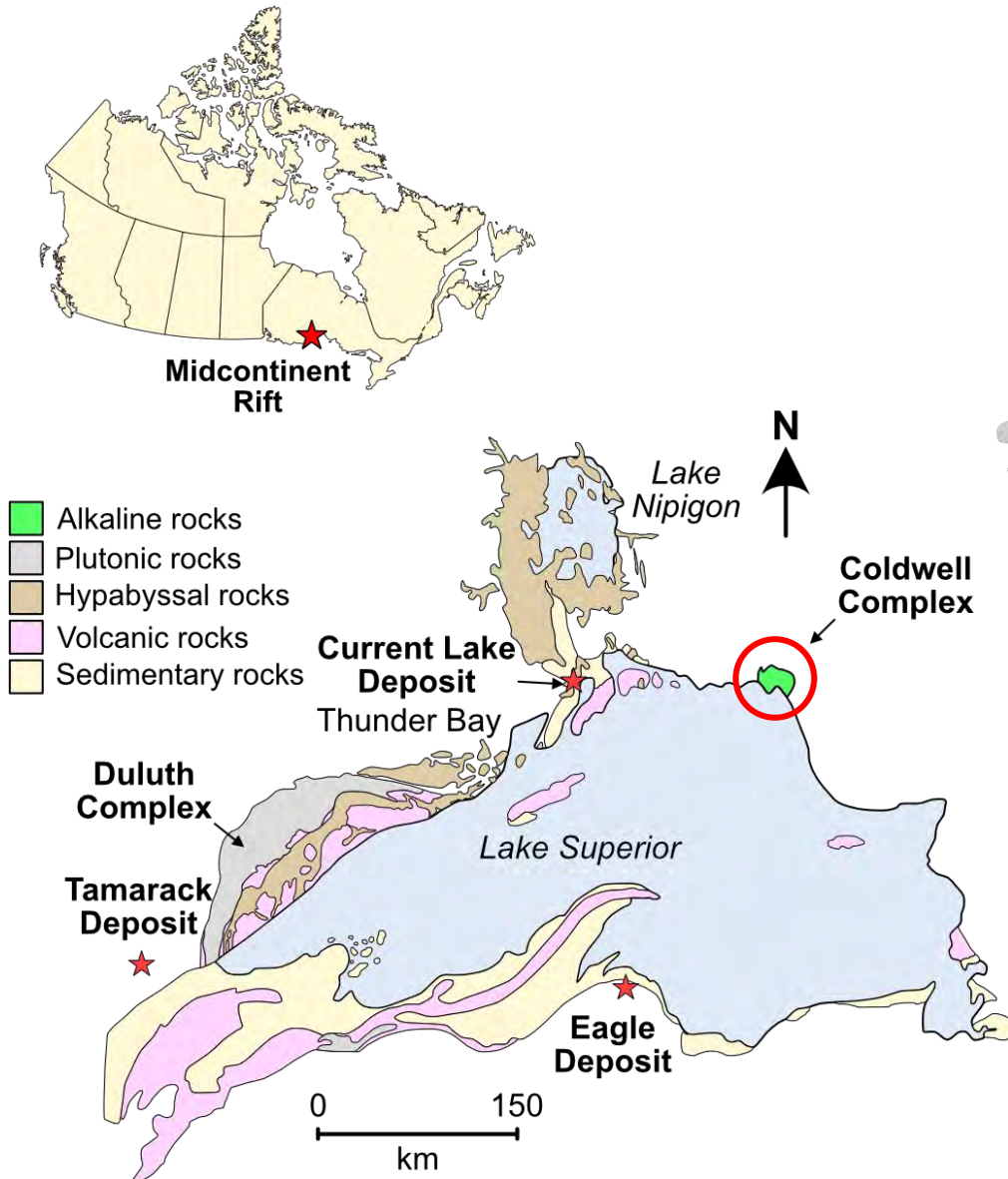
*Postdoctoral Fellow  
Lakehead University*

**CIM**

*2021*



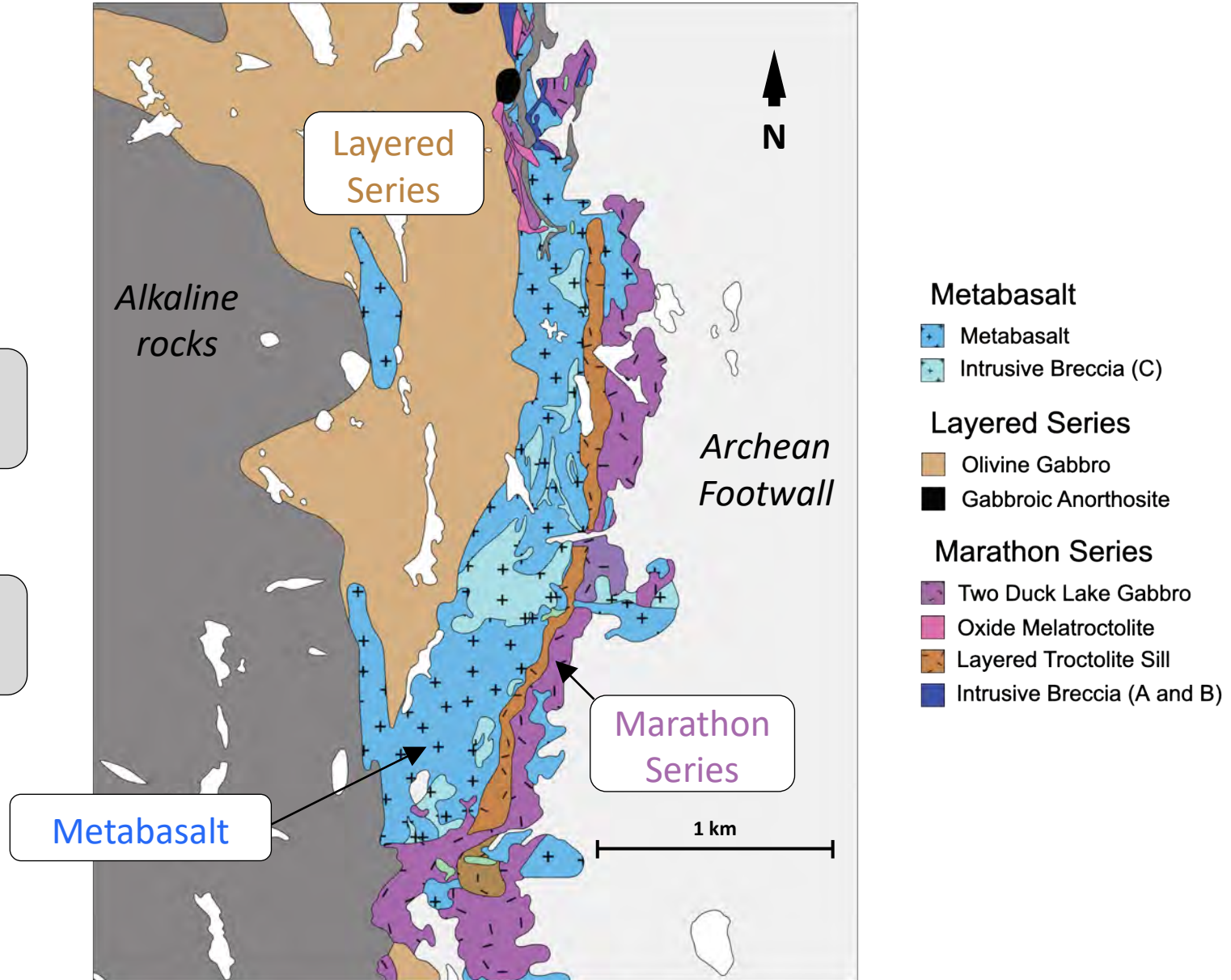
# Coldwell Complex



# Marathon deposit

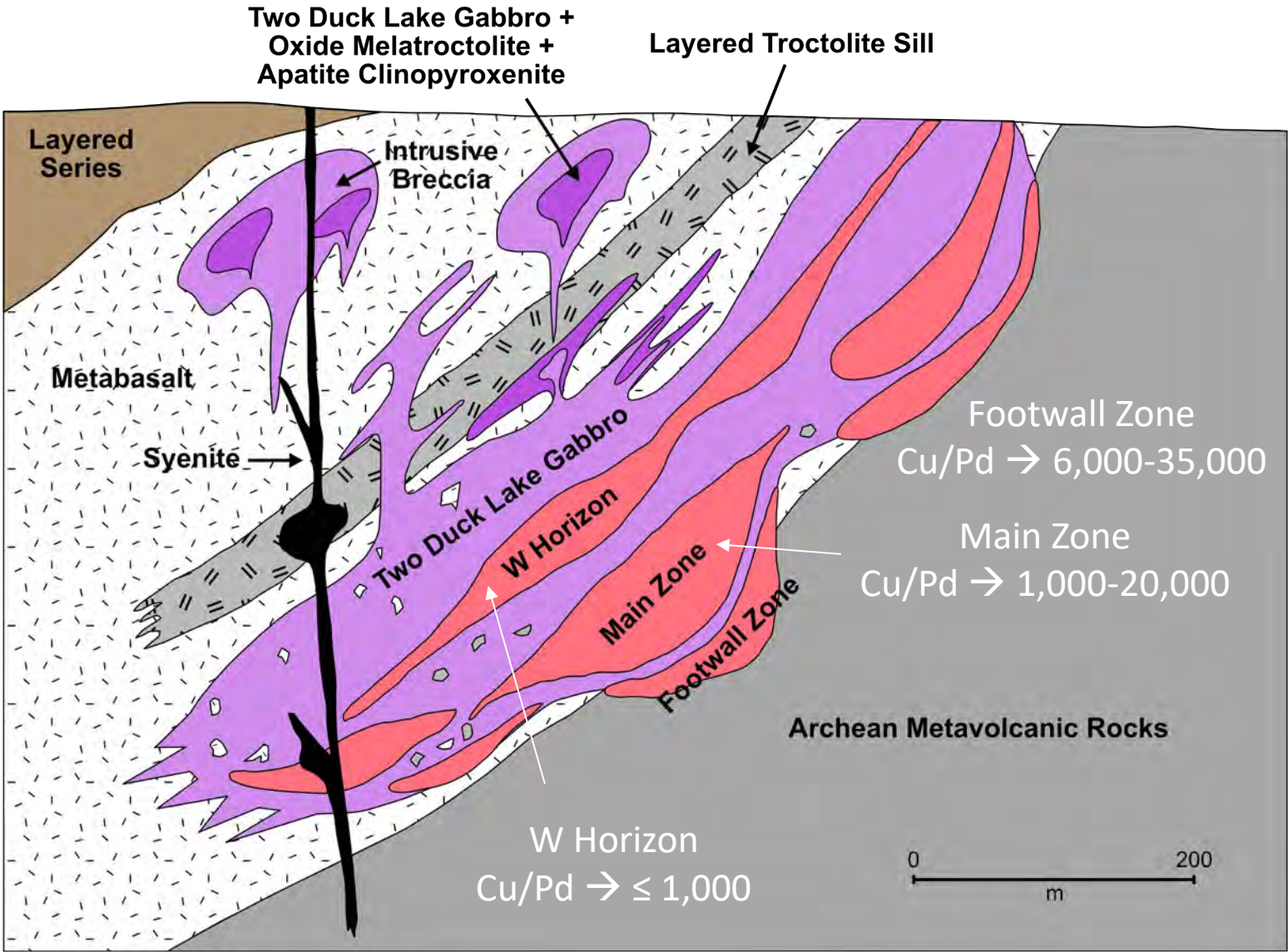
Cogenetic?

Magma mixing?





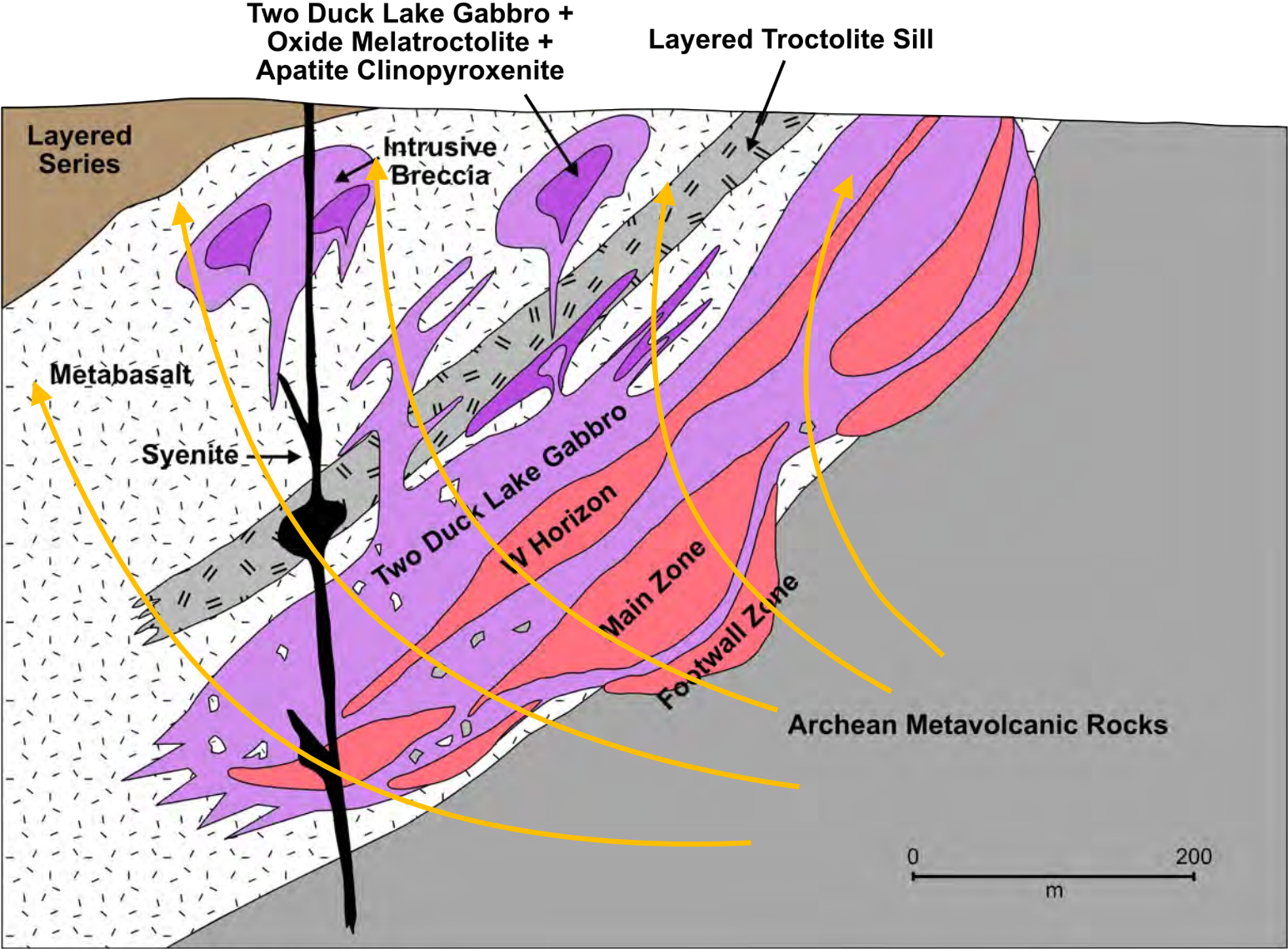
# Marathon deposit

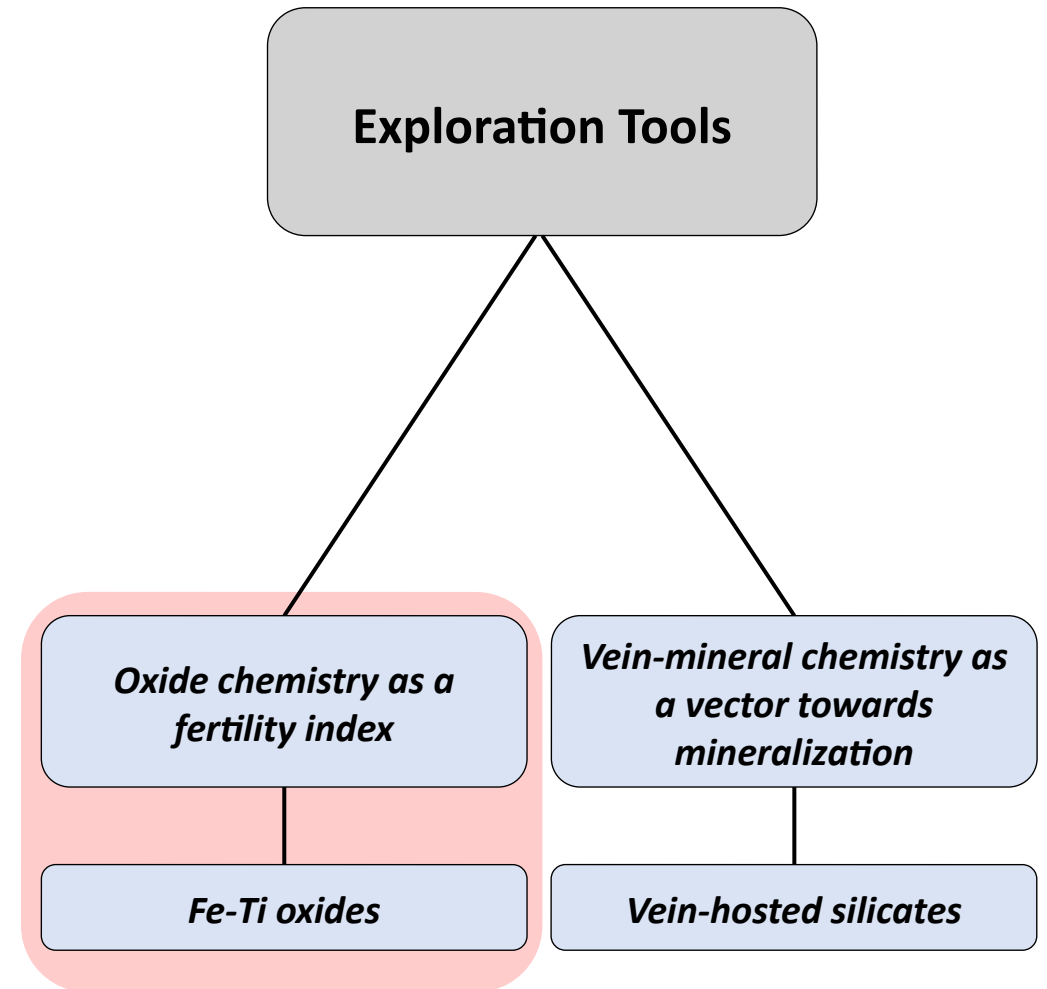
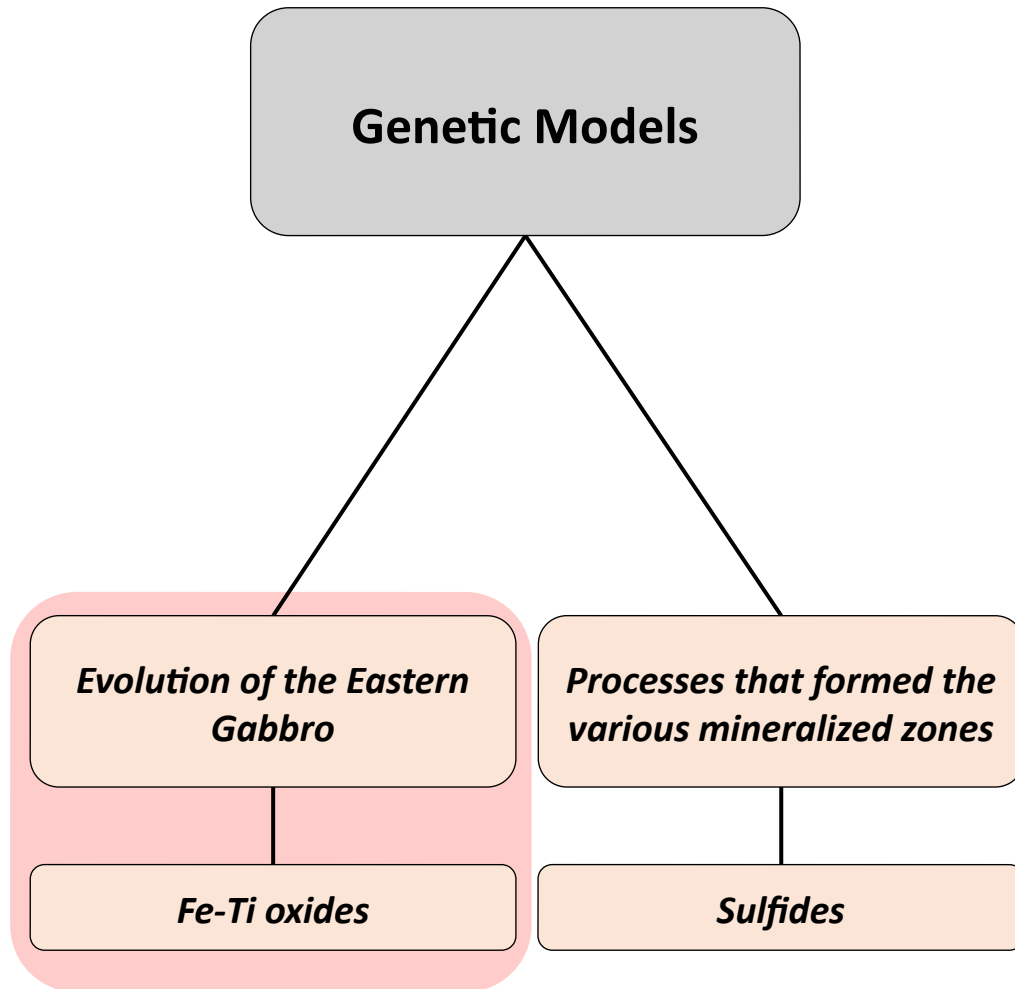


Cogenetic?

Mineralizing  
processes?

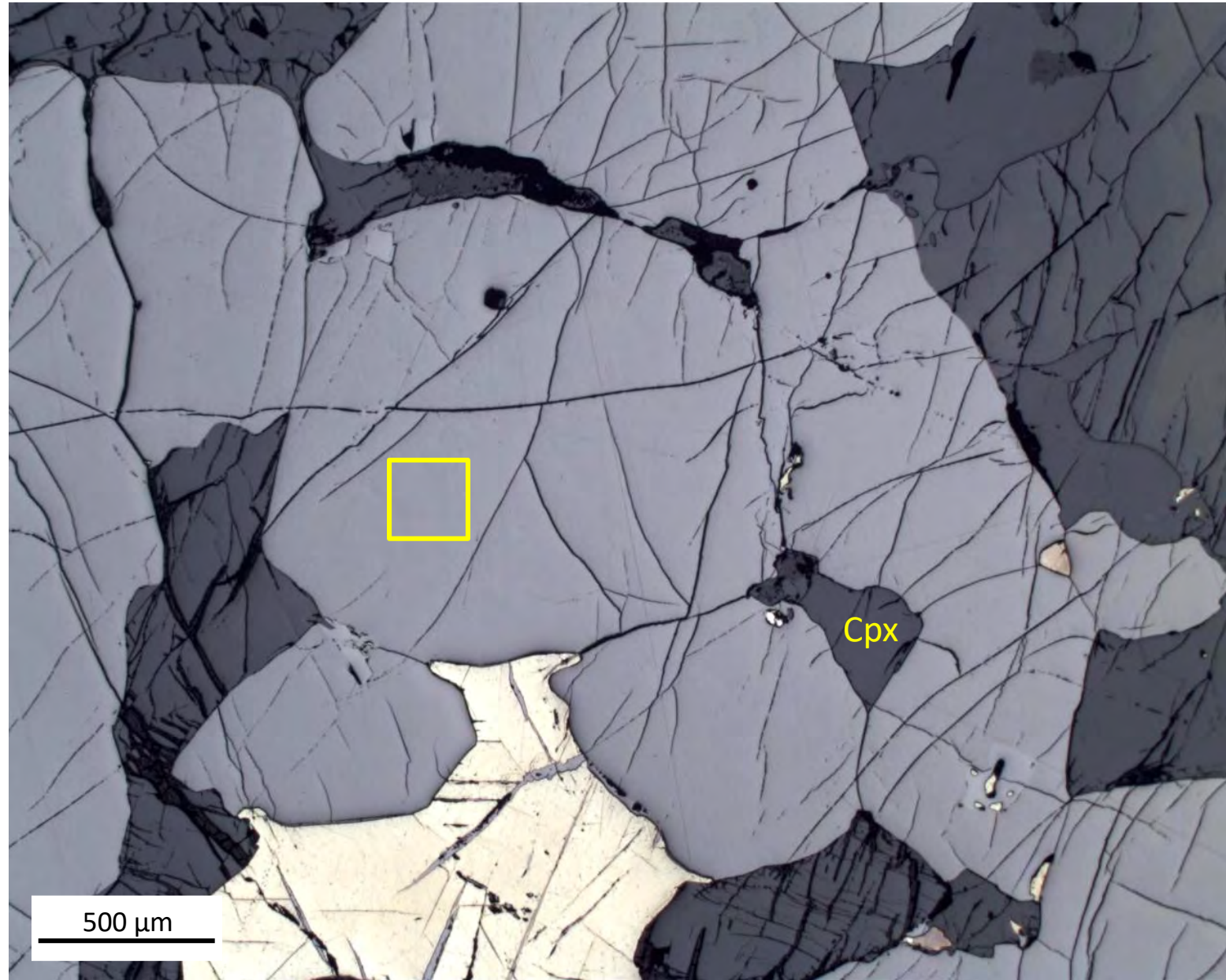
Marathon deposit





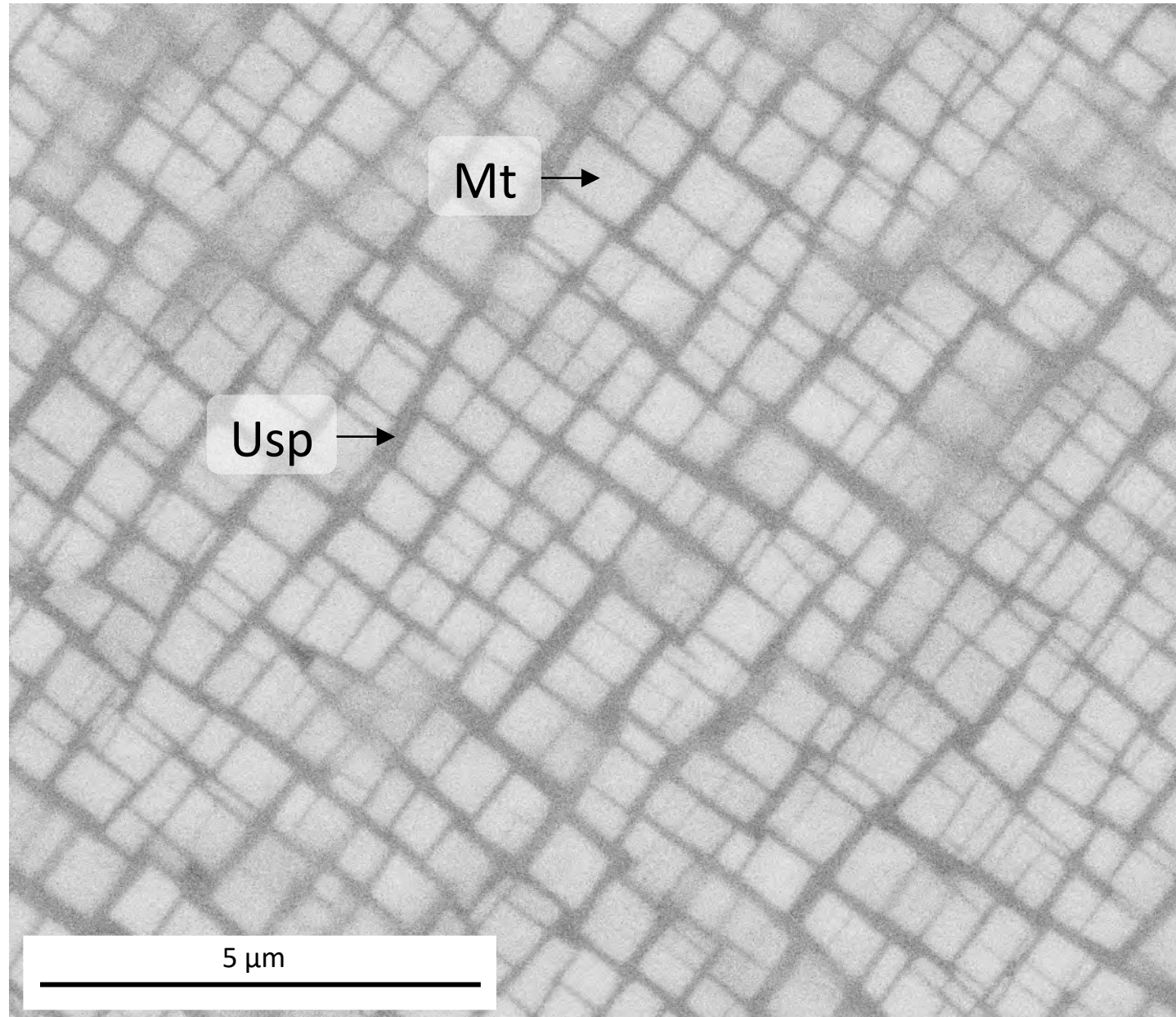


## Cloth-textured intergrowths

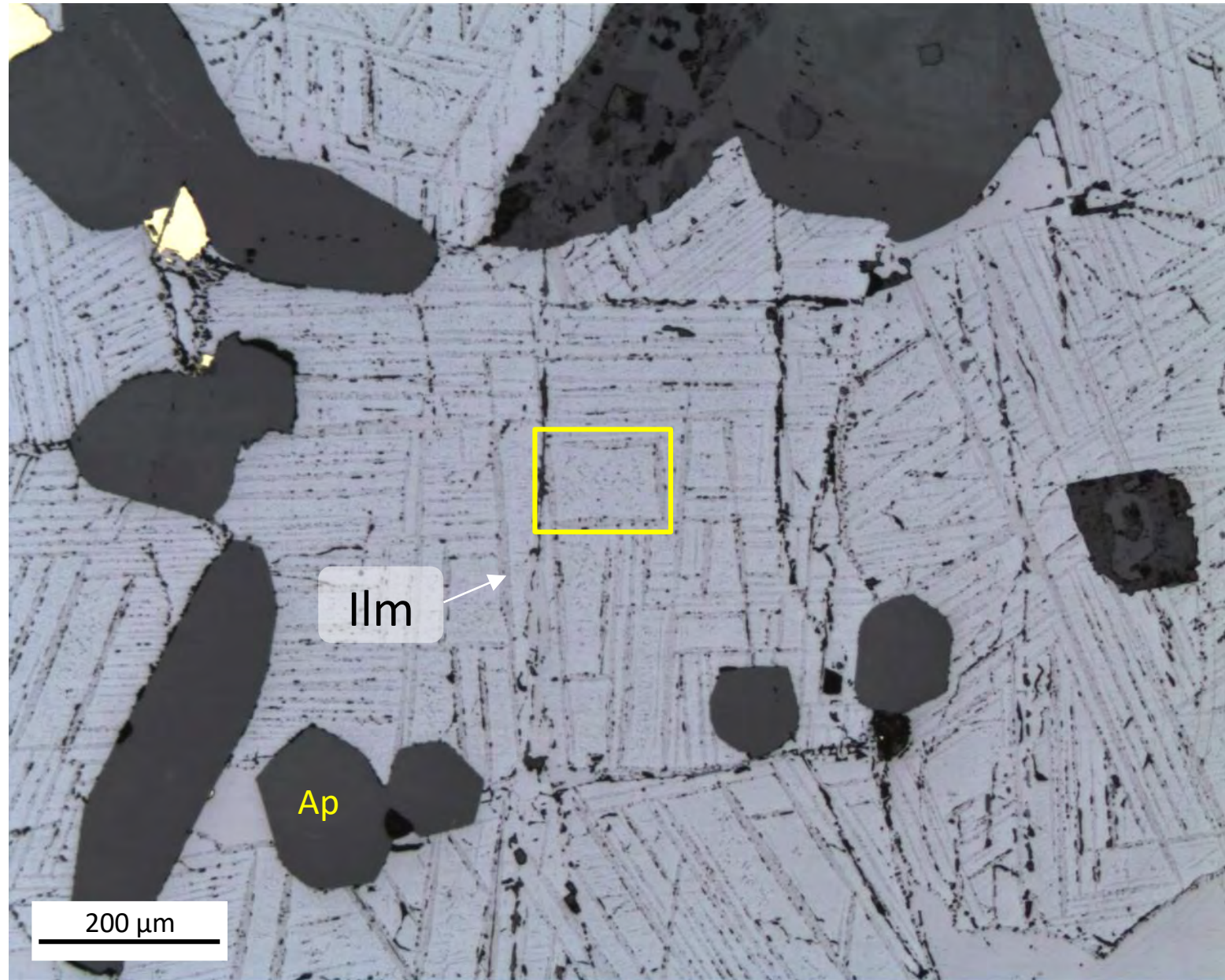




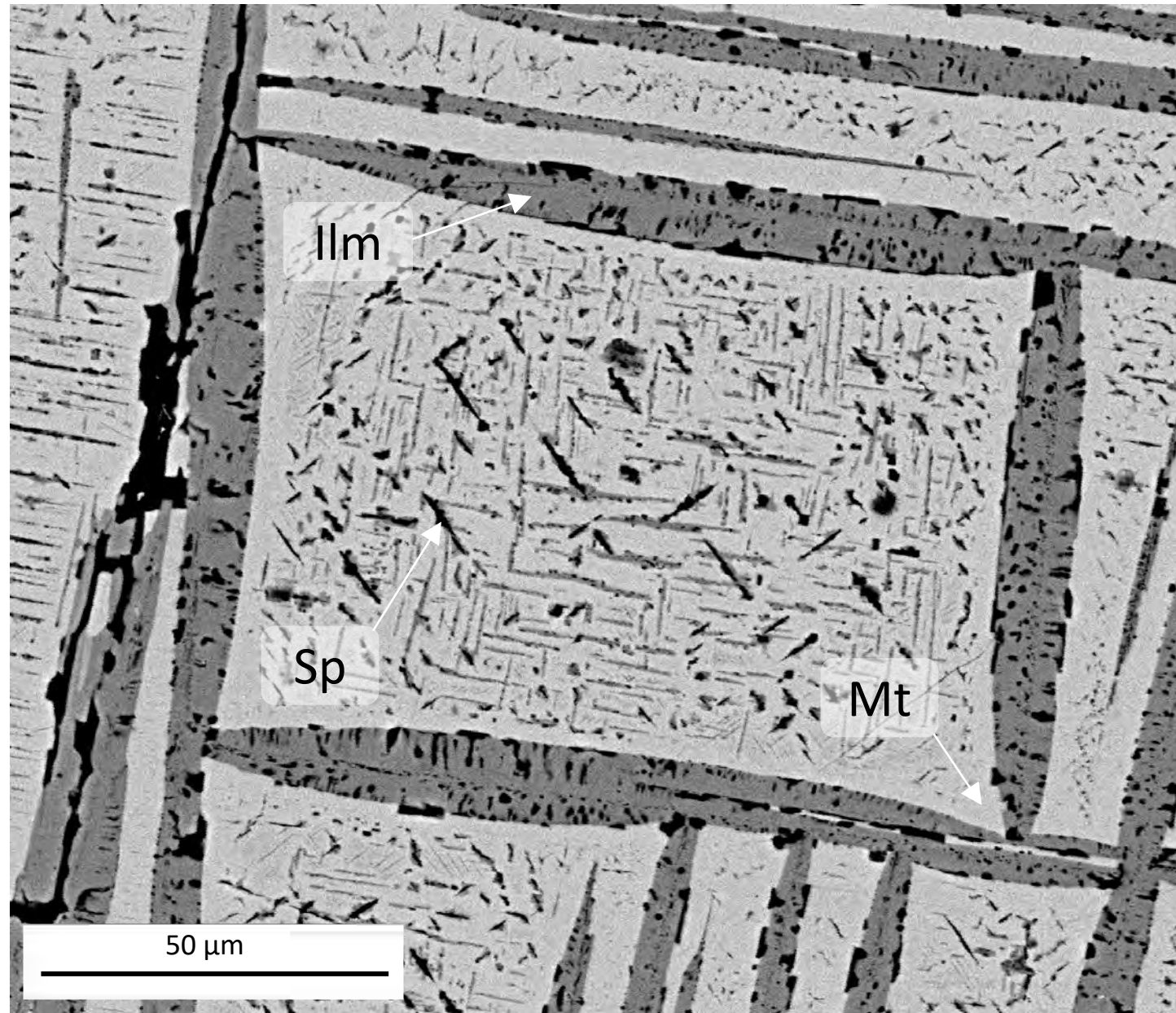
## Cloth-textured intergrowths



## Trellis-textured intergrowths

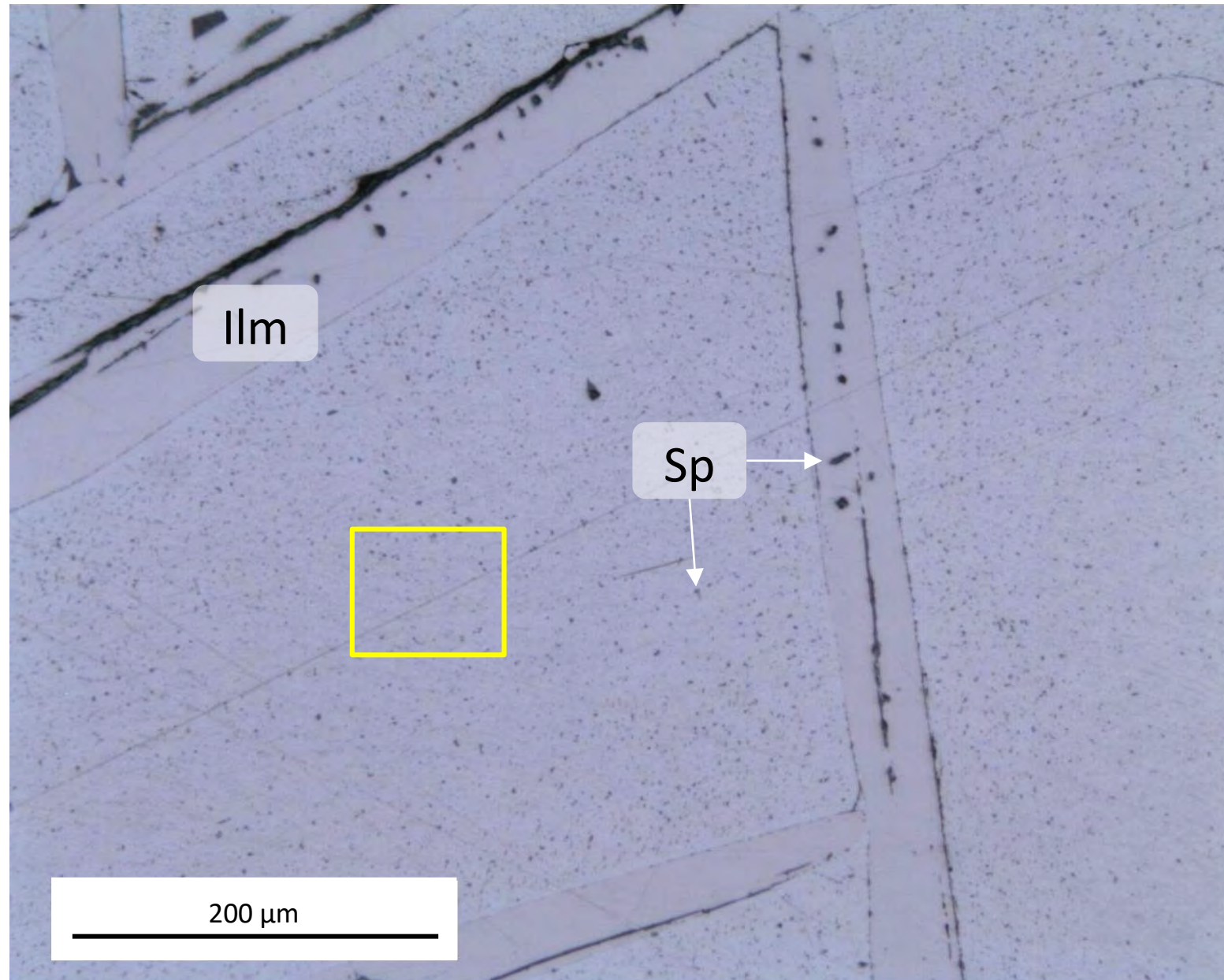


## Trellis-textured intergrowths



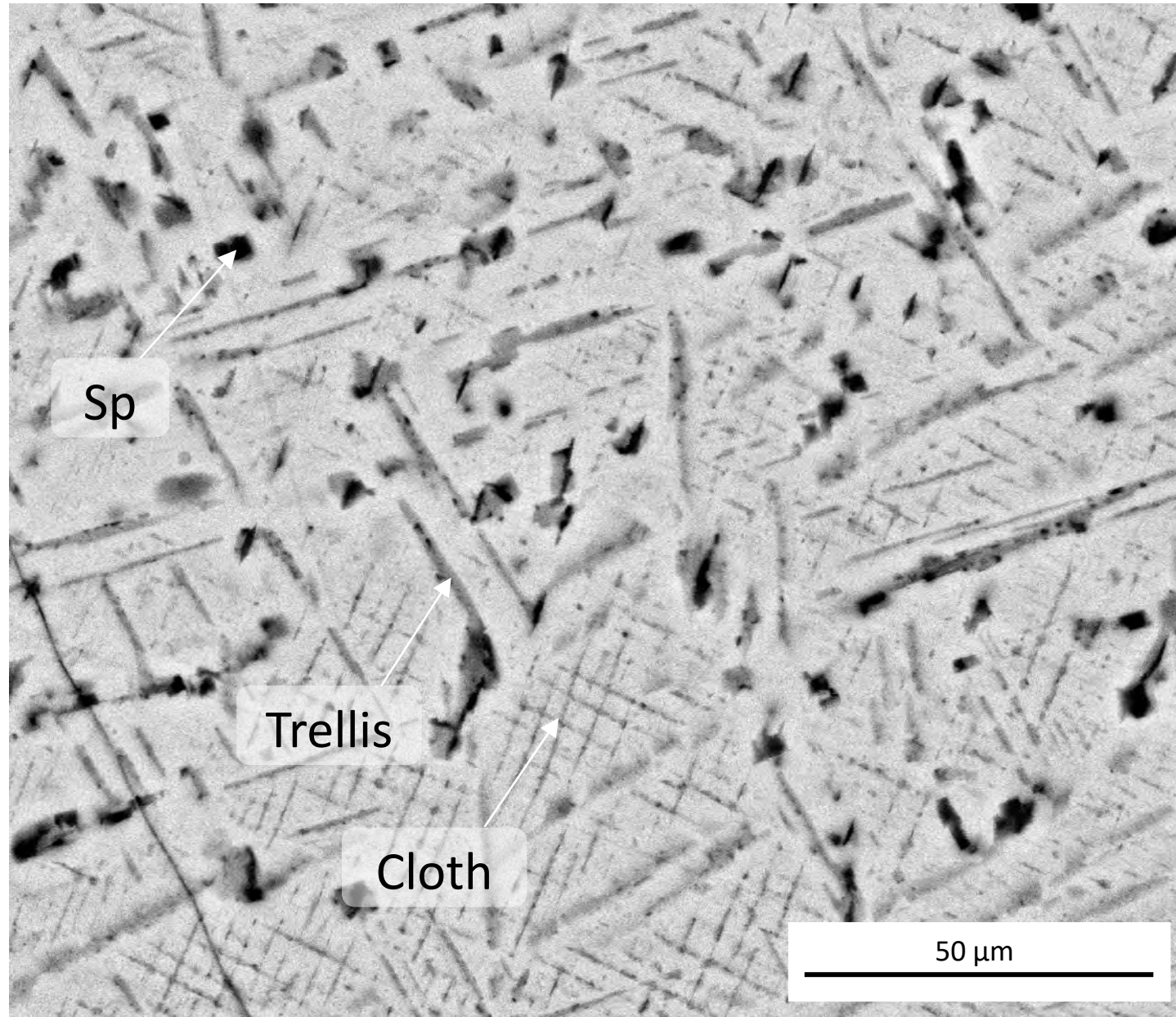


## Intermediate-textured intergrowths

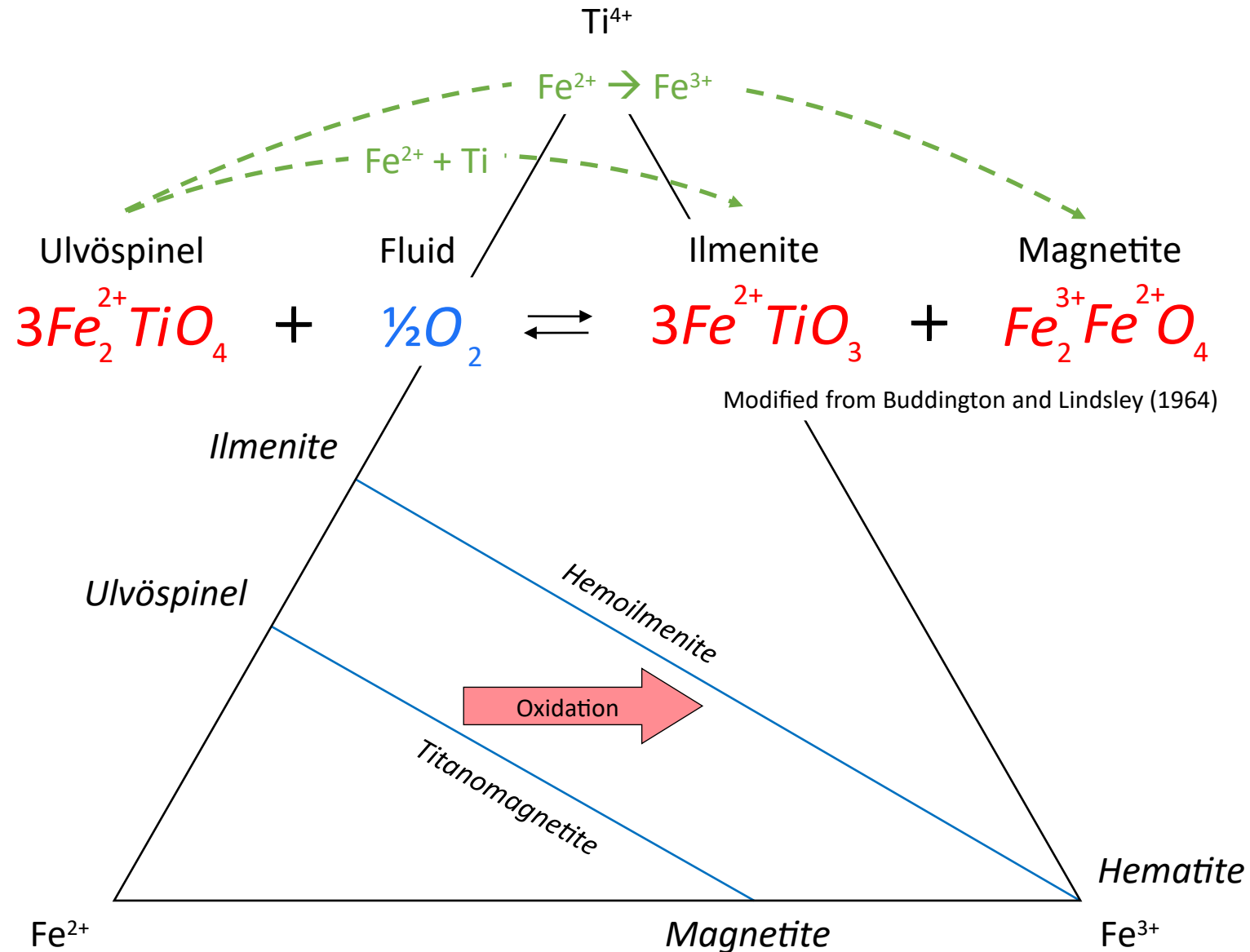




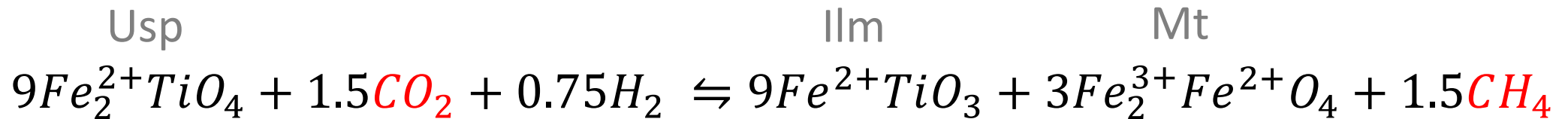
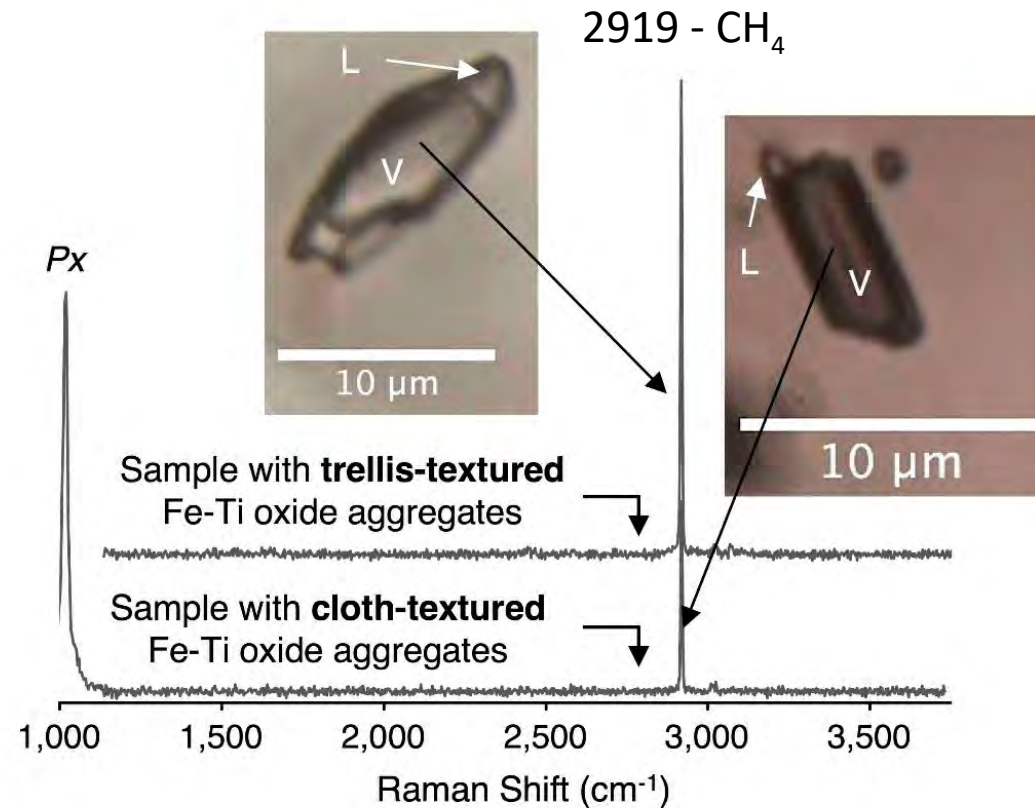
## Intermediate-textured intergrowths



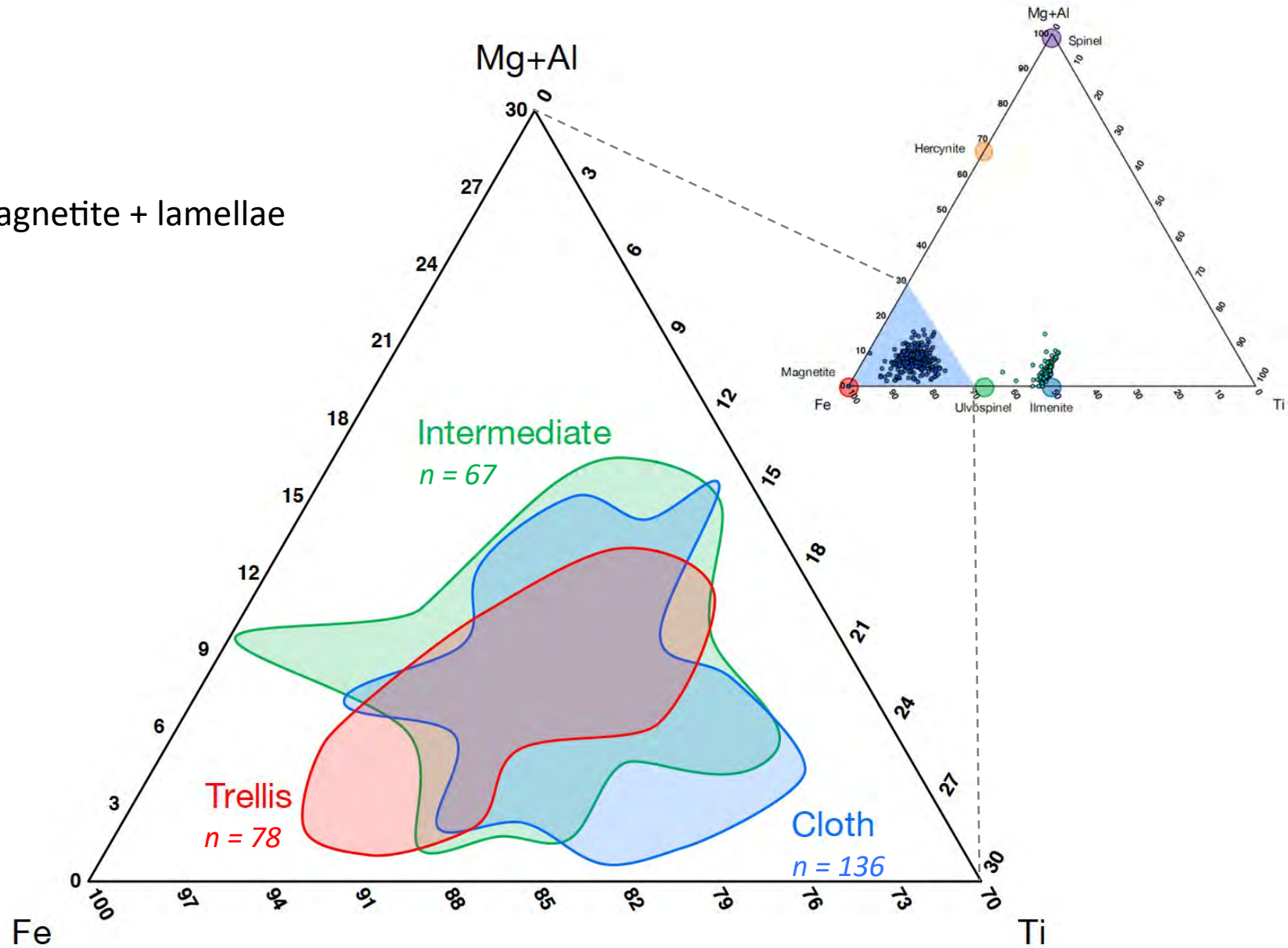
# Why do we get these textures?



## Alternative oxidizing agent?

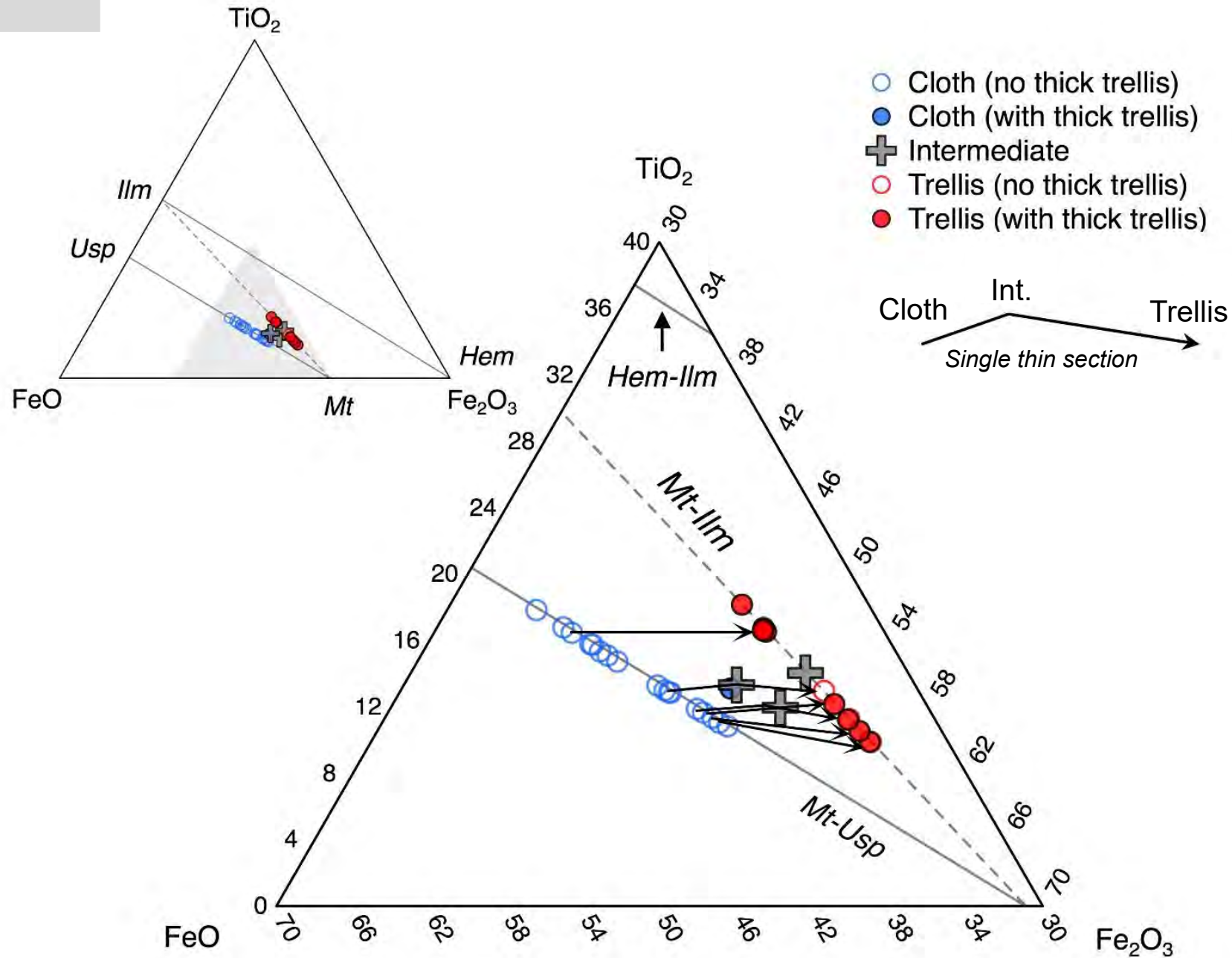


Bulk composition = magnetite + lamellae





# Fe<sup>3+</sup> : Fe<sup>2+</sup> ratio



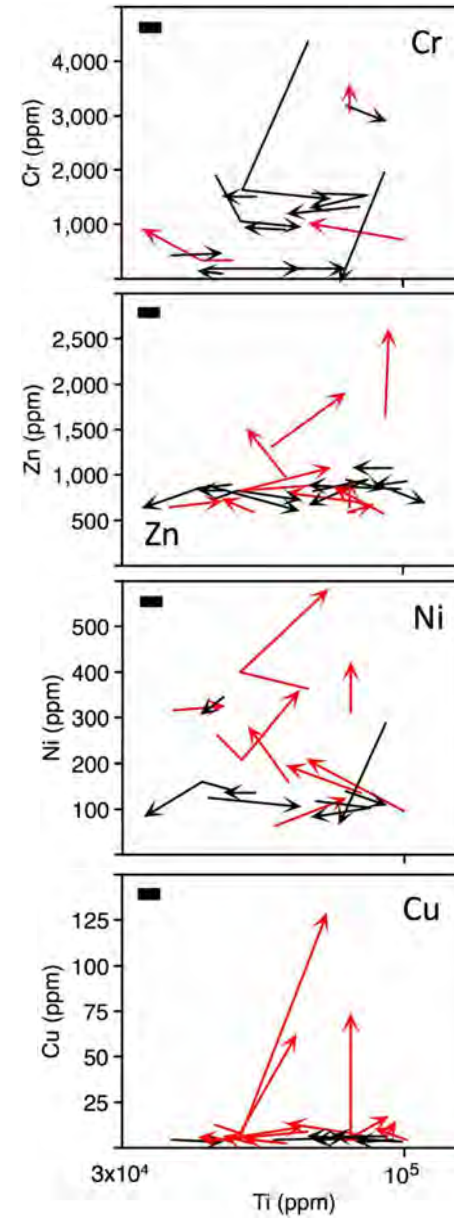
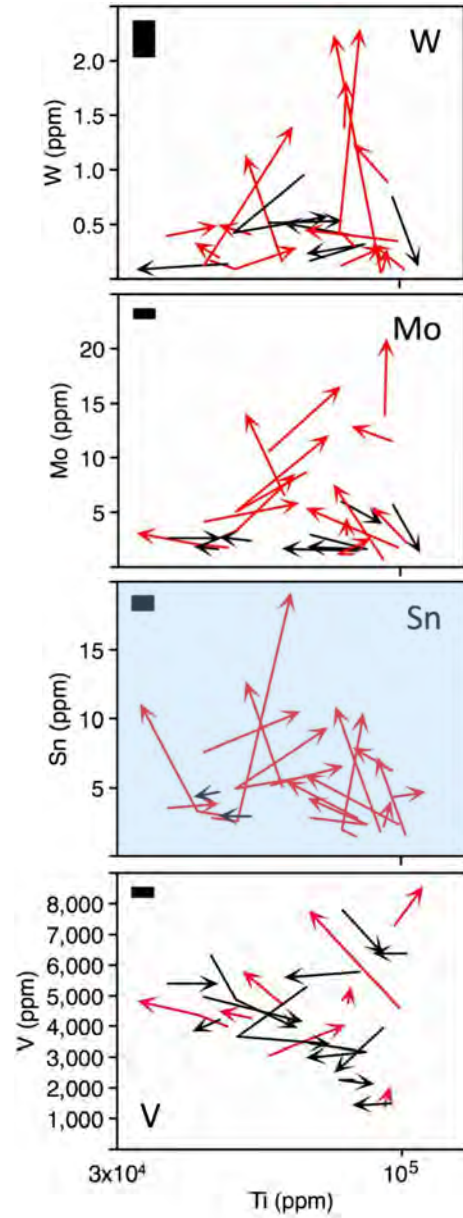
# Variations in trace-element chemistry

Trellis

Single thin  
section

Cloth

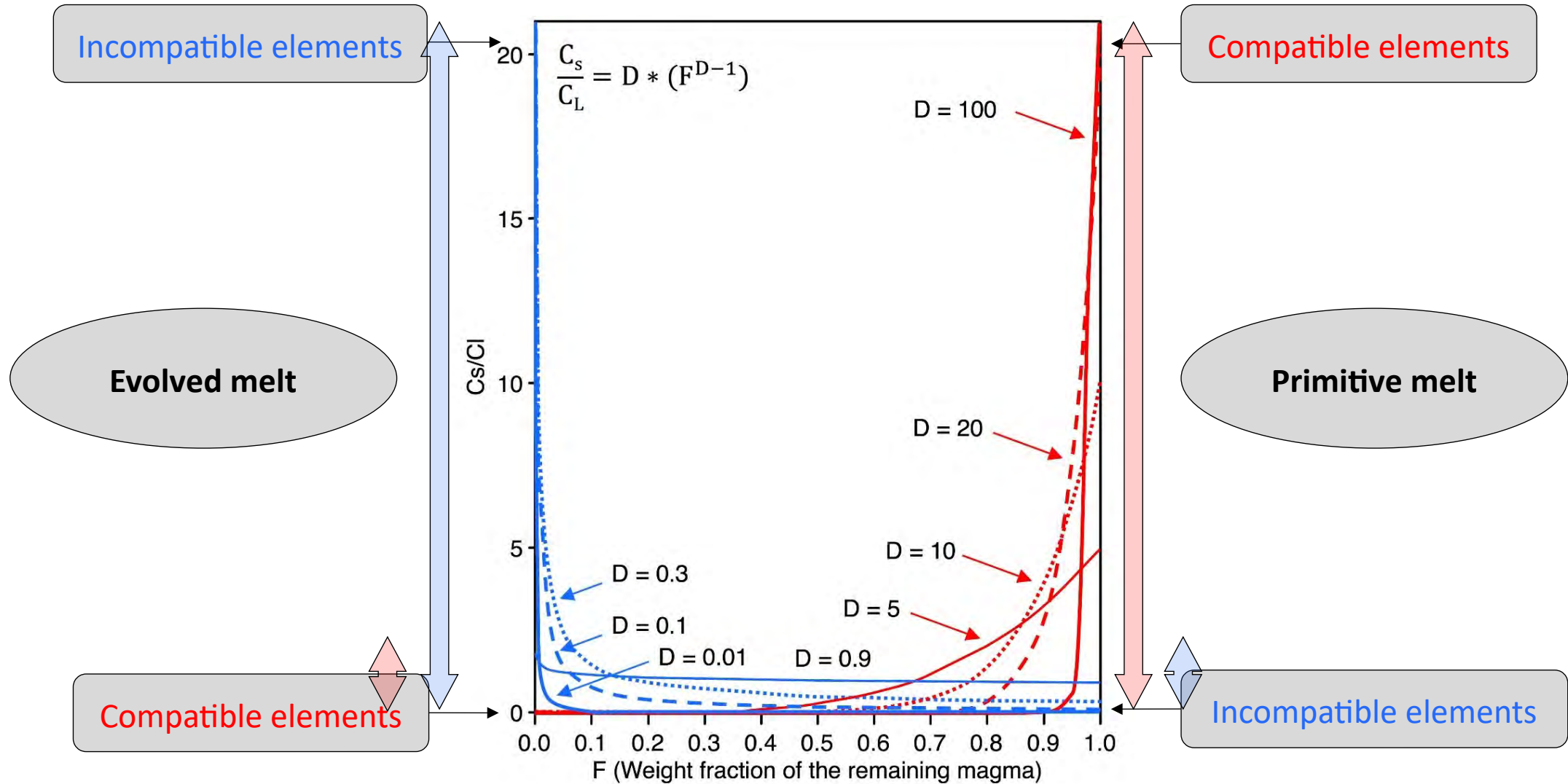
Multivalent



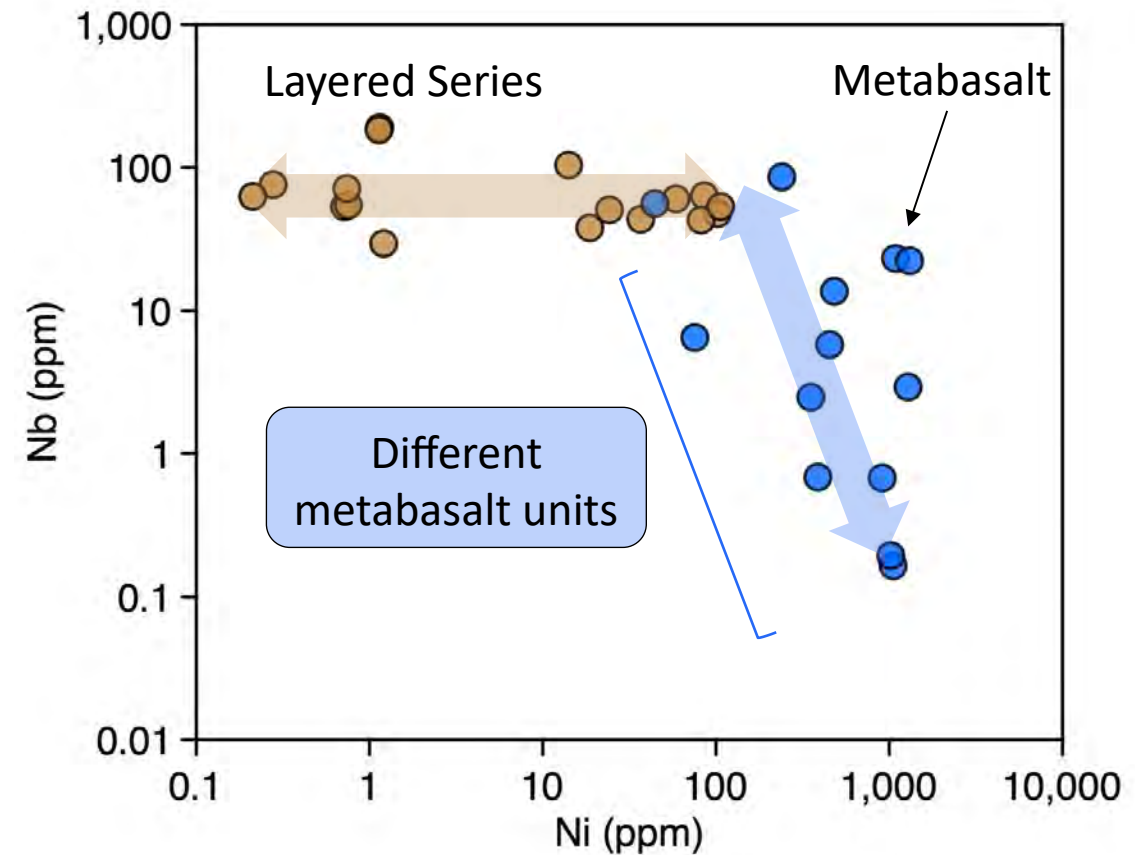
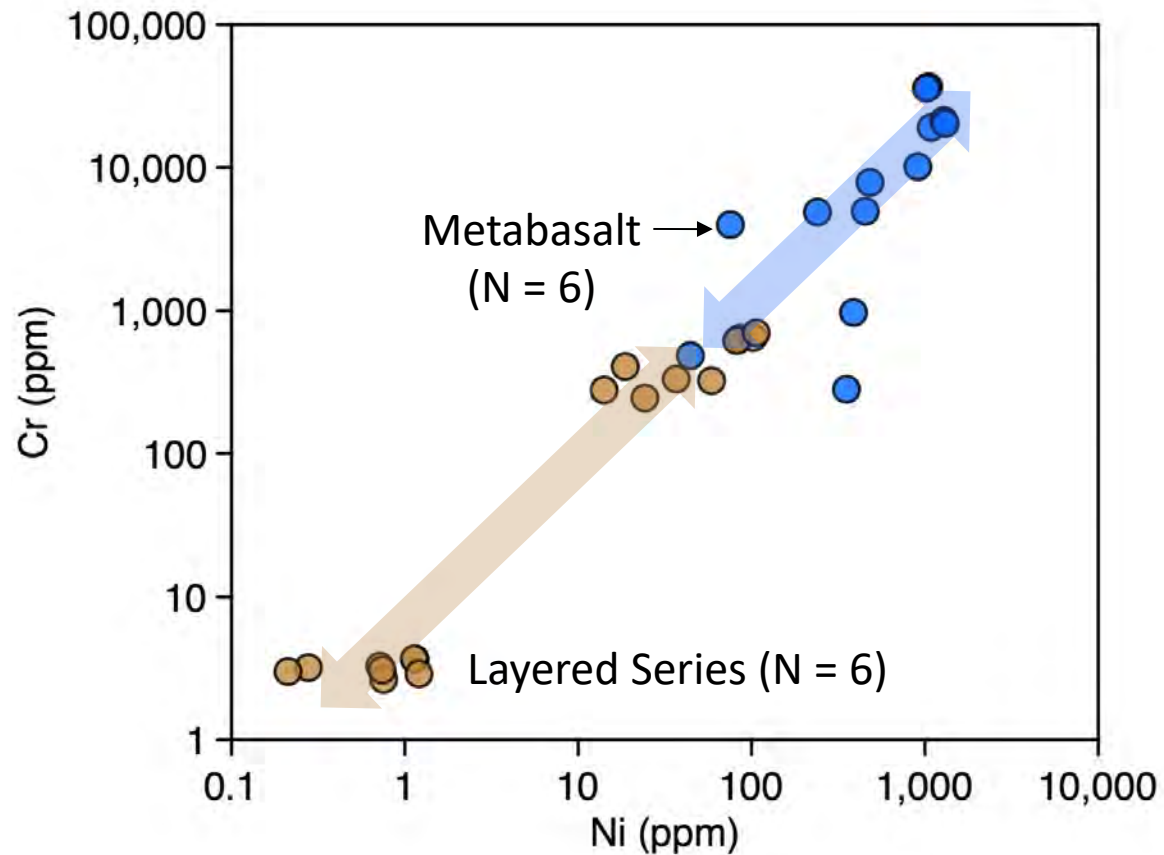
Single valent

Mobile

# Rayleigh fractional crystallization



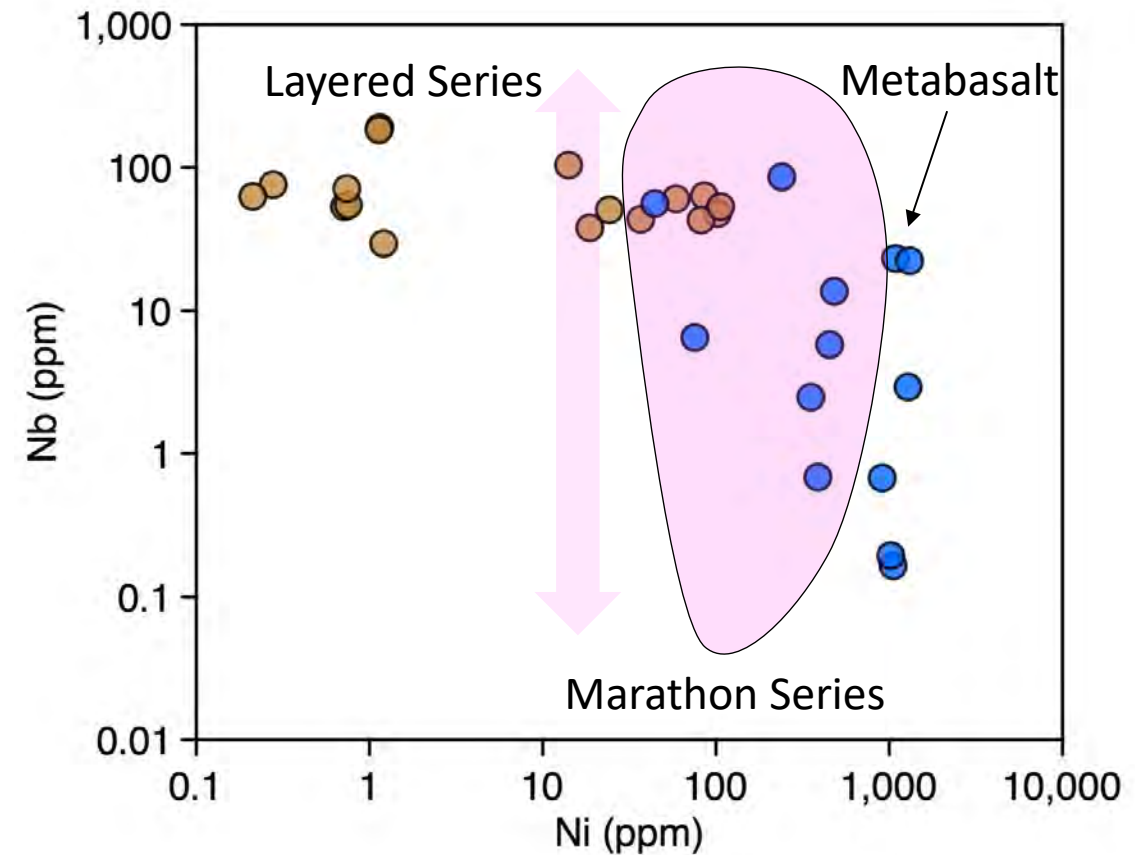
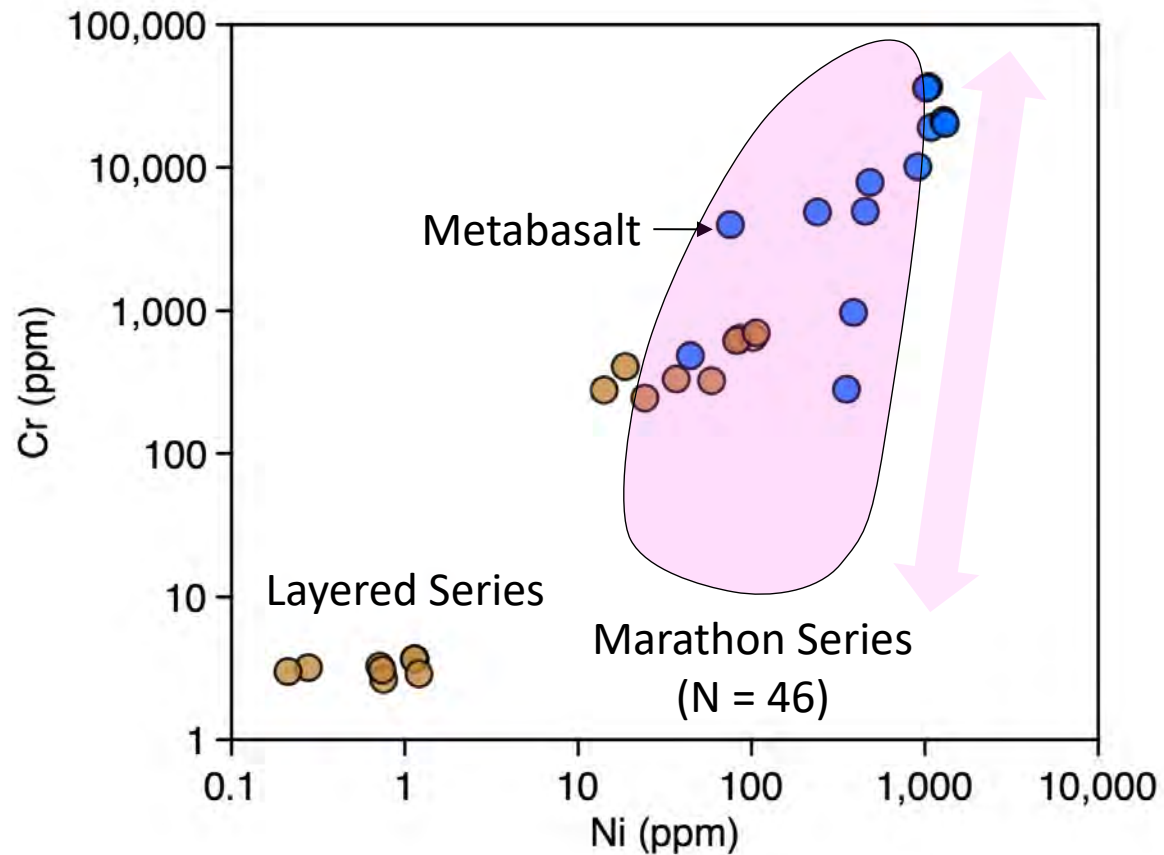
## Genetic relationship between rock series



**Layered Series = more evolved than metabasalt**

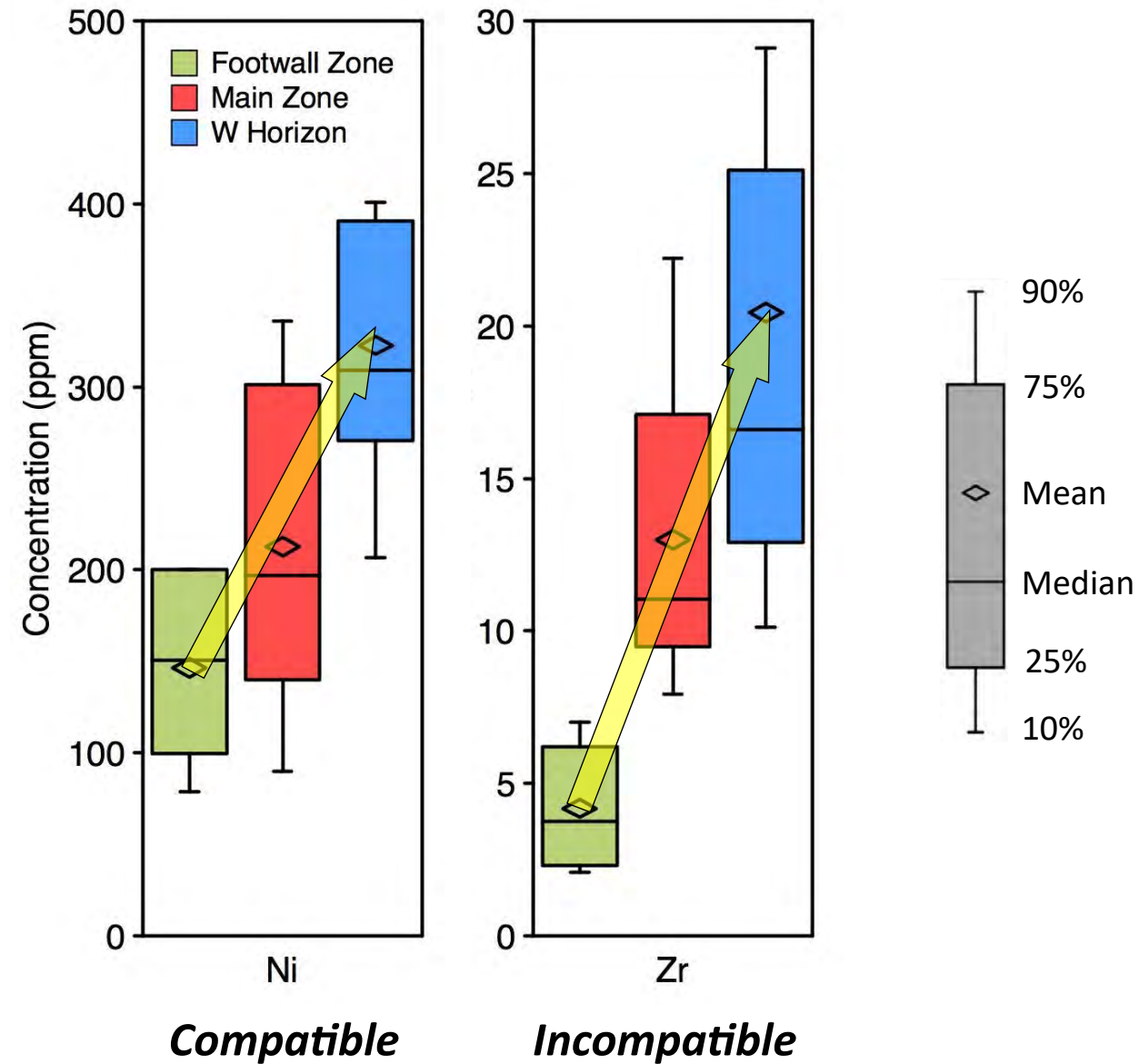


## Genetic relationship between rock series

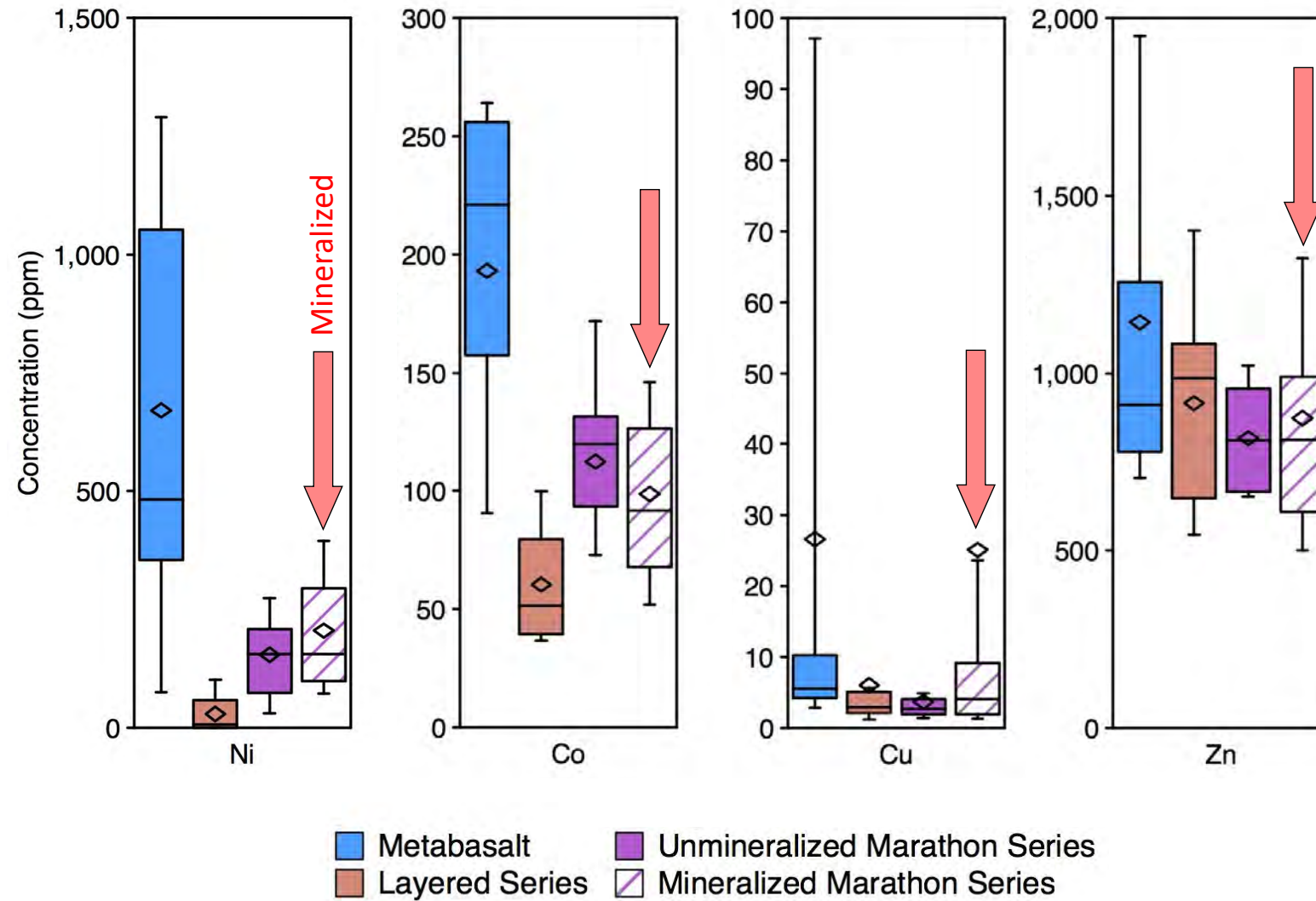


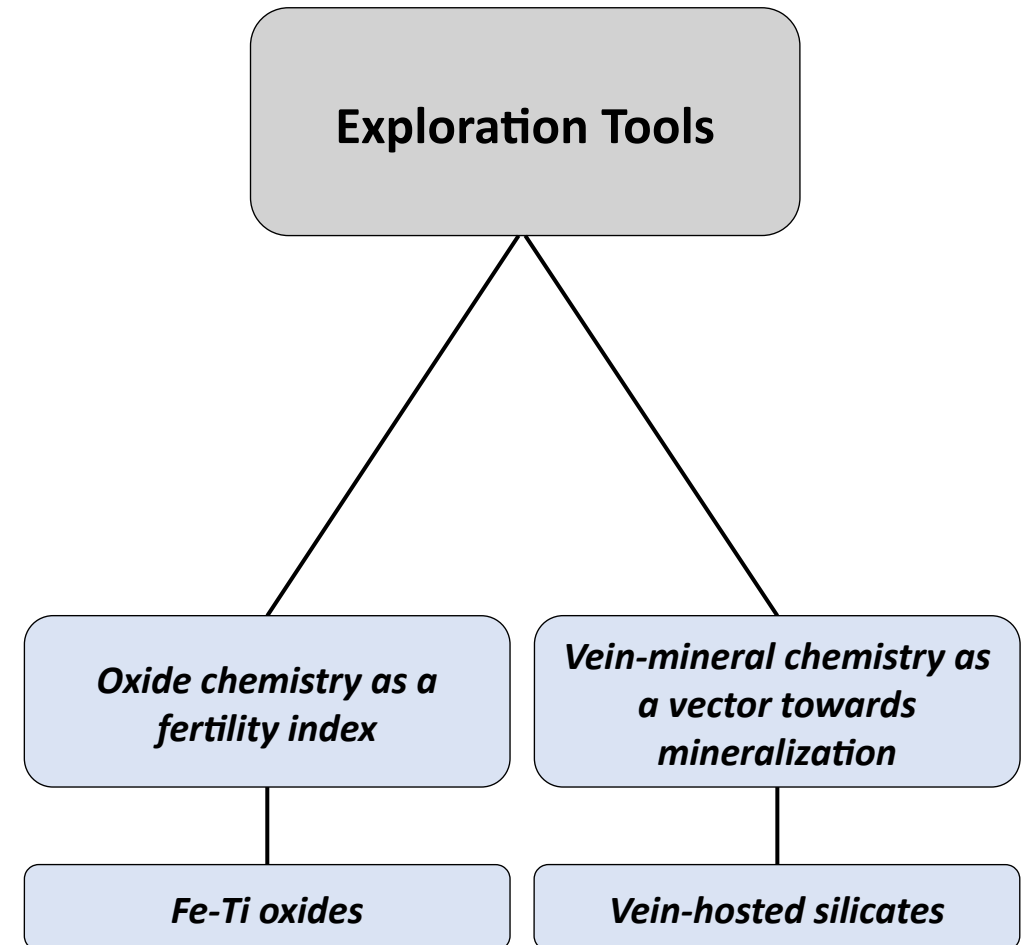
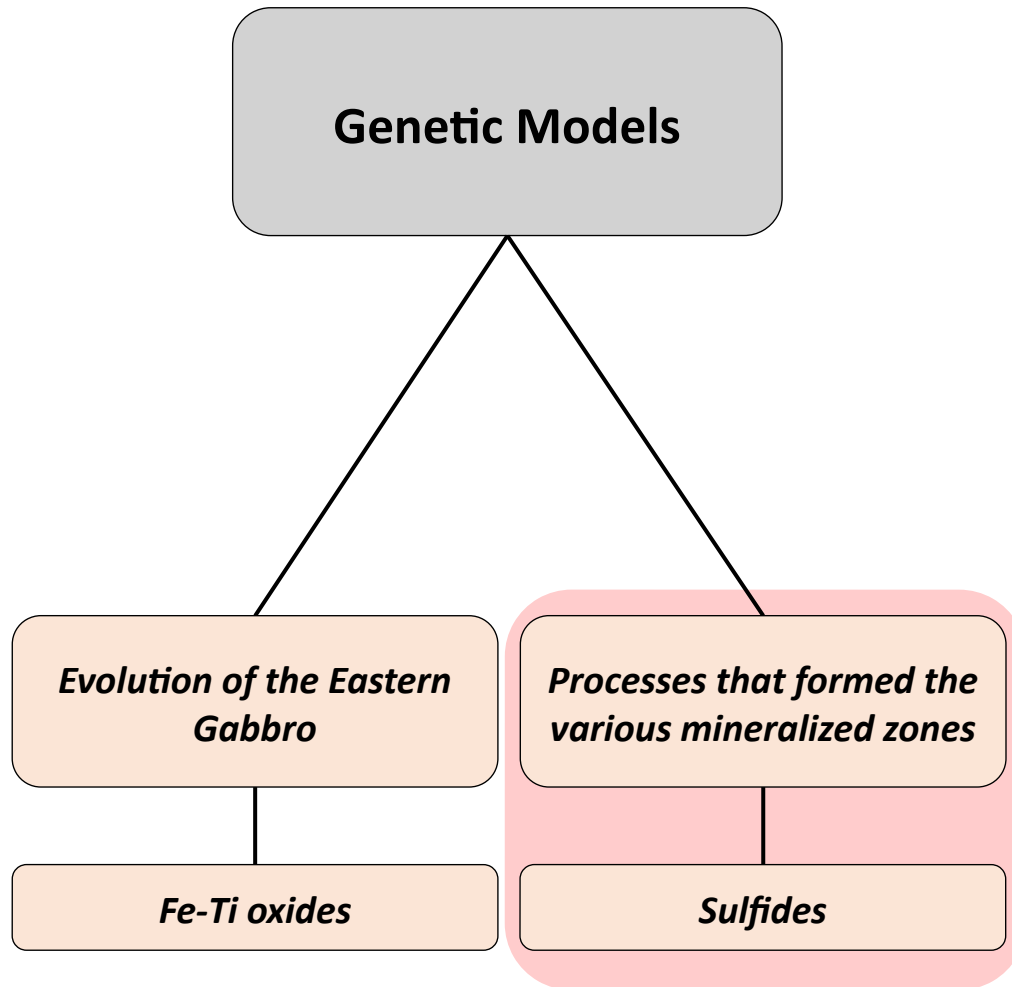
**Marathon Series** = Multiple batches of compositionally distinct magma

## Genetic relationship between the mineralized zones



## Fe-Ti oxides as indicators of mineralization

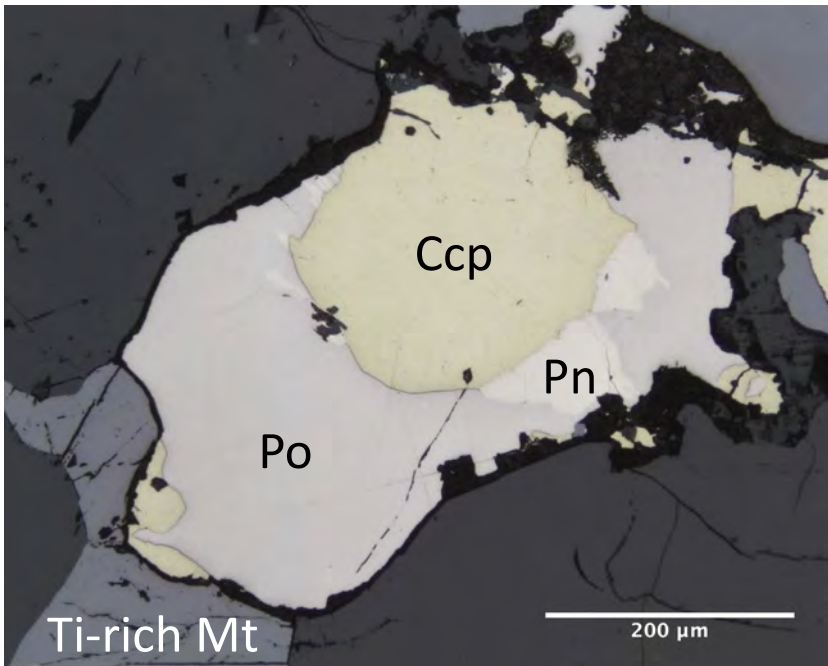




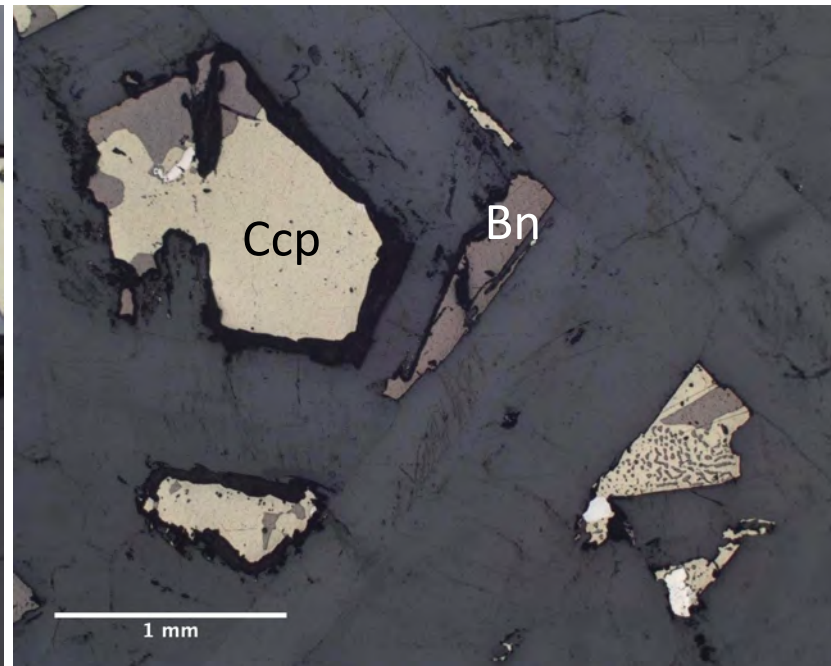


## Equilibrium sulfides

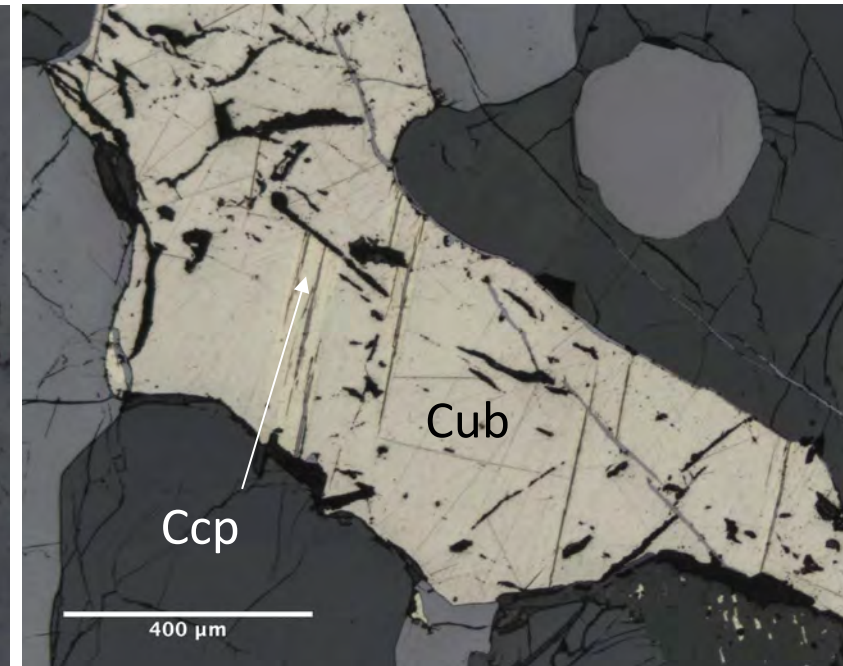
Main Zone



W Horizon

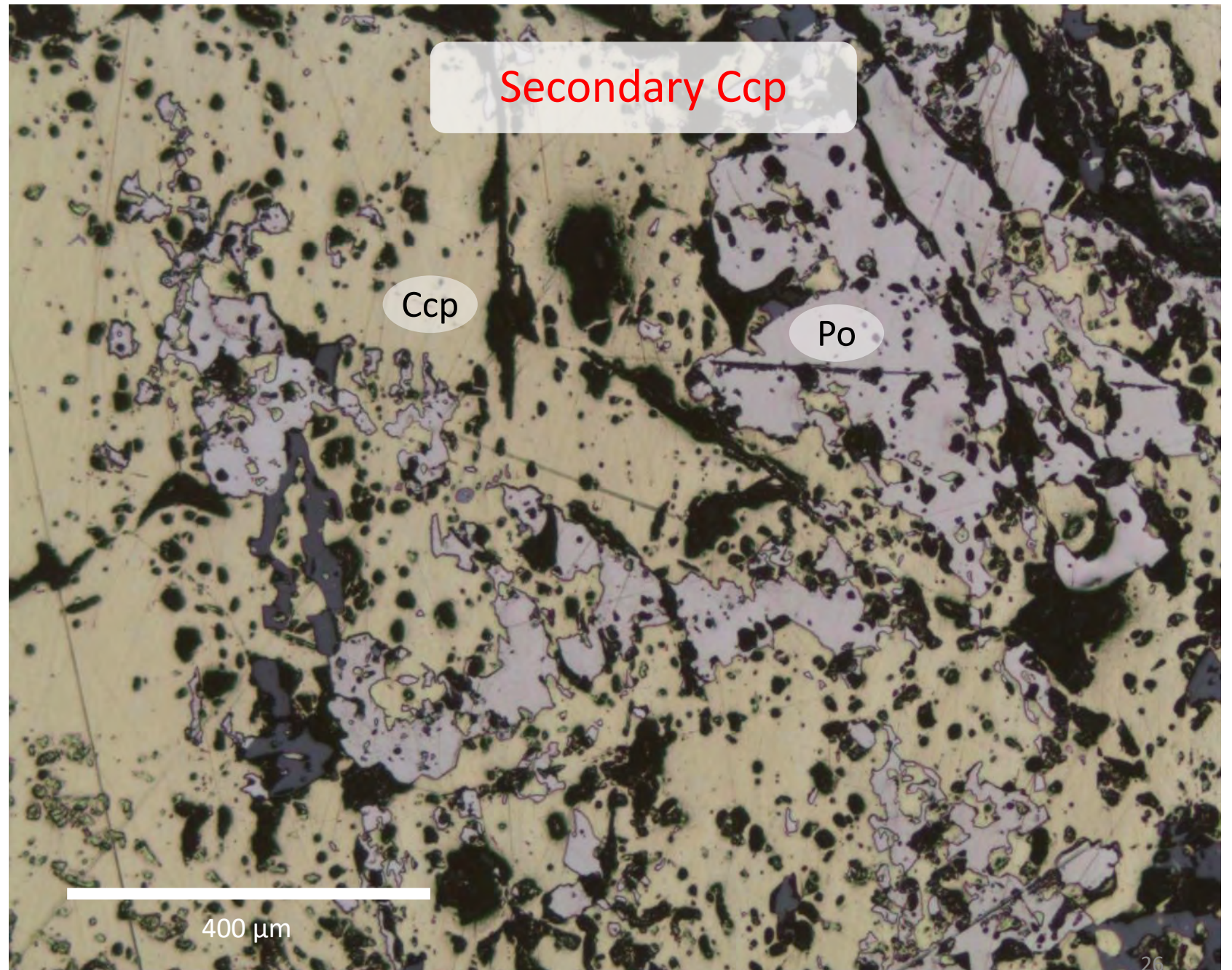


Redstone (Northern occurrence)





## Disequilibrium sulfides





## Disequilibrium(?) sulfides

Secondary Ccp

Ccp

Hydrous Silicates

400  $\mu\text{m}$

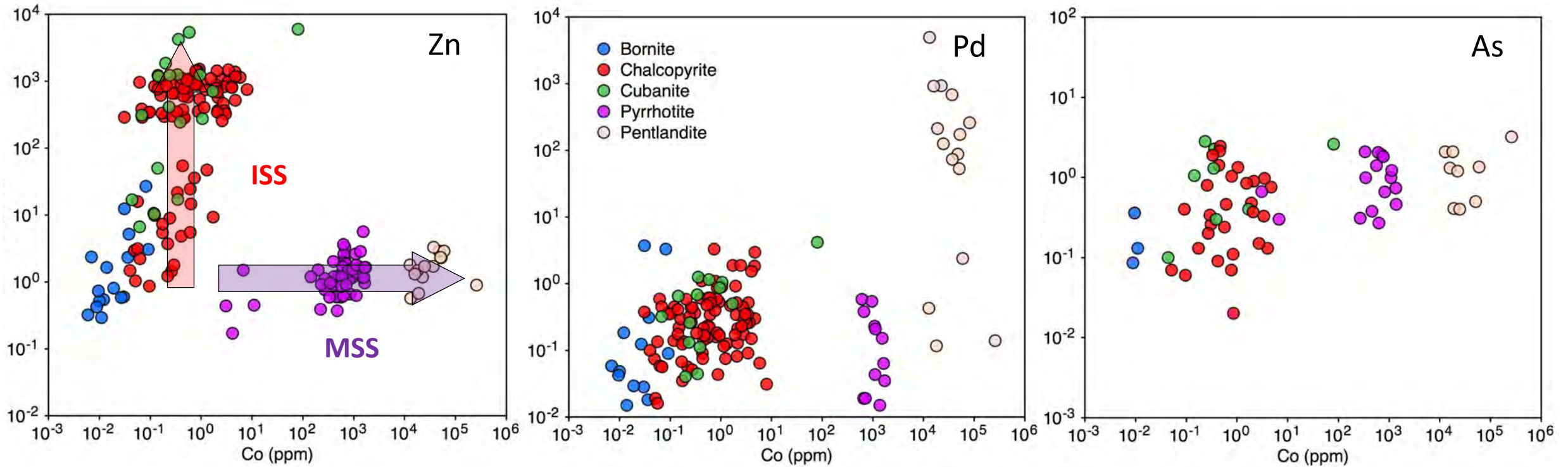
Magmatic Ccp

Hydrous  
Silicates

Ccp

1 mm

# Equilibrium sulfides



IPGE and Co  $\rightarrow$  MSS

PPGE, Au, Ag, and Zn  $\rightarrow$  ISS

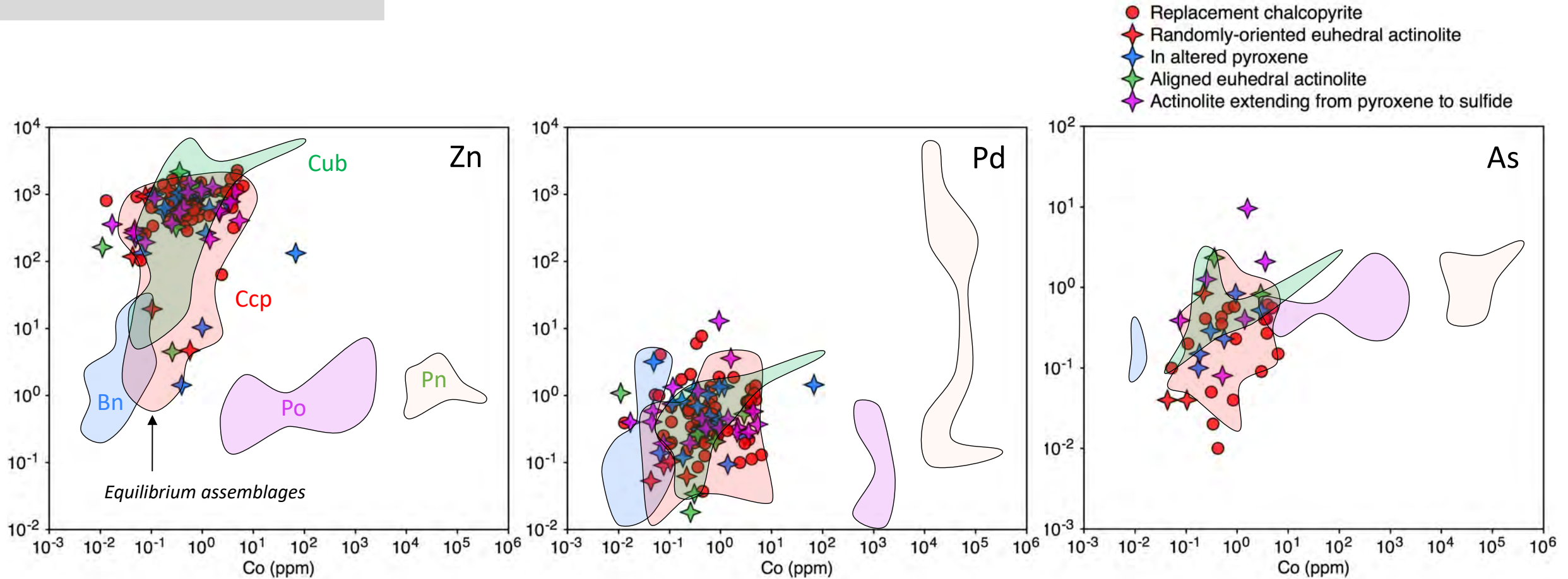
Main-group elements  $\rightarrow$  ISS

Similar concentrations in Fe-rich  
and Cu-rich sulfides

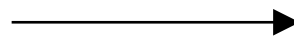
Exsolution  
of PGM



# Disequilibrium sulfides



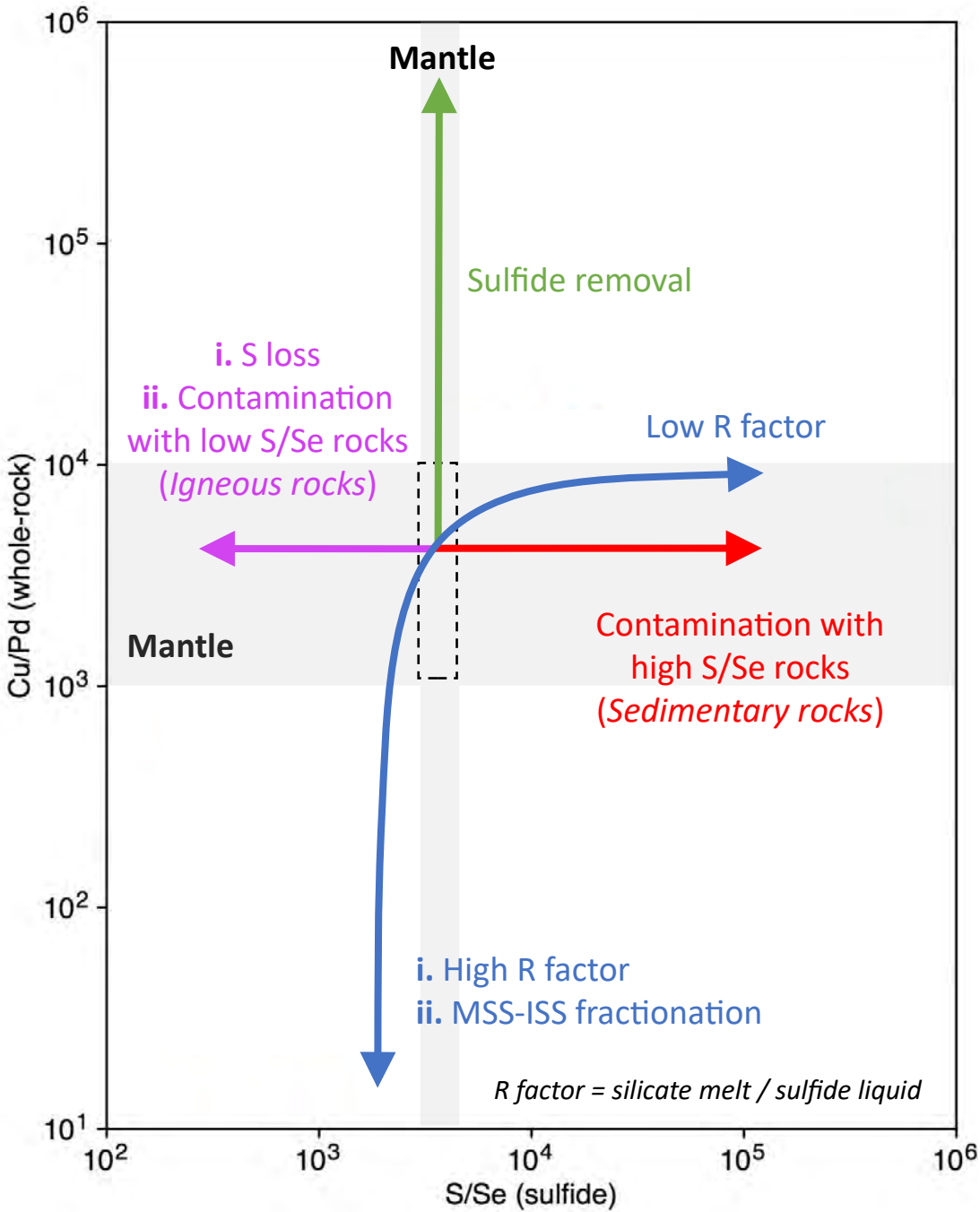
Disequilibrium Ccp = Equilibrium Ccp



Dissolution of magmatic Ccp  
Re-precipitation as secondary Ccp

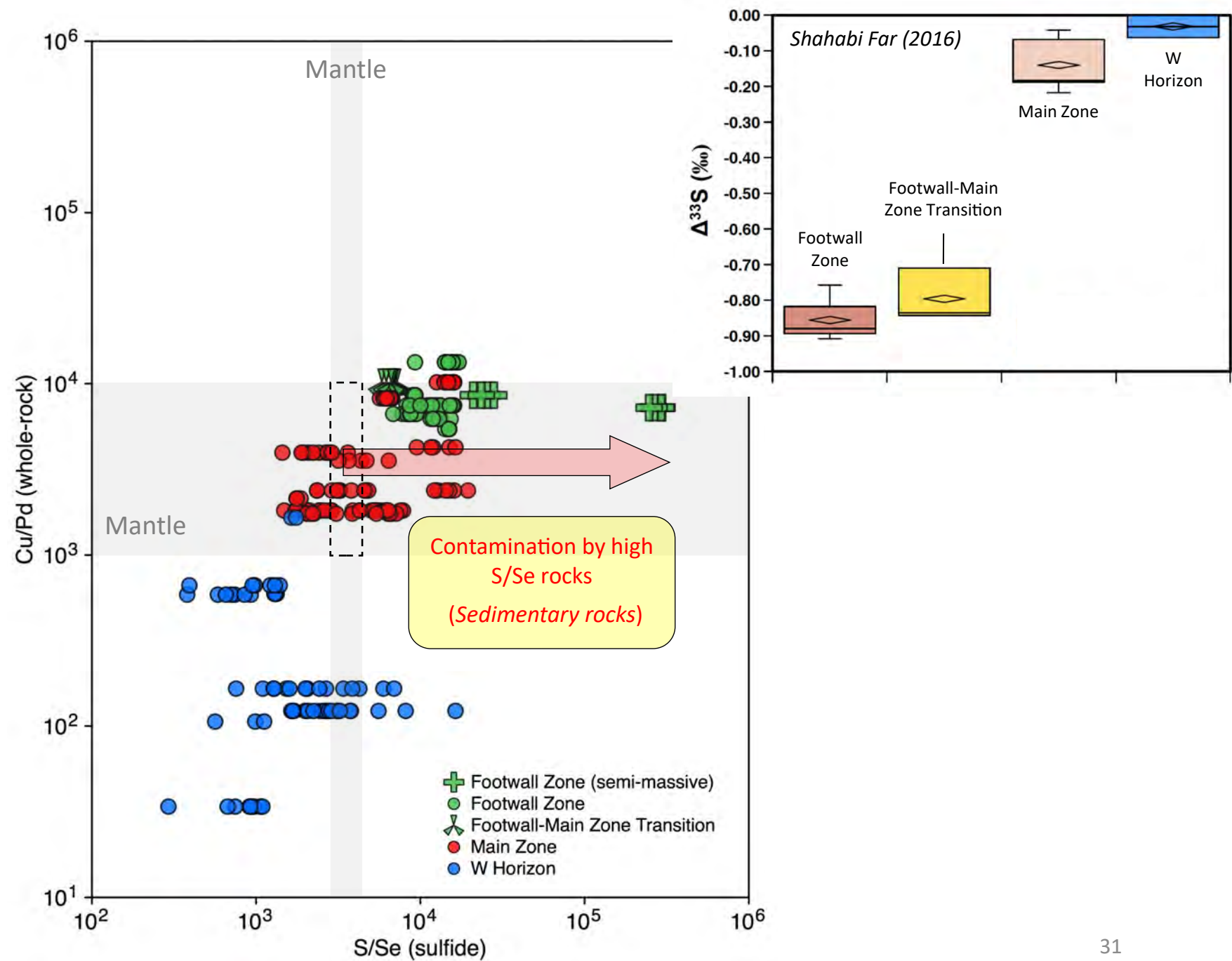
# Processes that affect S/Se ratios

$$D_{\text{Se}}^{\text{sul/sil}} = 10^2 \text{ to } 10^3$$
$$D_{\text{PGE}}^{\text{sul/sil}} = 10^3 \text{ to } >10^5$$

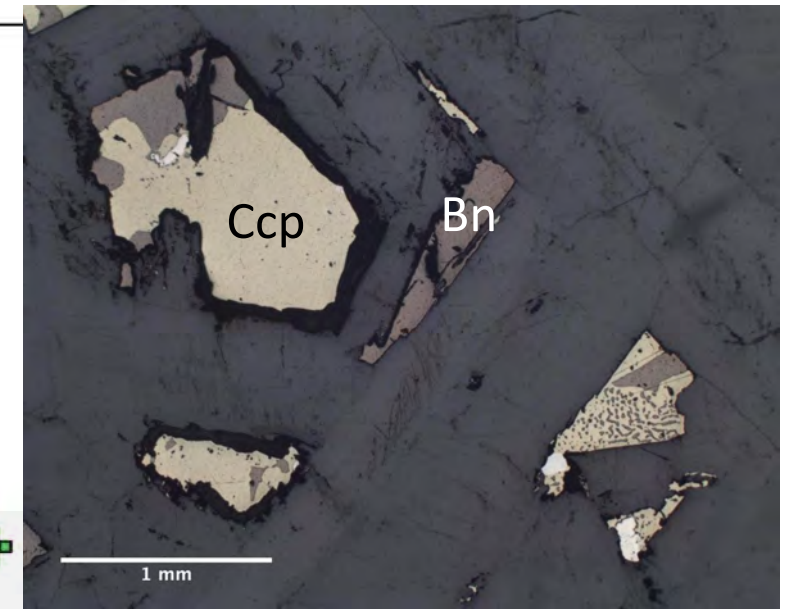
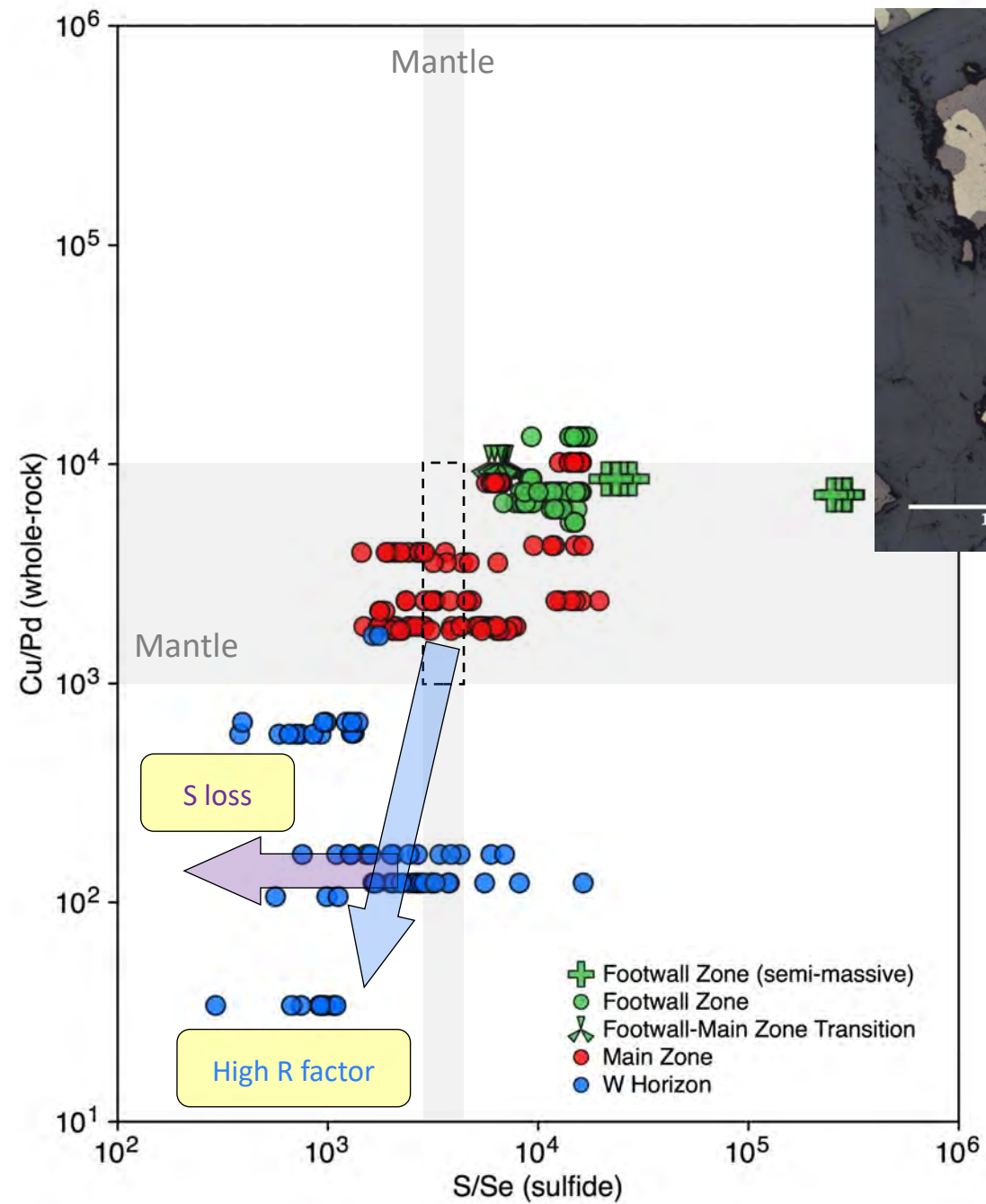


Modified from Queffurus and Barnes (2015)

# Marathon Cu-Pd



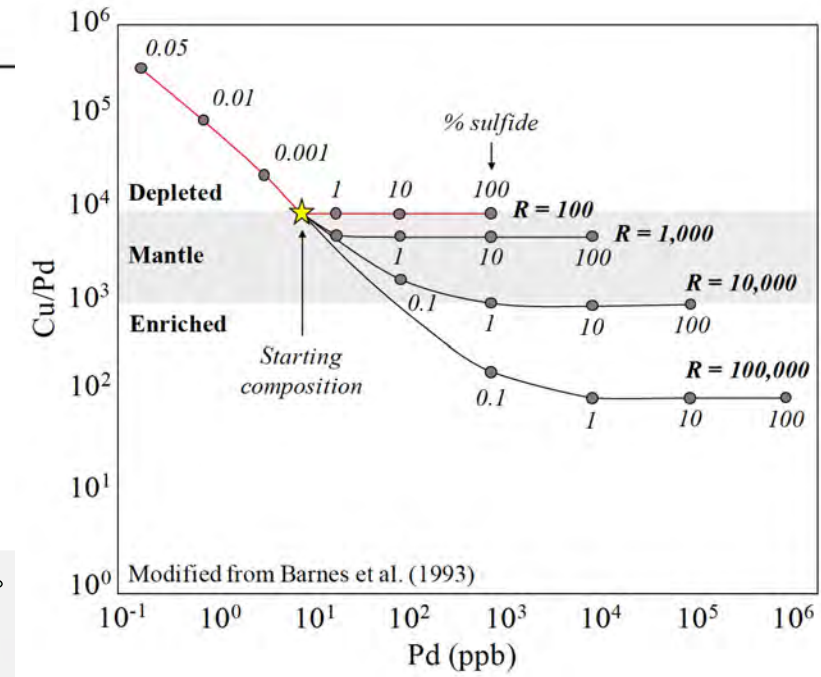
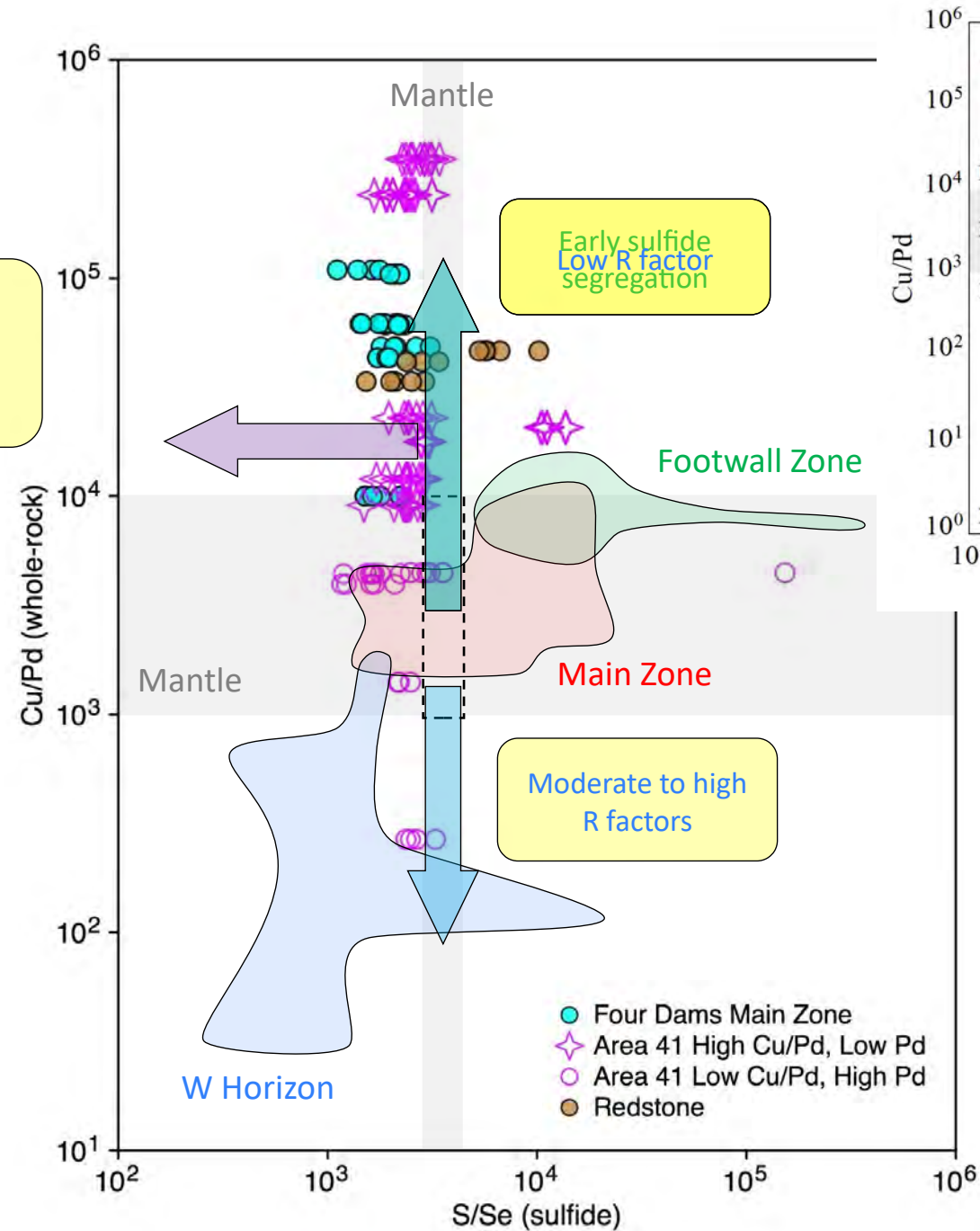
# Marathon Cu-Pd

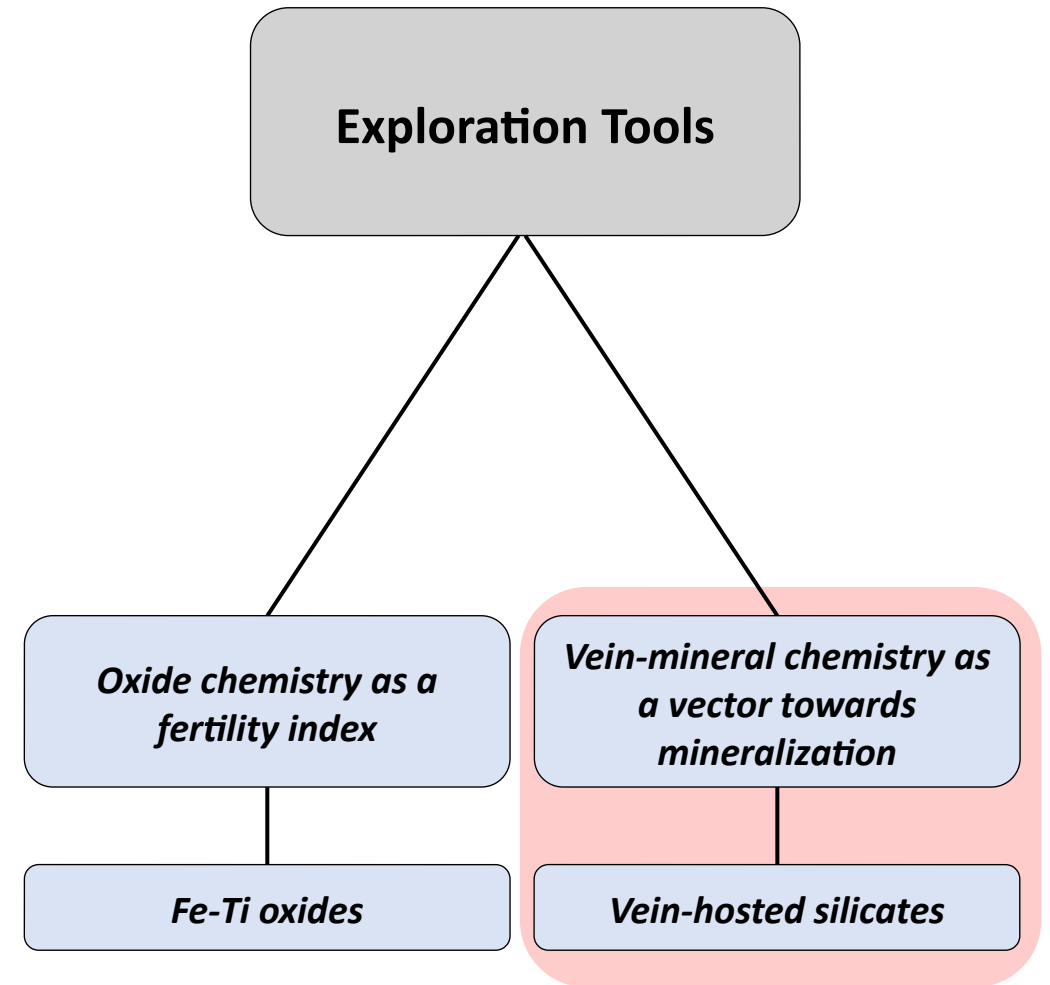
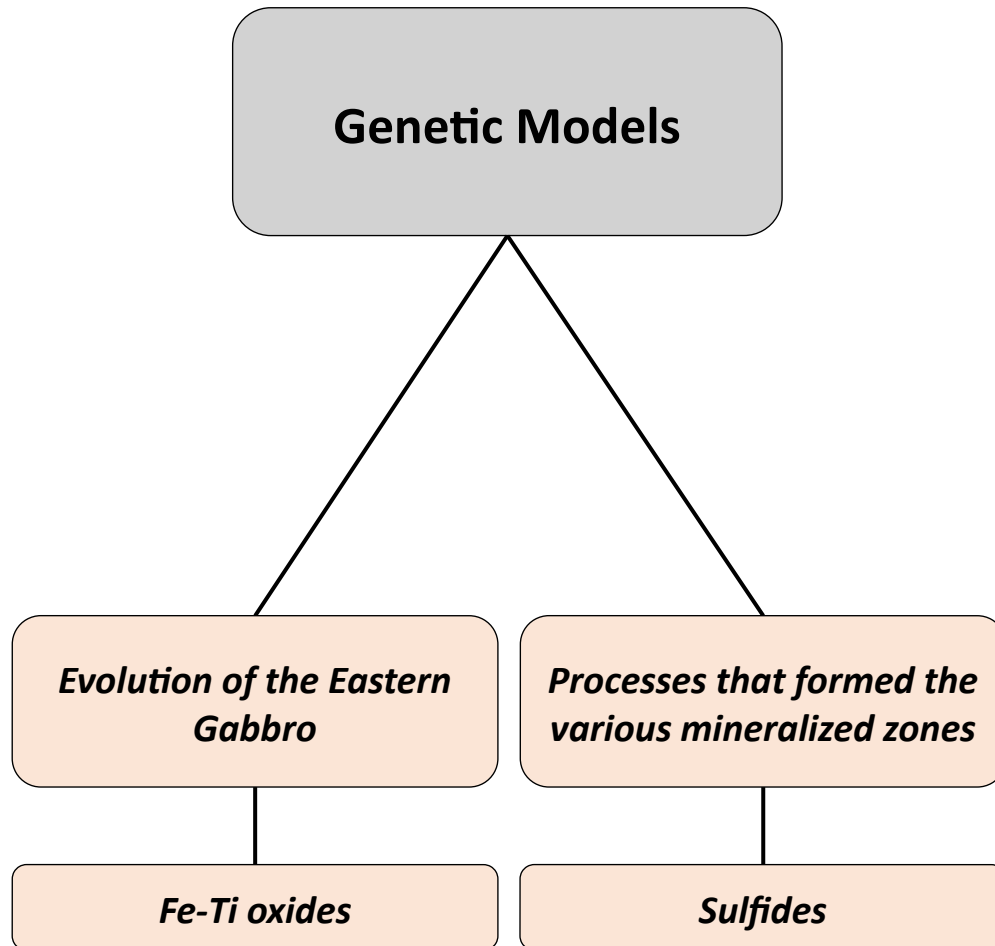




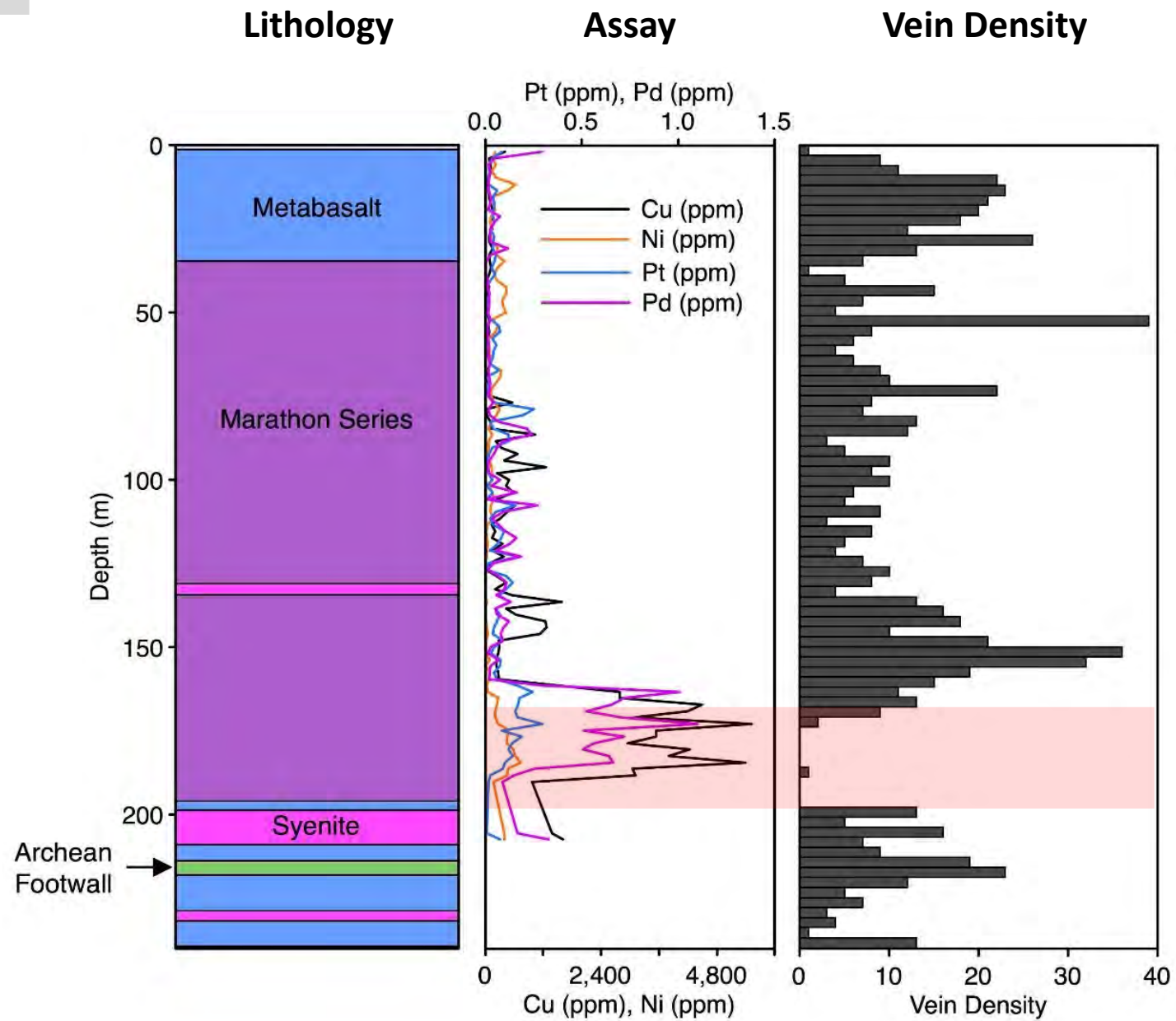
# Occurrence NW of Marathon

Contamination by low S/Se rocks  
(Igneous/Metamorphic rocks)



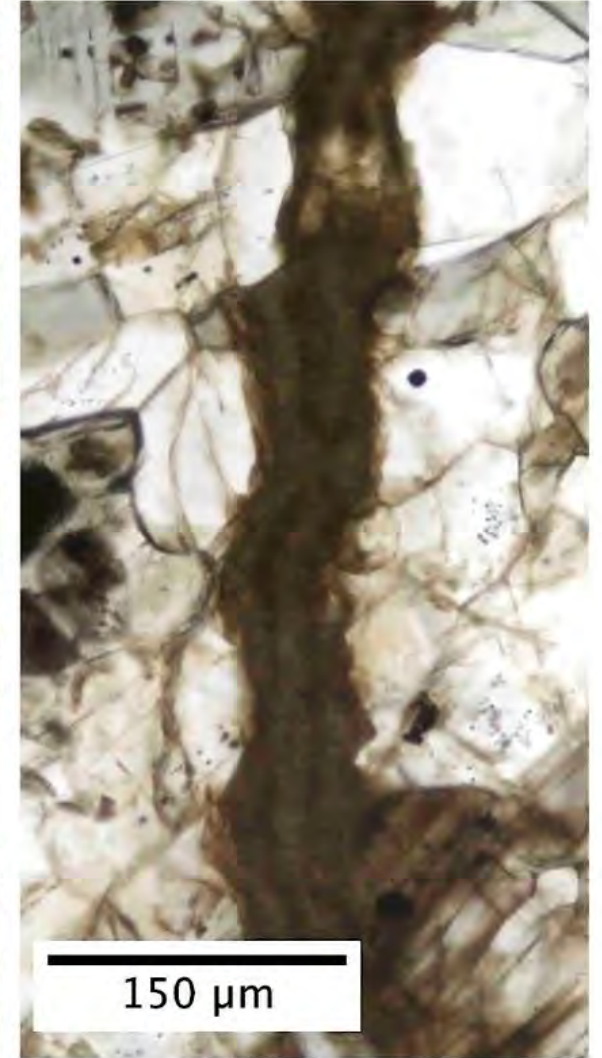
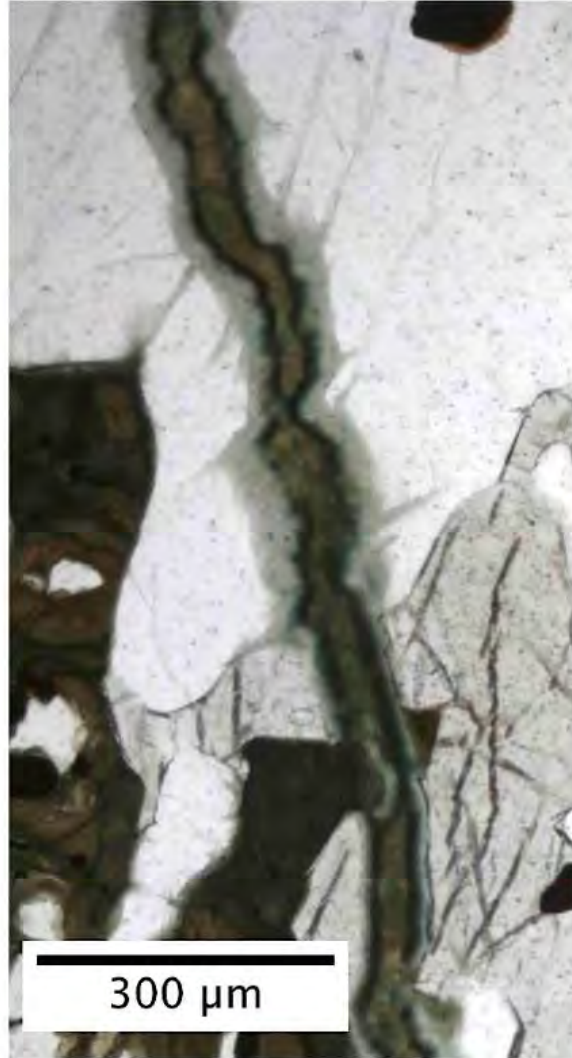


# Vein density

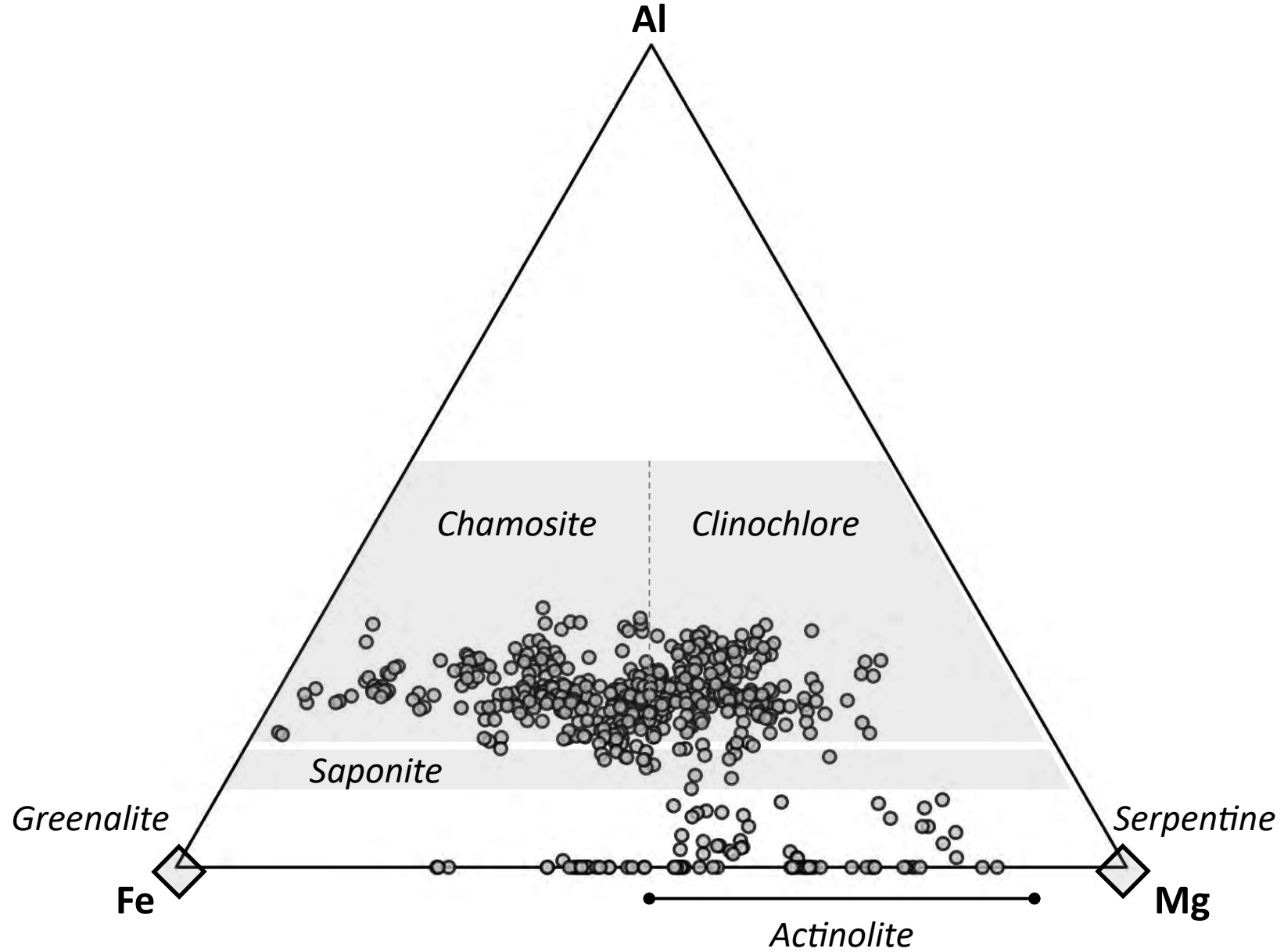




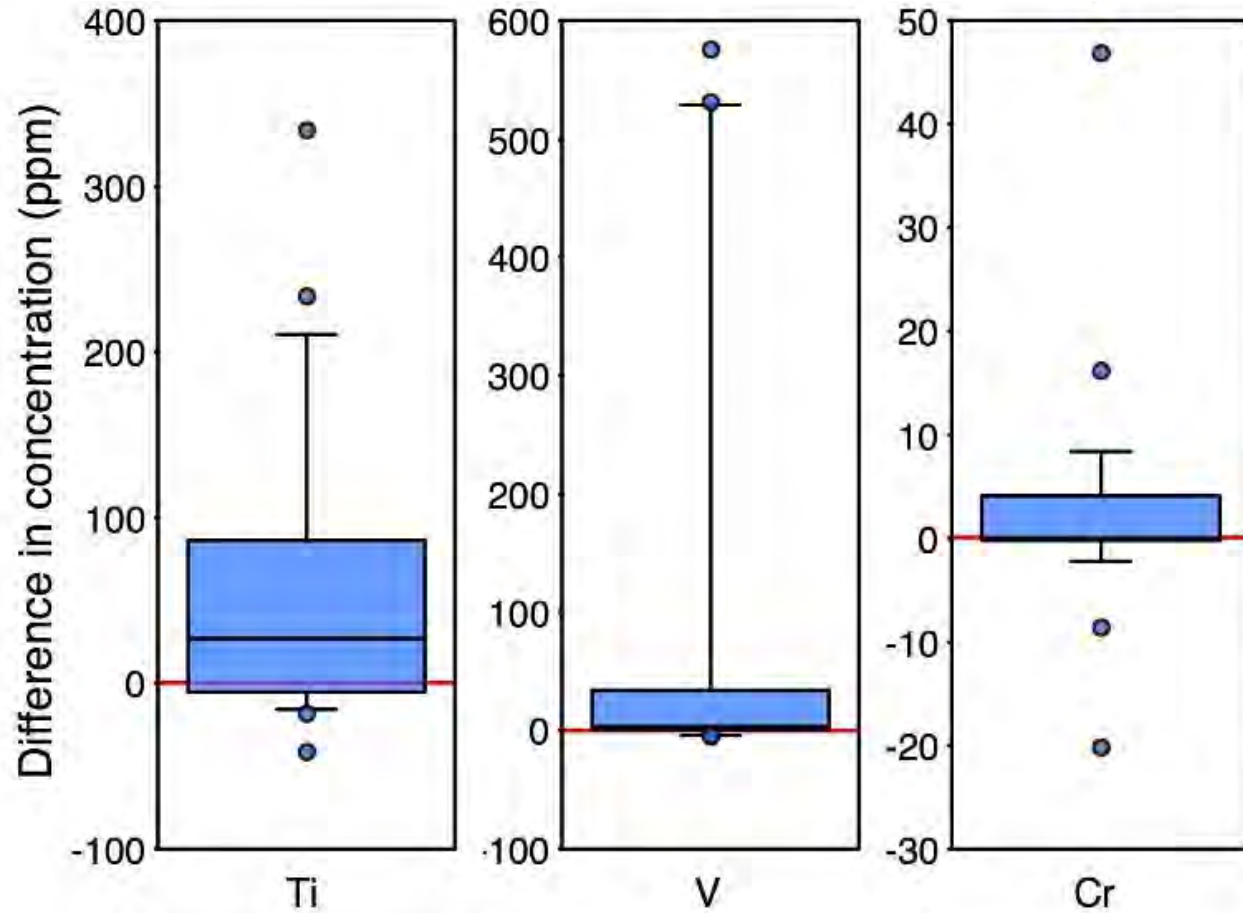
## Vein mineralogy



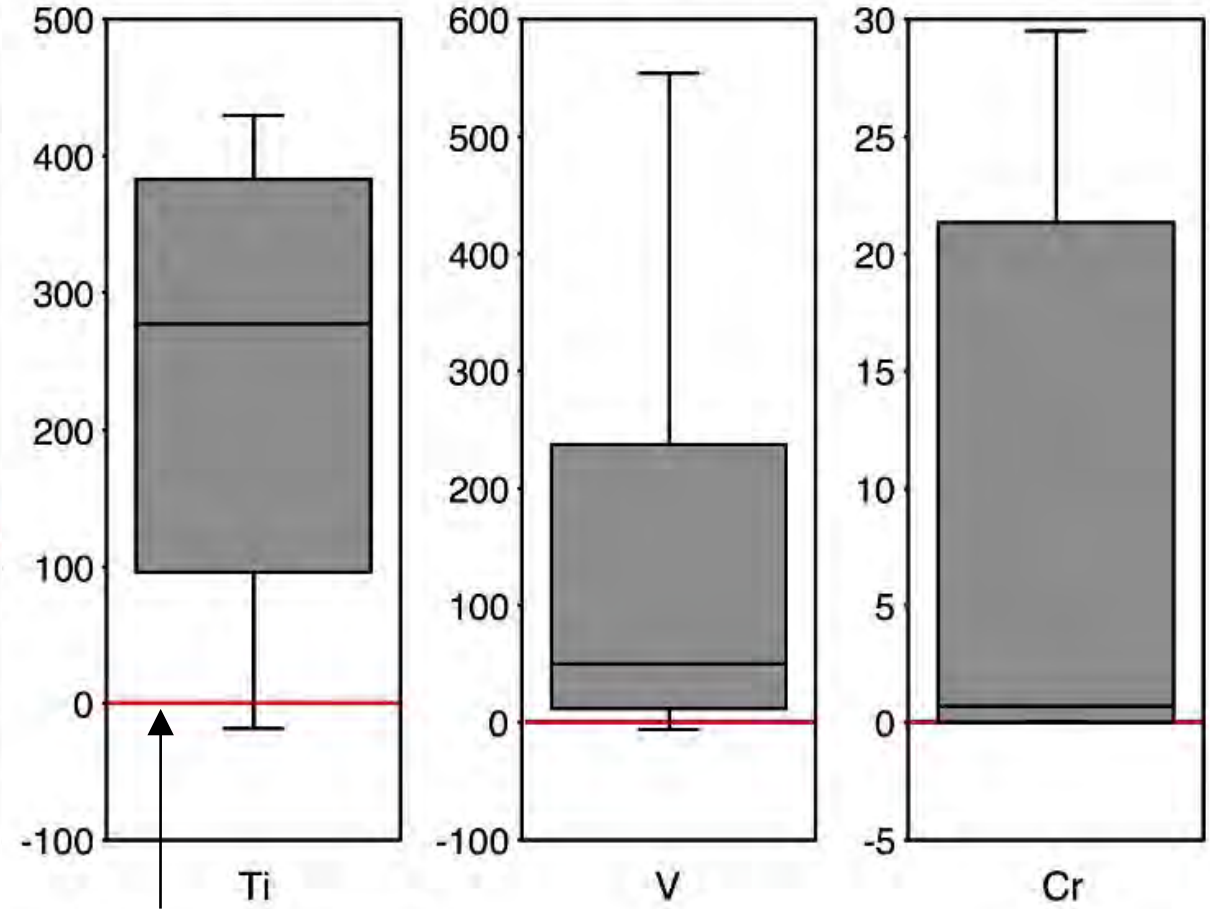




## Pyroxene - Plagioclase



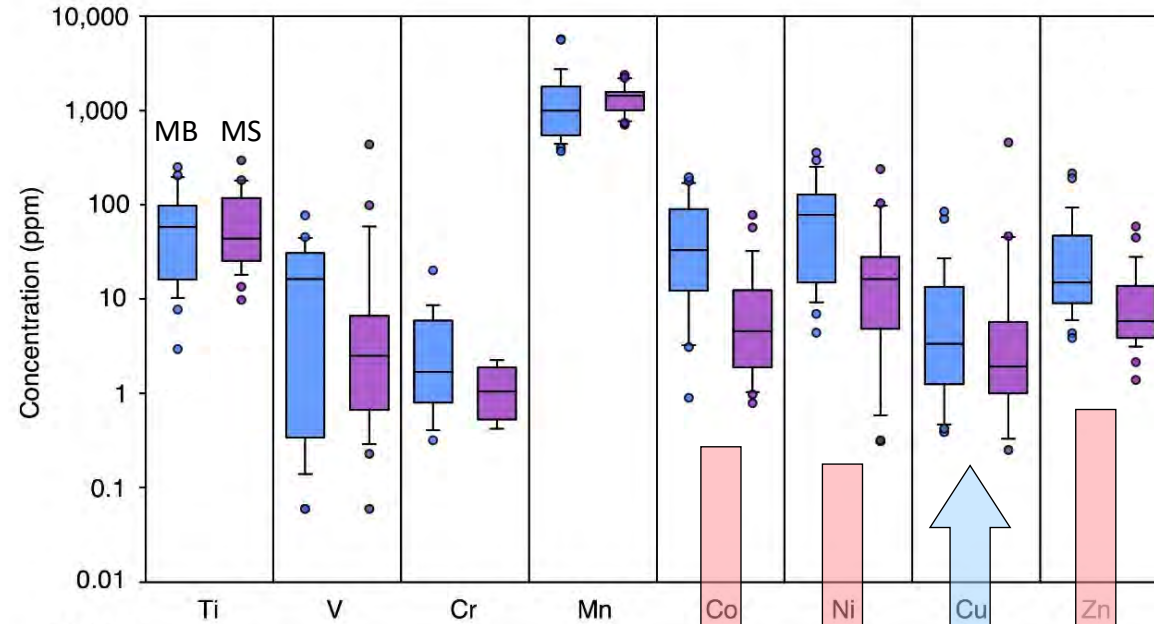
## Oxide - Plagioclase



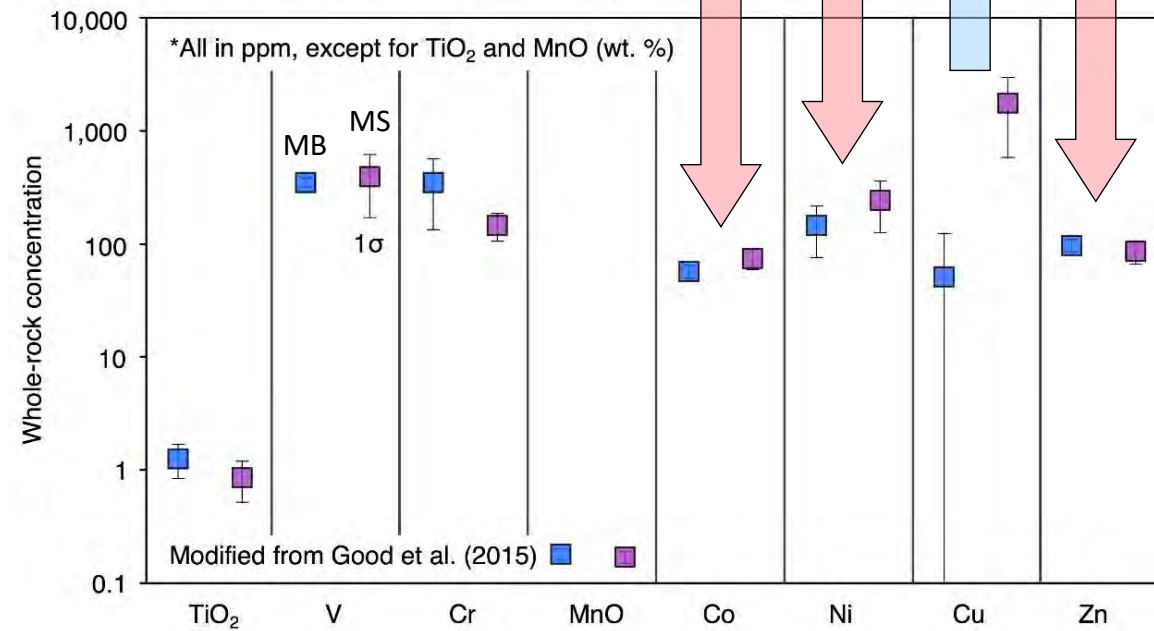
No host-mineral effect

# Host-rock control

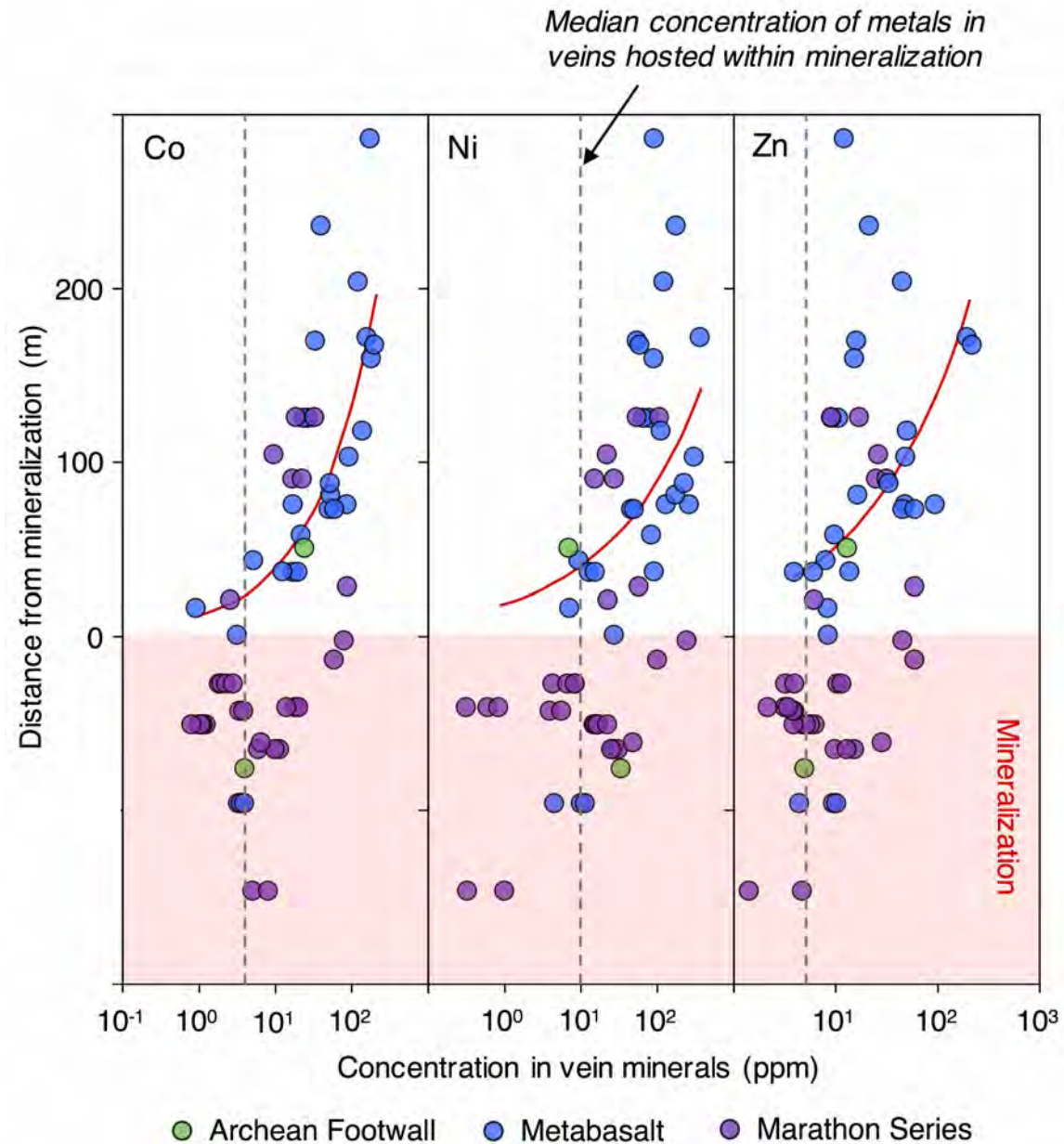
**Vein-mineral  
chemistry**



**Host-rock  
chemistry**



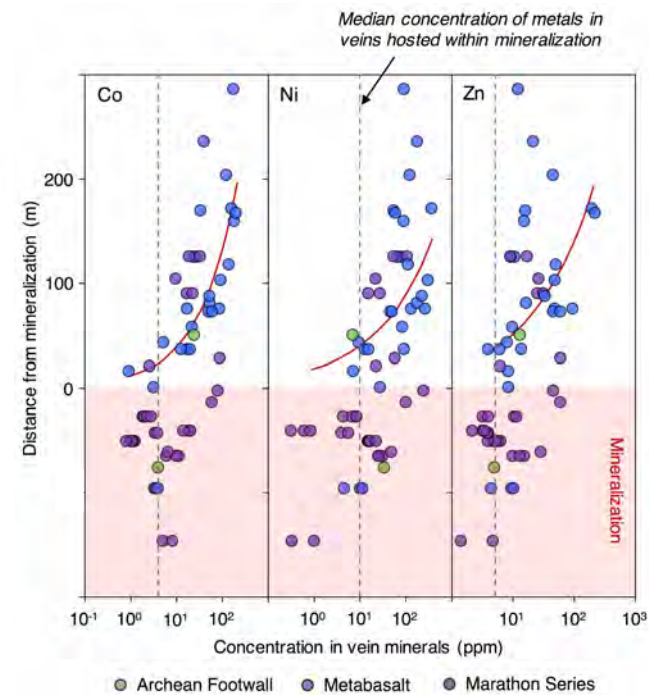
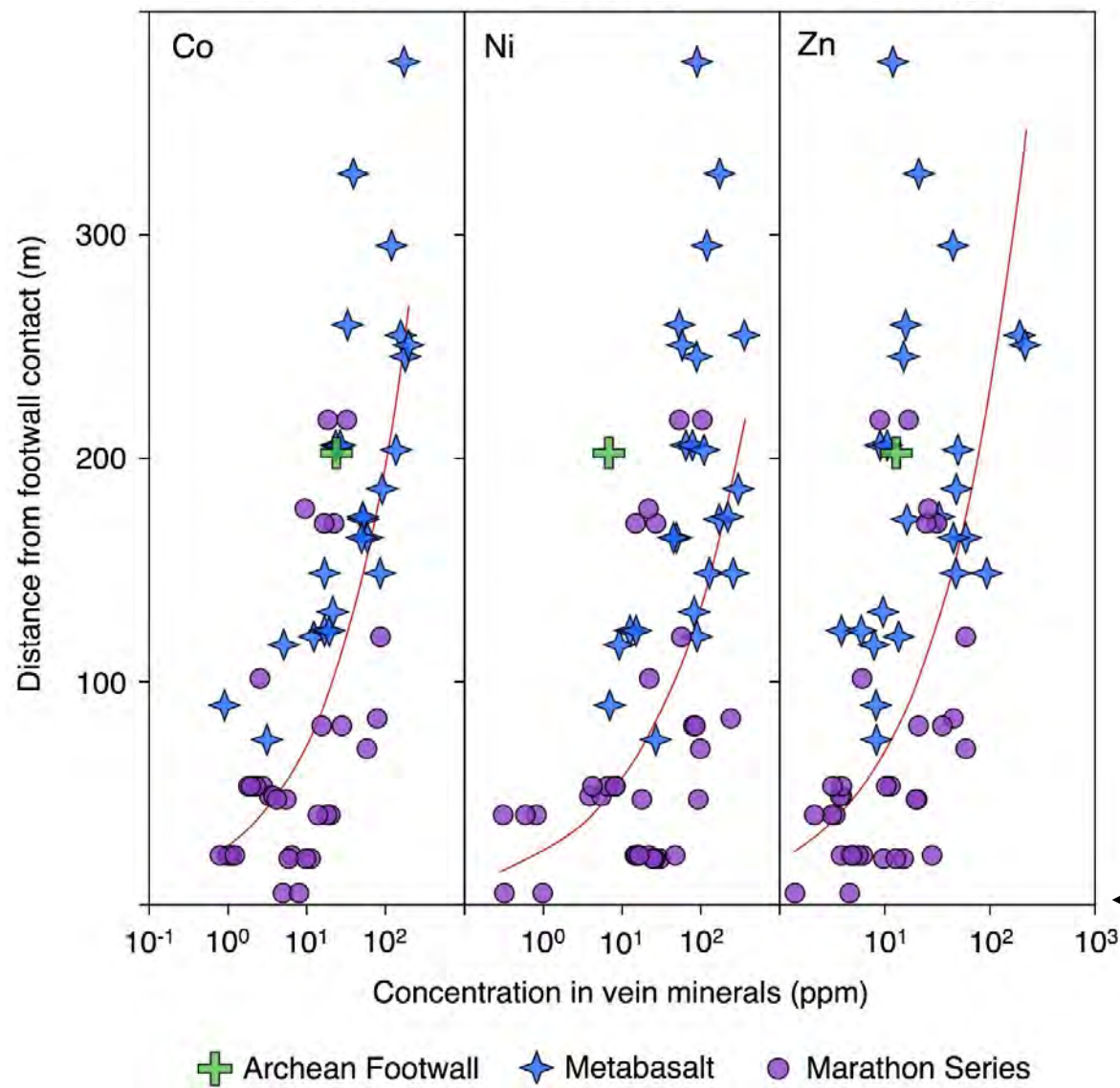
## Proximity to mineralization



\*Veins from all drill holes are plotted

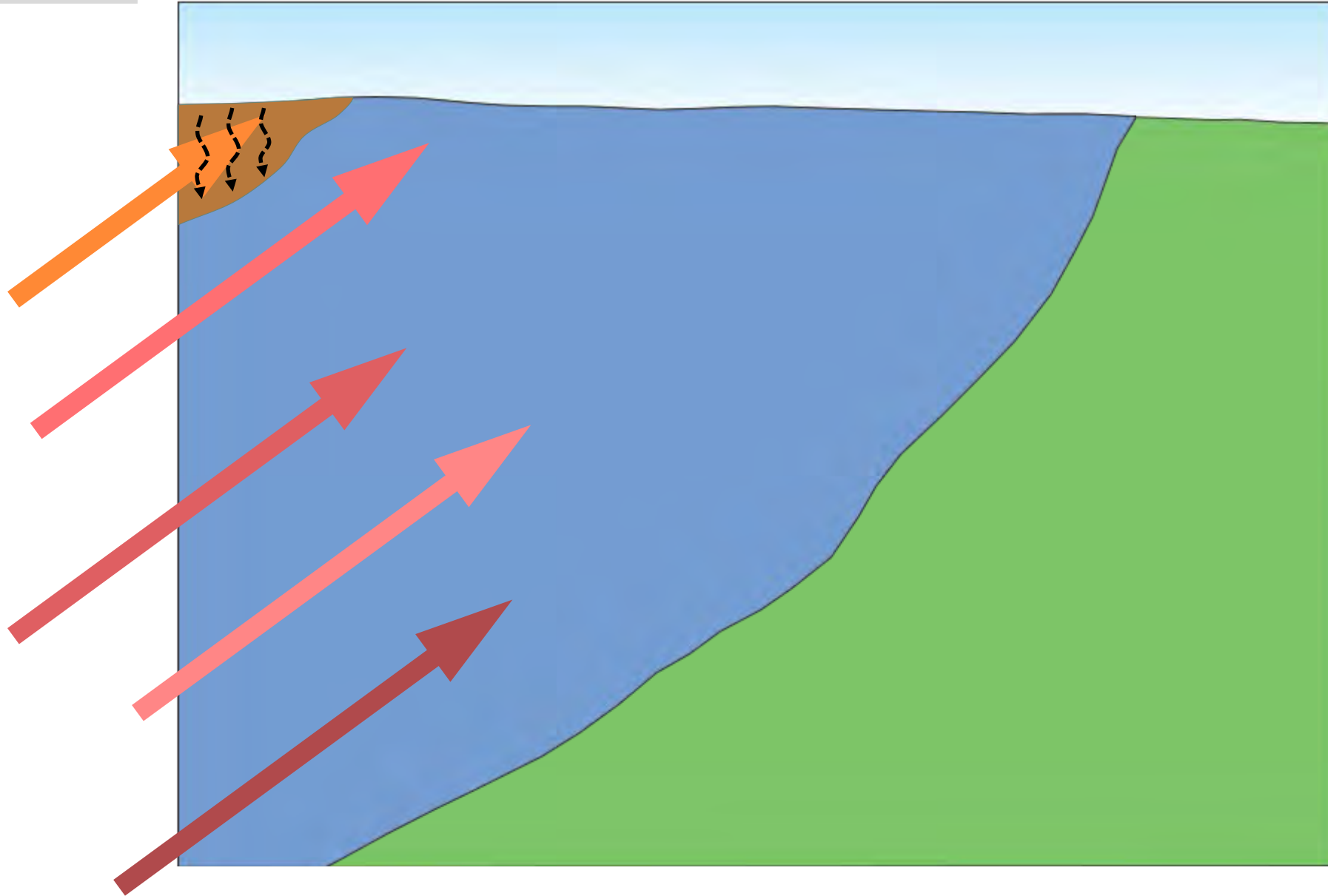


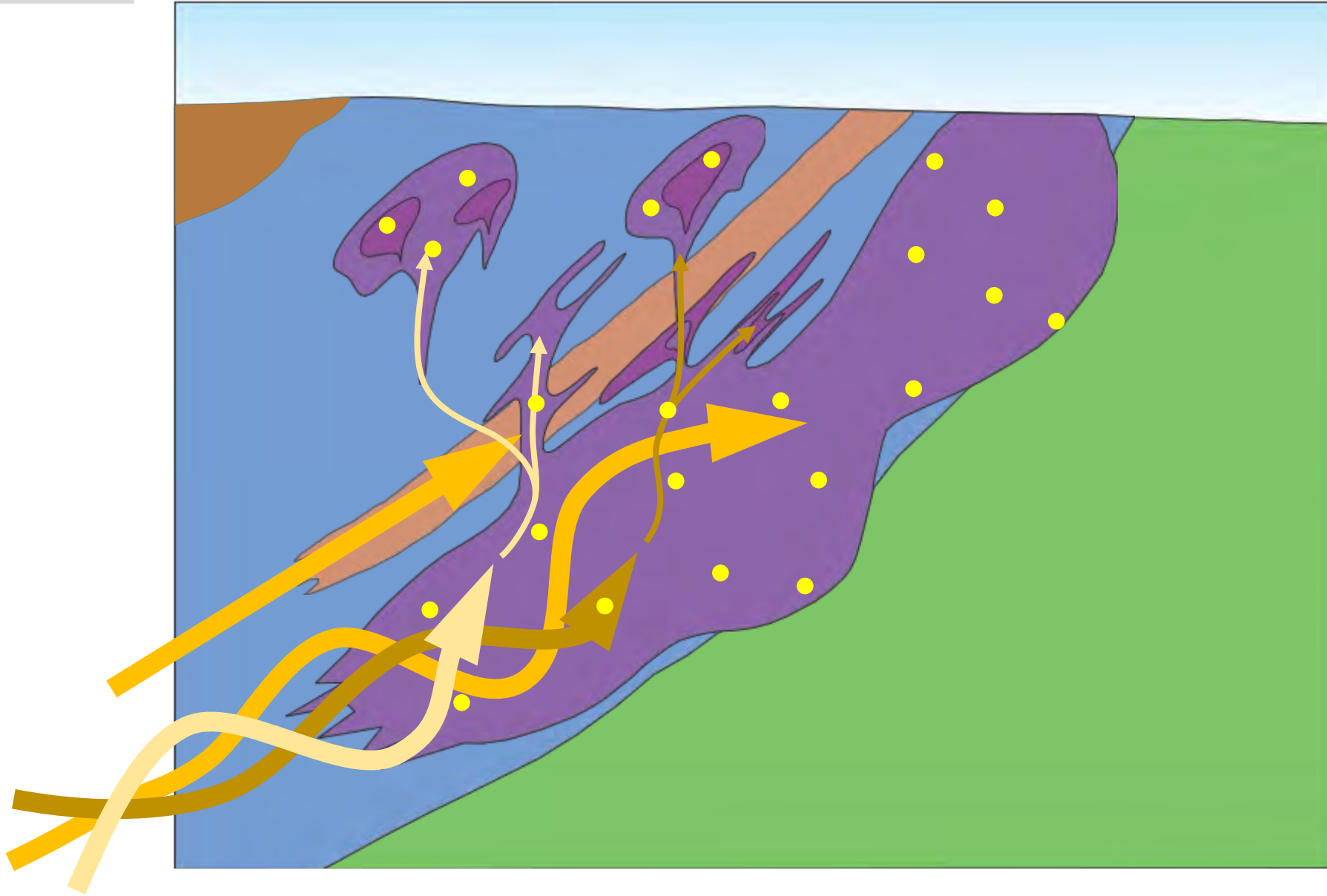
# Proximity to footwall contact



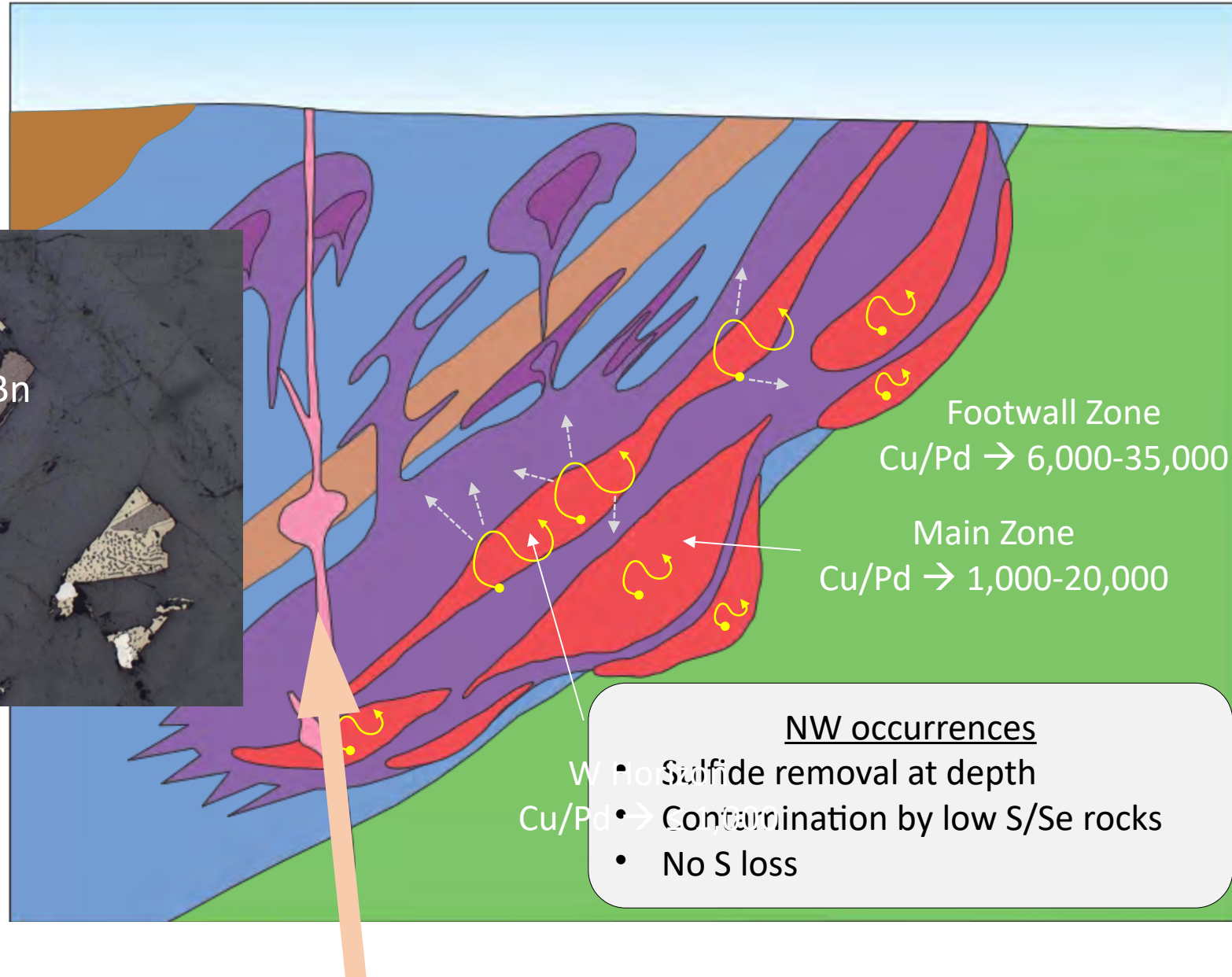
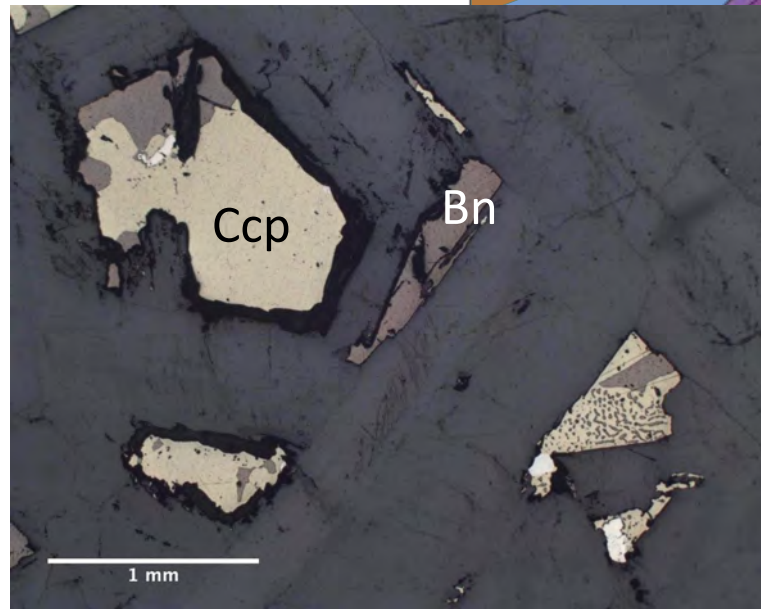
\*Veins from all drill holes are plotted

## Genetic model



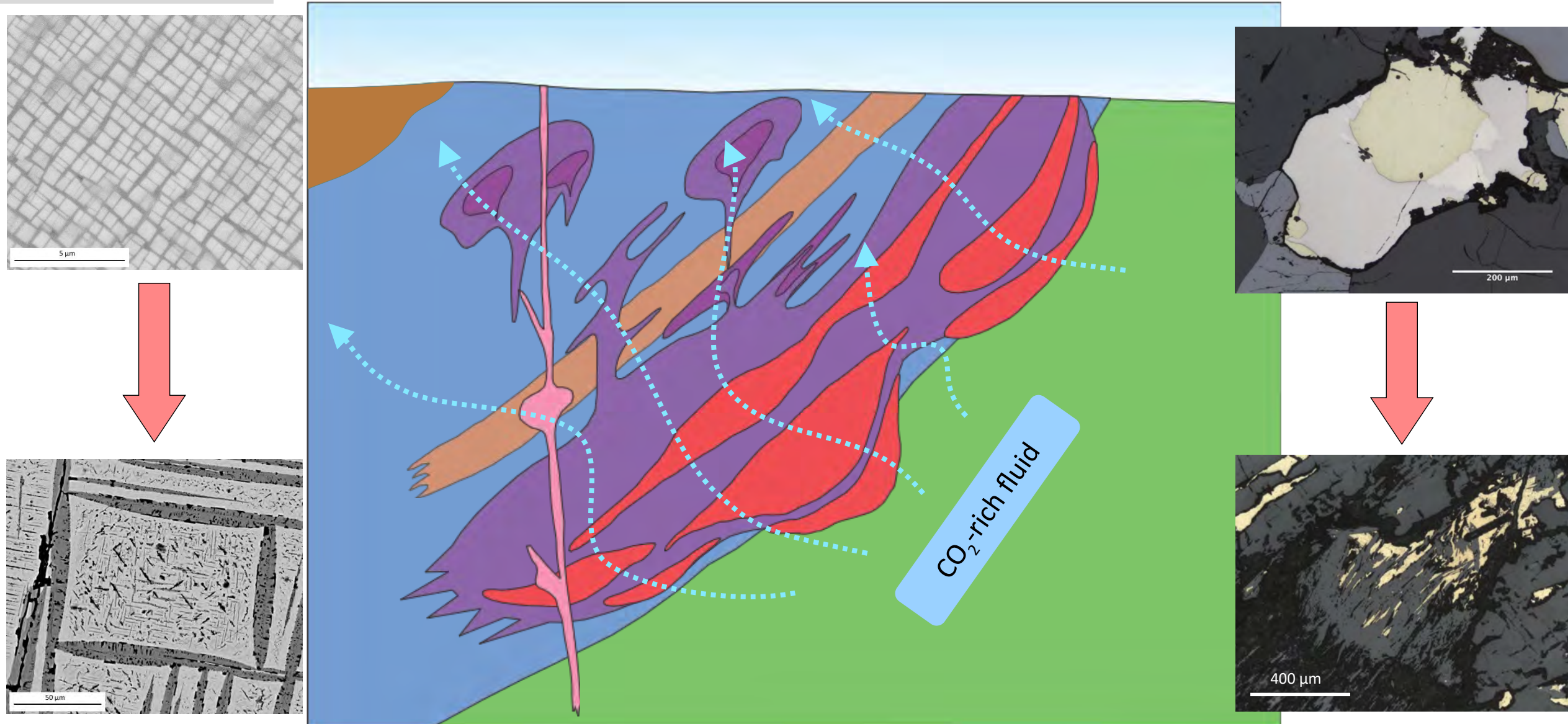


## Genetic model

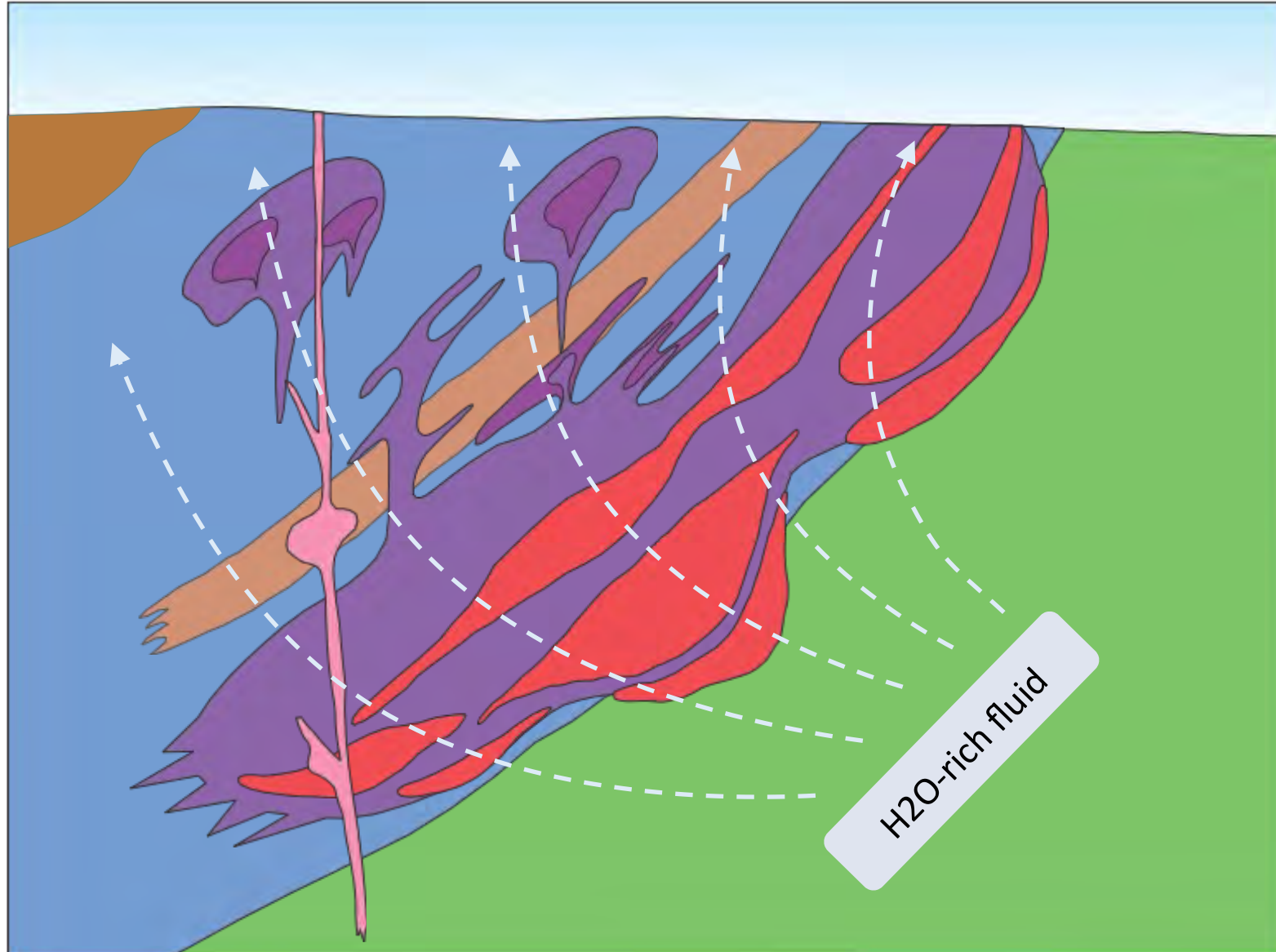
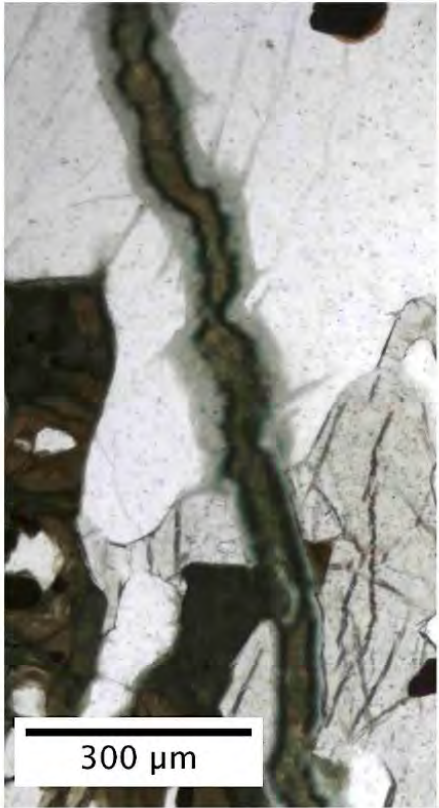




# Genetic model



## Genetic model





# Thank you



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