

Linking metamorphic assemblages to fabrics preserved as inclusions in porphyroblasts: implications for the tectonic significance of the Snowy shear zone, southwest Montana

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Paradise Valley



Geological context

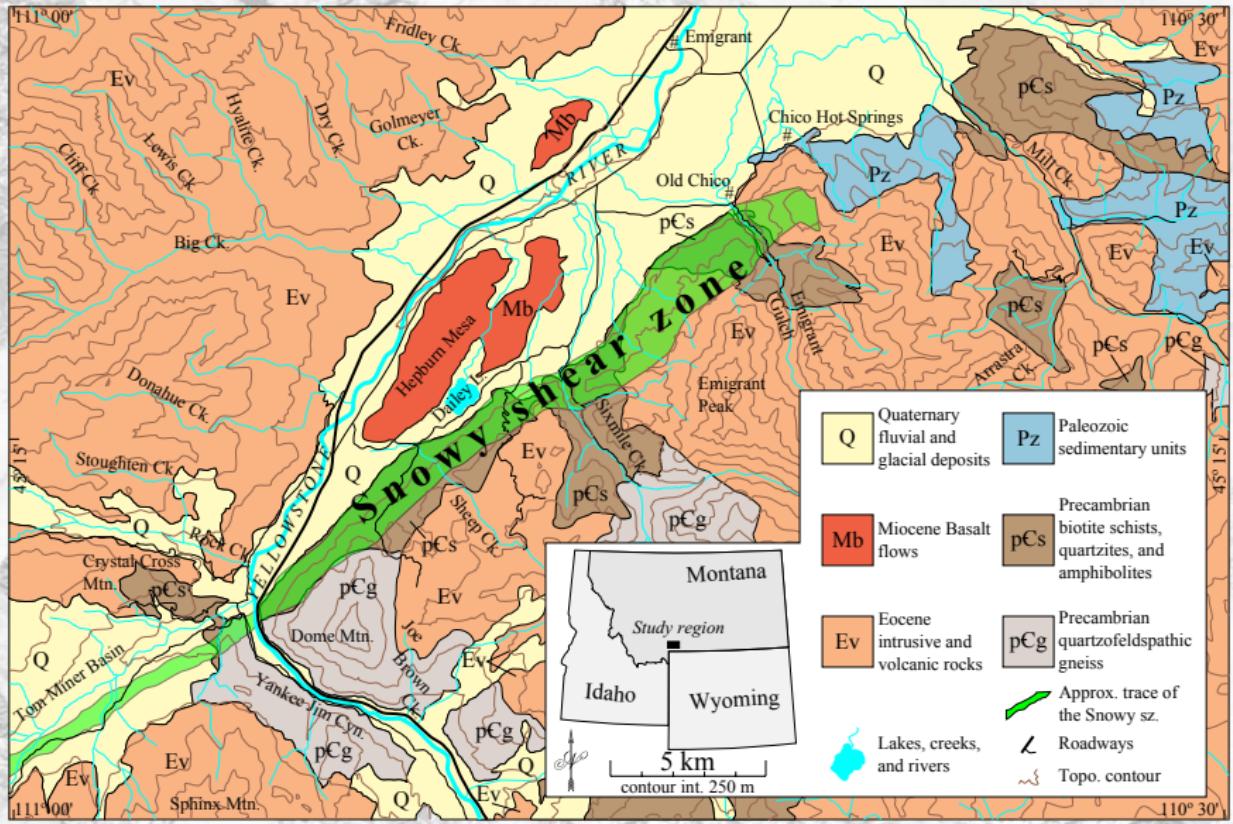


Geological context



Is this range bounding structure responsible for the Cenozoic development of the Paradise Valley or is there brittle reactivation of a Proterozoic structure?

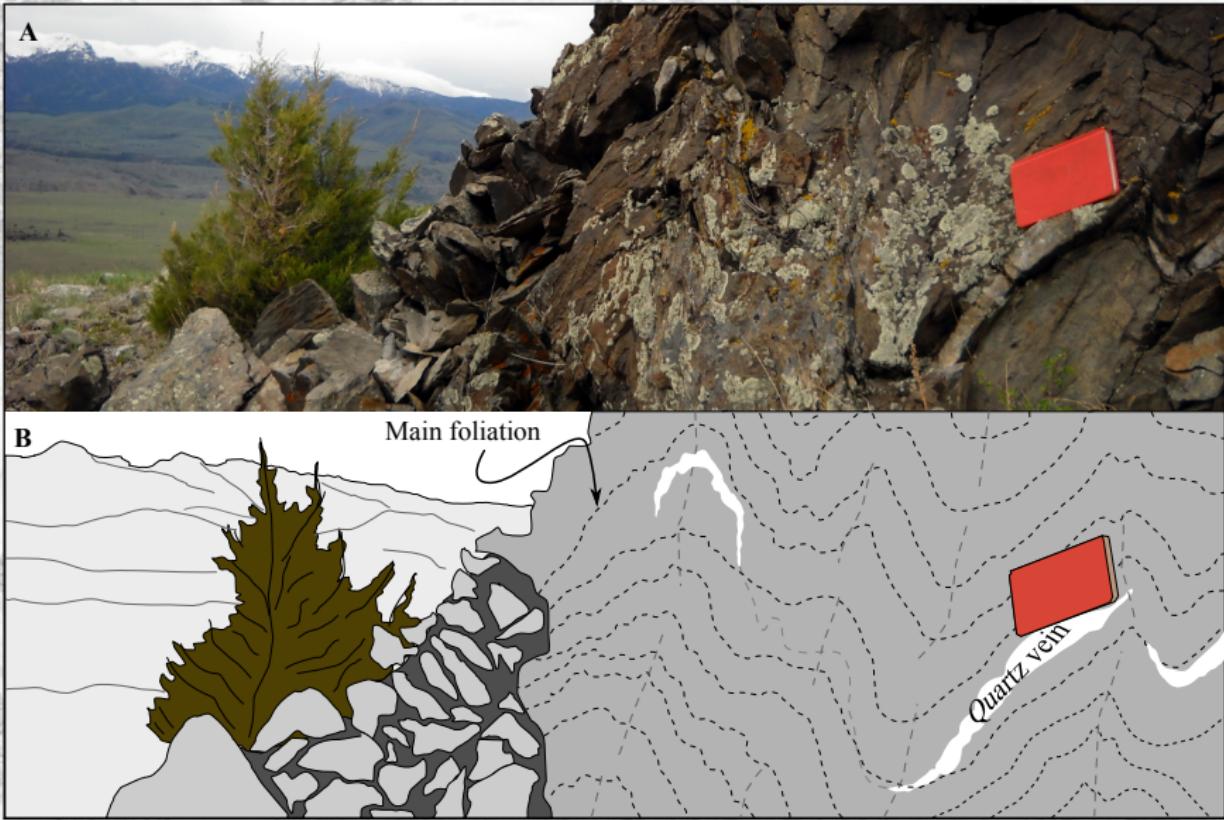
Geological context



Structural context and fabric development



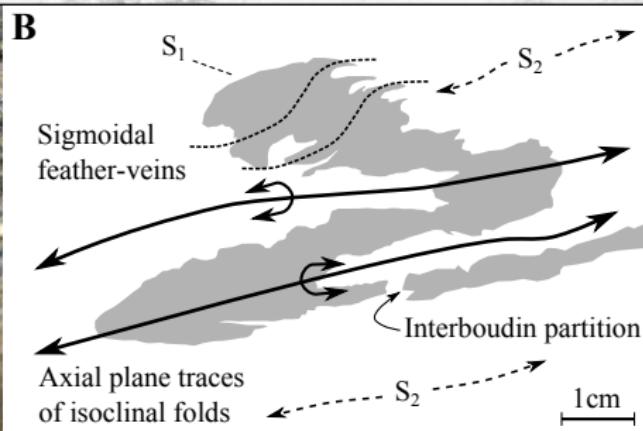
Structural context and fabric development



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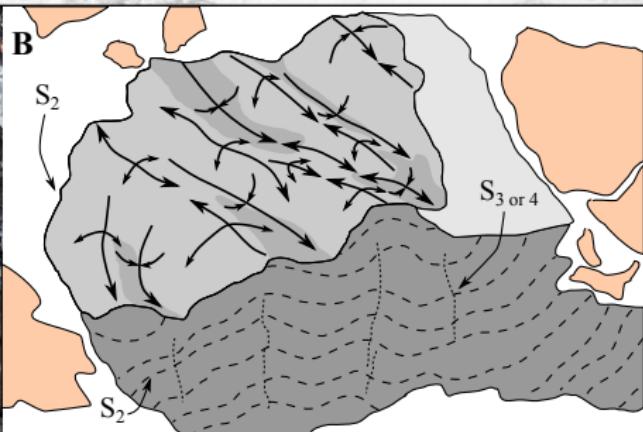
Structural context and fabric development



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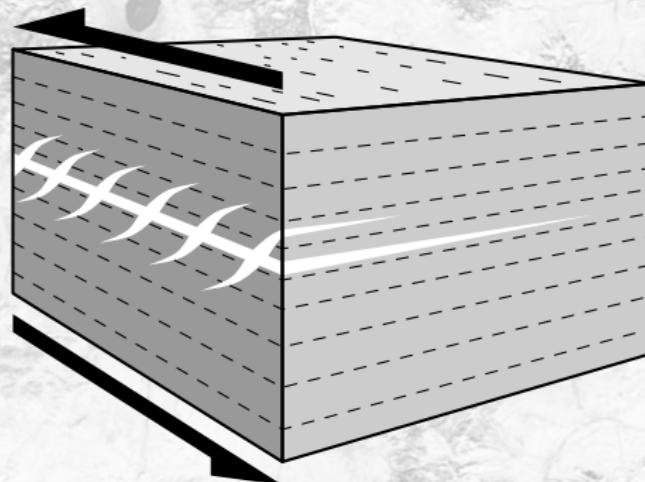
Structural context and fabric development



Structural context and fabric development

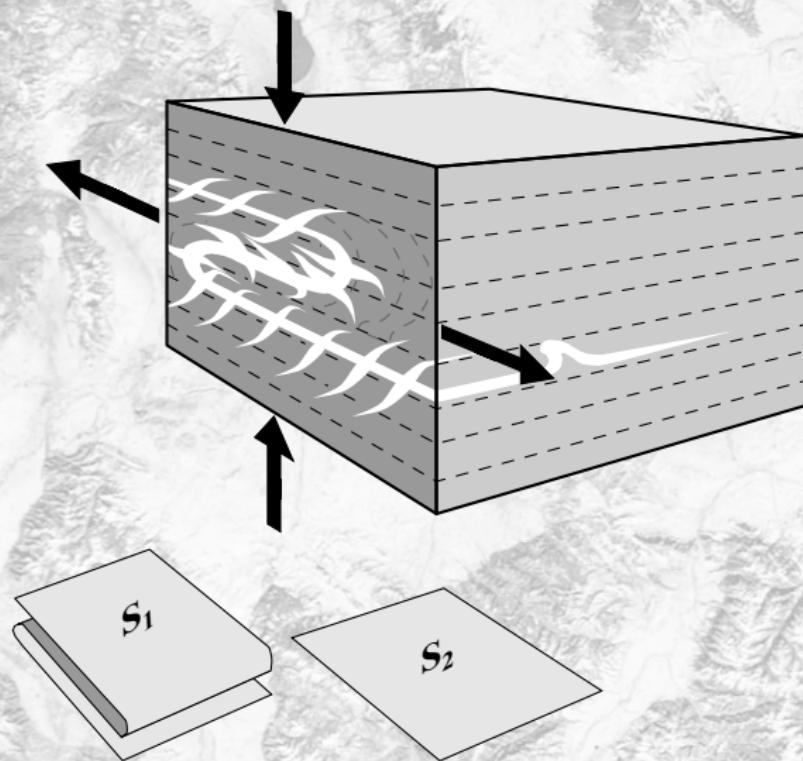


Structural context and fabric development

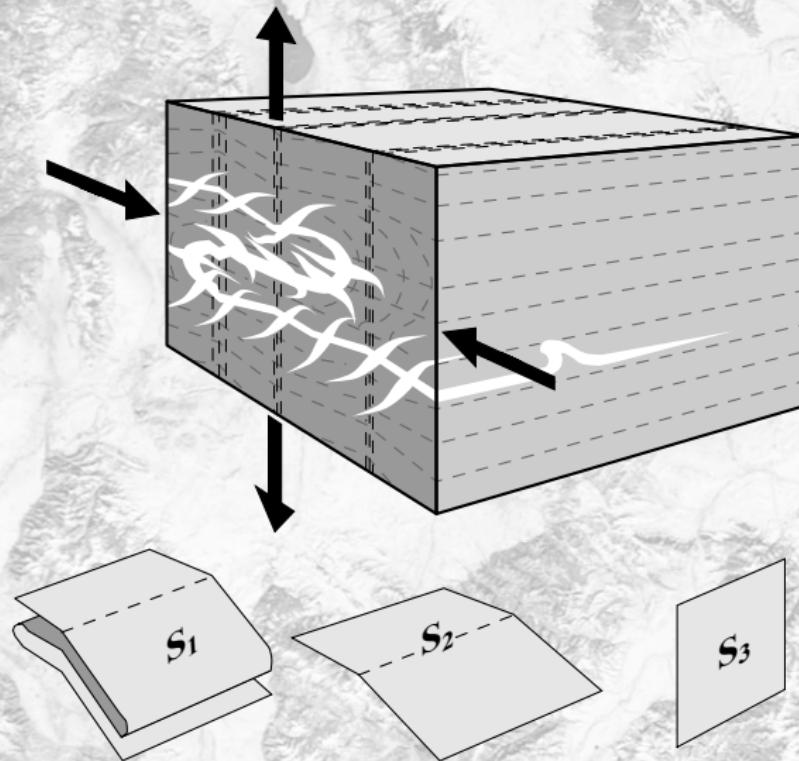


S_1

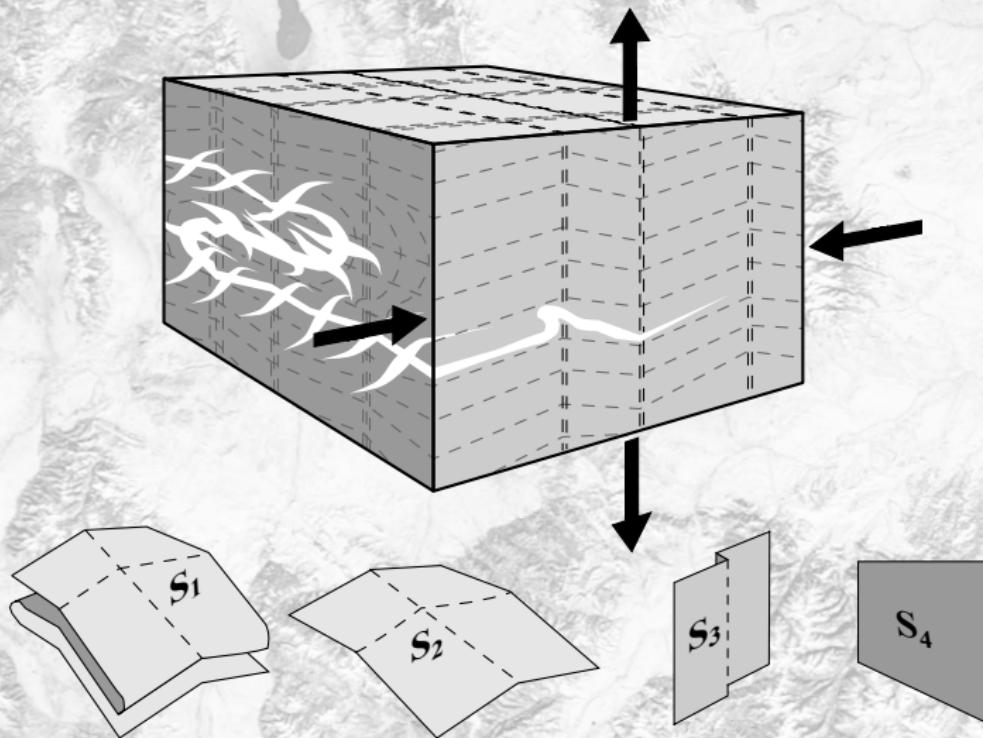
Structural context and fabric development



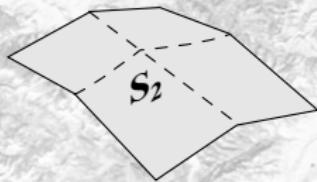
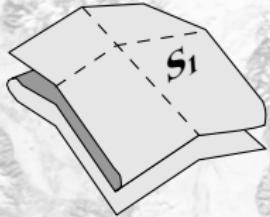
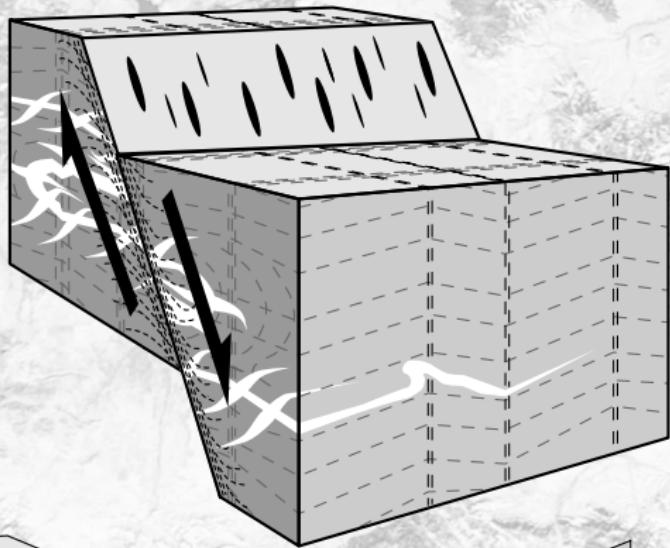
Structural context and fabric development



Structural context and fabric development



Structural context and fabric development



Microstructural observations

Linking fabric development to metamorphic grade...

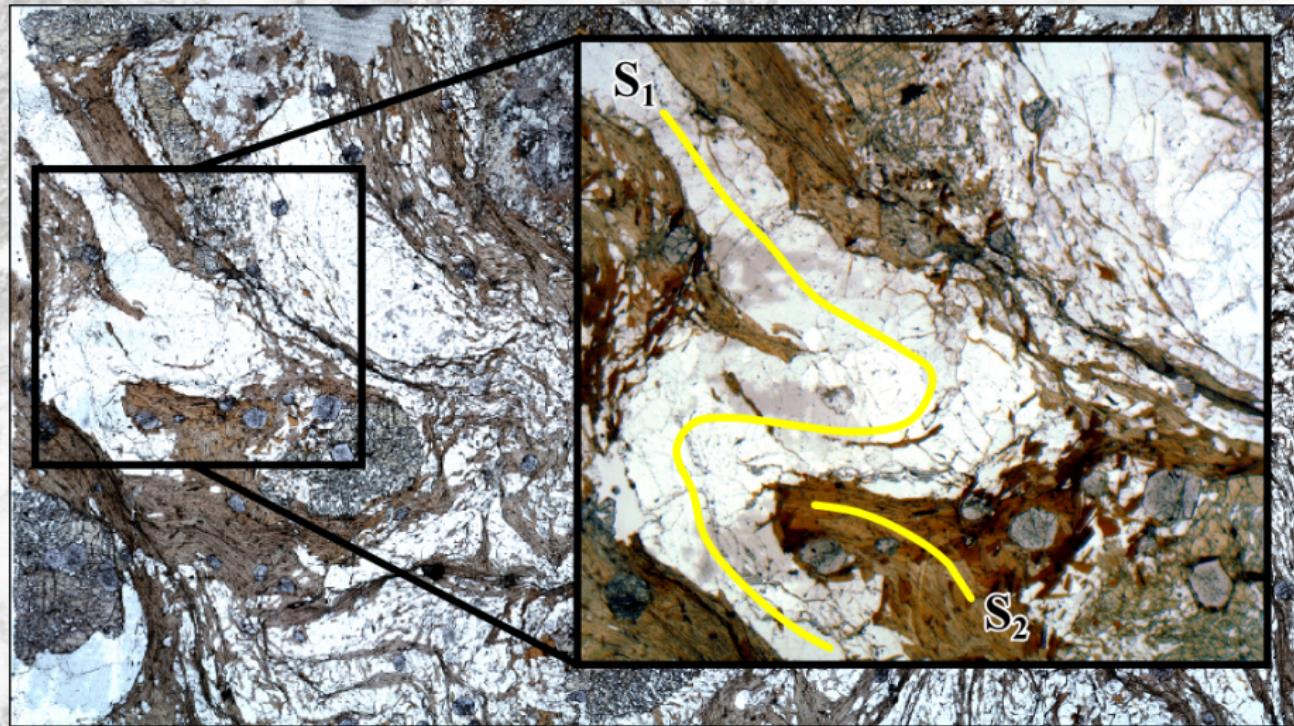


Microstructural observations: Crystal cross Mtn.



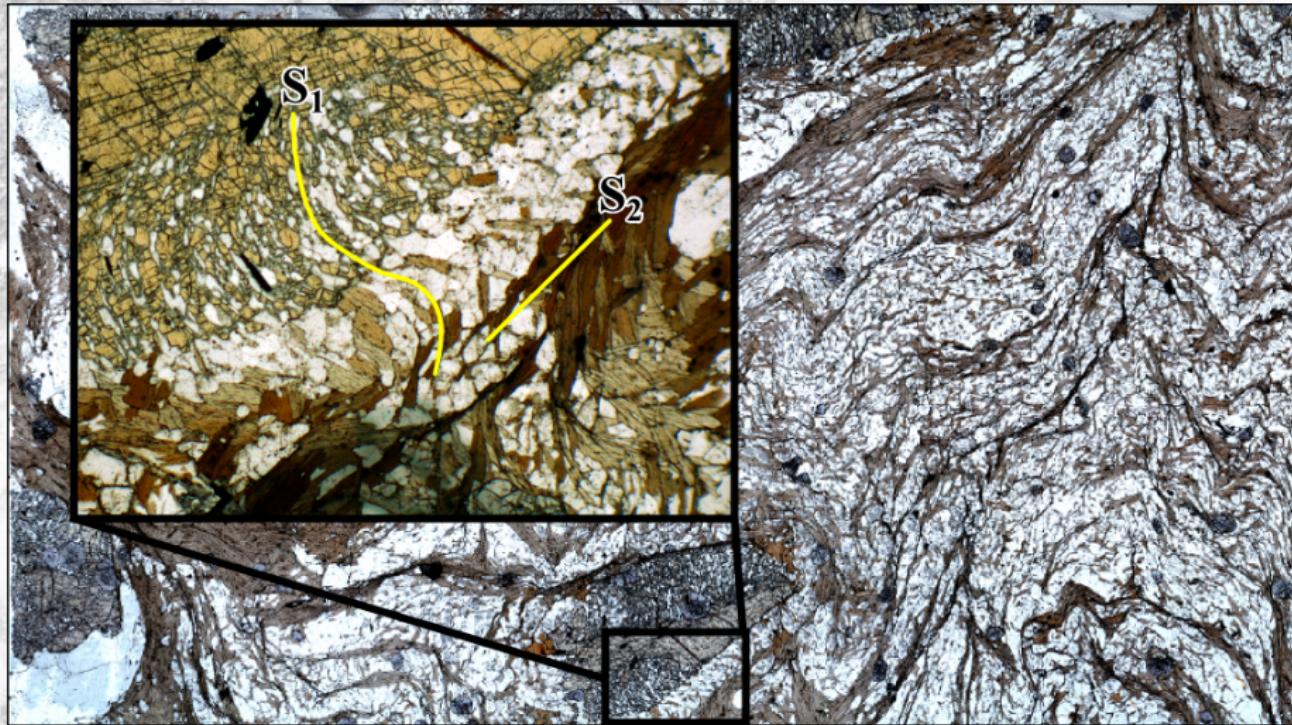
Field of view: 2 cm x 4 cm

Microstructural observations: Crystal cross Mtn.



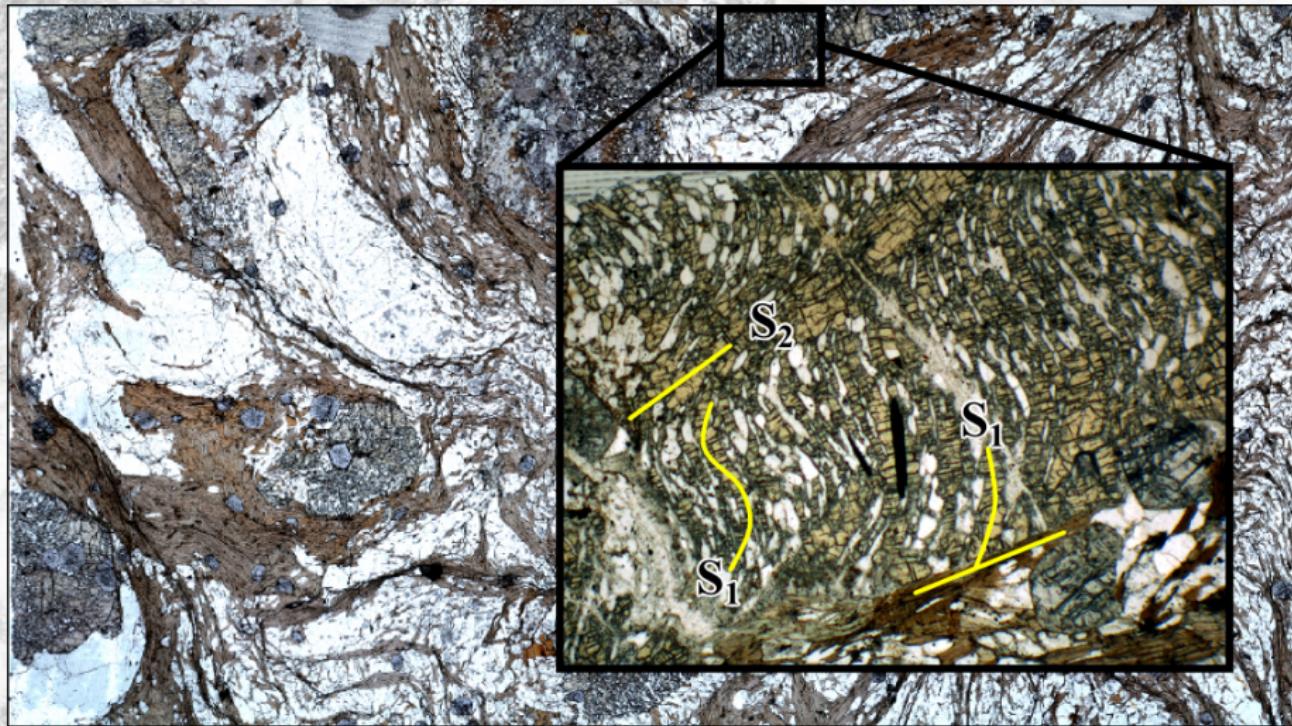
Field of view: 2 cm x 4 cm

Microstructural observations: Crystal cross Mtn.



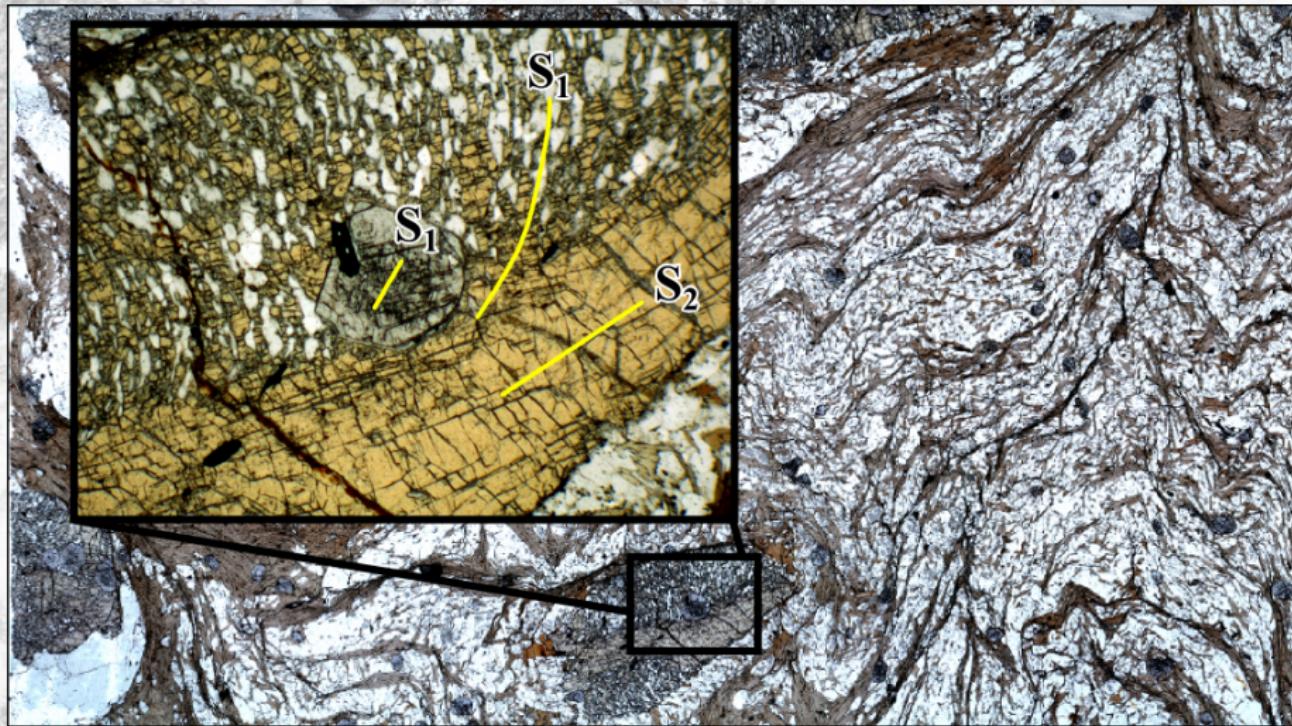
Field of view: 2 cm x 4 cm

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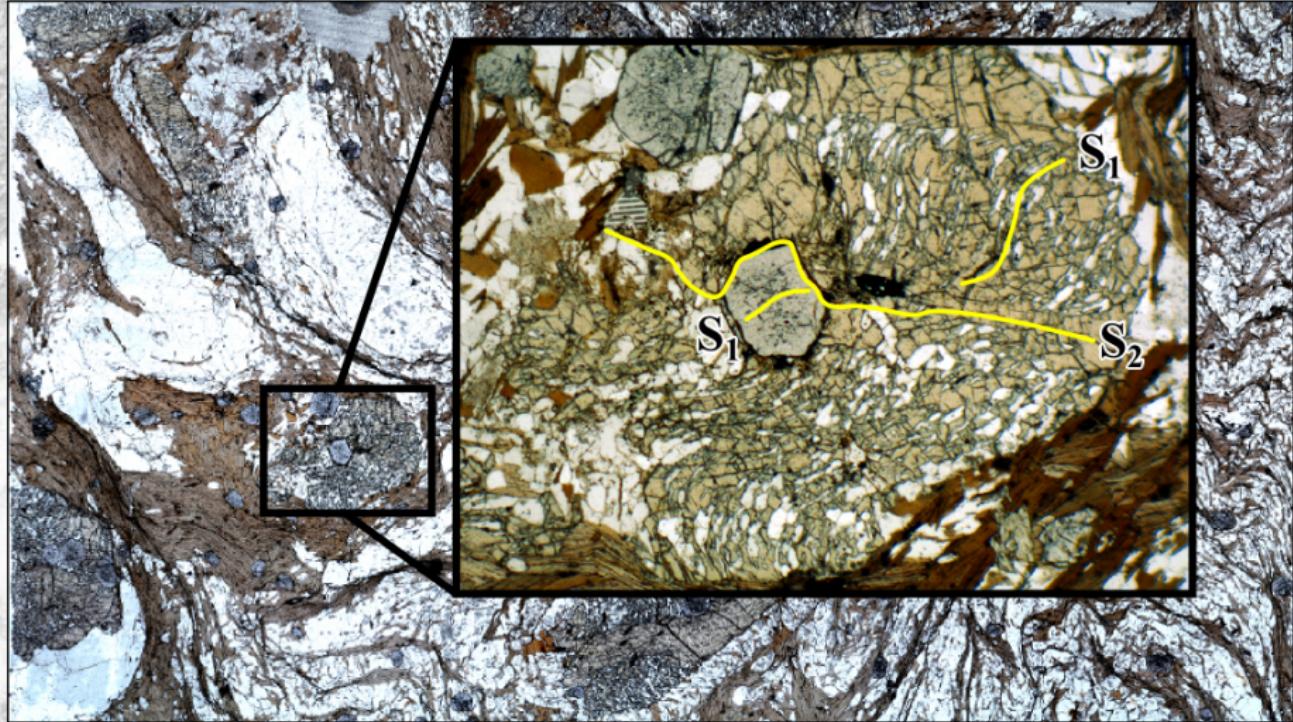
Field of view: 2 cm x 4 cm

Microstructural observations: Crystal cross Mtn.



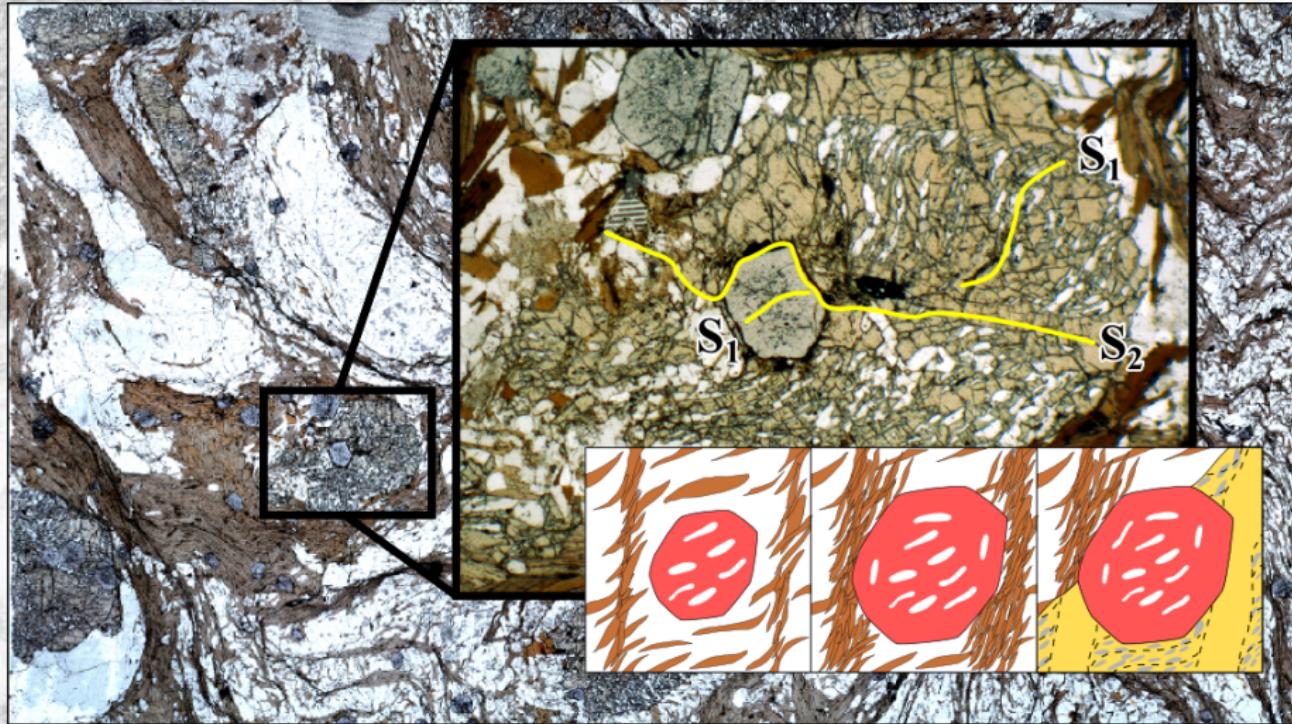
Field of view: 2 cm x 4 cm

Microstructural observations: Crystal cross Mtn.



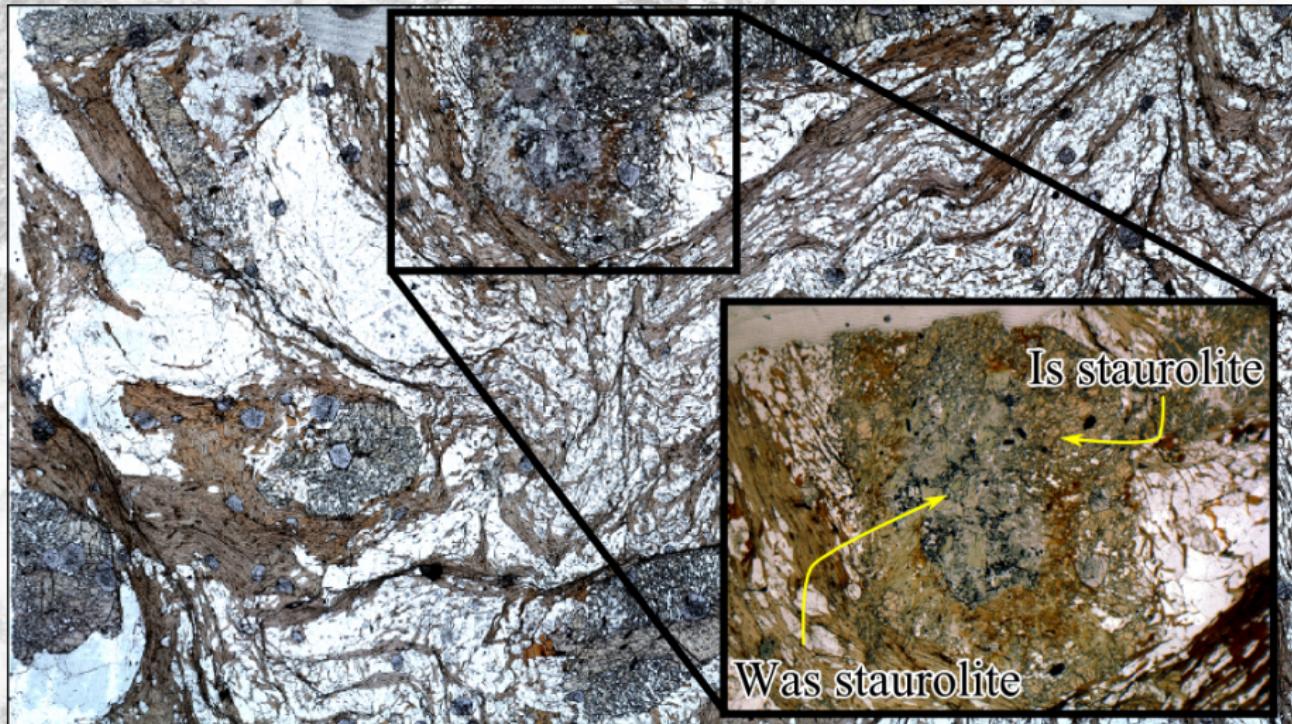
Field of view: 2 cm x 4 cm

Microstructural observations: Crystal cross Mtn.



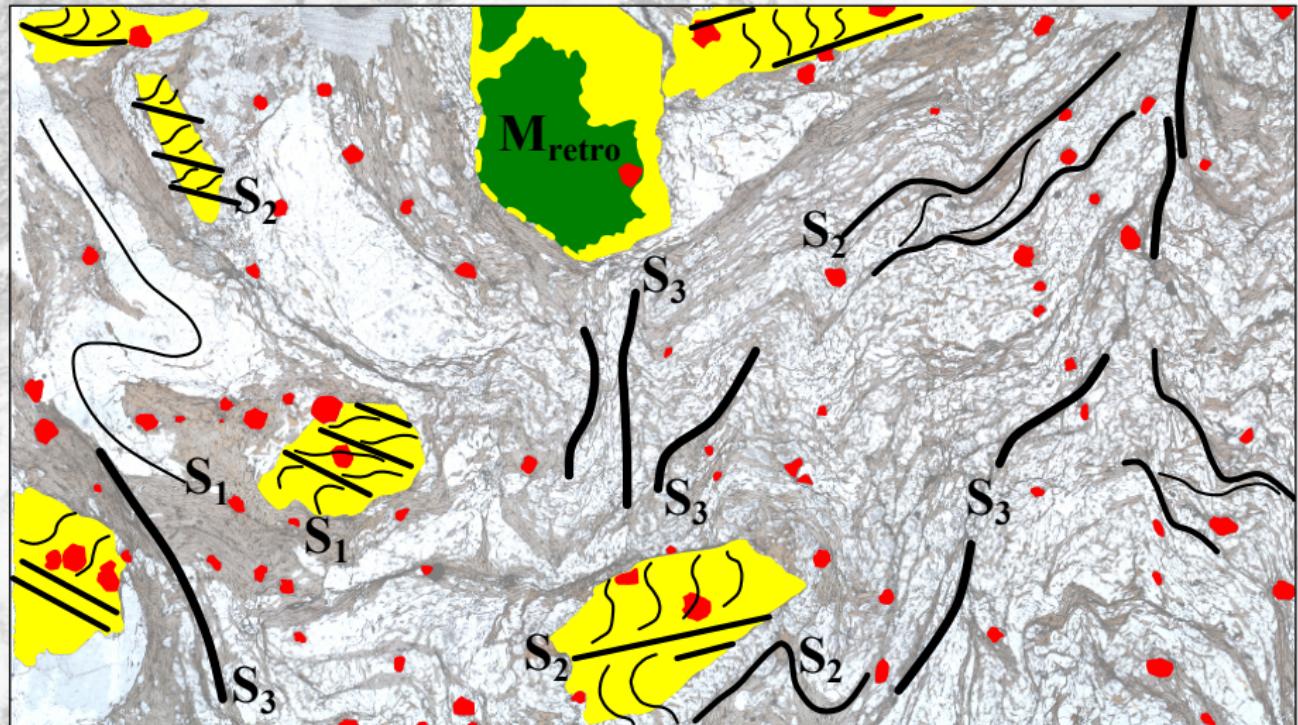
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Microstructural observations: Crystal cross Mtn.



Field of view: 2 cm x 4 cm

Microstructural observations: Crystal cross Mtn.

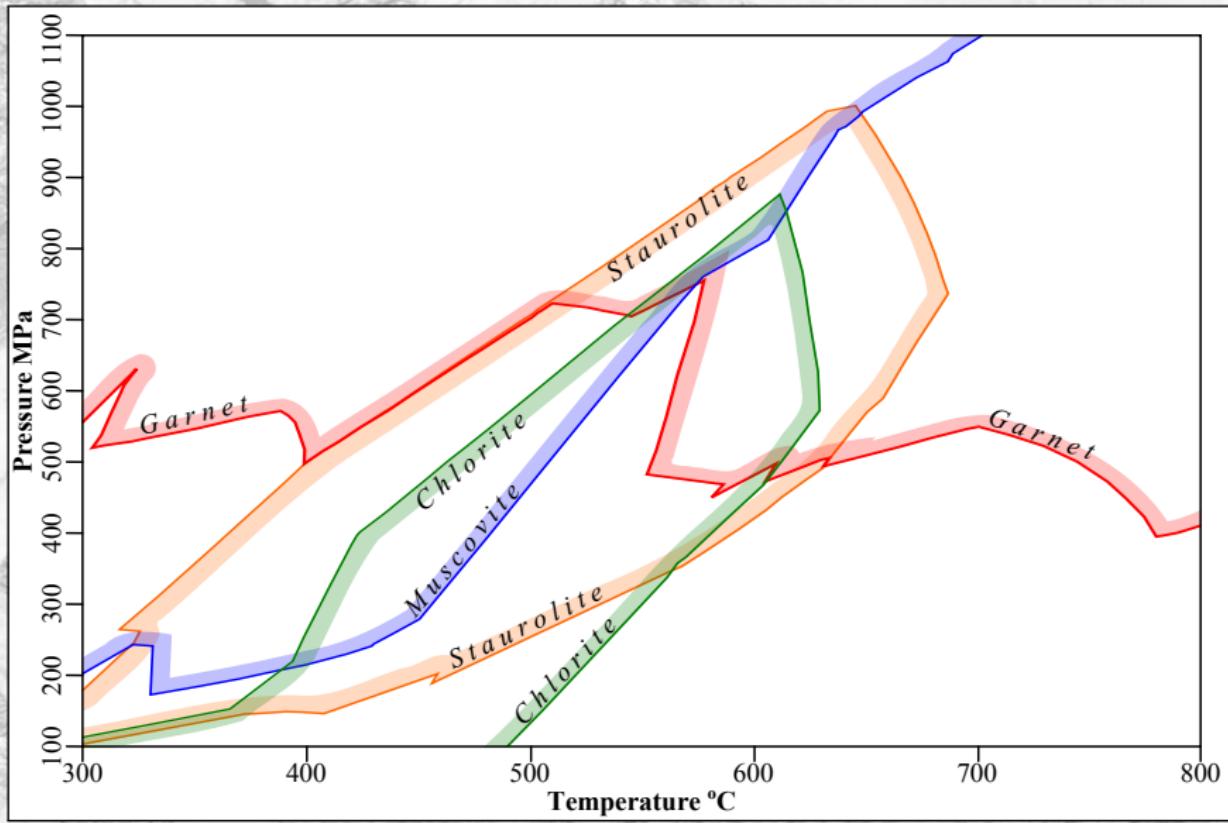


Field of view: 2 cm x 4 cm

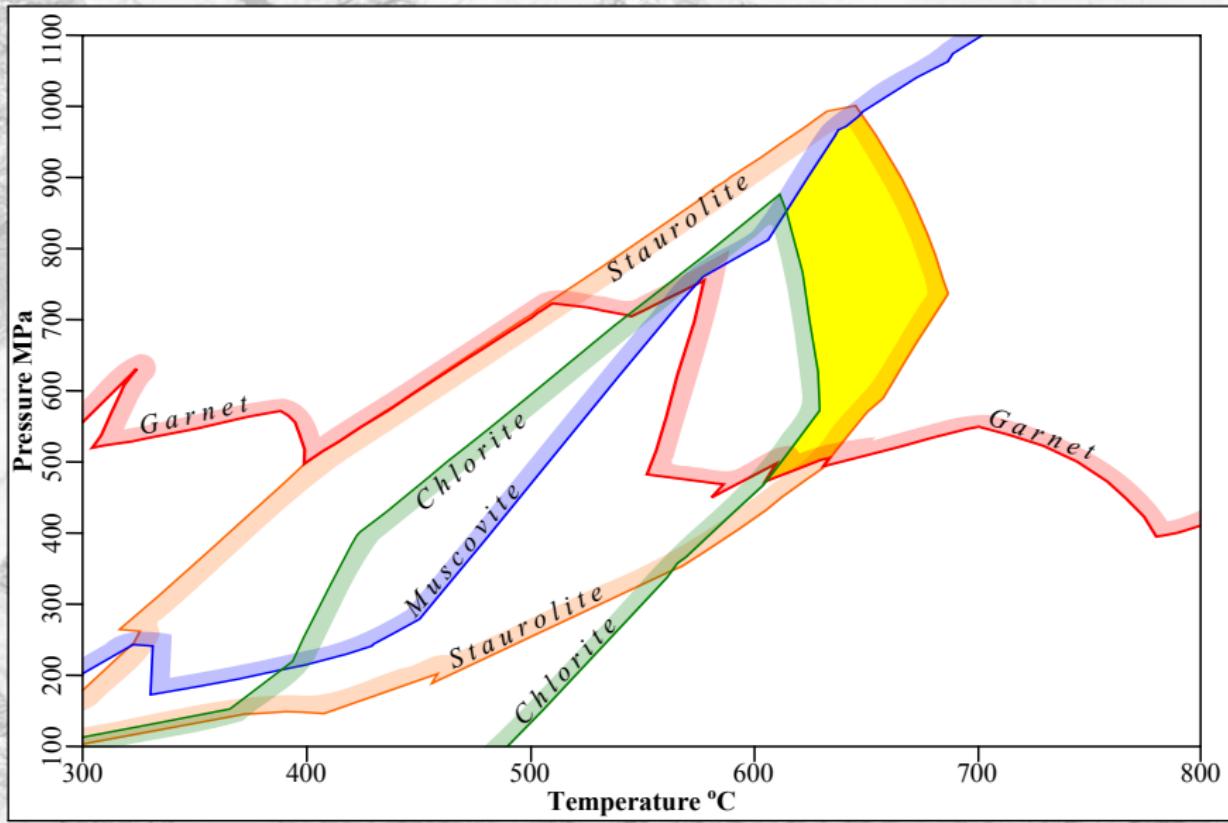
Microstructural observations: Crystal cross Mtn.

- *Staurolite + Biotite + Garnet + Plagioclase + Quartz + H₂O*
 - Records the growth of S₂
 - S₂ is the dominate fabric.
 - This is the peak metamorphic assemblage.
 - $23Gr + 6Fst + 48Qtz = 8Alm + 69An + 12H_2O$
 - $Py + 2Gr + 3East + 6Qtz = 3Phl + 6An$
 - $Py + Ann = Alm + Phl$
- Breakdown of Staurolite and Garnet.
 - Retrograde metamorphism to greenschist facies.
 - Becomes pervasive towards the Snowy shear zone.
- **What are the peak metamorphic conditions?**

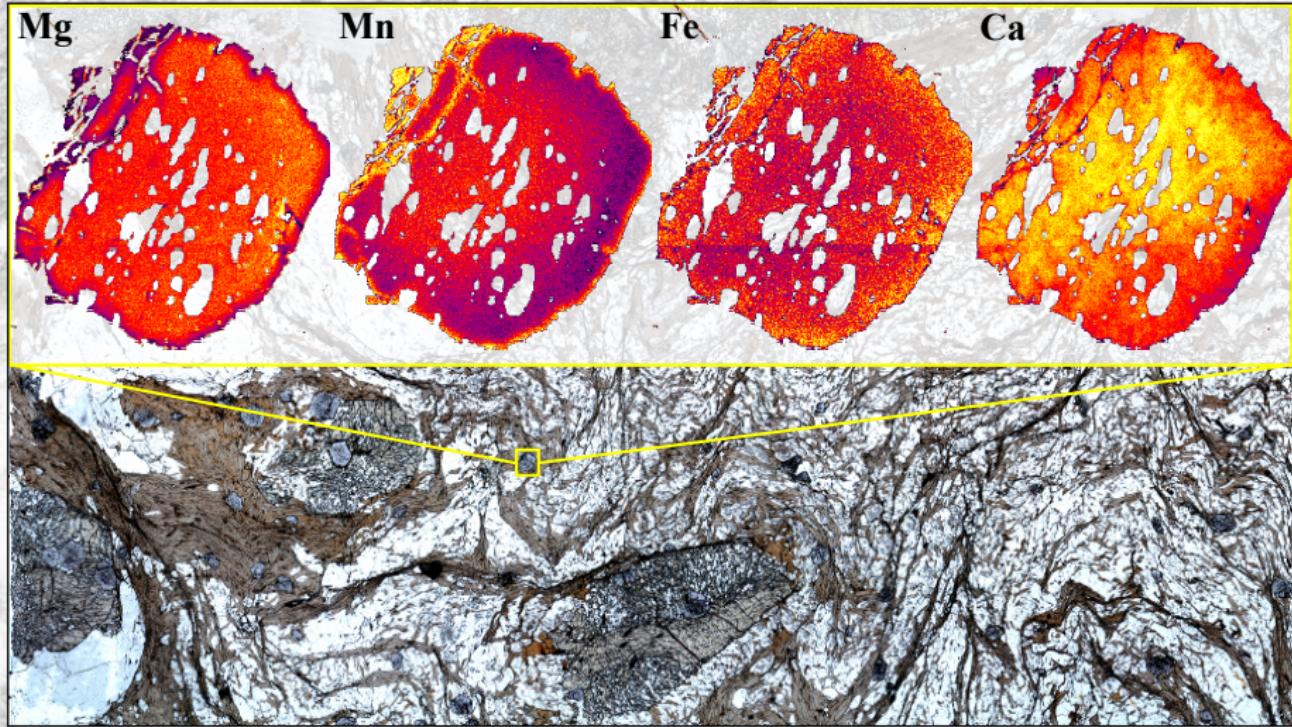
Thermodynamic modeling: equilibrium assemblage



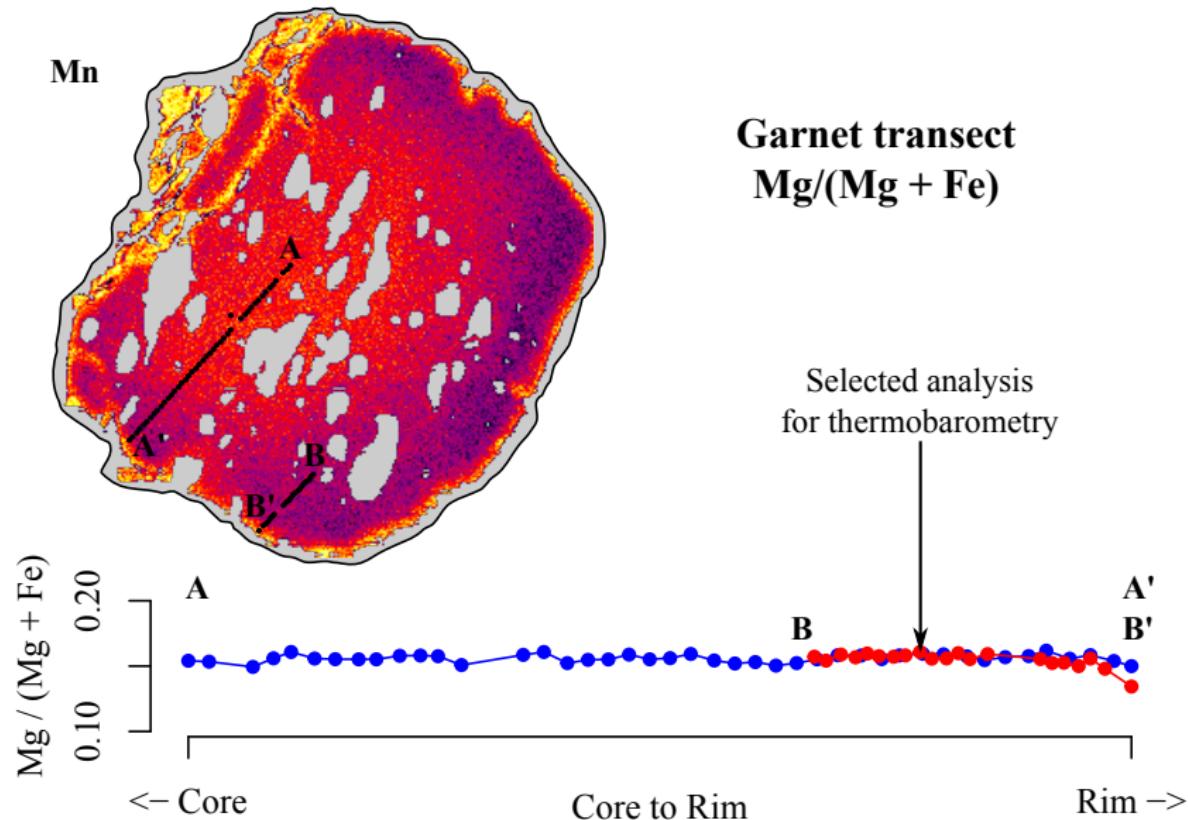
Thermodynamic modeling: equilibrium assemblage



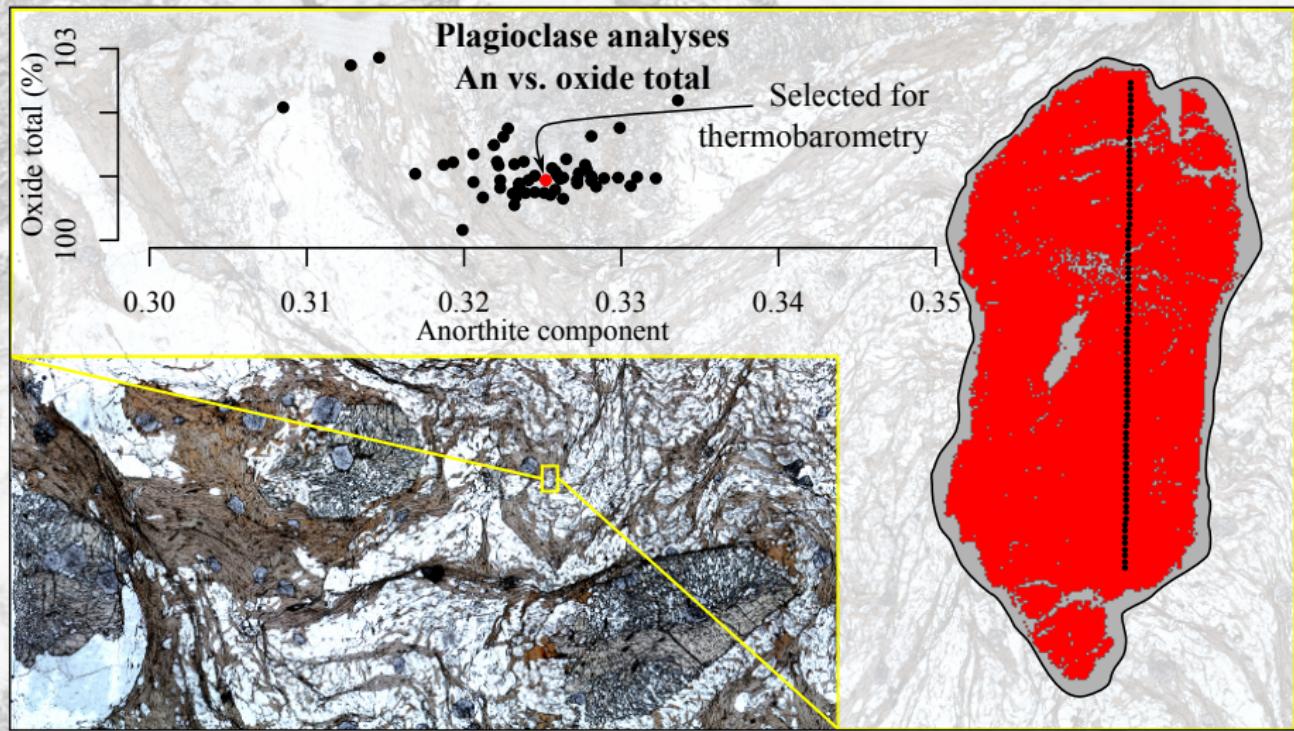
Quantitative analyses: Matrix garnet



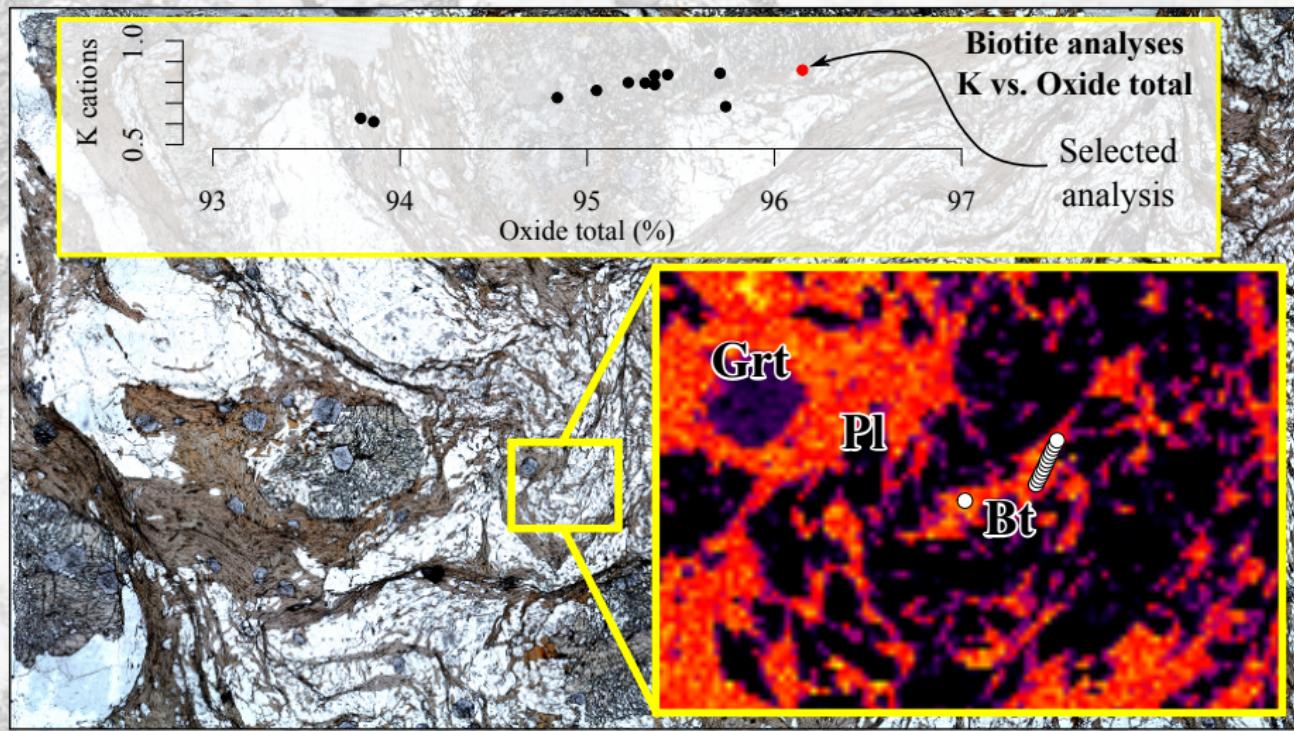
Quantitative analyses: Matrix garnet



Quantitative analyses: Matrix plagioclase



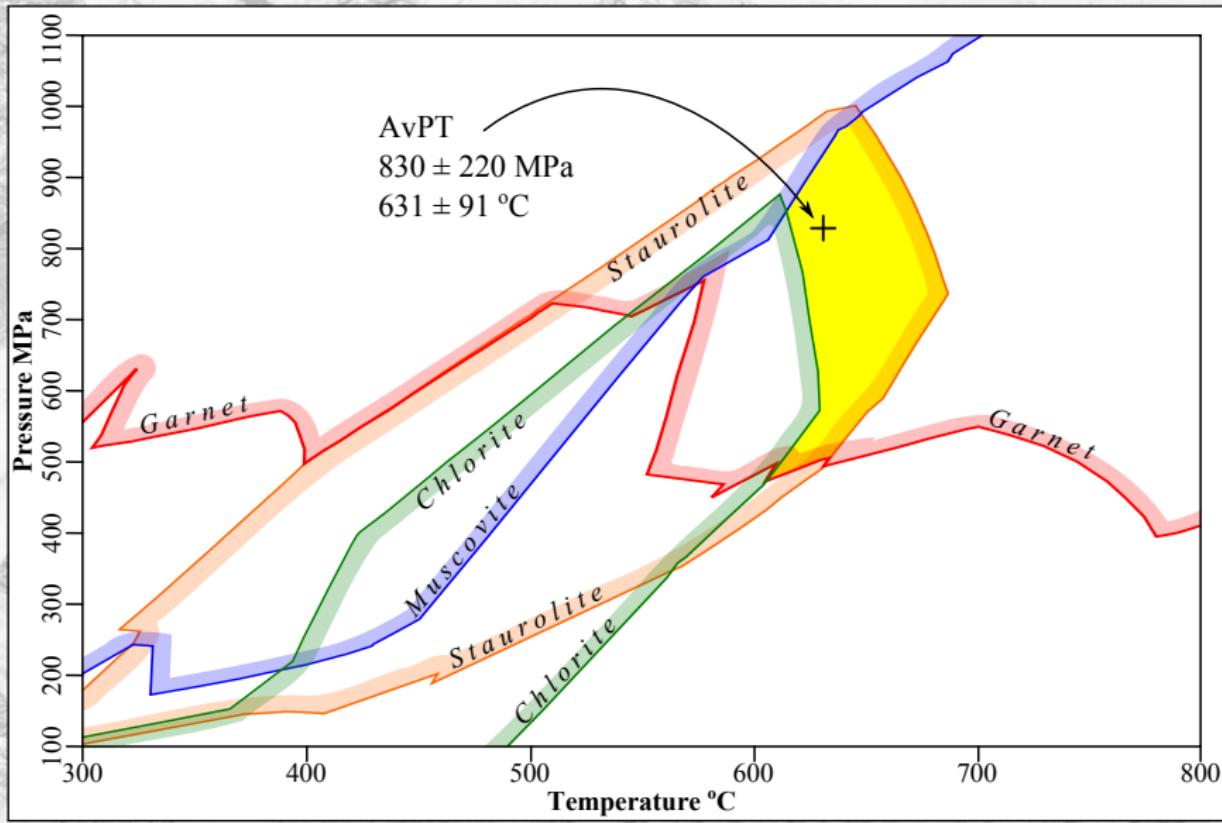
Quantitative analyses: Matrix biotite



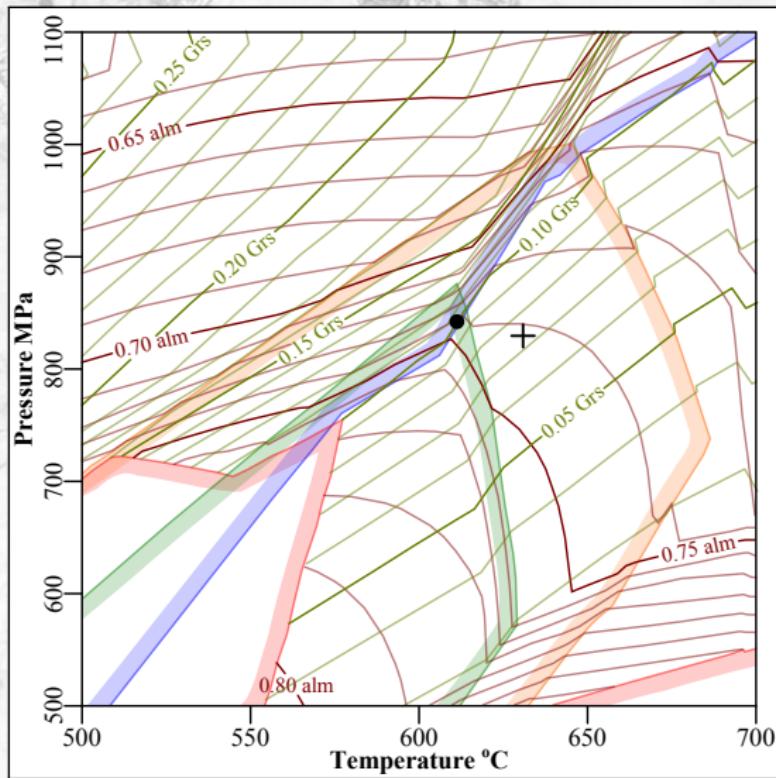
AvPT: Geothermobarometry

- THERMOCALC: AvPT. Following same database used in equilibrium phase assemblage diagram.
- Pressure: 830 ± 220 MPa
- Temperature: $631^\circ\text{C} \pm 91^\circ\text{C}$
- Previous interpretations: $\sim\text{max } 300$ Mpa $\sim 540^\circ\text{C}$

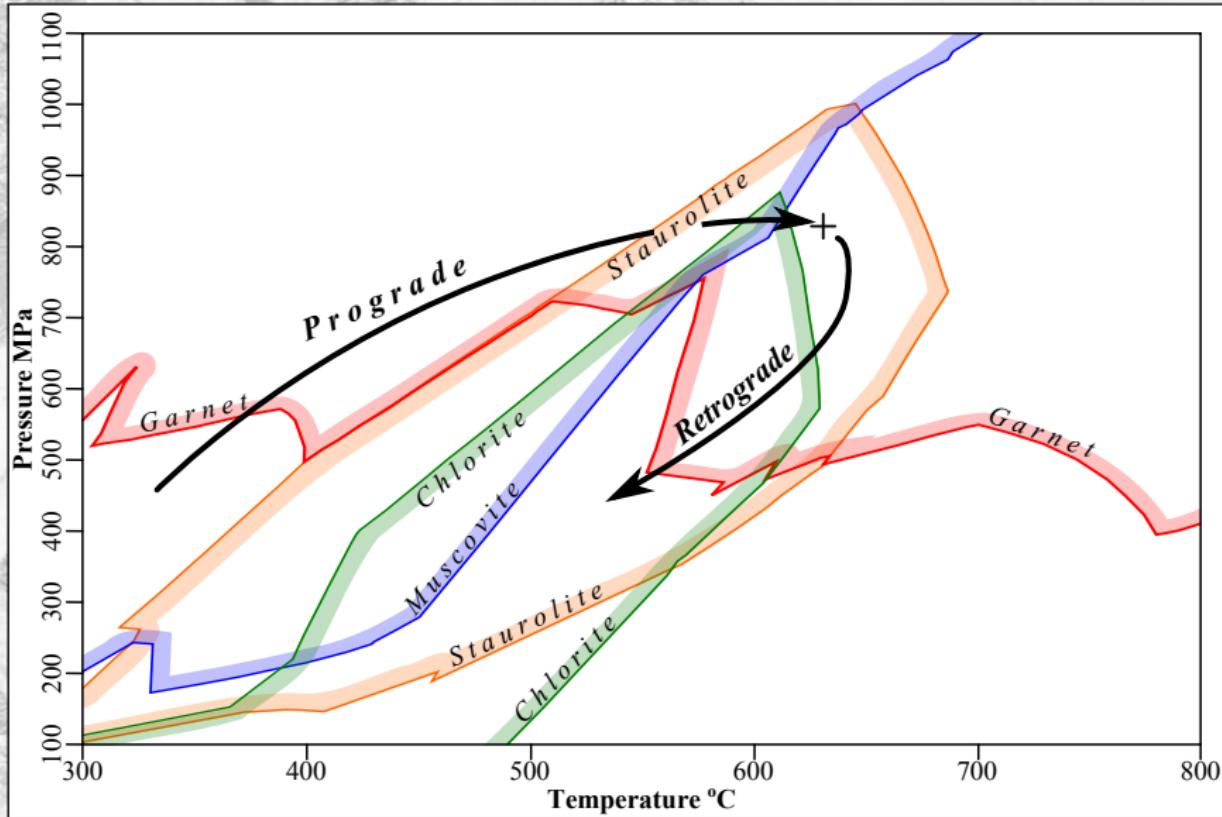
Thermodynamic modeling: Peak metamorphic conditions



Thermodynamic modeling: Peak metamorphic conditions



Thermodynamic modeling: Peak metamorphic conditions

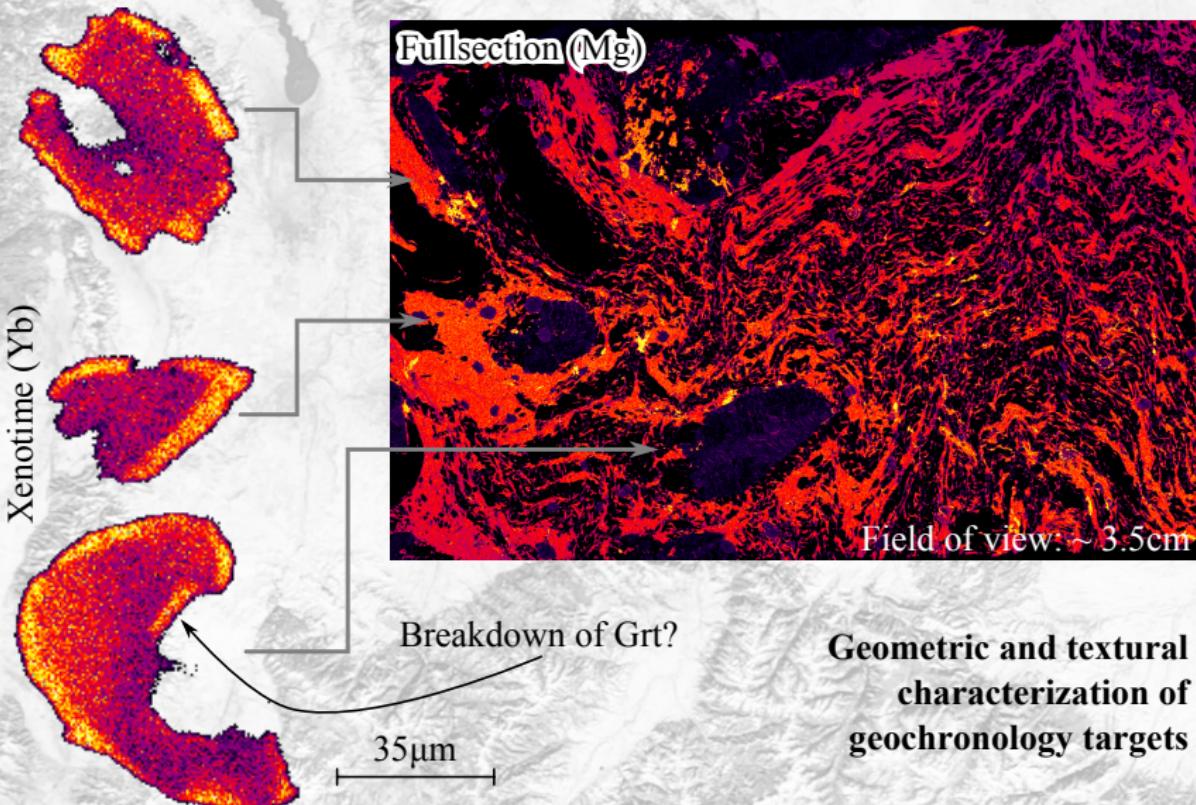


Retrograde metamorphism and the Snowy shear zone

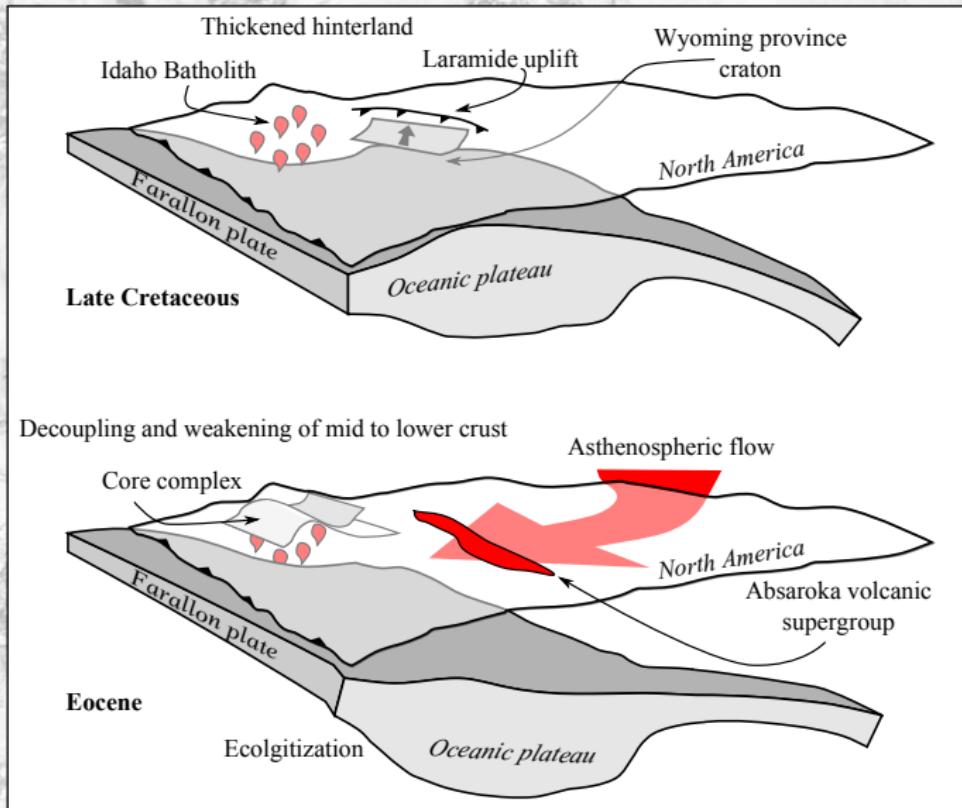


Field of view: 1.5 cm x 4 cm

In the queue: fabric specific geochronology



Back-rotation vs. reactivation



Acknowledgments

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Laurie L. Brown: advice and discussions.

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Analytical support and microprobe wizardry.

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MSU Undergraduate scholars program (2008)



Moon rise over Emigrant peak and Sixmile Creek

