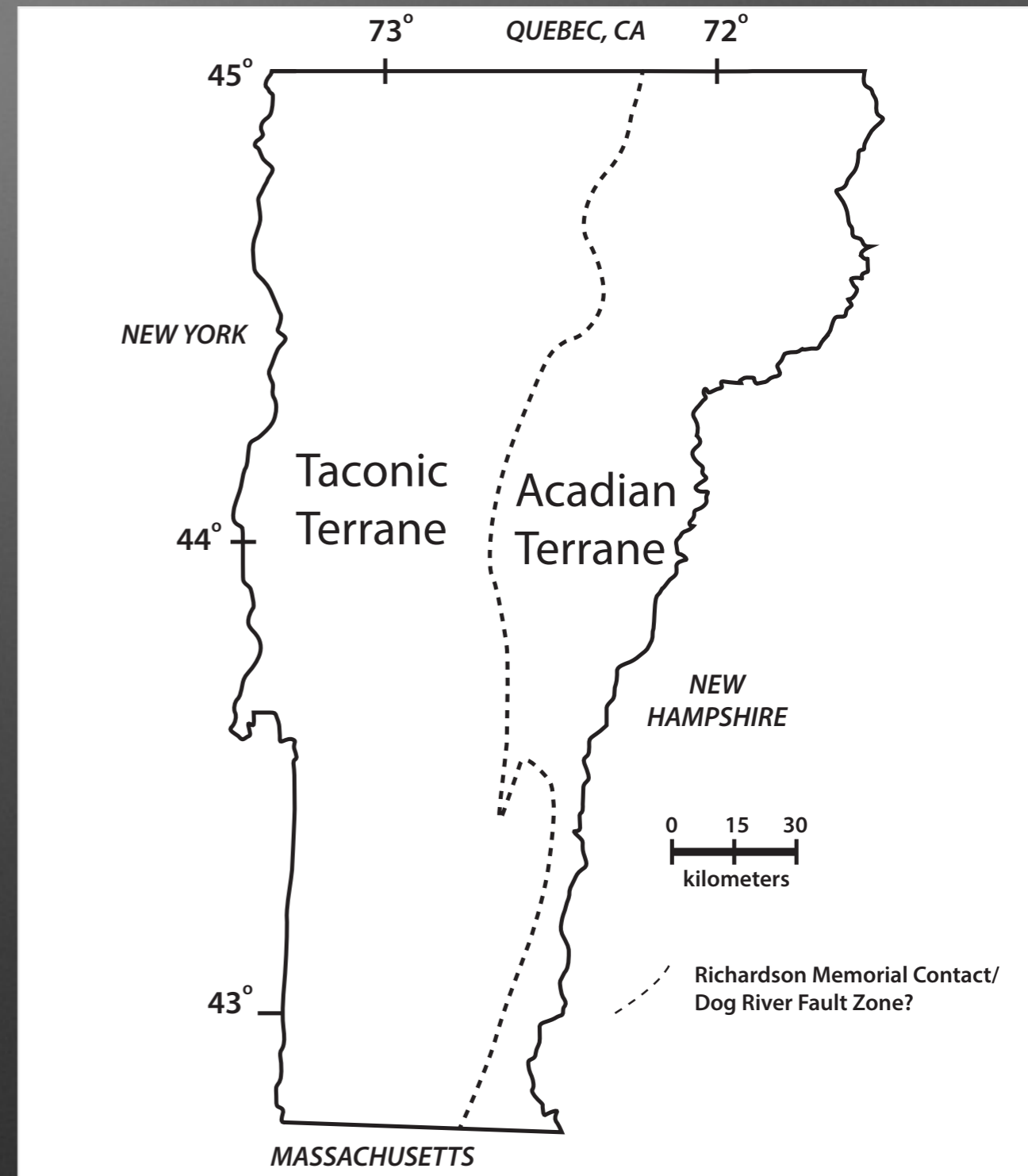


The Richardson Memorial Contact and The Dog River Fault Zone: Evidence for Ductile Shearing in Woodbury, VT

DeFelice, Christopher and Christopher Koteas
Norwich University

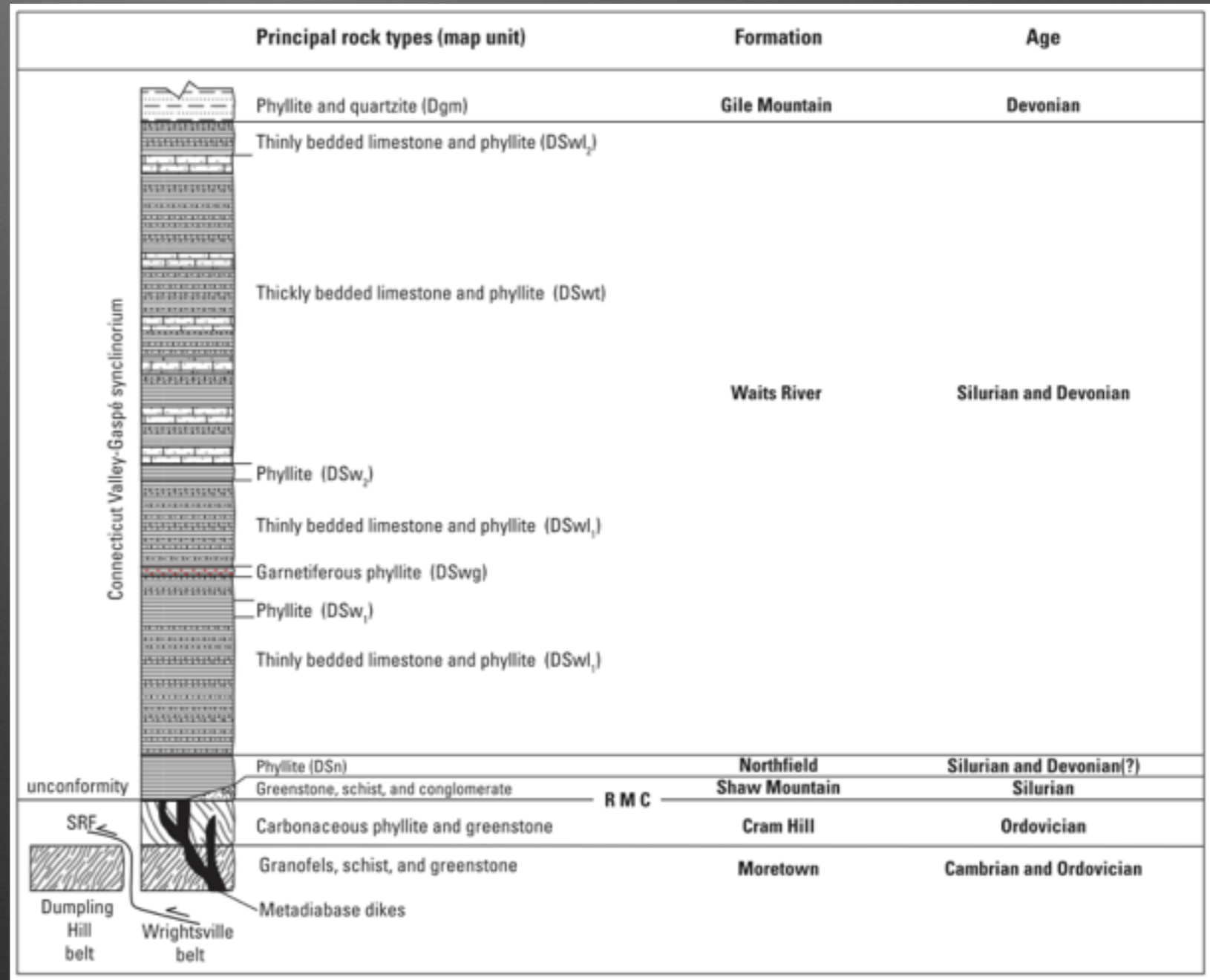
Origins

- Surface dividing Cambro-Ordovician rocks from Siluro-Devonian rocks
- Disputed origin- is it a stratigraphic unconformity of a tectonic boundary/structure?
- Woodbury, VT provides insight with exposure



Richardson's Contribution

- First identified by C.H. Richardson in 1919
- Erosional unconformity
- Meta-conglomerates sitting on meta-pelites
- Different depositional environments



Taken from Walsh et al., 2010

Dog River Fault Zone

- Contiguous with RMC
- Exposed in Northfield, VT
- High level of ductile shearing
- Evidence of tectonism



Modified from Walsh et al., 2010

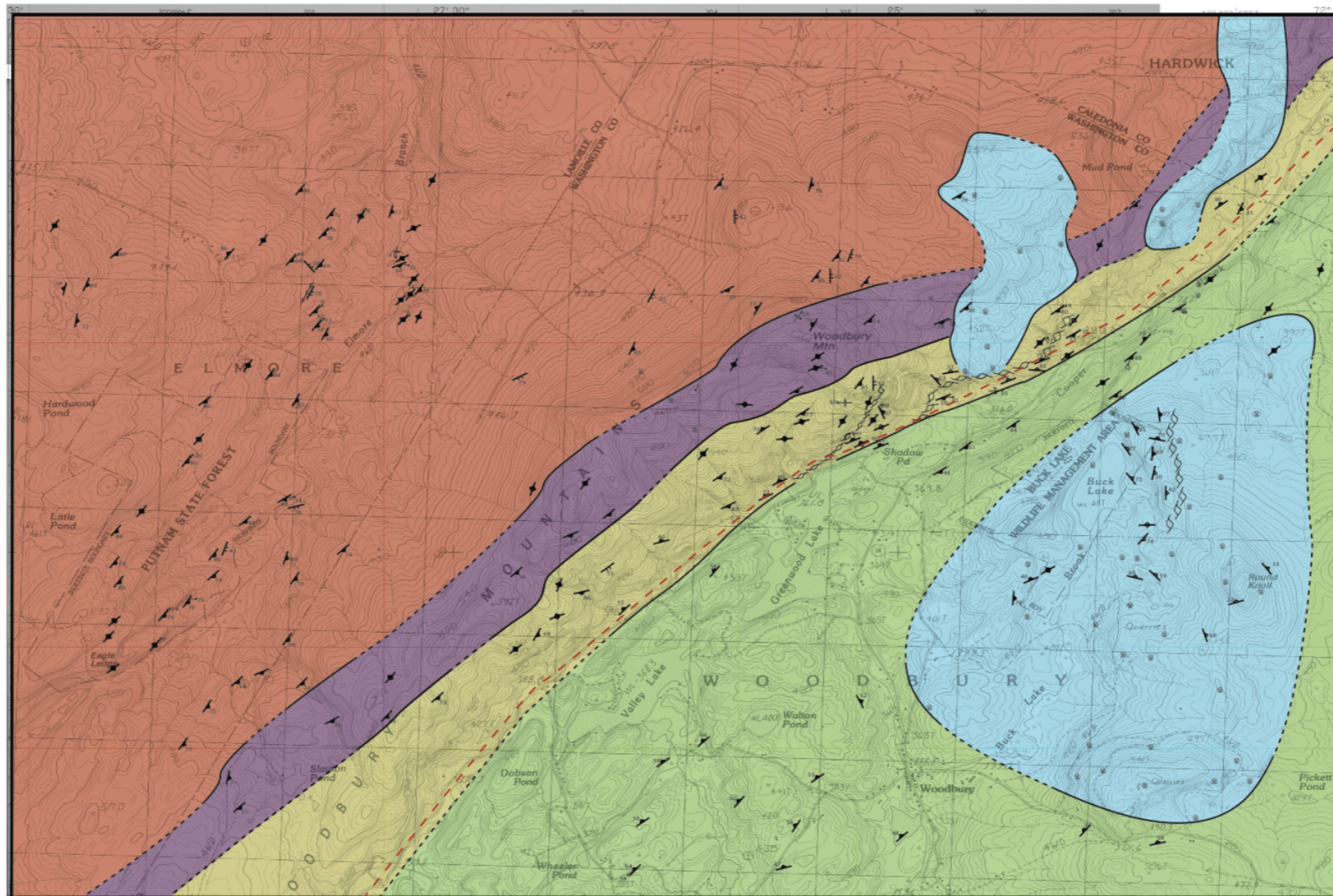
Role of Igneous Intrusions

- Why focus on igneous rocks when the focus is a ductile shear zone?
- They occur syn-kinematic or post-kinematic
- Combo of metamorphic structures and igneous geochemistry can help explain what kind of tectonic role the RMC played in the region!

Role of Igneous Intrusions

- Why focus on ductile shear
- They occur s
- Combo of me geochemistry role the RMC











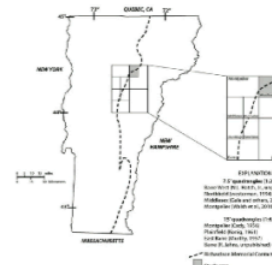
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- Cram Hill Formation (Cambro-Ordovician):** Grey to dark grey, fine-grained phyllites interbedded with quartzites. Often weathers rusty. Dominant mineralogy includes muscovite, chlorite and quartz.
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- Devonian Intrusive Suite:** Medium-coarse grained, equigranular typically homogeneous granitoids. Major mineralogy is composed of orthoclase, quartz and muscovite. Pods of hornblende occur as schlieren structures. Xenoliths of host rock are common in localities and the level of digestion varies from near complete to rotated screens.

Legend

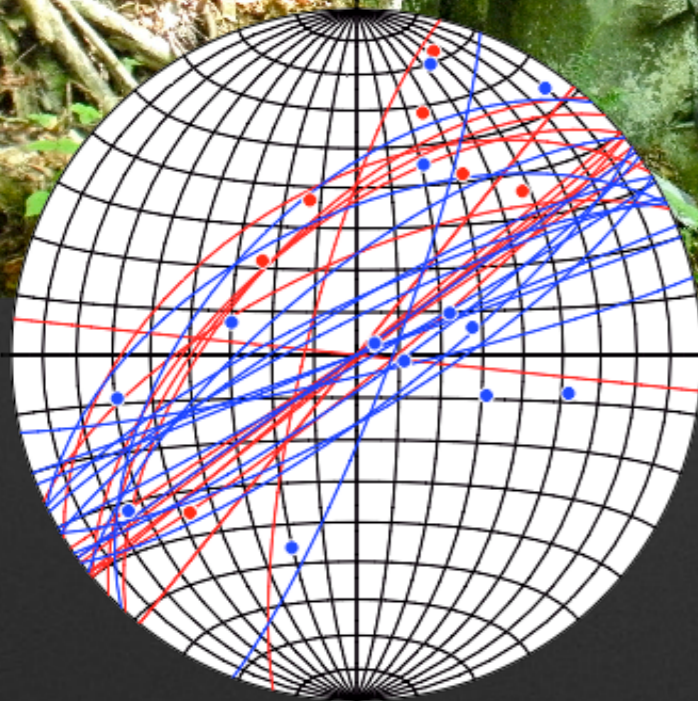
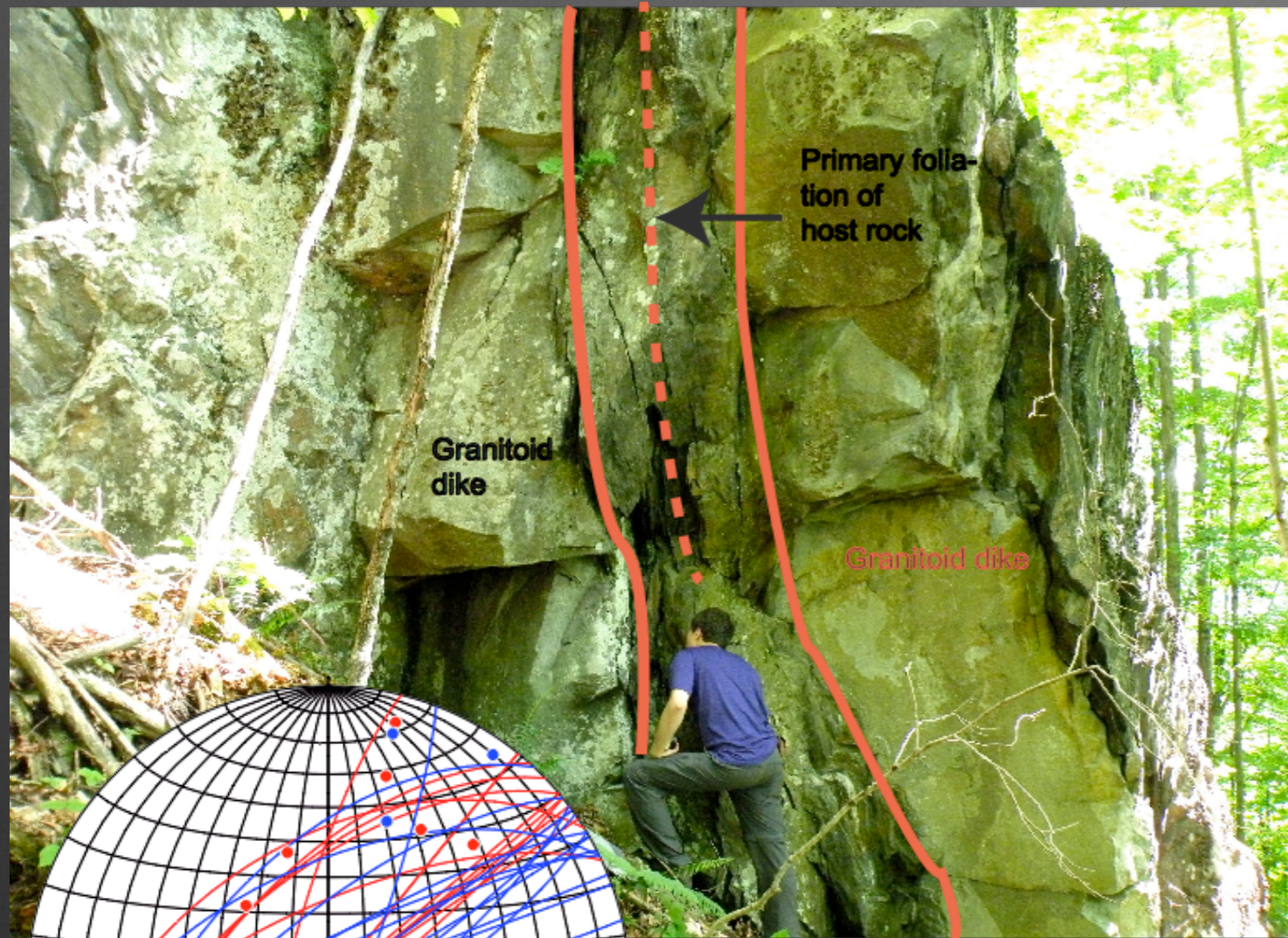
-  Igneous foliation
-  Metamorphic foliation
-  Shear band
-  Crenulation cleavage as lineation
-  Zone of high strain
-  Richardson Memorial Contact (interpreted)

0 0.5 1
kilometers



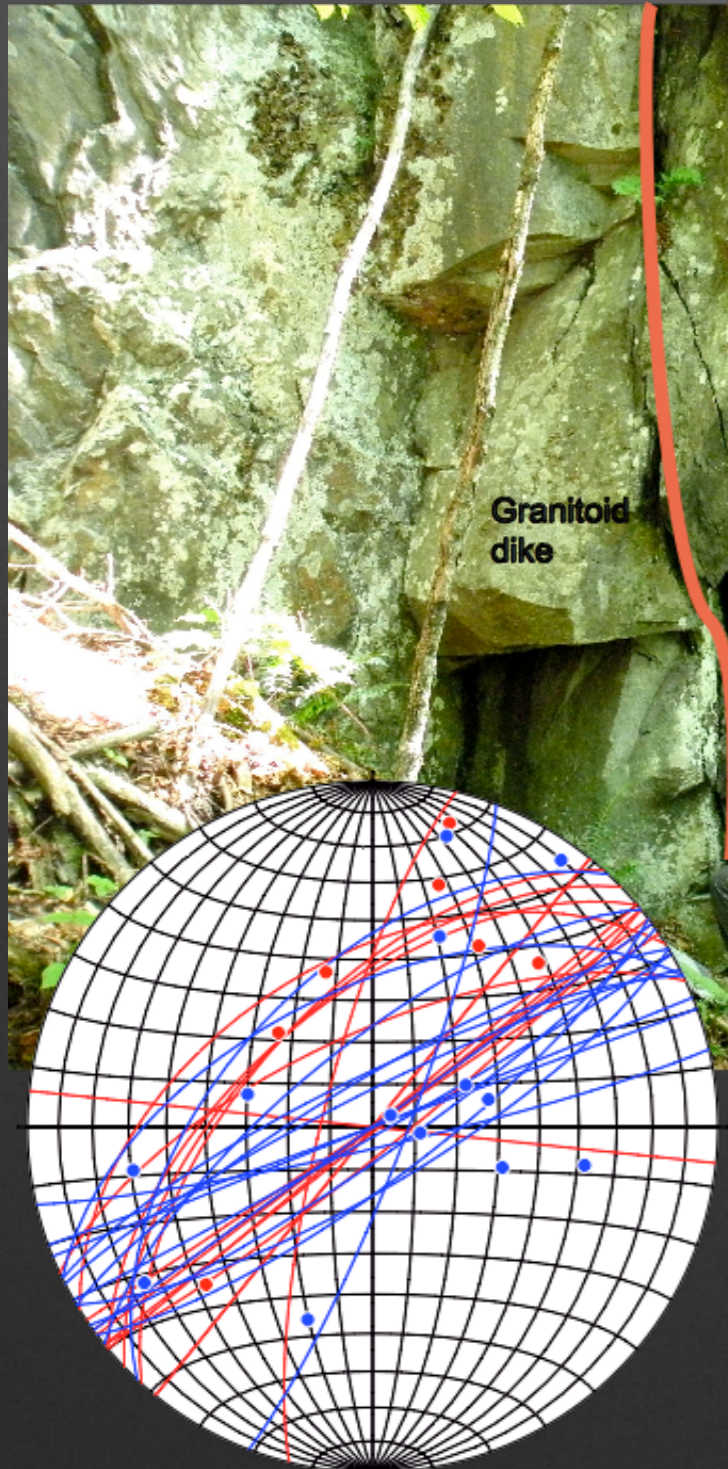
Modified from Ratcliffe et al., 2011

Field Evidence and Relations from Woodbury, VT

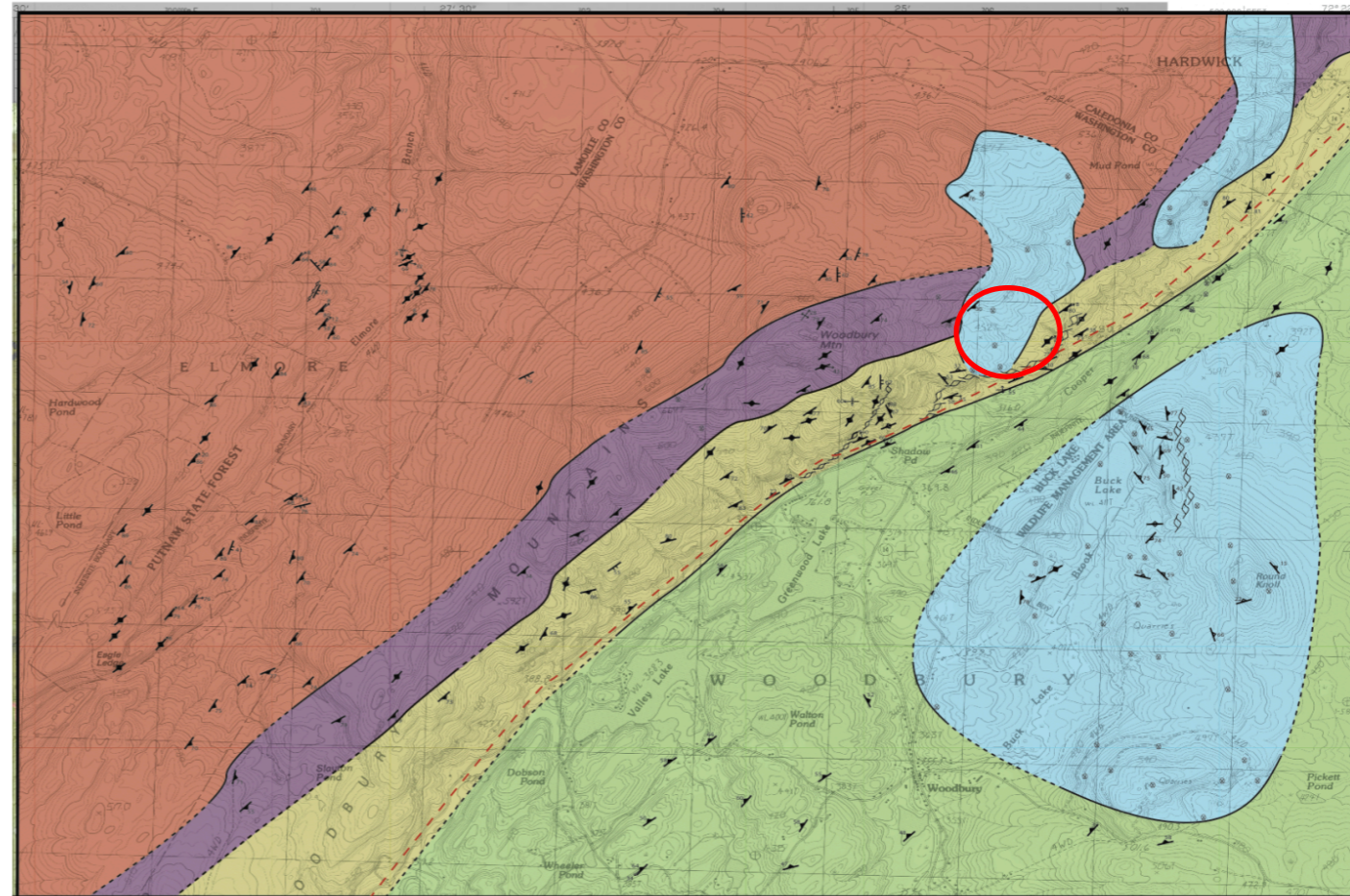


Blue=west
Red=east
n=57

Field Evidence and Relations from Woodbury VT



Granitoid dike



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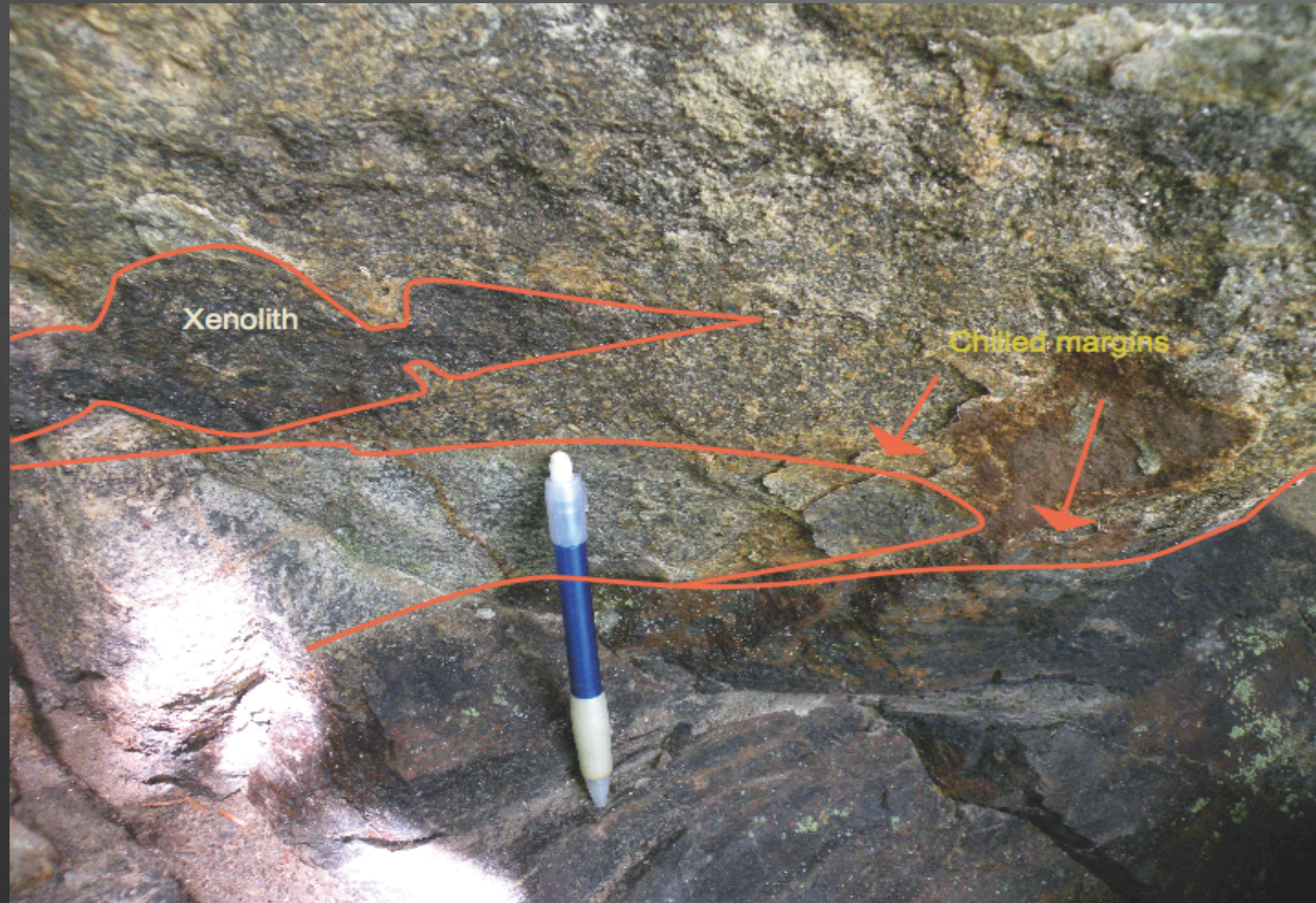
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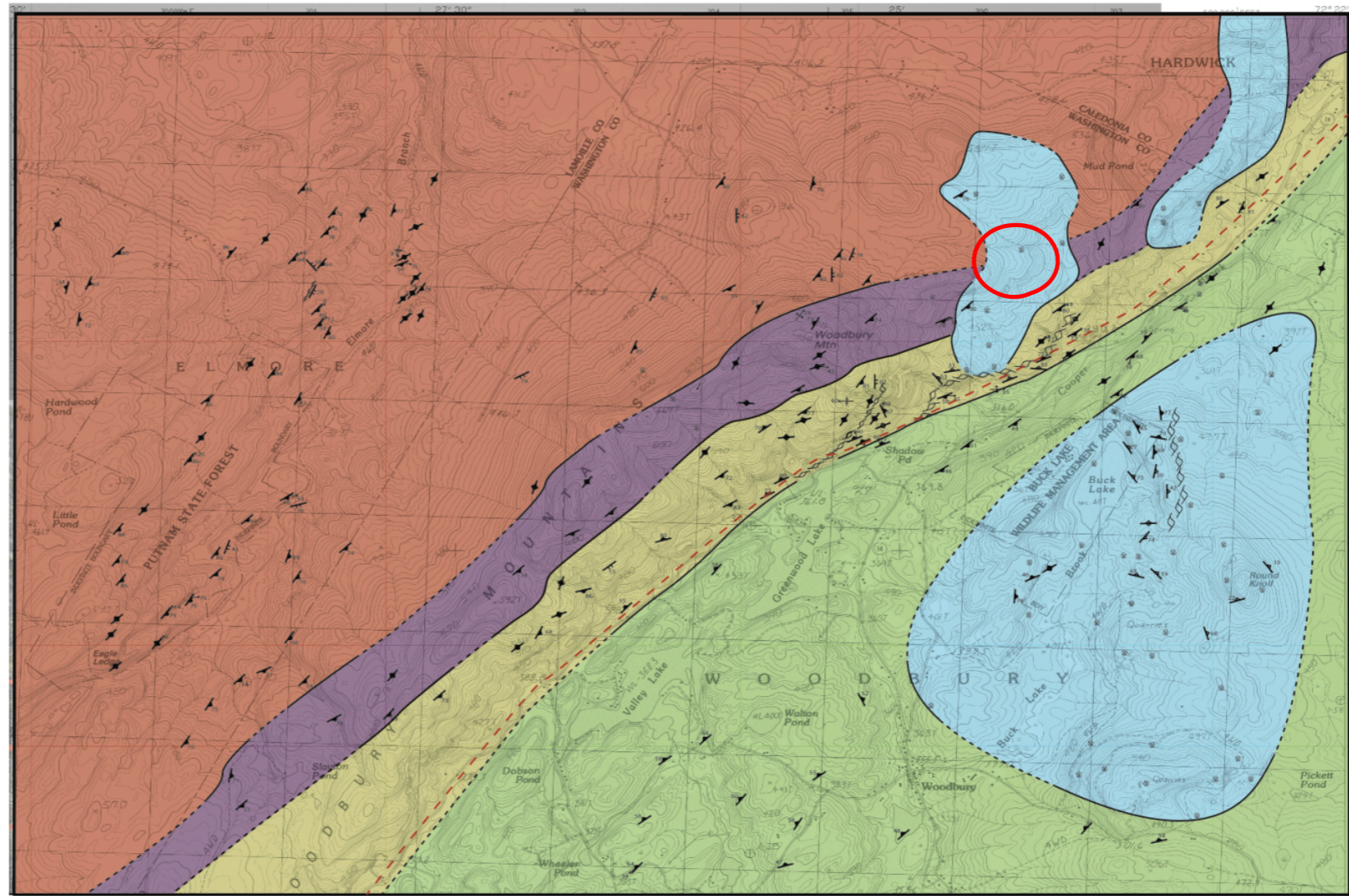
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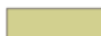


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Field Evidence and Relations from Woodbury, VT

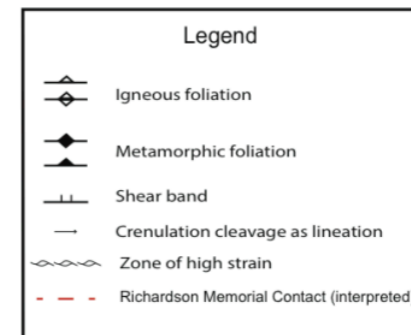




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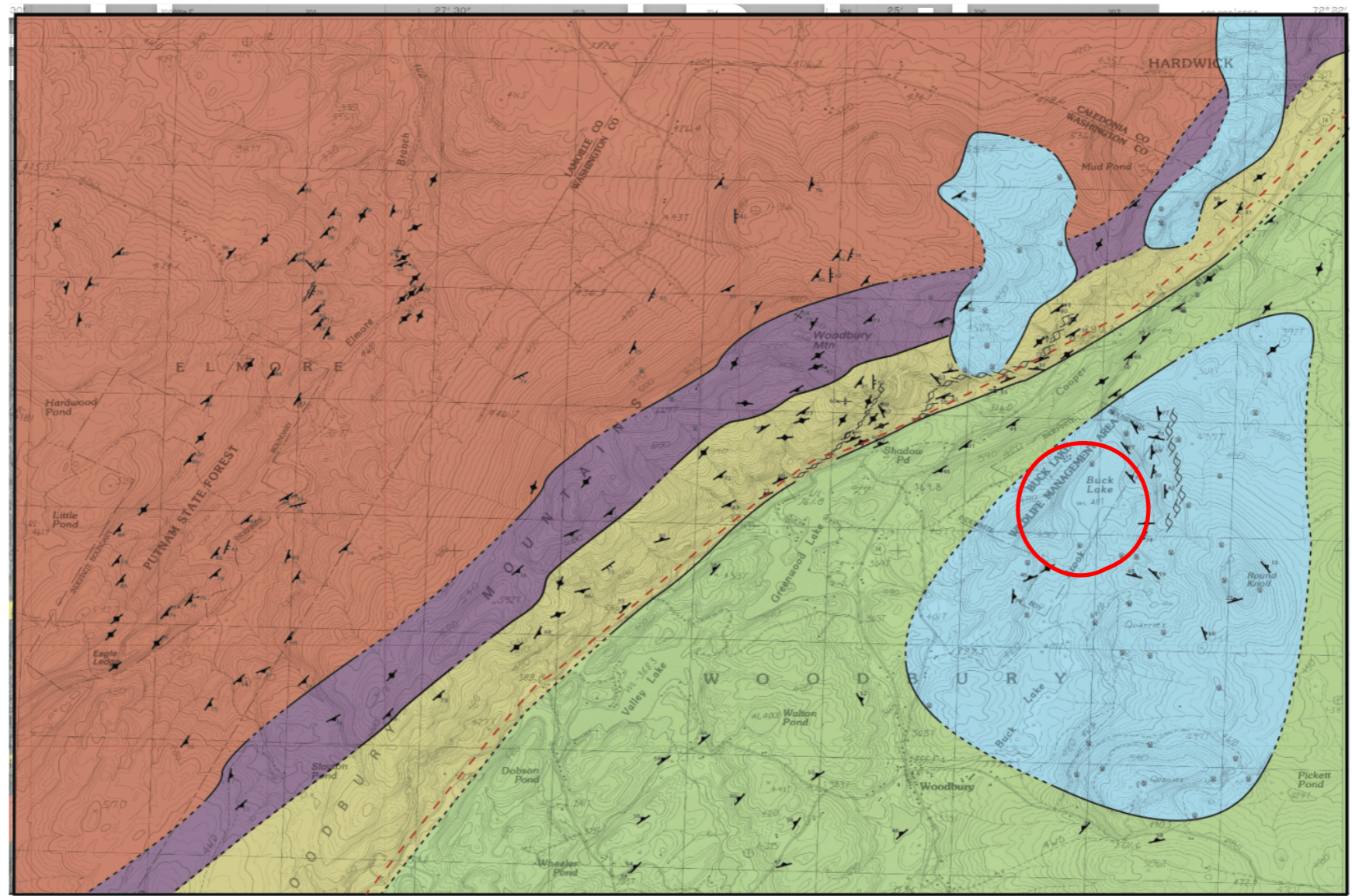


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Field Evidence and Relations from Woodbury, VT

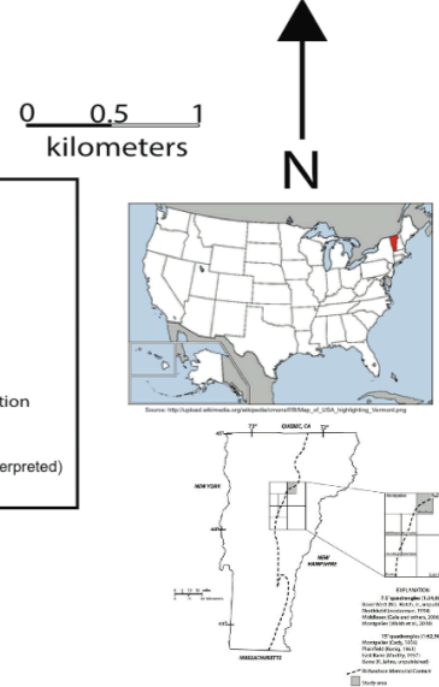


F



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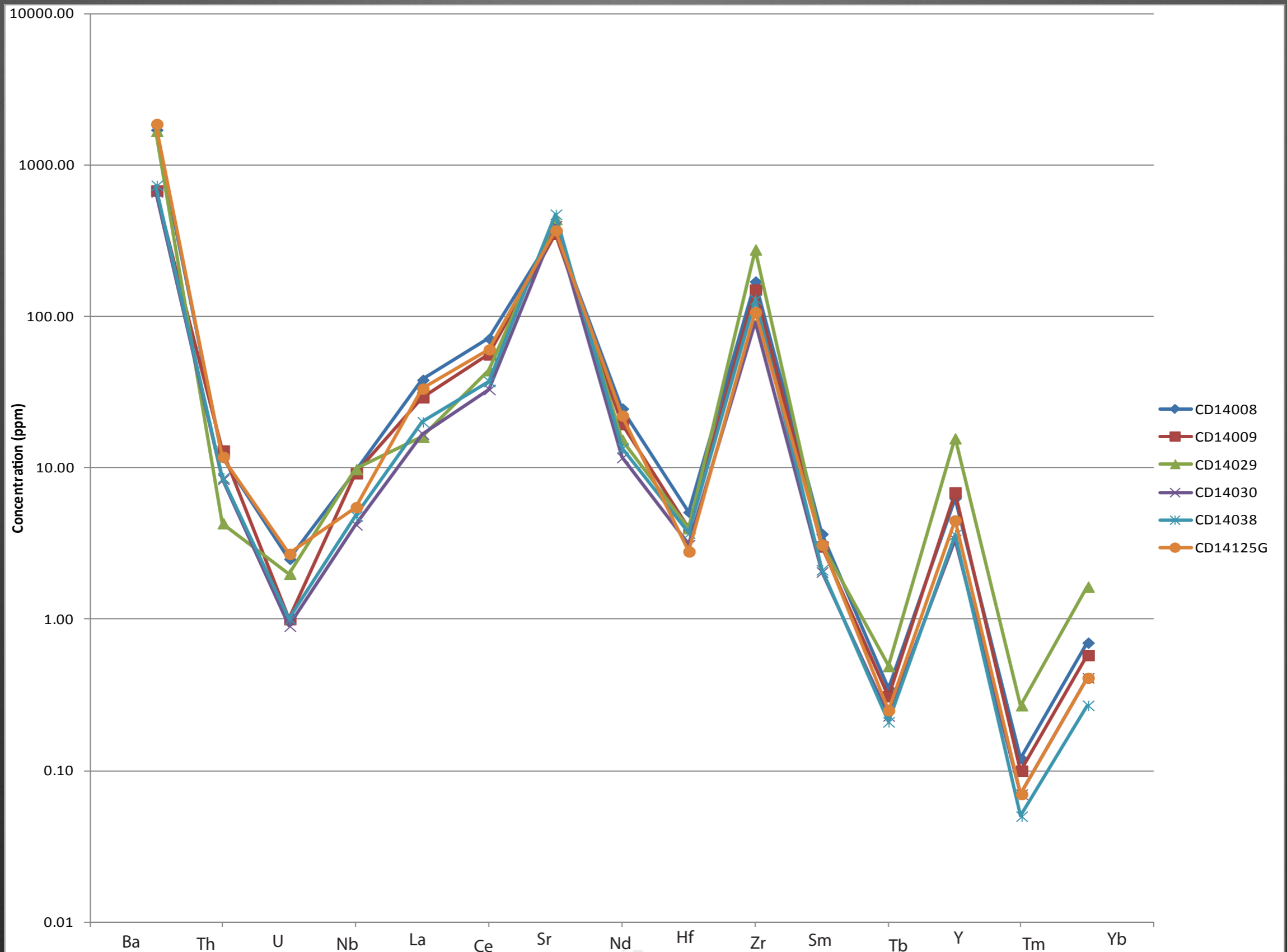
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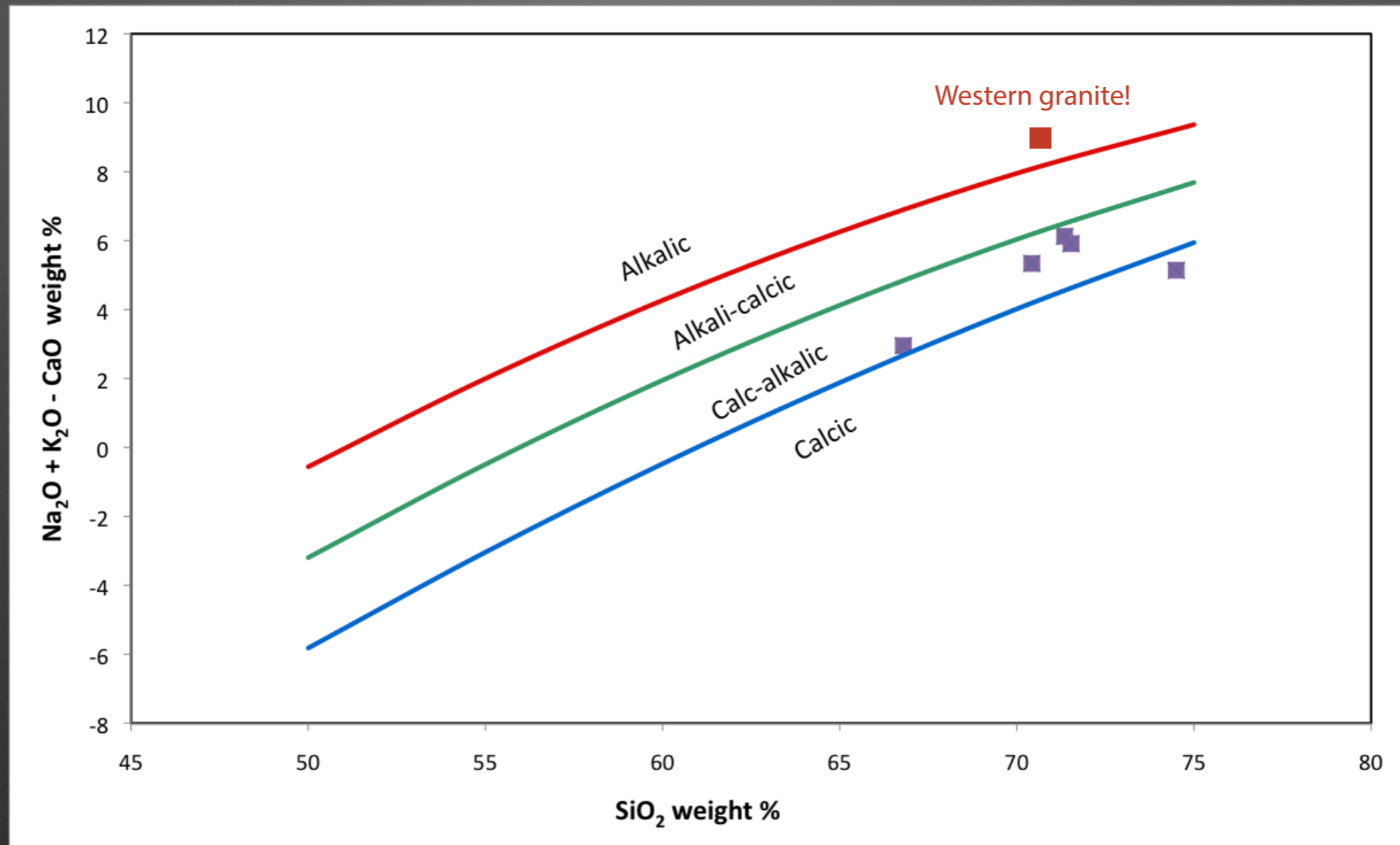
Summarizing Intrusion Methods

Field Relations, location	Intrusion style	Interpretation
Granitoid units intrude concordant to primary foliation, generally xenolith-free. Found in lower elevations of Woodbury range, eastern side of Buck Lake	Dike and sill	Magma from source took, when available, inherited planes of weakness in the form of joints and fractures that were foliation-parallel
Brecciated host material incorporated into granitoid, chilled margins. Found in higher elevations of Woodbury range	shatter zone	Initial pulse of magma broke-up host material, incorporating angular clasts into magma chamber. Successive pulses took advantage of new weaknesses and are xenolith-free
Xenolith riddled granitoid with large screens of slightly rotated host rock. Found in the Buck Lake region.	Stoping	Large magma chamber 'stoped' blocks of varying size of host material, digesting some and just rotating others in the magma chamber

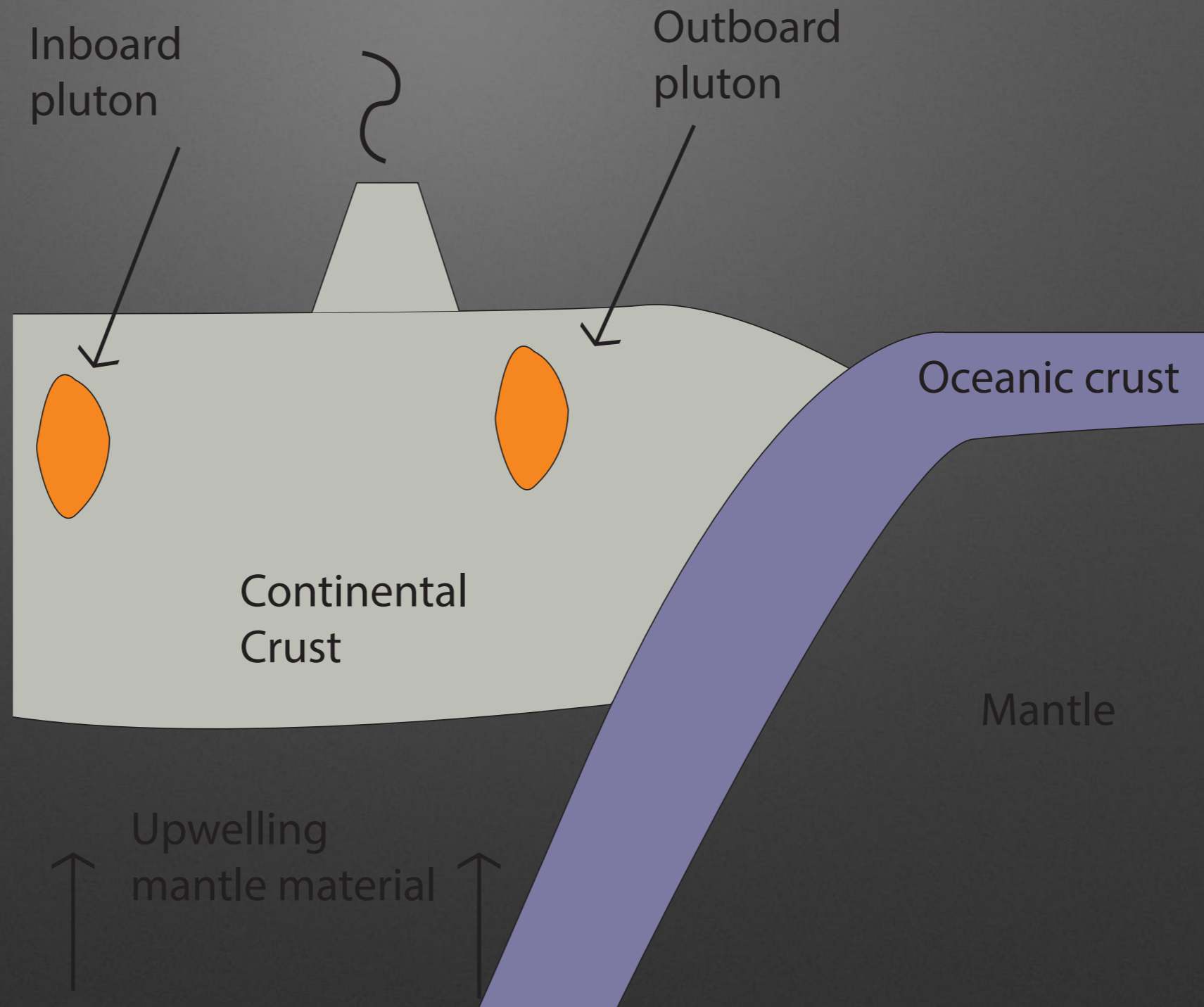
Geochemistry



Modified Alkali-Lime Index



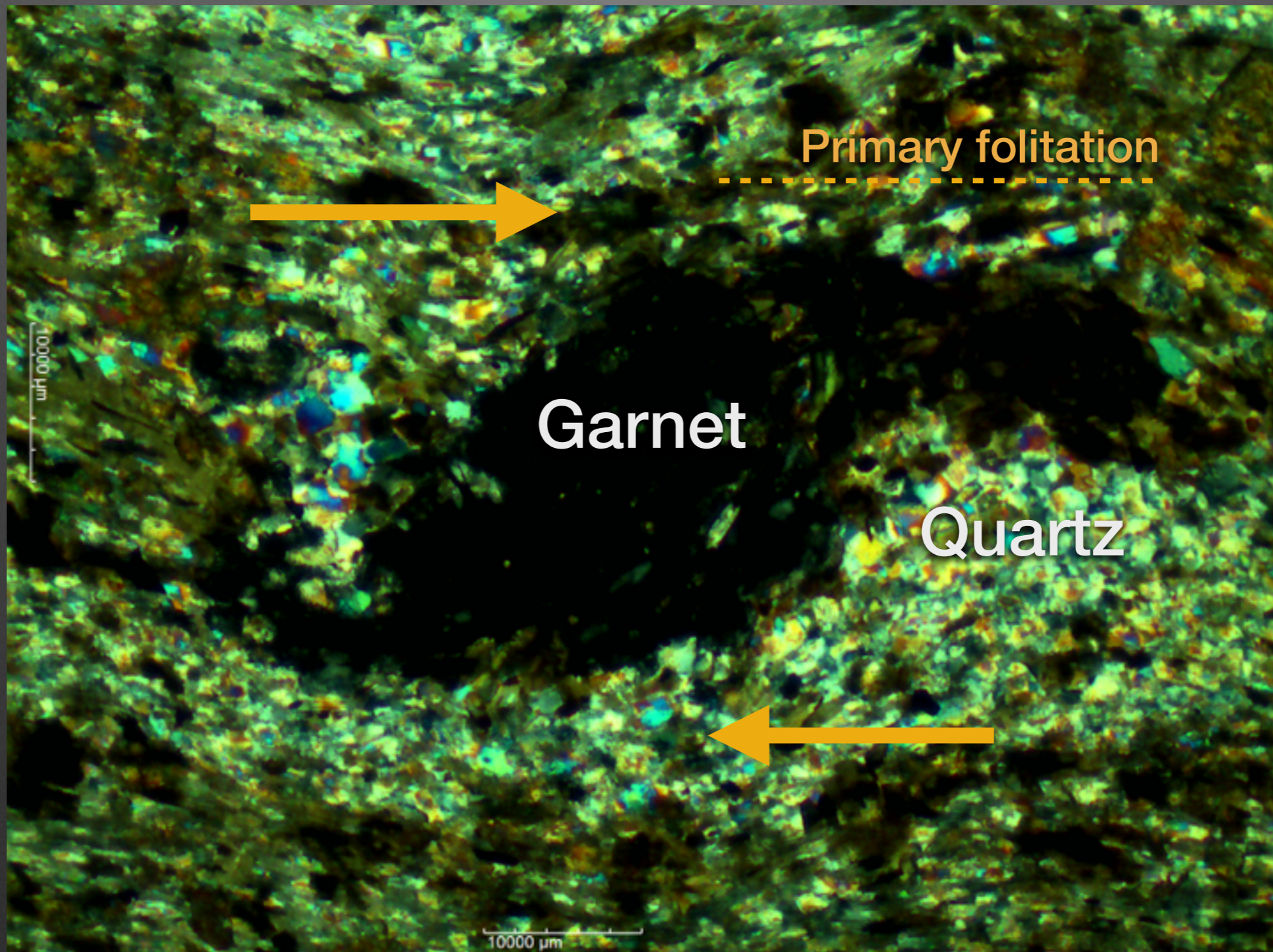
Outboard vs. Inboard

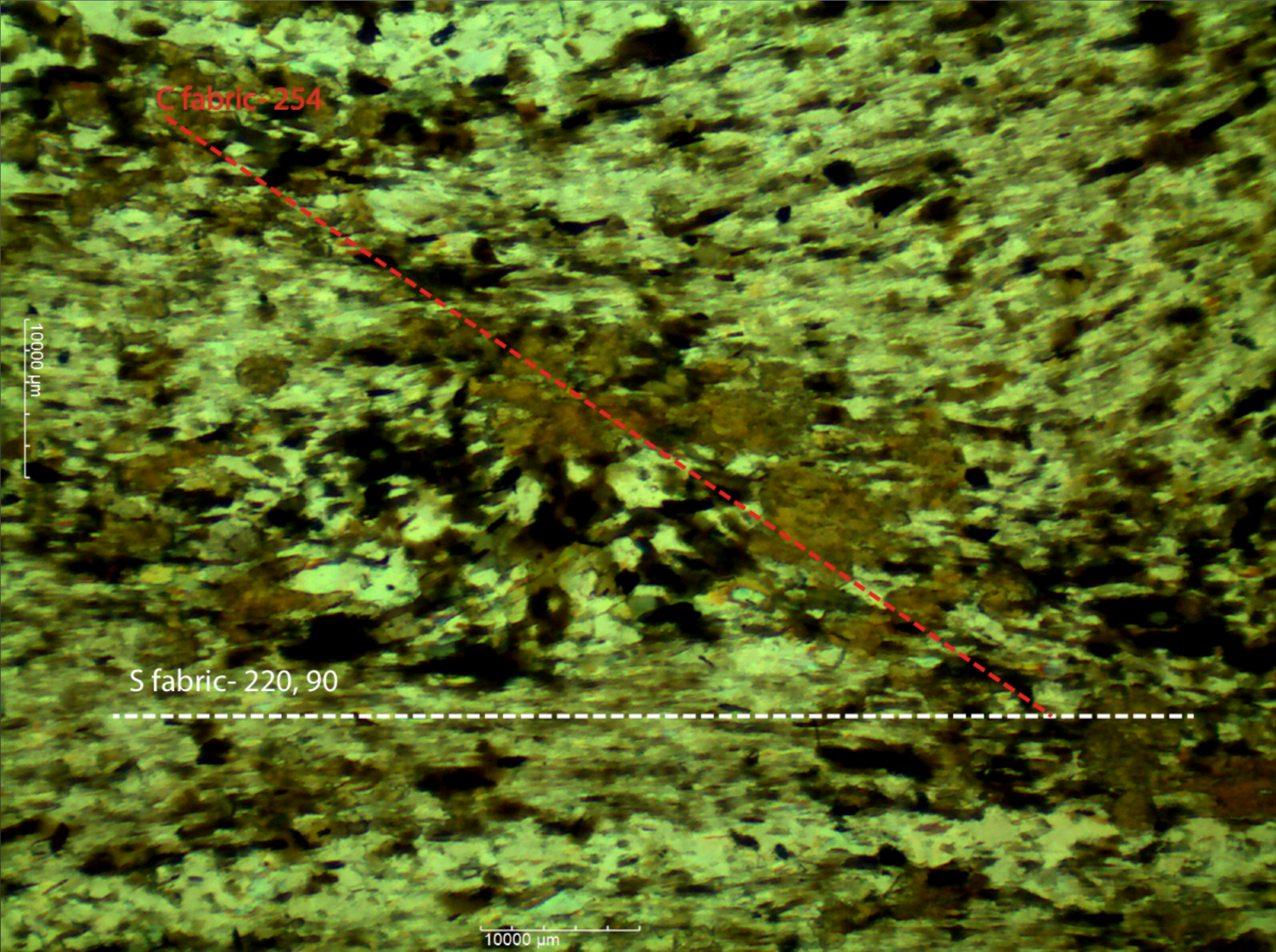


Summarizing the importance of the geochemistry

- Granitoids were allowed to fractionally crystallize, sitting in the crust cooling slowly
- The magma originated in the lower crust, generated by a volcanic arc source
- Although genetically related, the western granite associates on the MALI with granites that form outboard vs. inboard of the subduction zone

Microstructural Evidence for Shearing



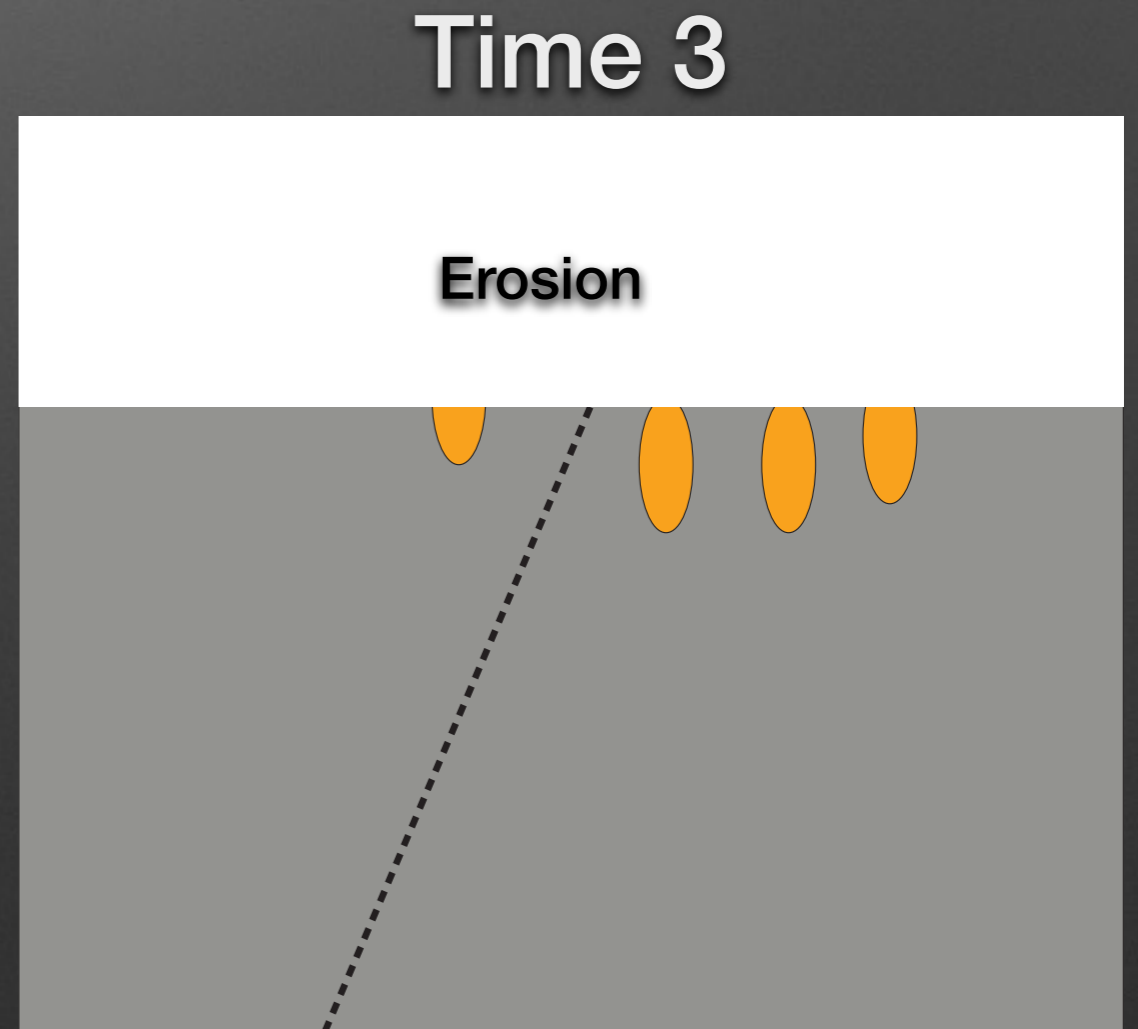
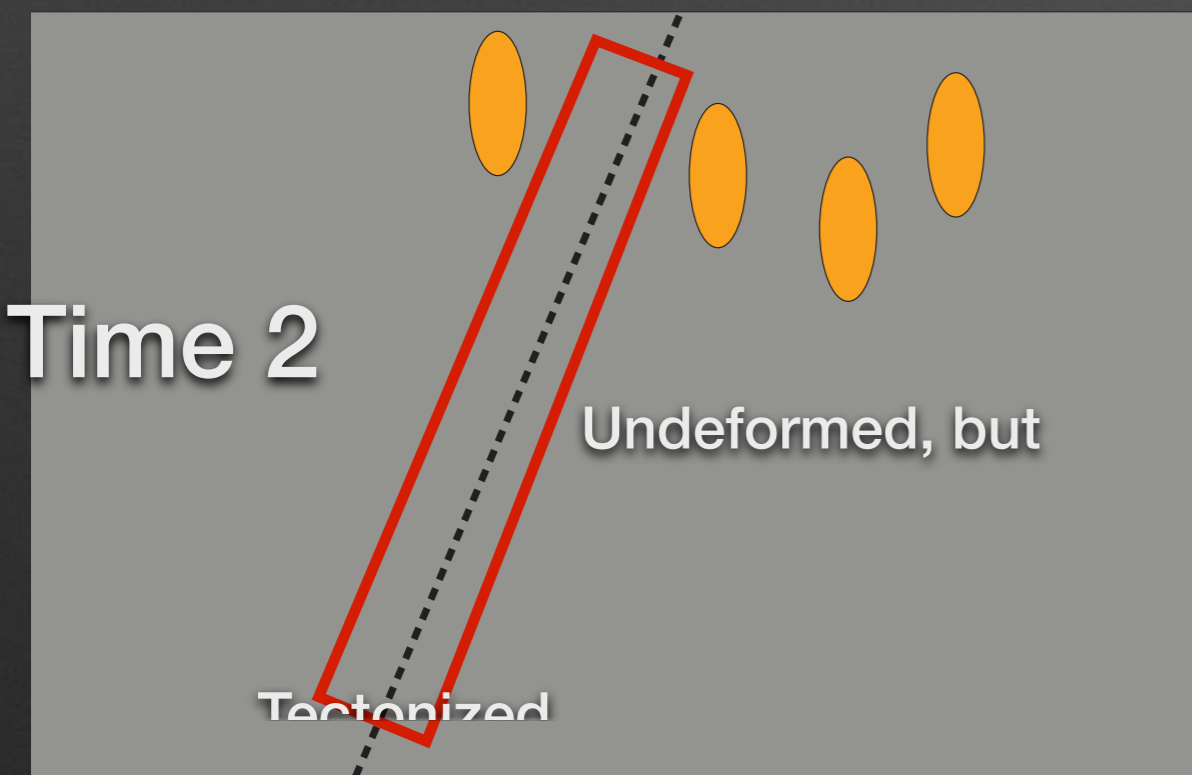
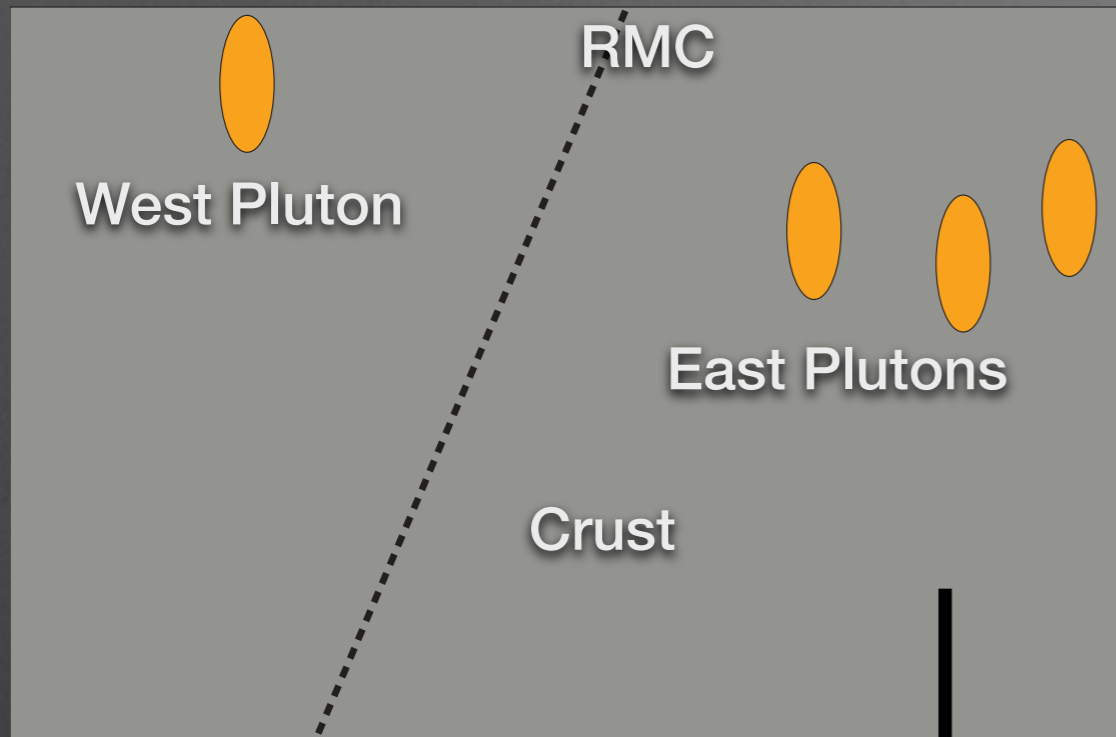


Discussion

- Importance of different intrusion styles
- Interpreted crustal *depths*

Field Relations, location	Intrusion style	Interpretation	Interpreted Depth
Granitoid units intrude concordant to primary foliation, generally xenolith-free. Found in lower elevations of Woodbury range, eastern side of Buck Lake	Dike and sill	Magma from source took, when available, inherited planes of weakness in the form of joints and fractures that were foliation-parallel	Relatively deeper
Brecciated host material incorporated into granitoid, chilled margins. Found in higher elevations of Woodbury range	shatter zone	Initial pulse of magma broke-up host material, incorporating angular clasts into magma chamber. Successive pulses took advantage of new weaknesses and are xenolith-free	Shallow
Xenolith riddled granitoid with large screens of slightly rotated host rock. Found in the Buck Lake region.	Stoping	Large magma chamber 'stoped' blocks of varying size of host material, digesting some and just rotating others in the magma chamber	Relatively deeper

RMC Model for juxtaposition



Crustal Heterogeneity?

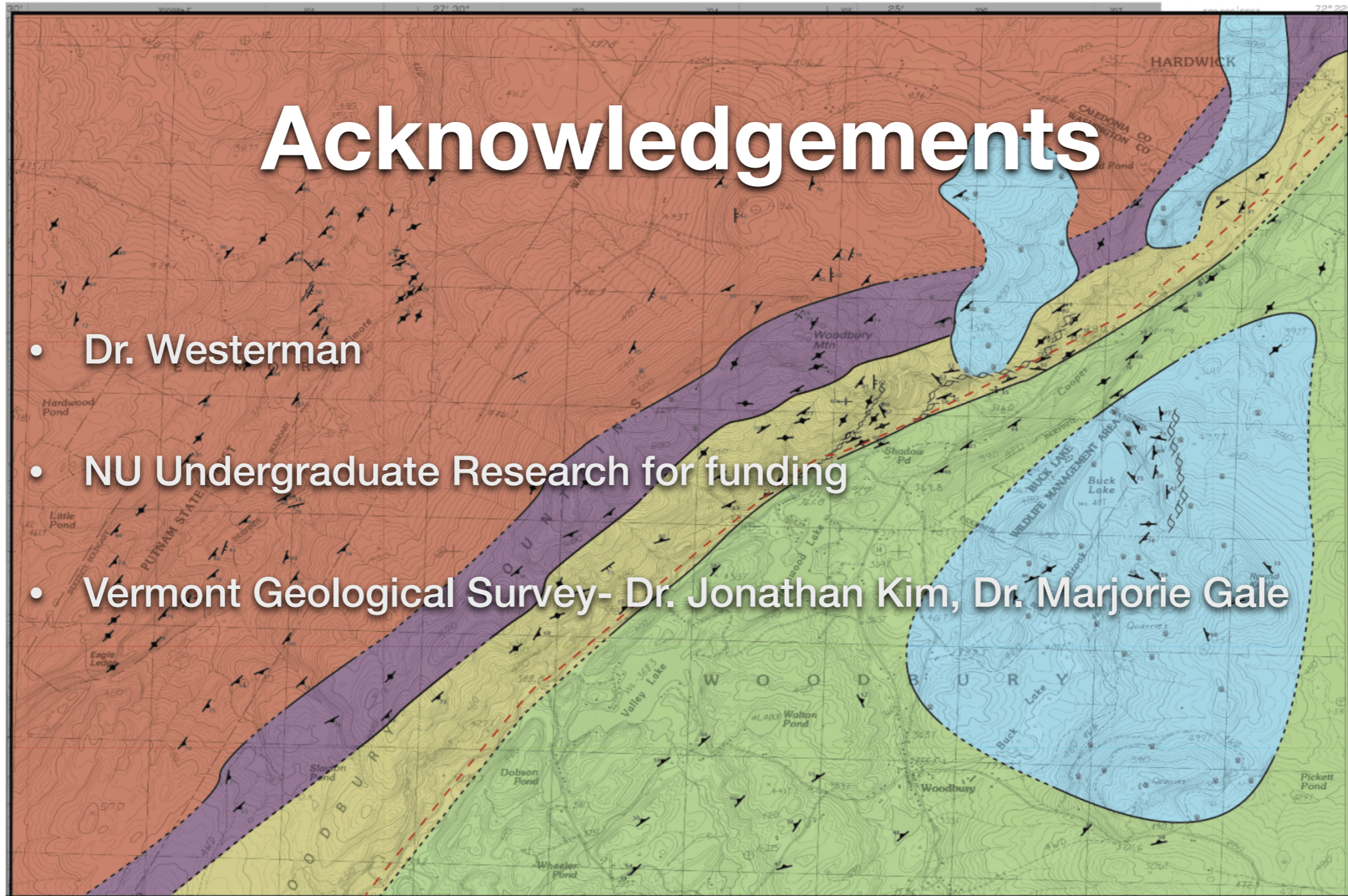
- Or plutons east and west are sampling a heterogeneous crust that is then sheared locally
- If this is a west-side up fault, that would explain why we see a shallow structural level on the west (shatter zone) vs. relatively deeper stoping in the east

Summary



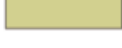

- Plutons in Woodbury, VT record a geochemical history of their source along with a signature of where the material originated
- Intrusion methods used to determine crustal depth
- Plutons are genetically related, but unique mineralogy suggests different emplacement settings
- A documented structure exists juxtaposing the plutons
- Mylonites, ductile shear indicators near this boundary
- The RMC is a ductile shear zone that occurs along strike with the Dog River Fault Zone, possible contiguous

Acknowledgements







- Dr. Westerman
- NU Undergraduate Research for funding
- Vermont Geological Survey- Dr. Jonathan Kim, Dr. Marjorie Gale



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