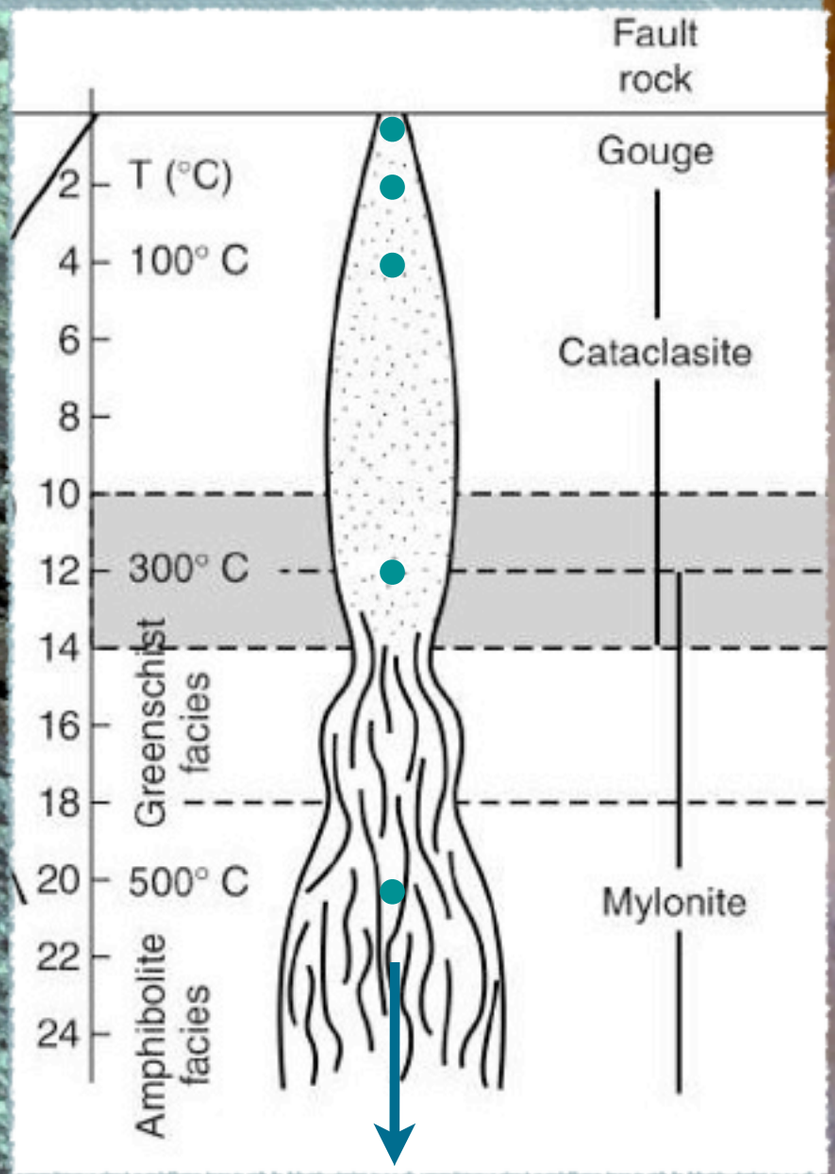
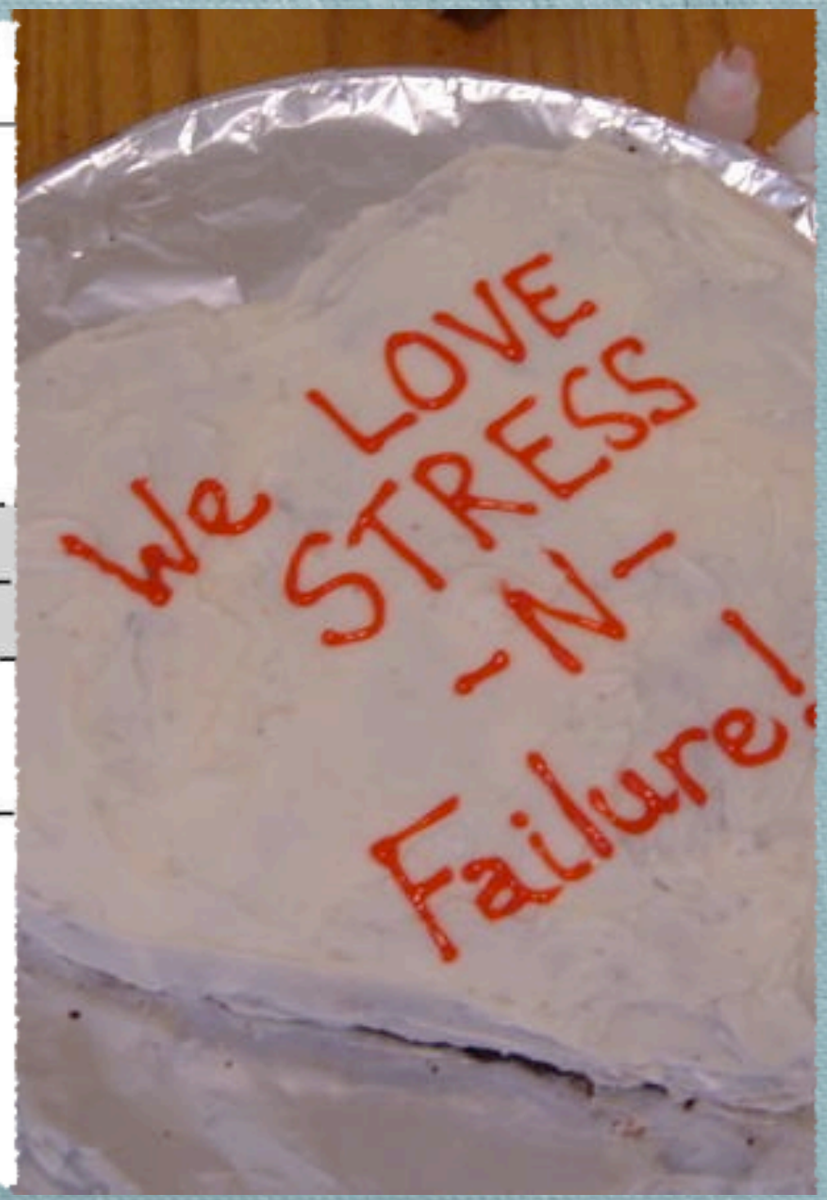
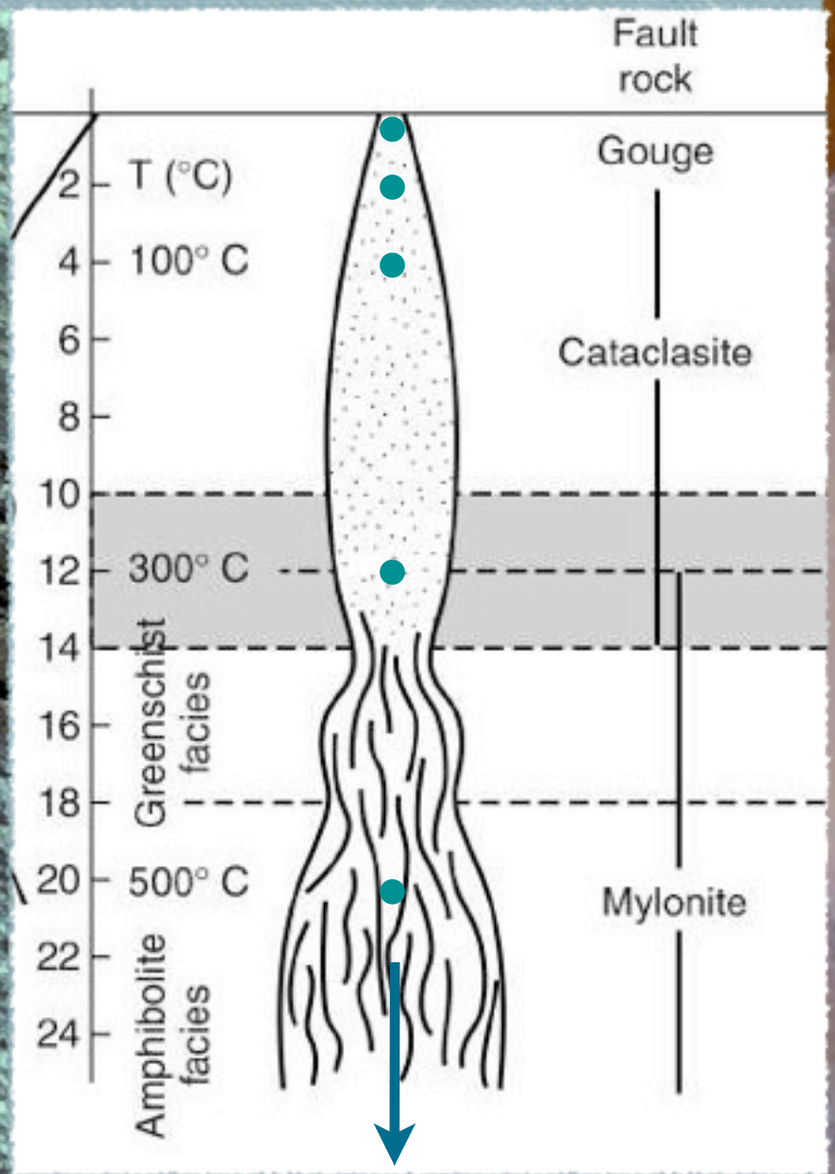




Extracting quantitative rheological information from field-based studies

Laurel B. Goodwin, UW-Madison

Madison, Wisconsin



Extracting quantitative rheological information from field-based studies

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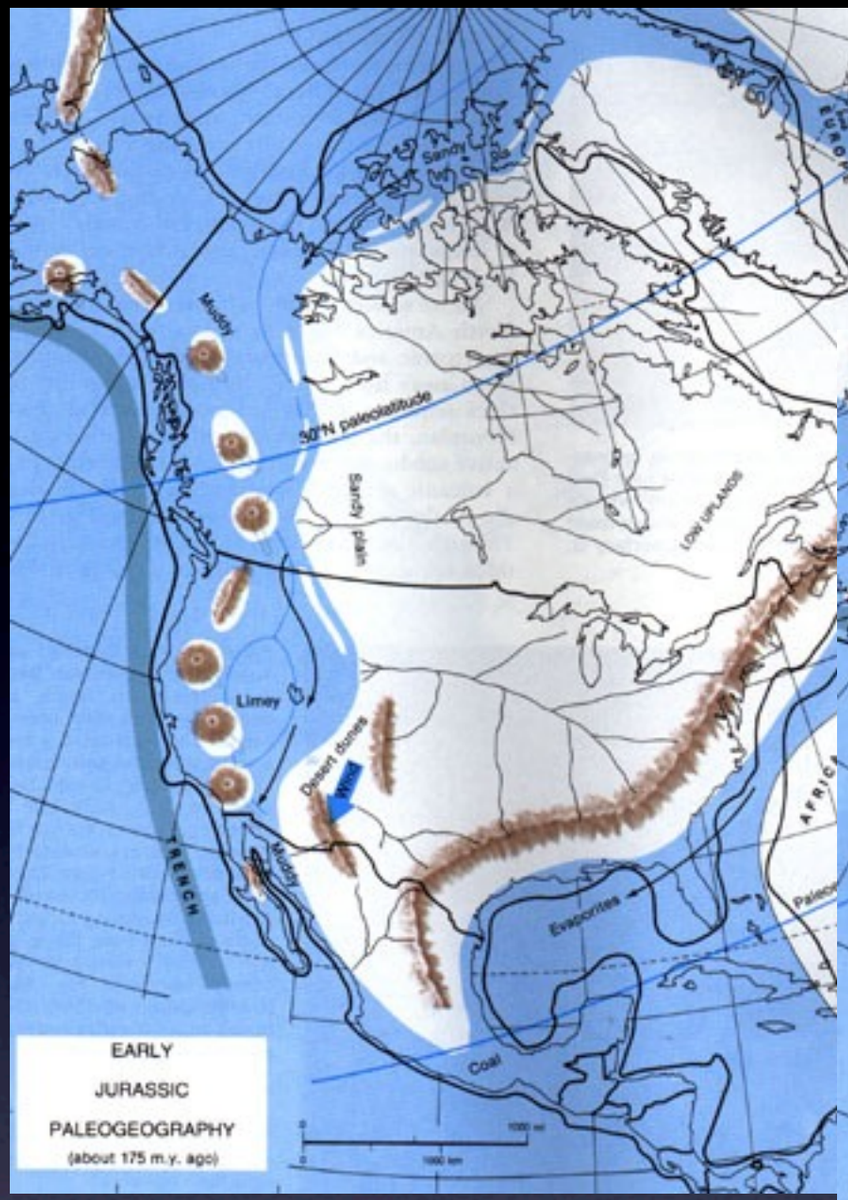
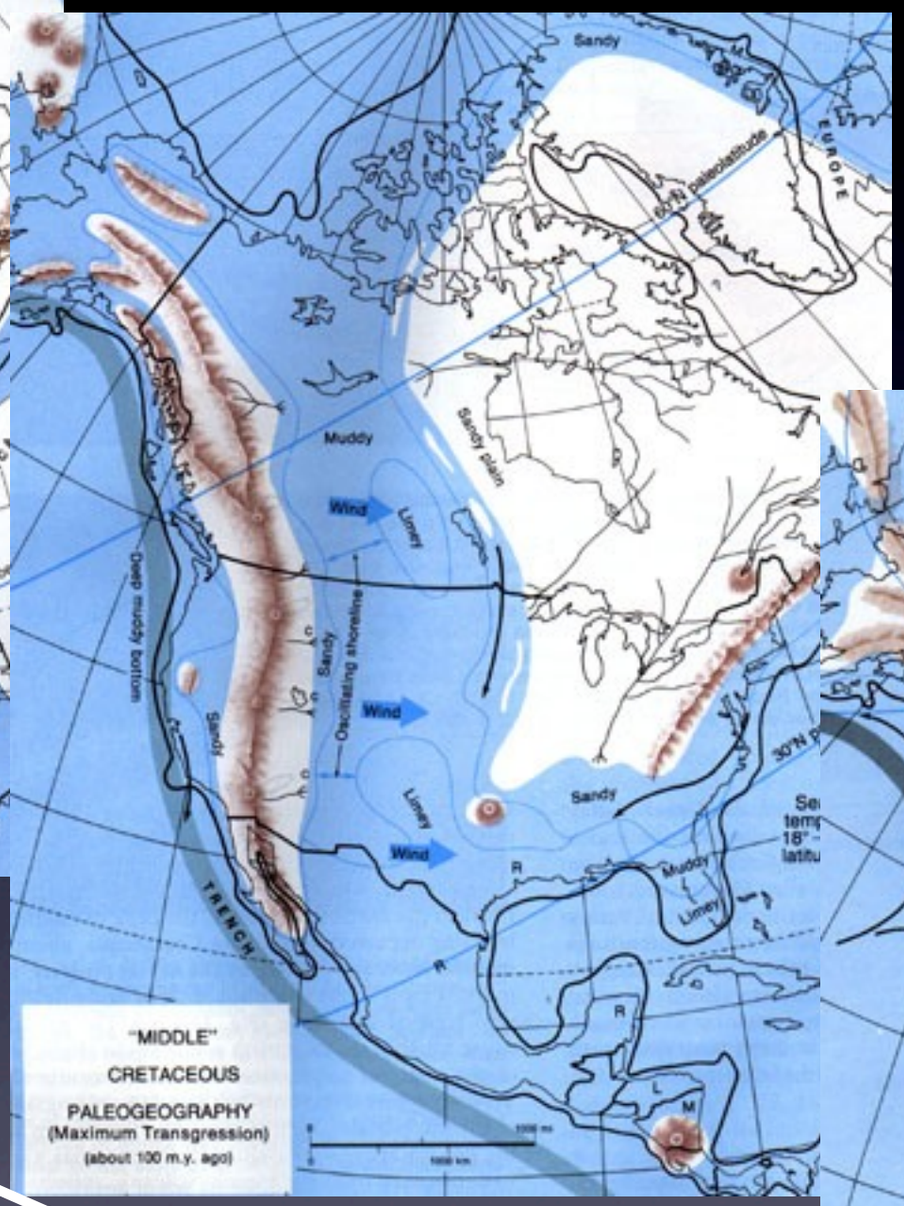
distribution of sediments over time reflects tectonic/ sea level/climate controls on clastic versus carbonate sedimentation as the Cordilleran mountain belt was constructed





Extending the lab to the outcrop: an approach to extracting flow laws from natural systems

Extending the lab to the outcrop: an approach to extracting flow laws from natural systems

- Strain magnitude

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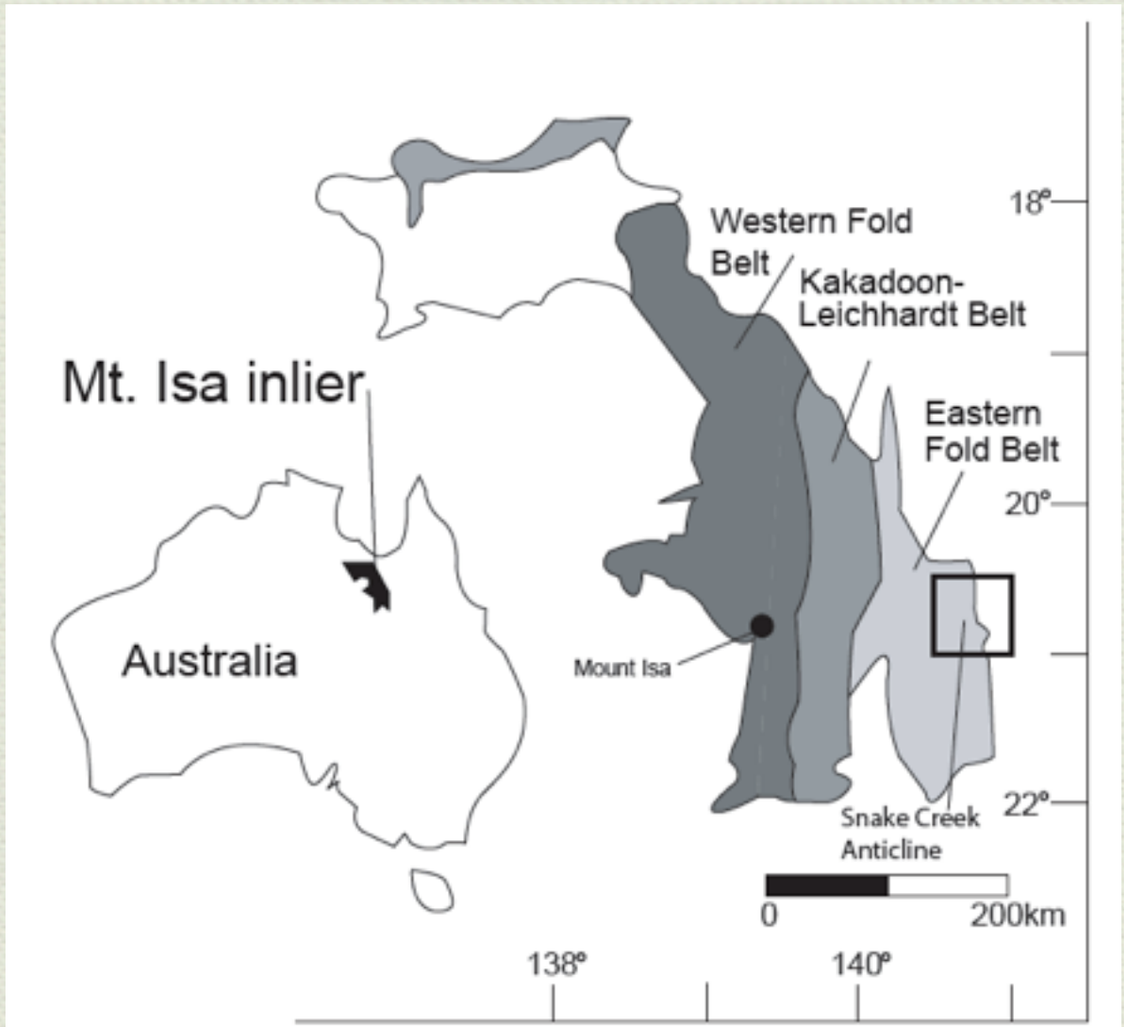
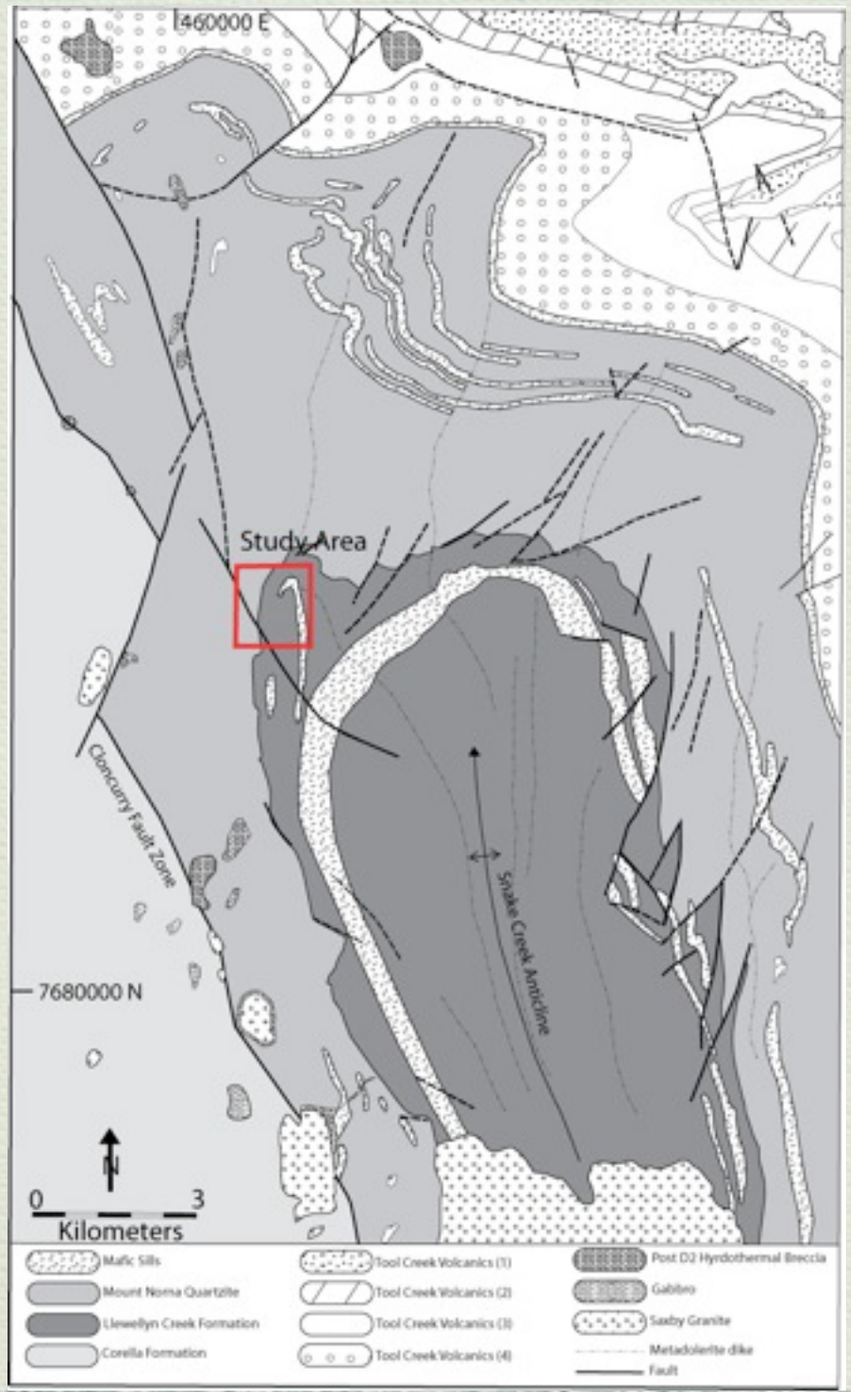
Extending the lab to the outcrop: an approach to extracting flow laws from natural systems

- Strain magnitude
- Kinematics
- Temperature
- Modal mineralogy (if testing the effect of a given phase, need range in content)
- Deformation mechanisms
- Stress

Case study: turbidite sequences in Queensland, Australia, deformed during the ~1.5-1.6 Ga Isan Orogeny

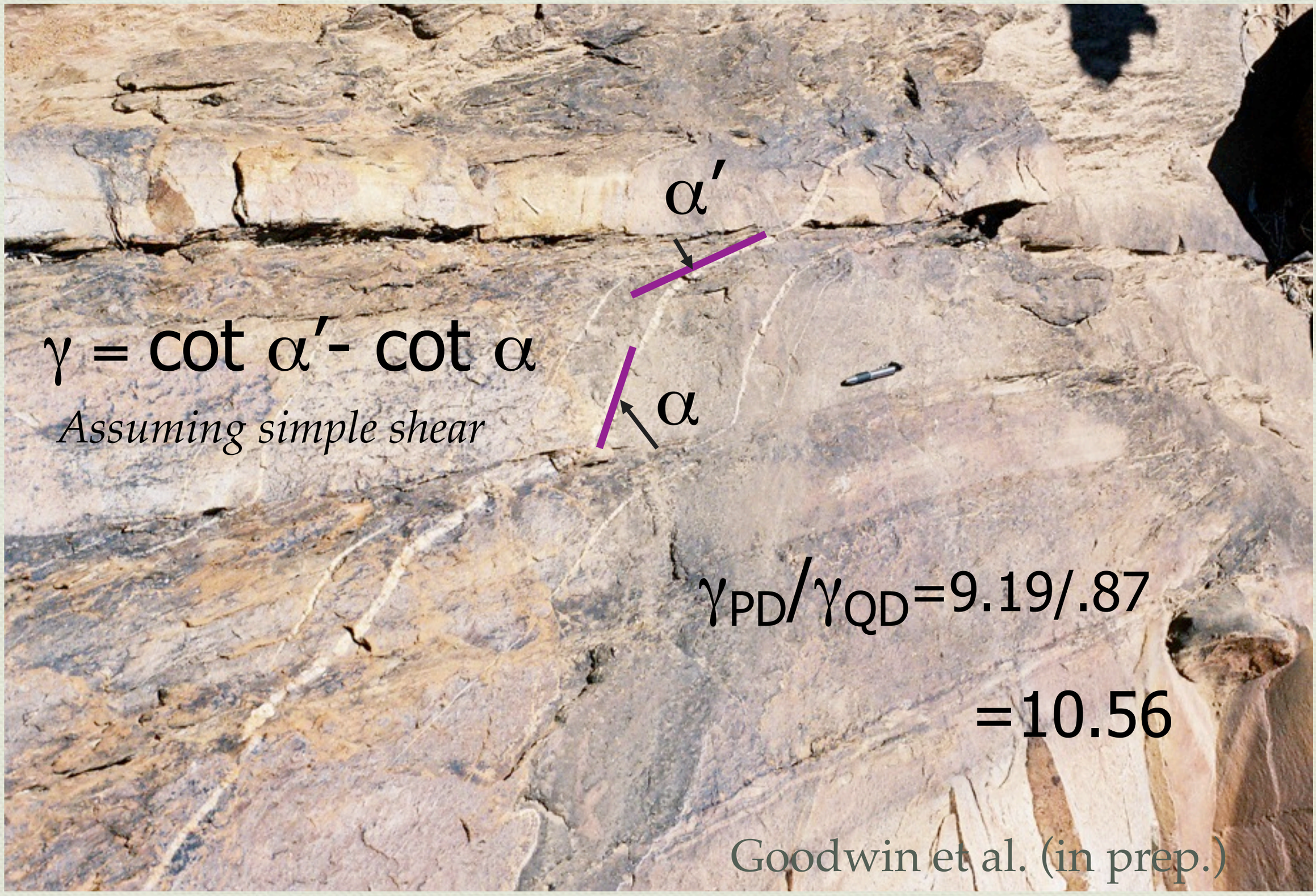




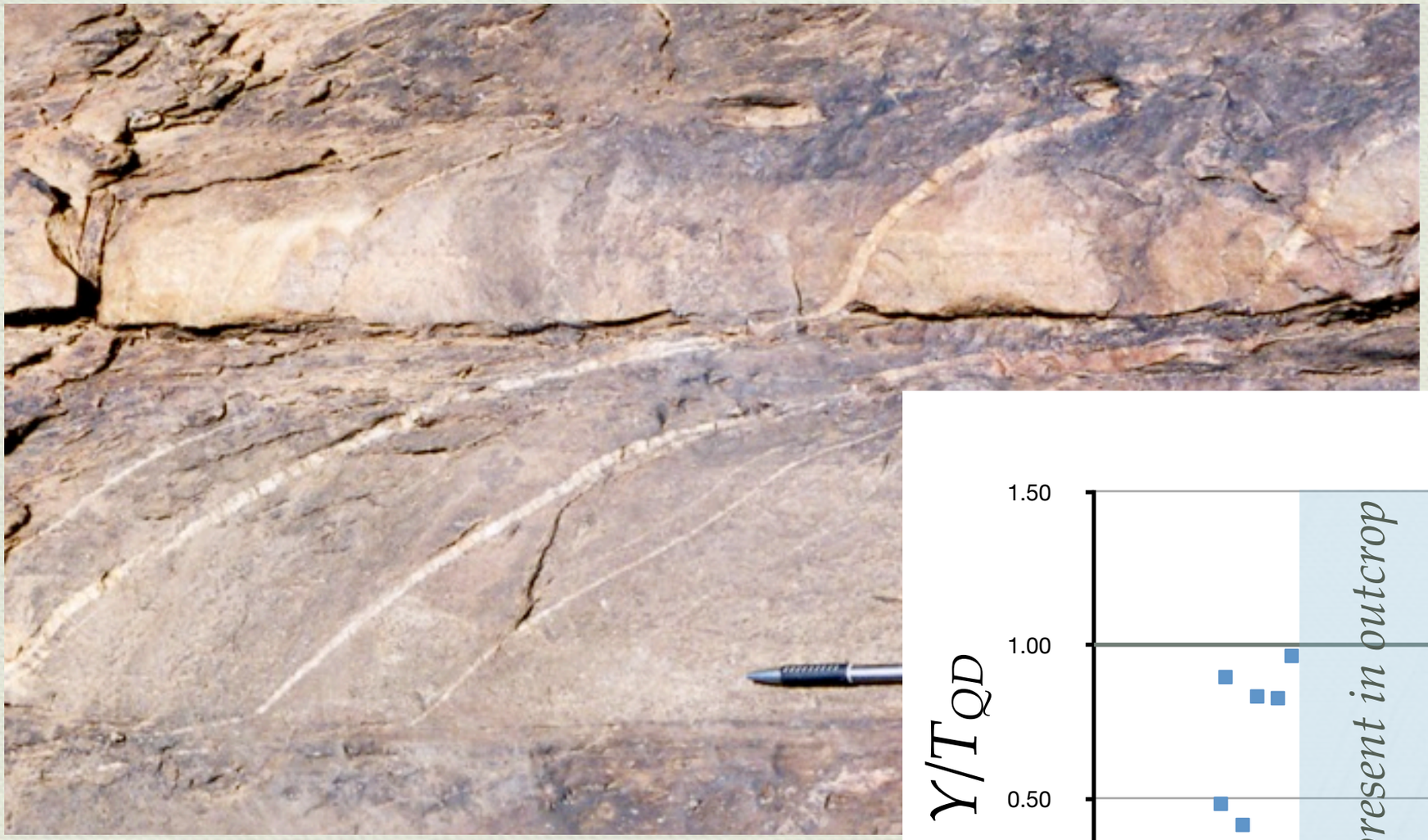
Research team includes: Evan Earnest, Heckler, Basil Tikoff, and Tom Blenkinsop

Vein deflection records dextral shearing on western limb of Snake Creek anticline

Quantifying variations in shear strain

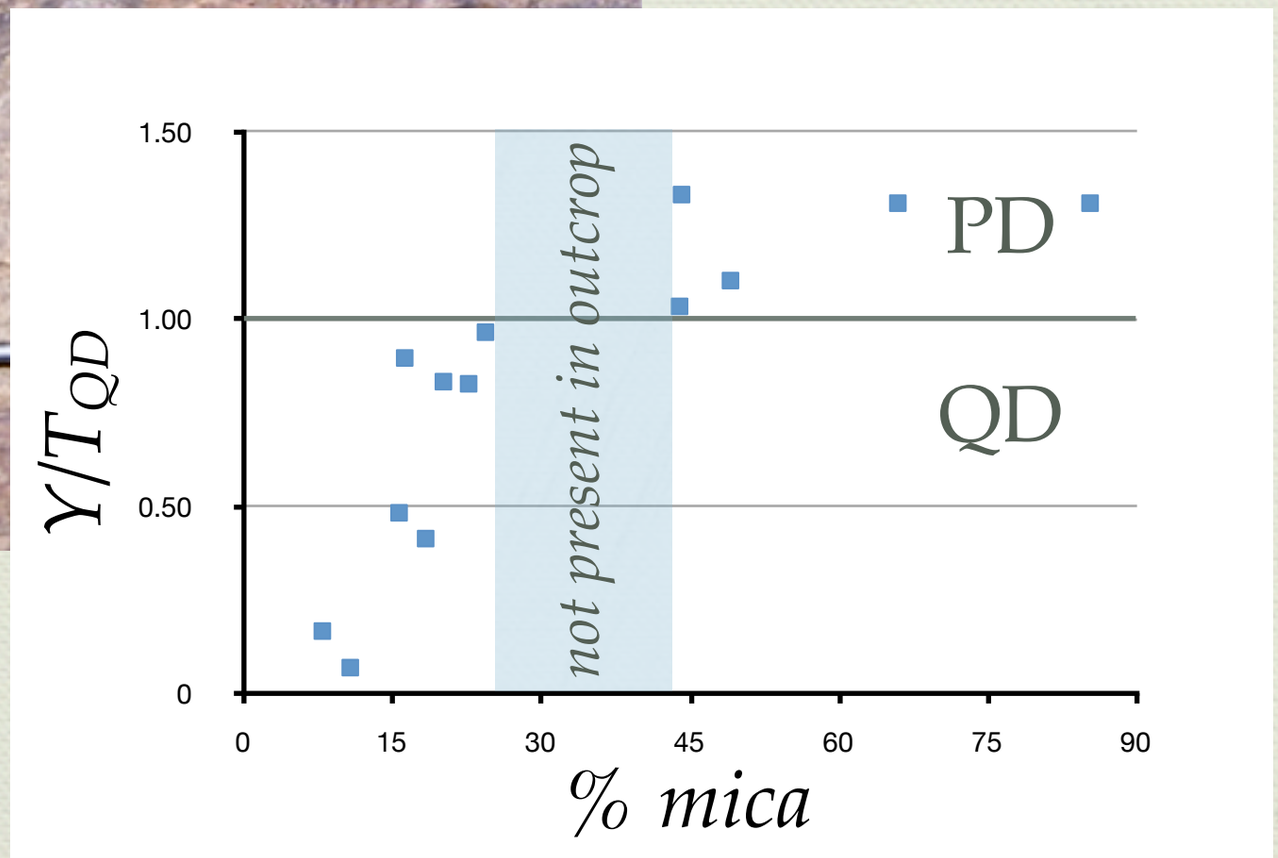


Mica (biotite & muscovite) content increases with distance from base of each sequence

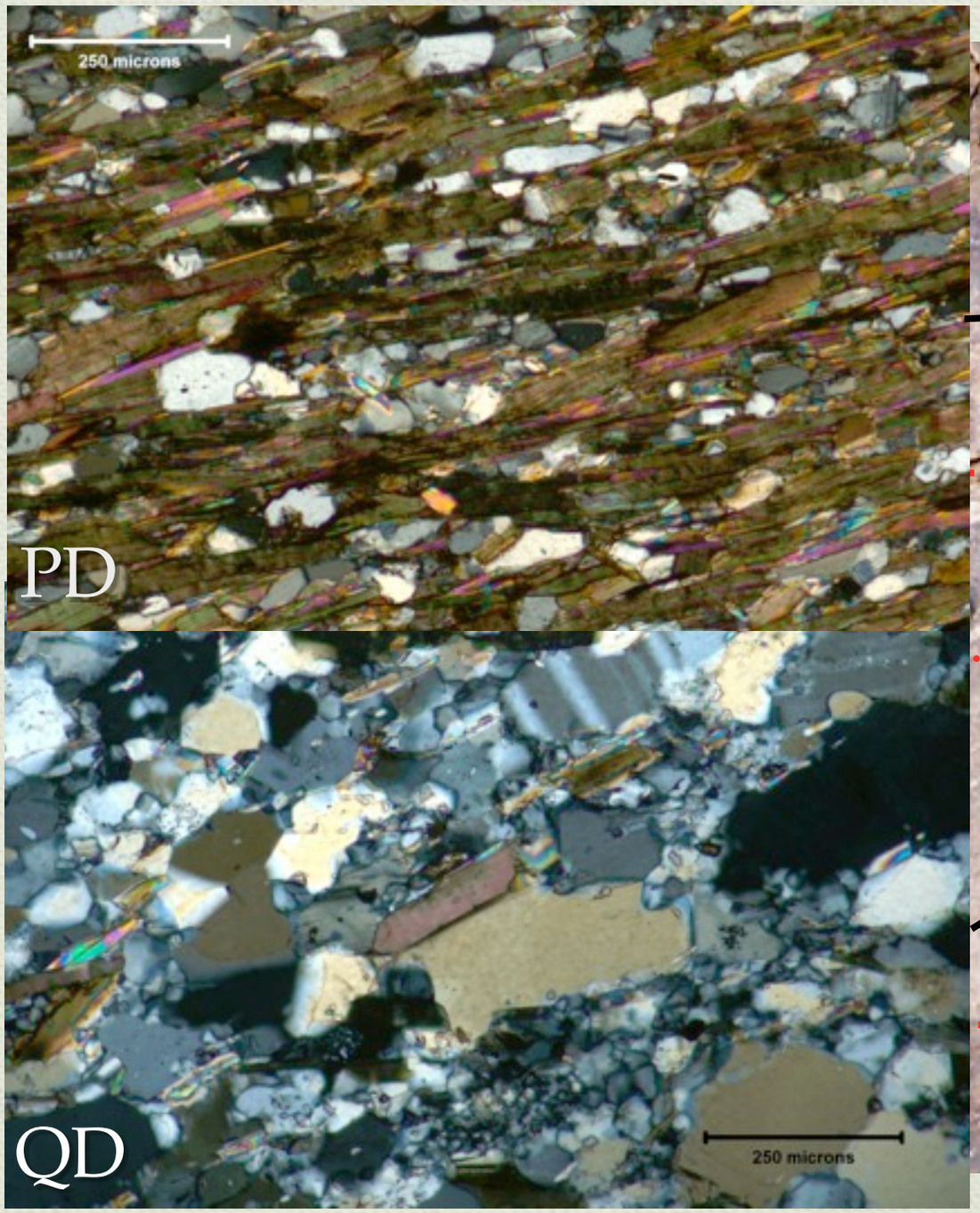


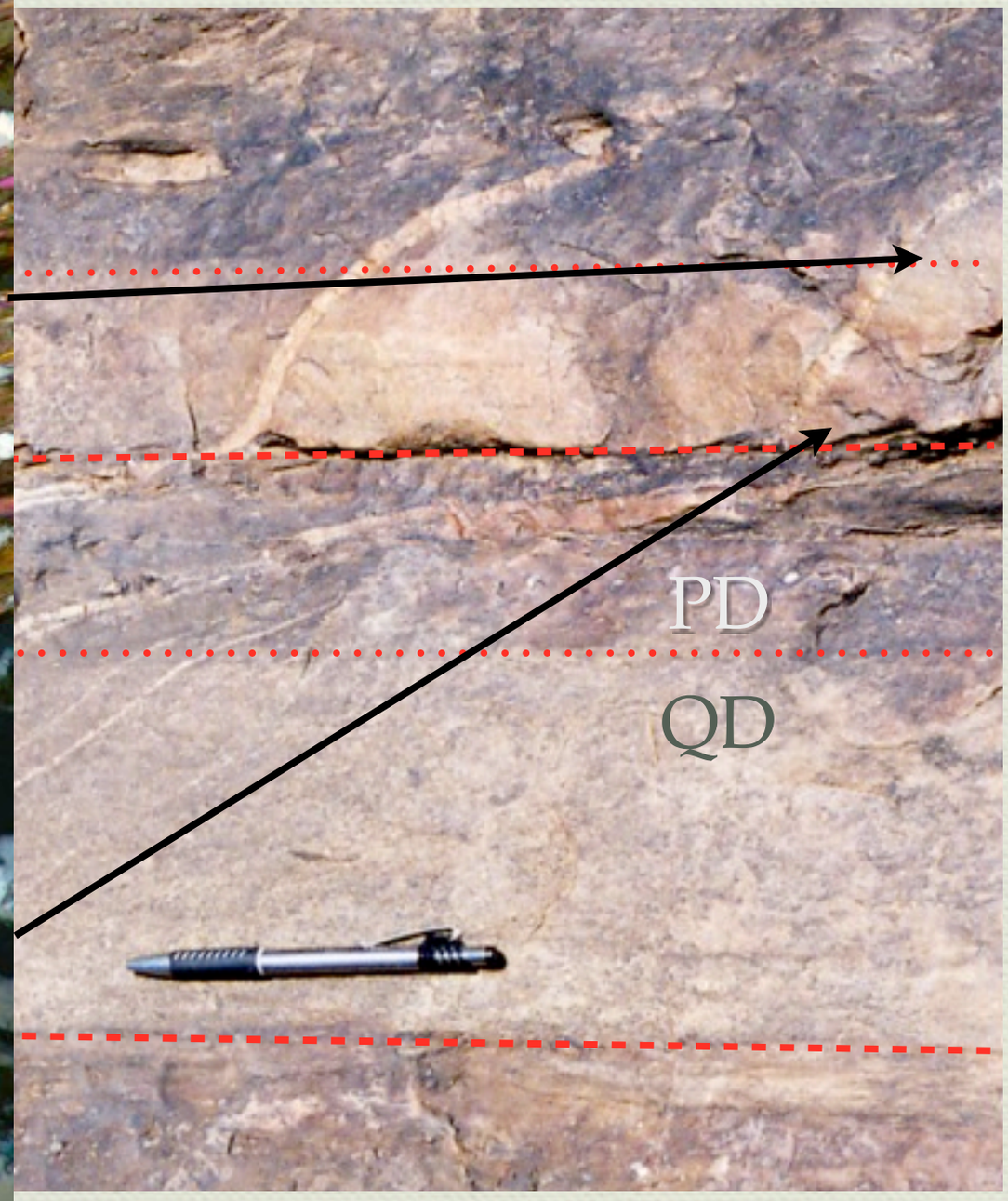
Goodwin et al. (in prep.)

Boundary reflects a change in deformation mechanism with change from <25 to >43% mica

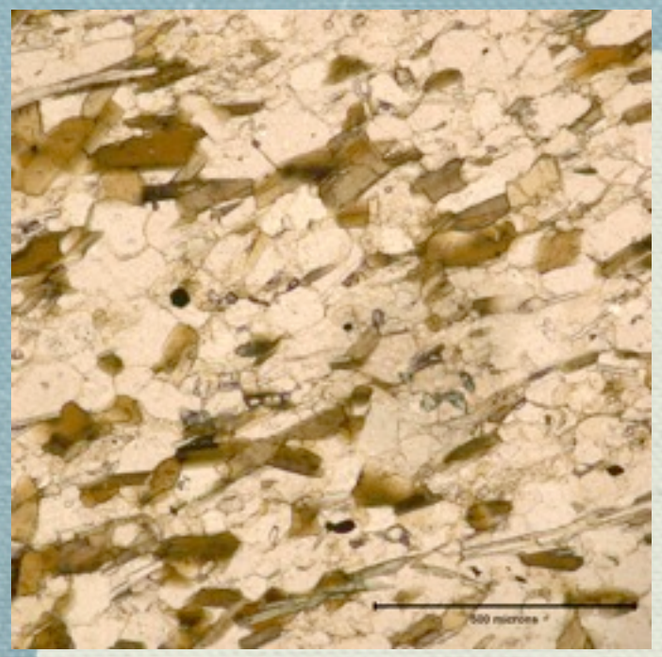


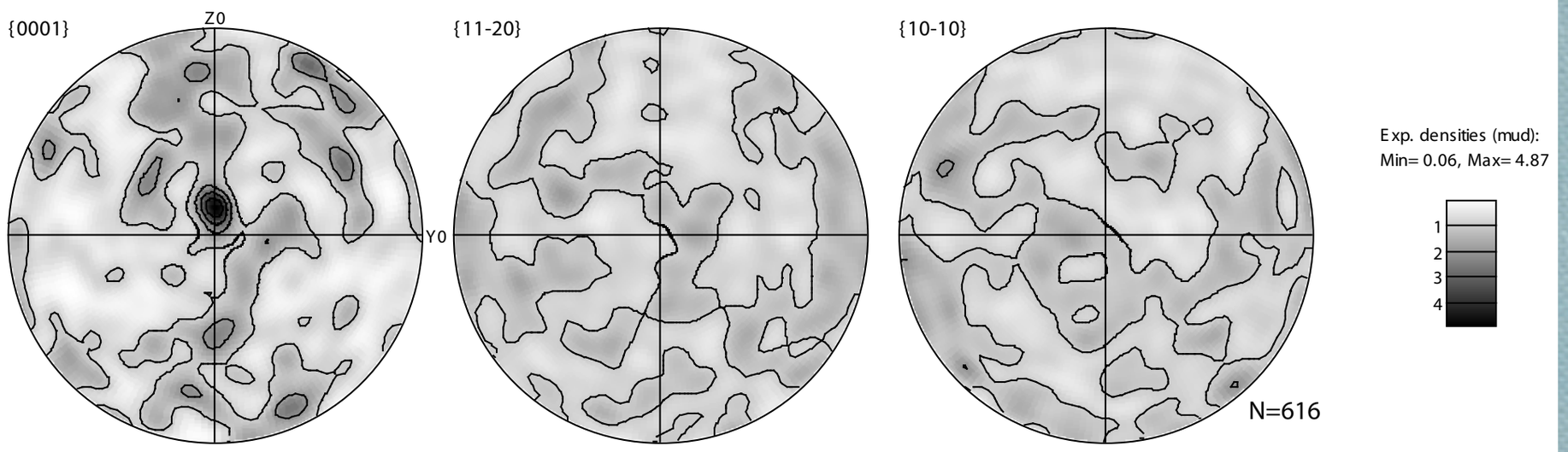
Grain size, mica content, and microstructures change abruptly across domain boundaries



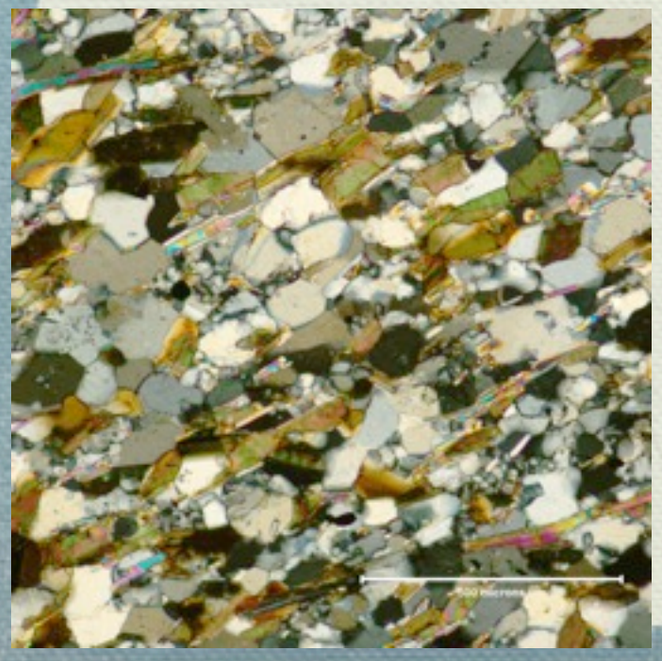


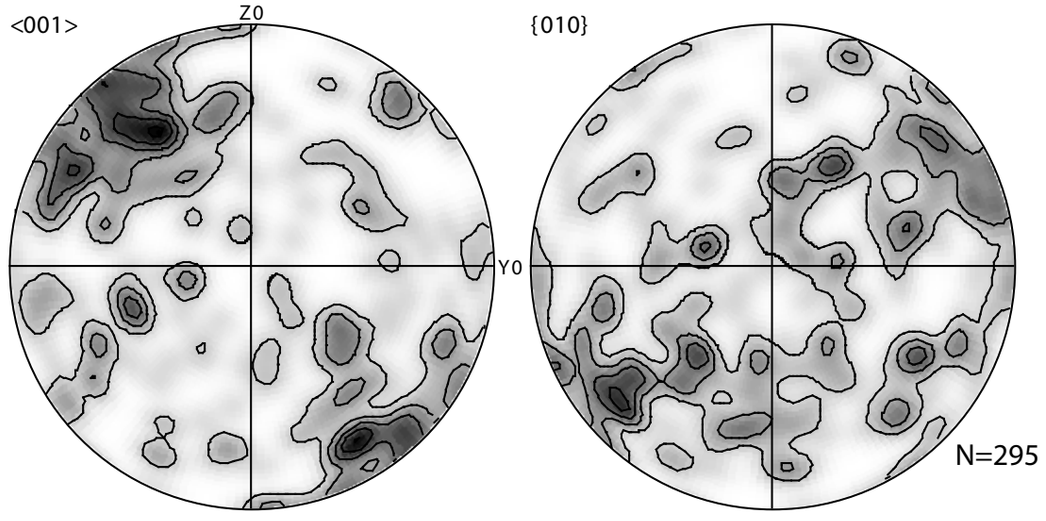
18-50 μm grains of quartz and plagioclase





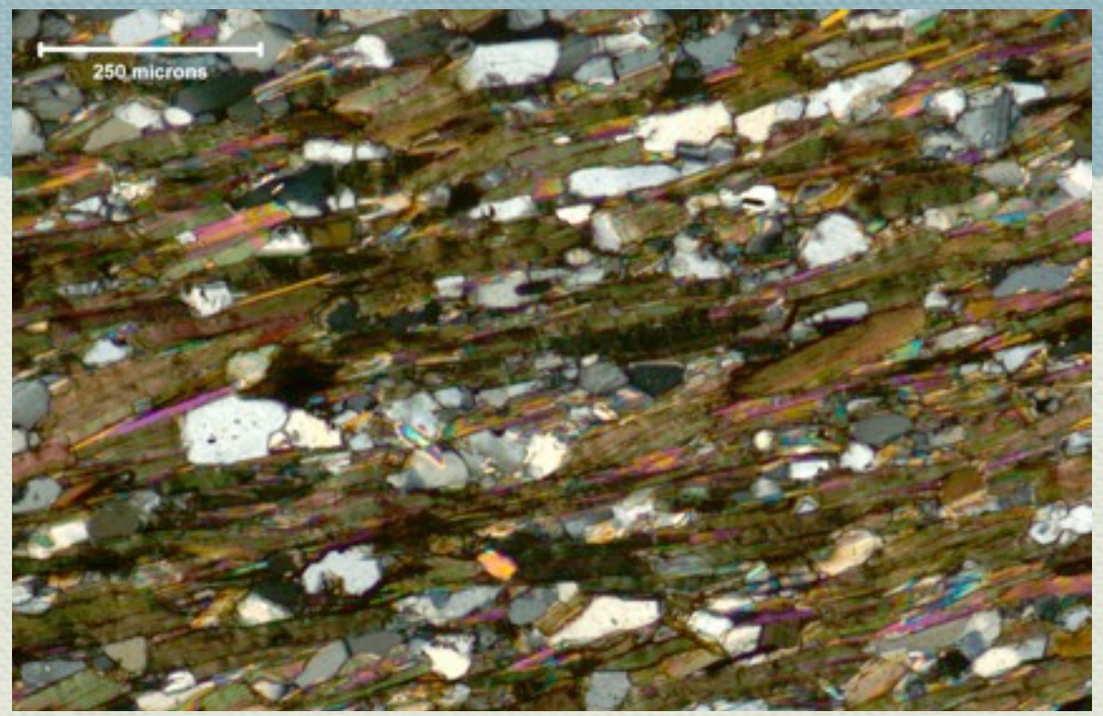
Quartz shows evidence for prism <a> slip, consistent with lower amphibolite facies metamorphism

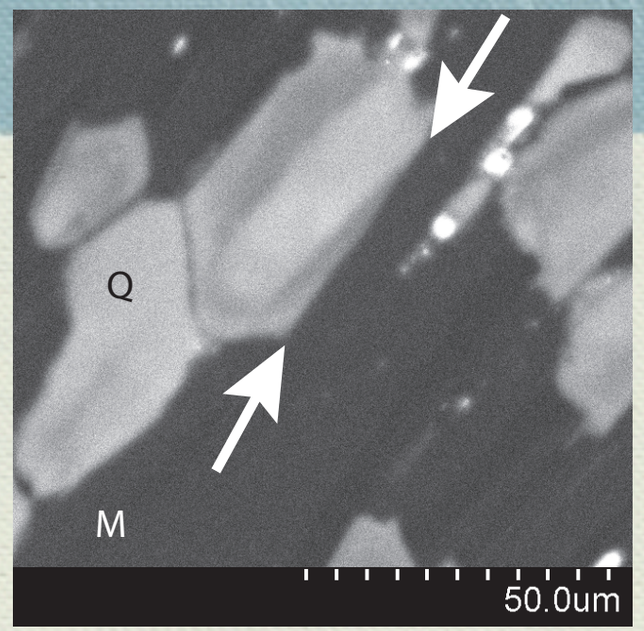


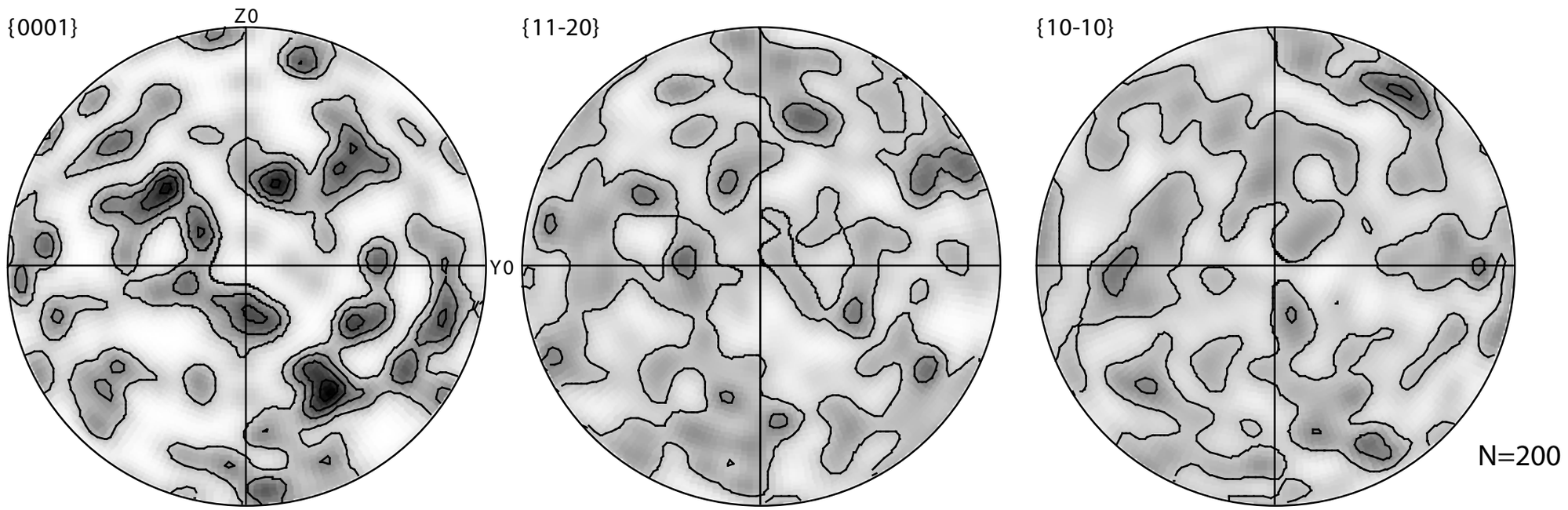


Albite CPO shows (010) <001> slip, records dextral shearing

Quartz in Phyllosilicate Domain

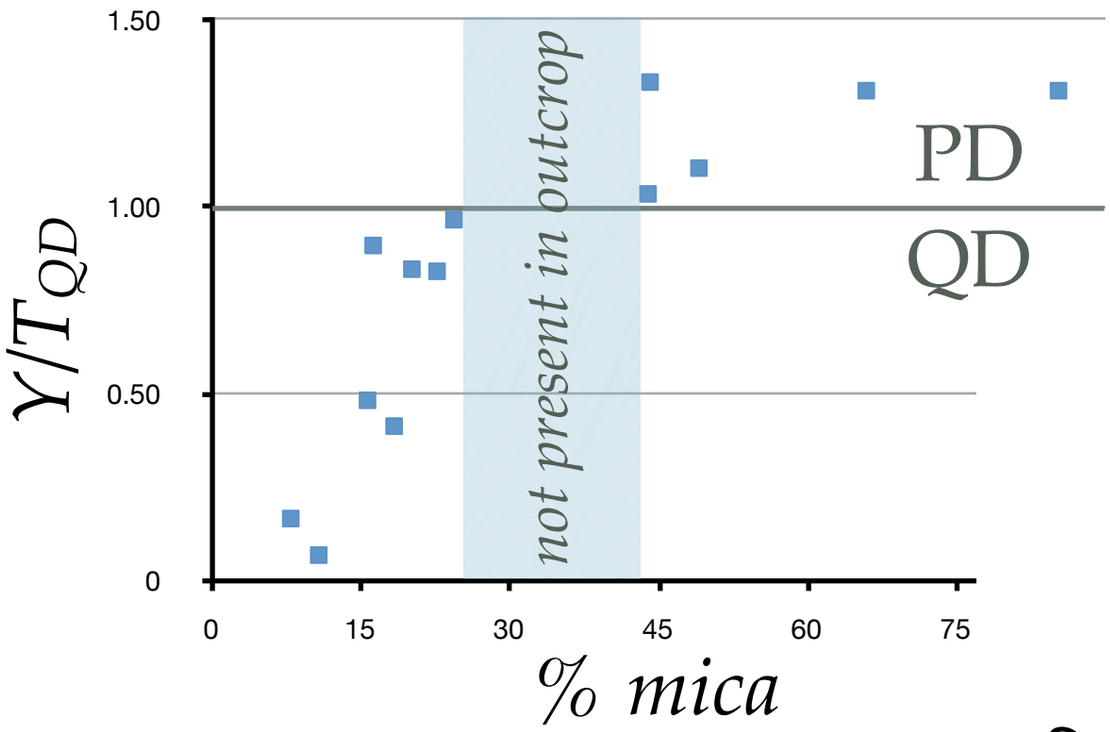


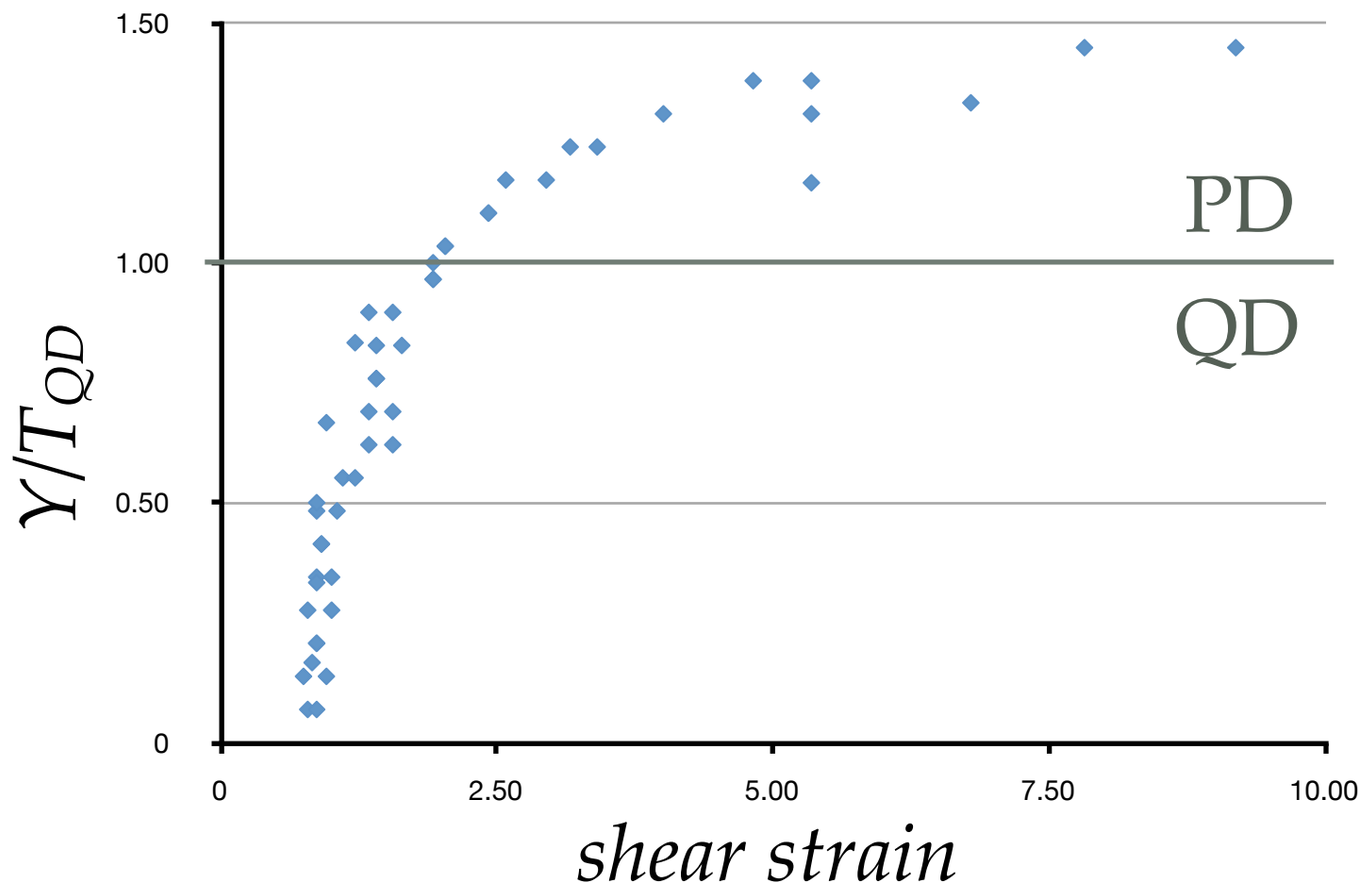




No crystallographic preferred orientation; consistent with microstructural evidence for diffusive mass transfer, grain boundary sliding

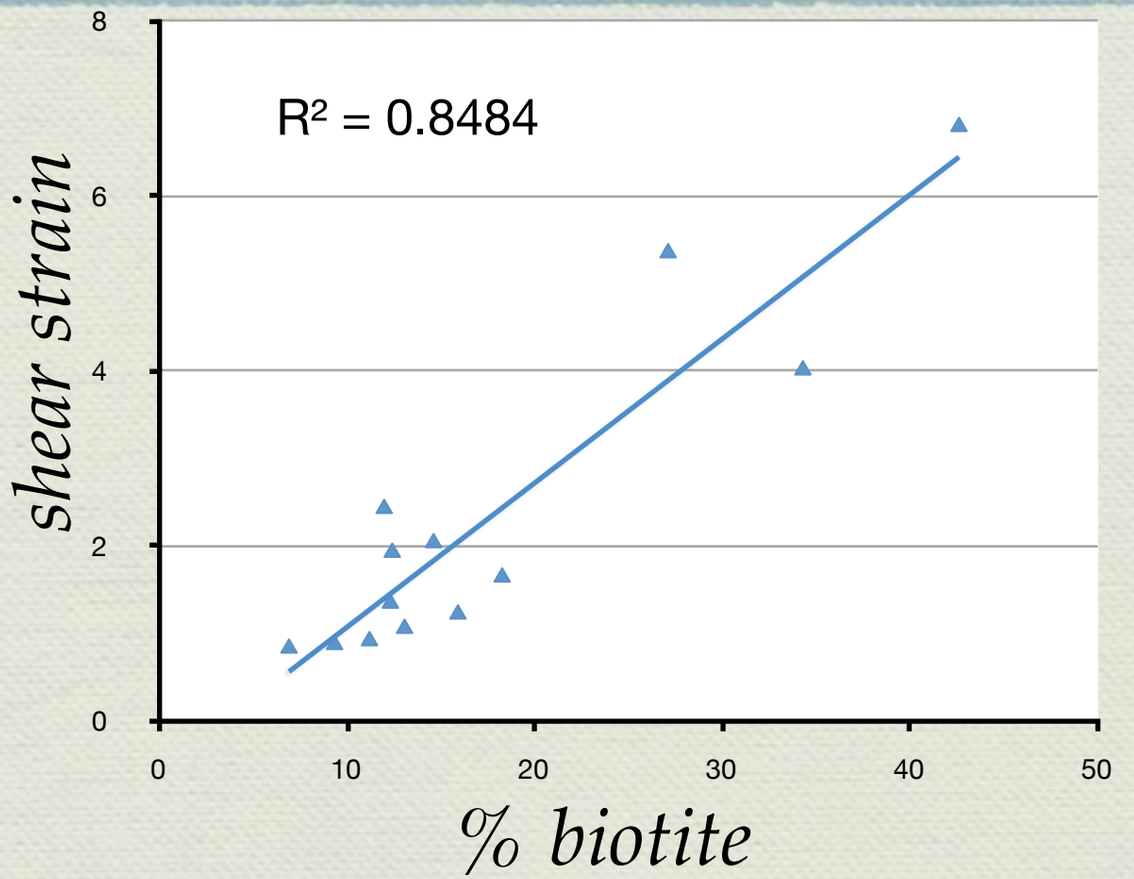
%Mica and shear strain show similar variation





Goodwin et al. (in prep.)

Mica type matters



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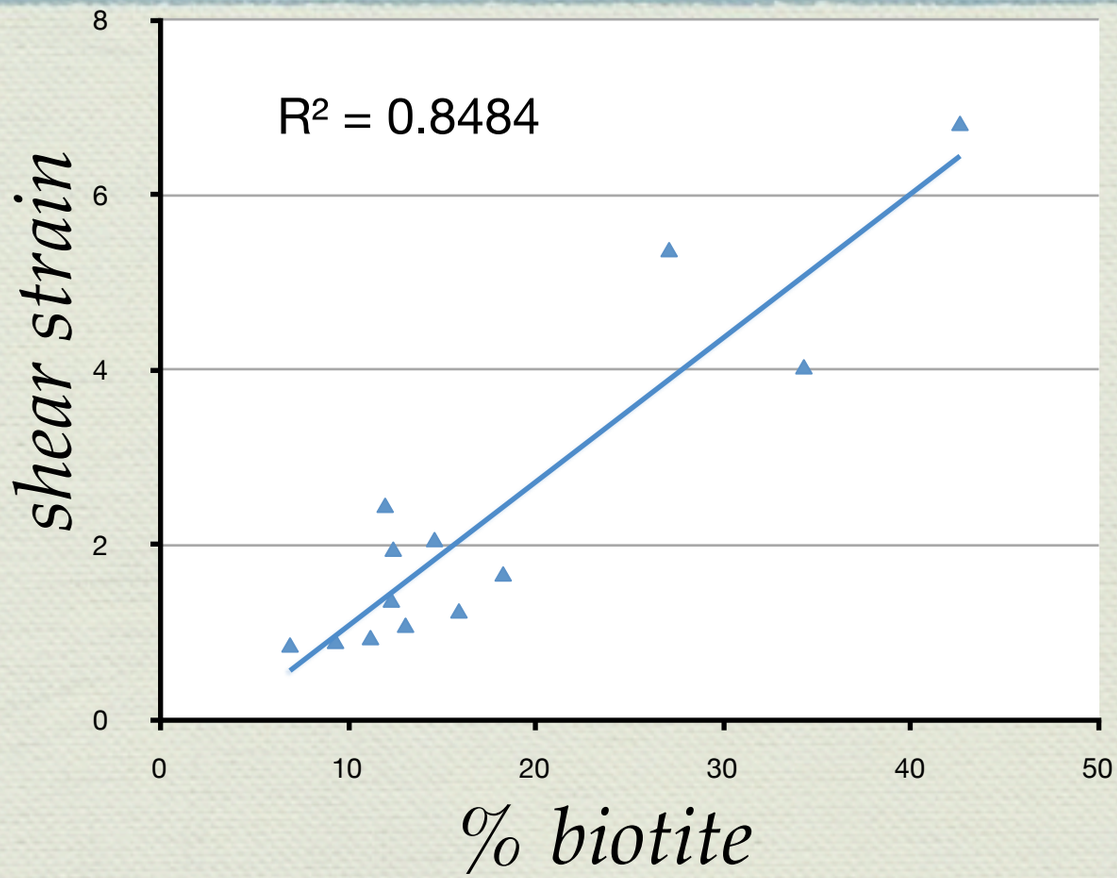
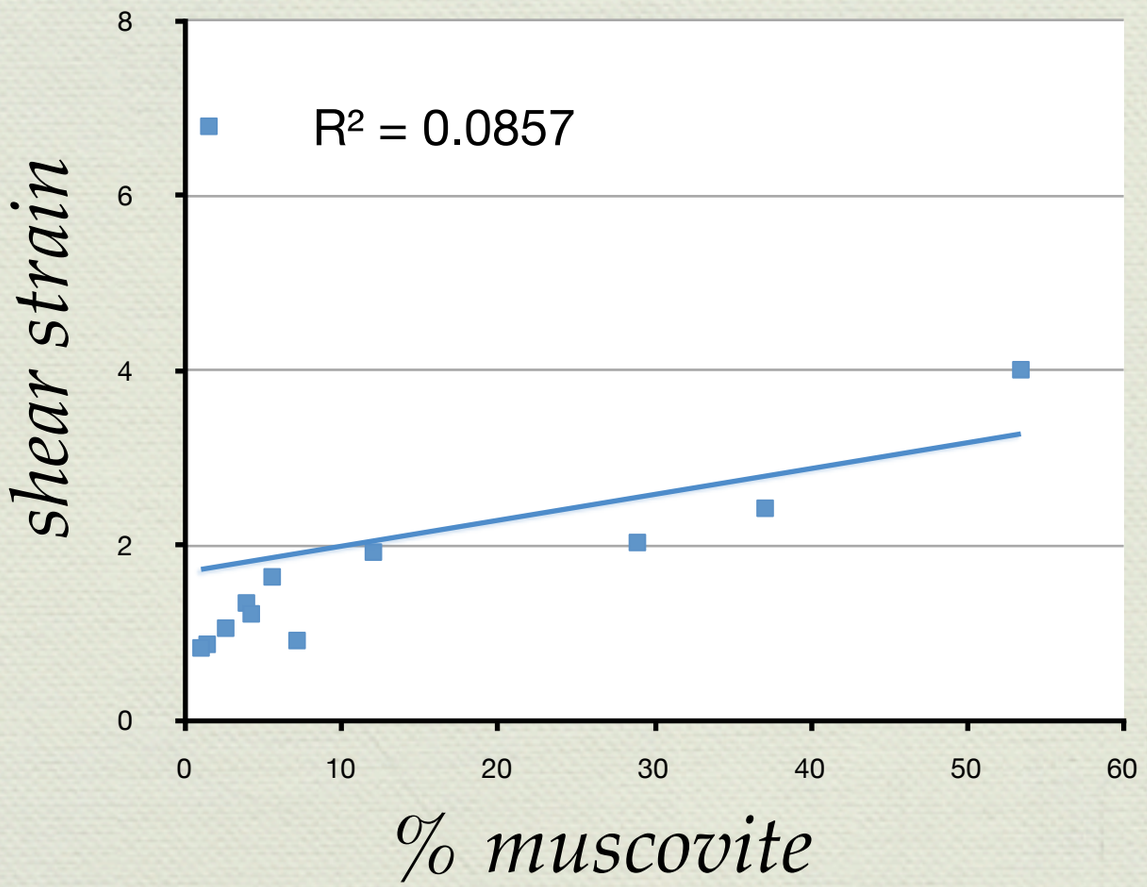
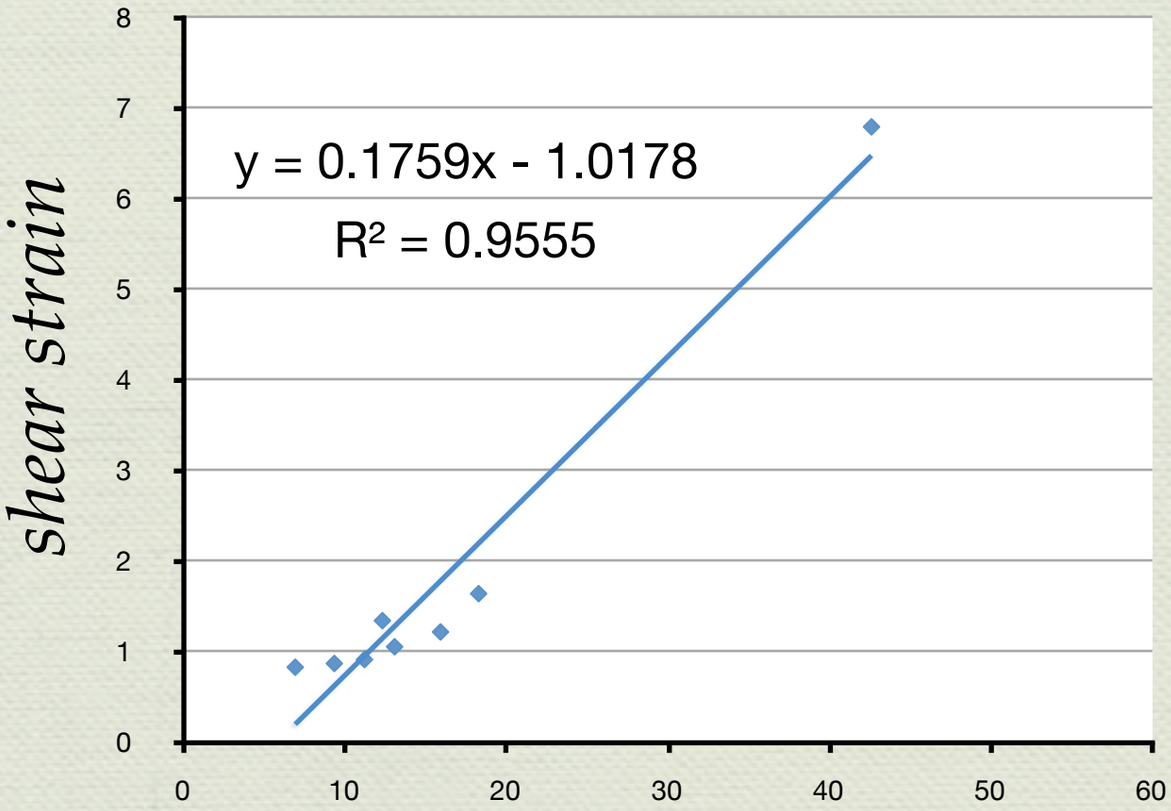
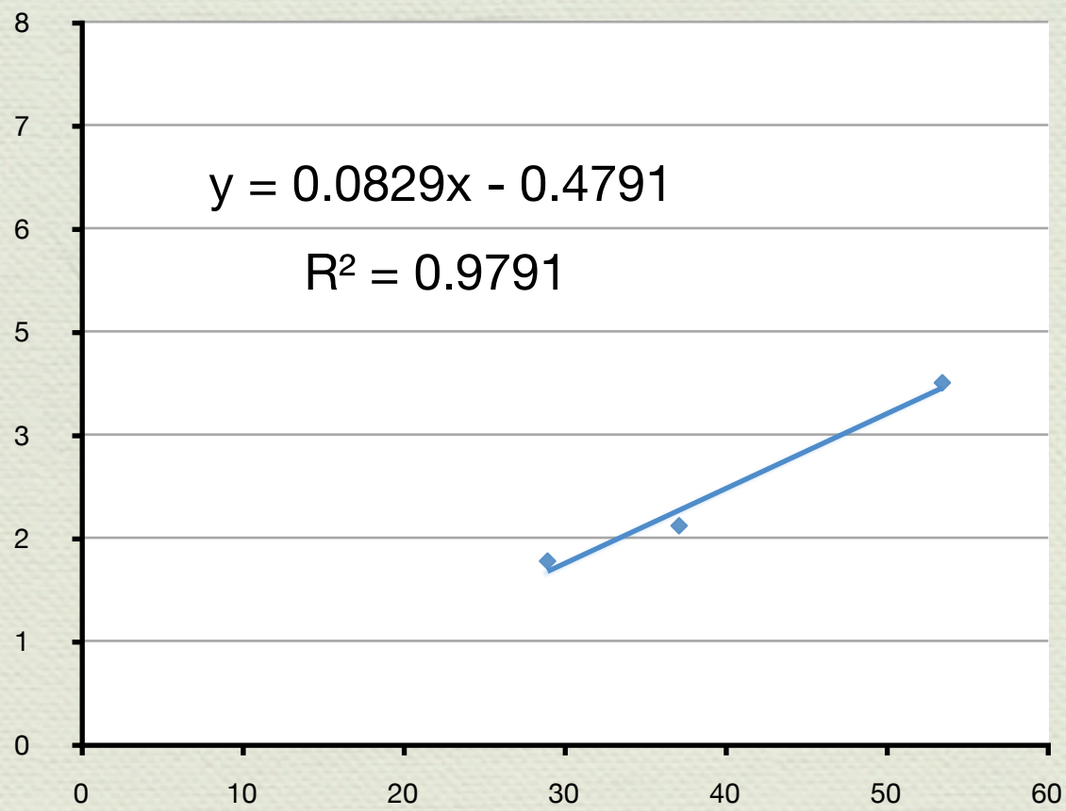




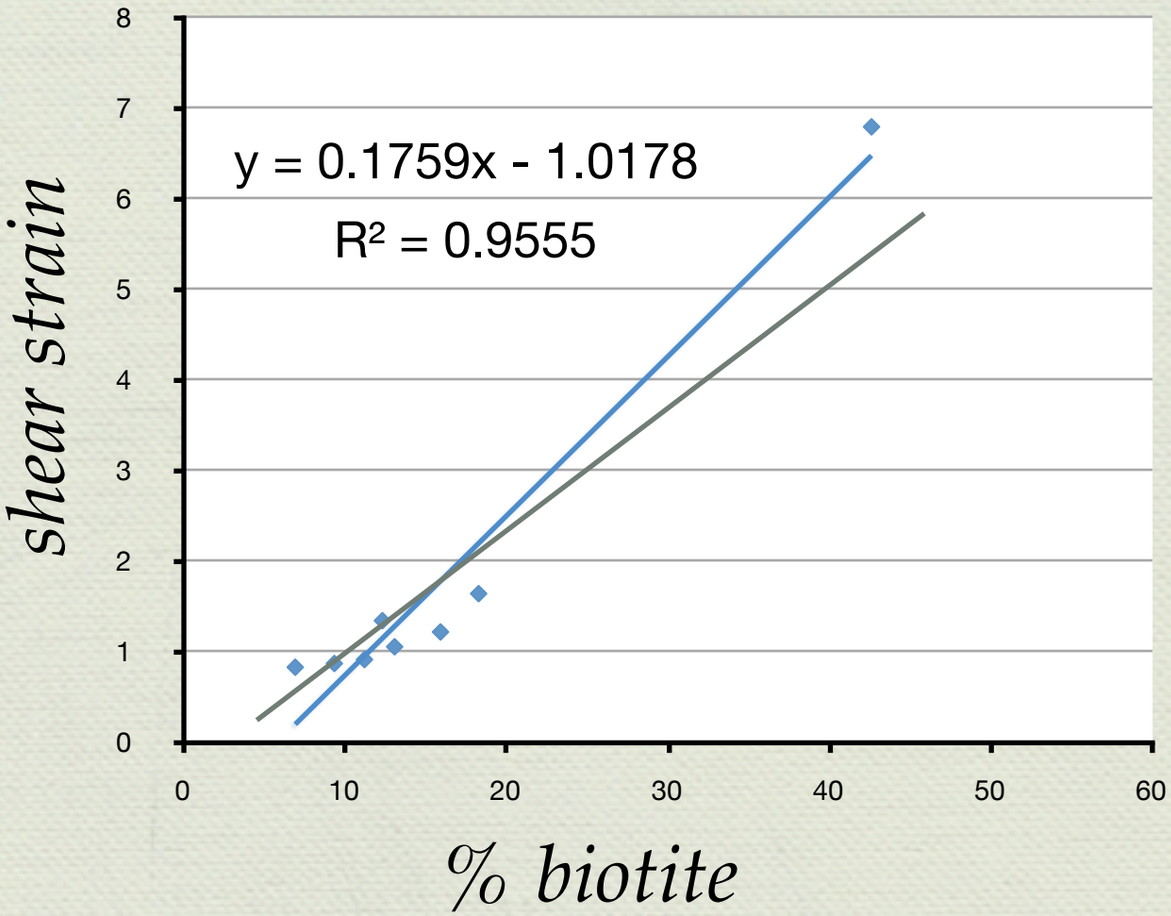
How much does it matter?

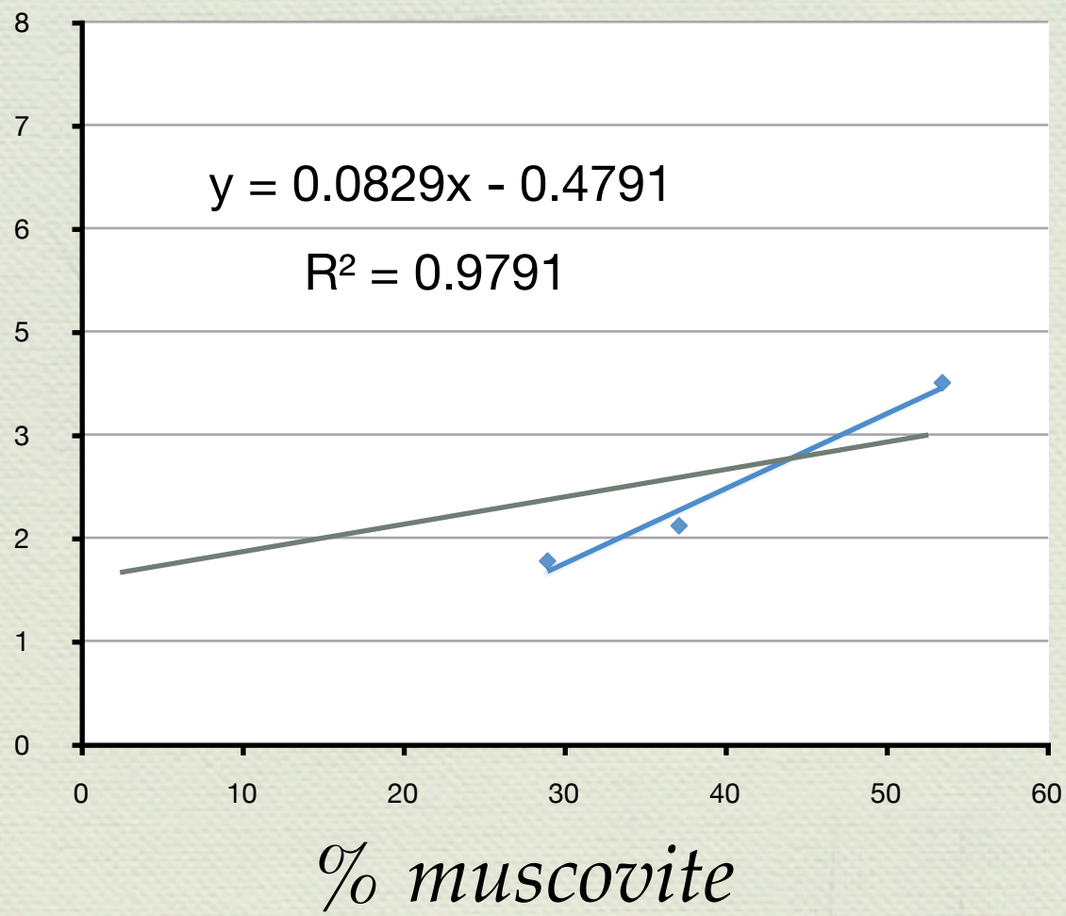




Need more than ~6% of either mica to affect deformation

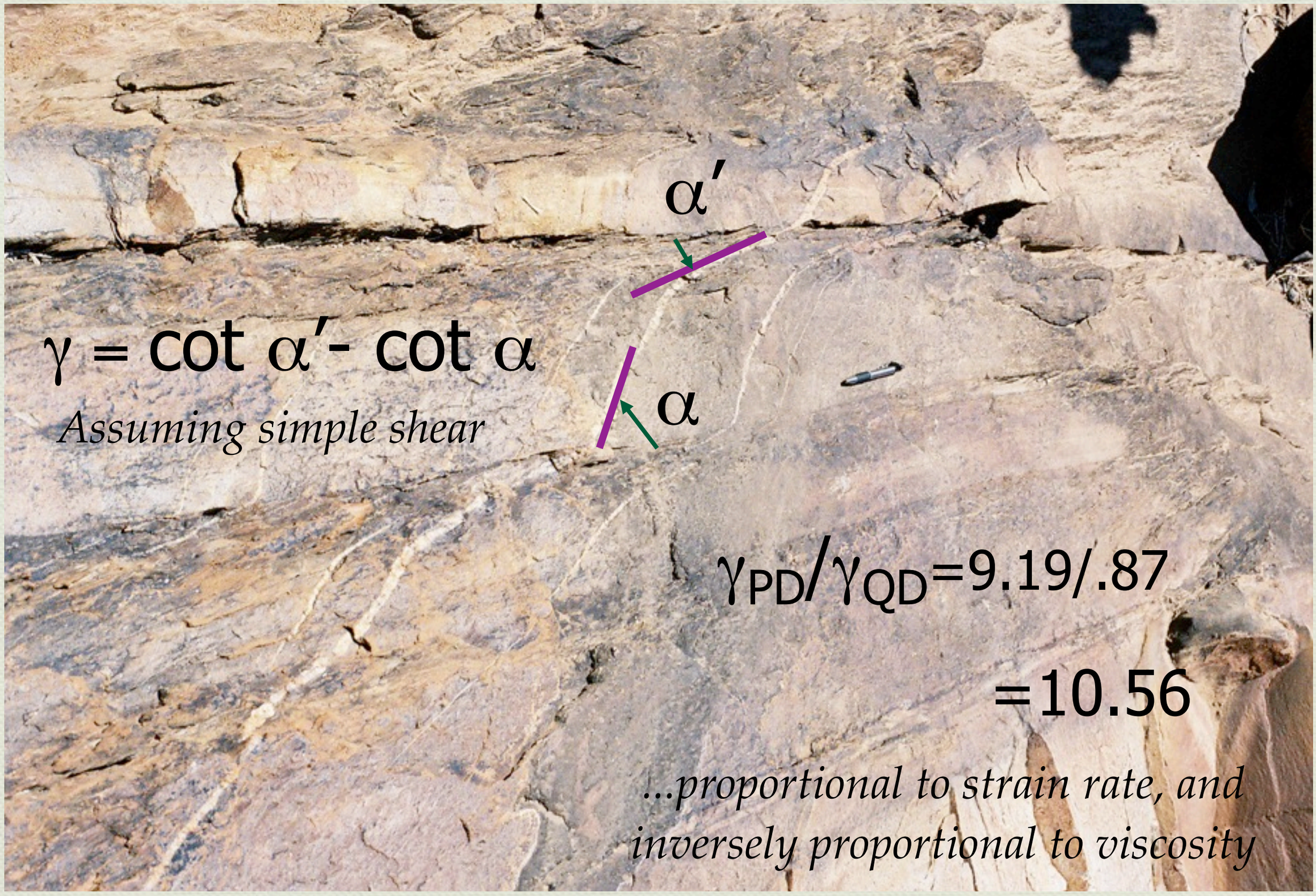
How much does it matter?





Need more than ~6% of either mica to affect deformation

Variations in shear strain with mica content

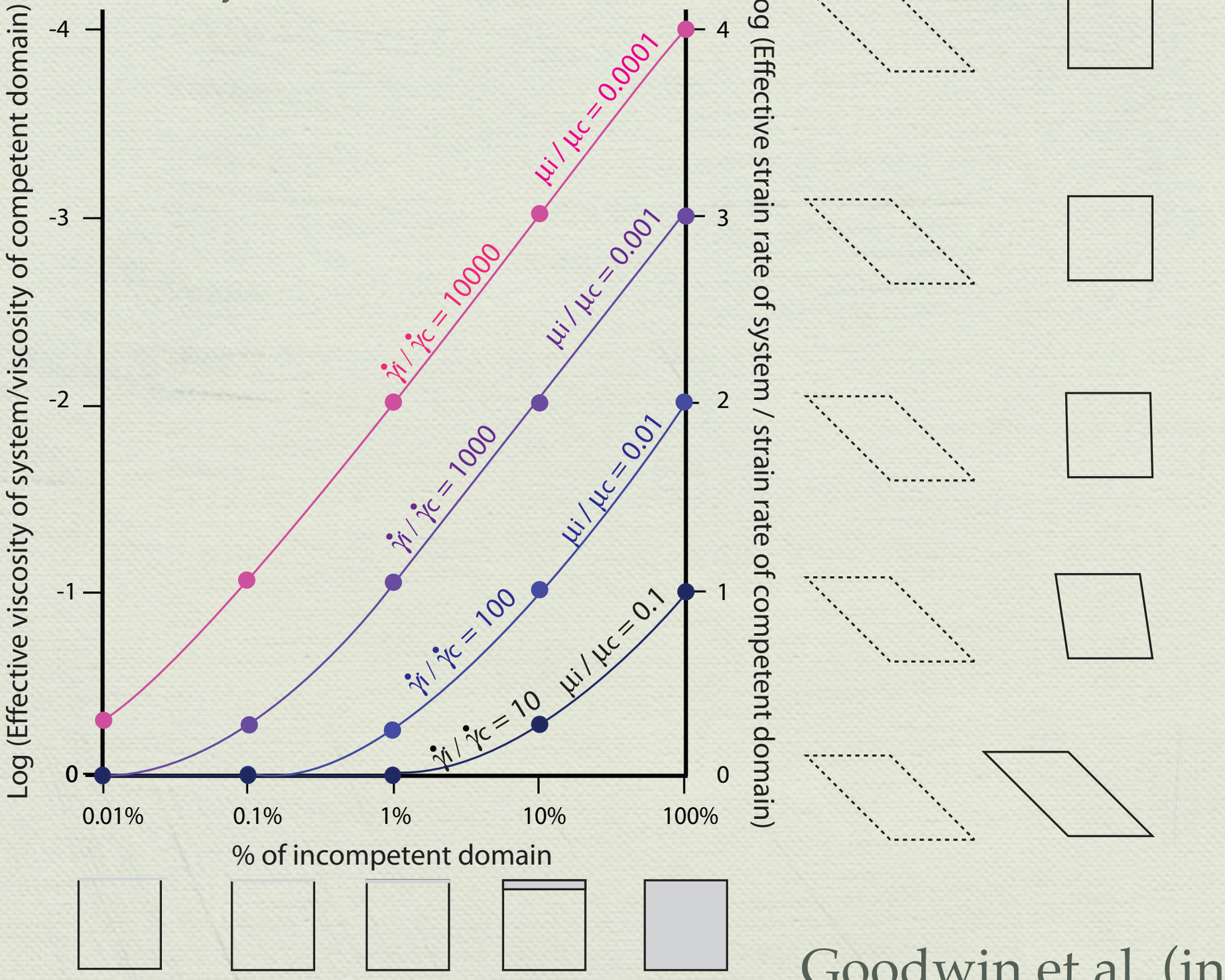


Observables: % incompetent domain, strain variations within individual turbidite sequences

- Can consider the effect on bulk strain of adding either a thicker or a weaker incompetent domain

Constructed using Biot's (1965) equation for viscosity for shear stress of a multilayer

Assuming constant bulk strain



Goodwin et al. (in prep.)

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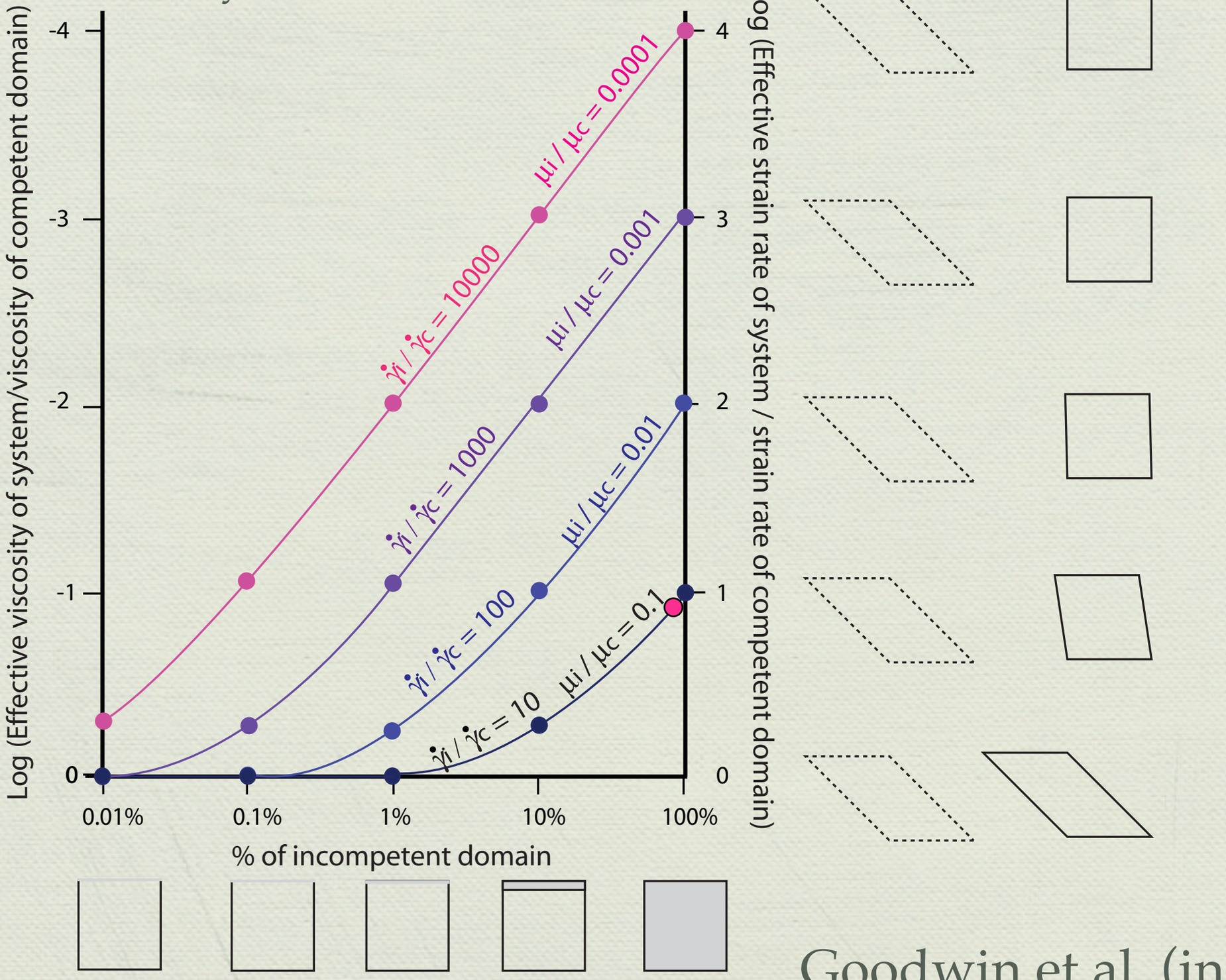

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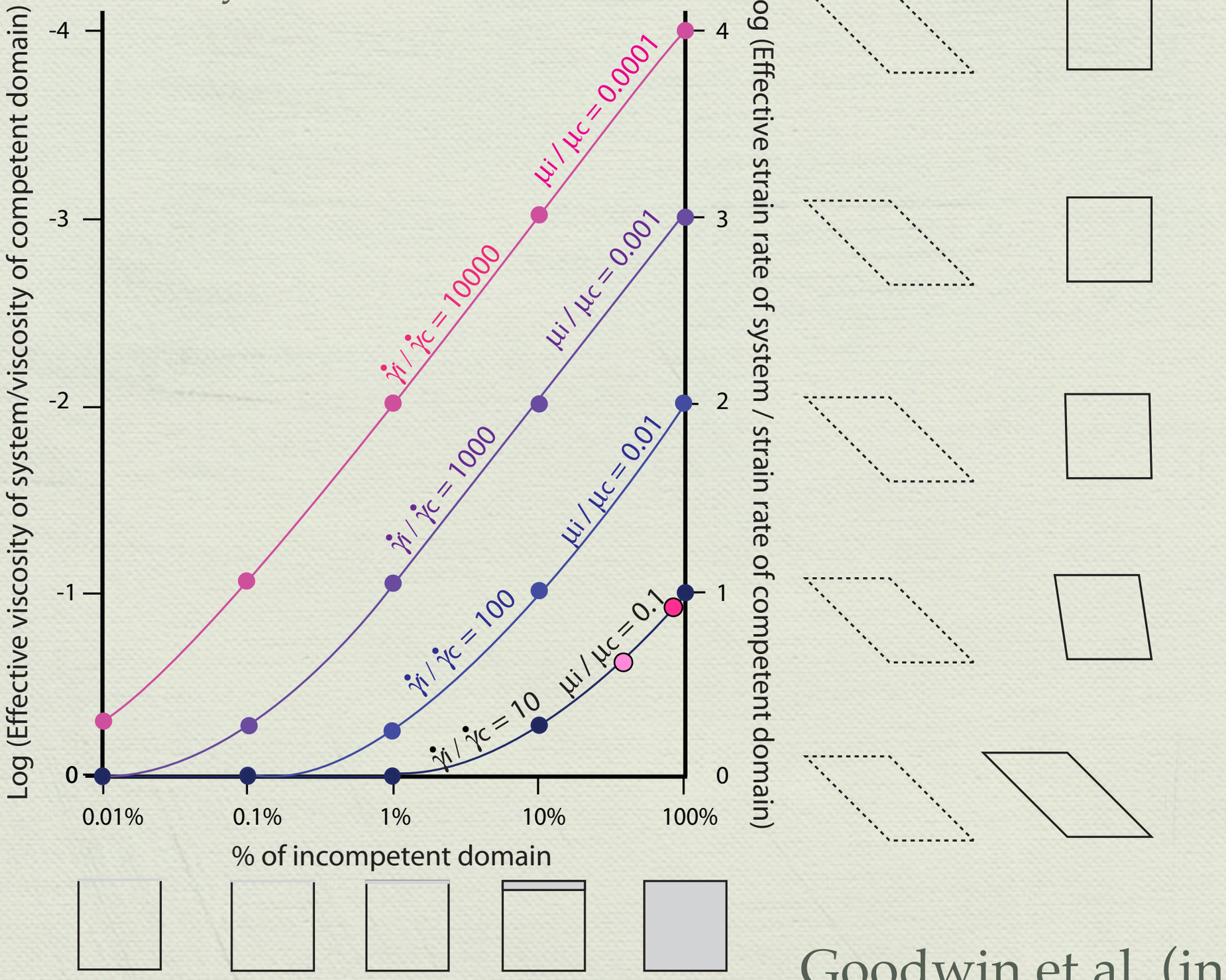

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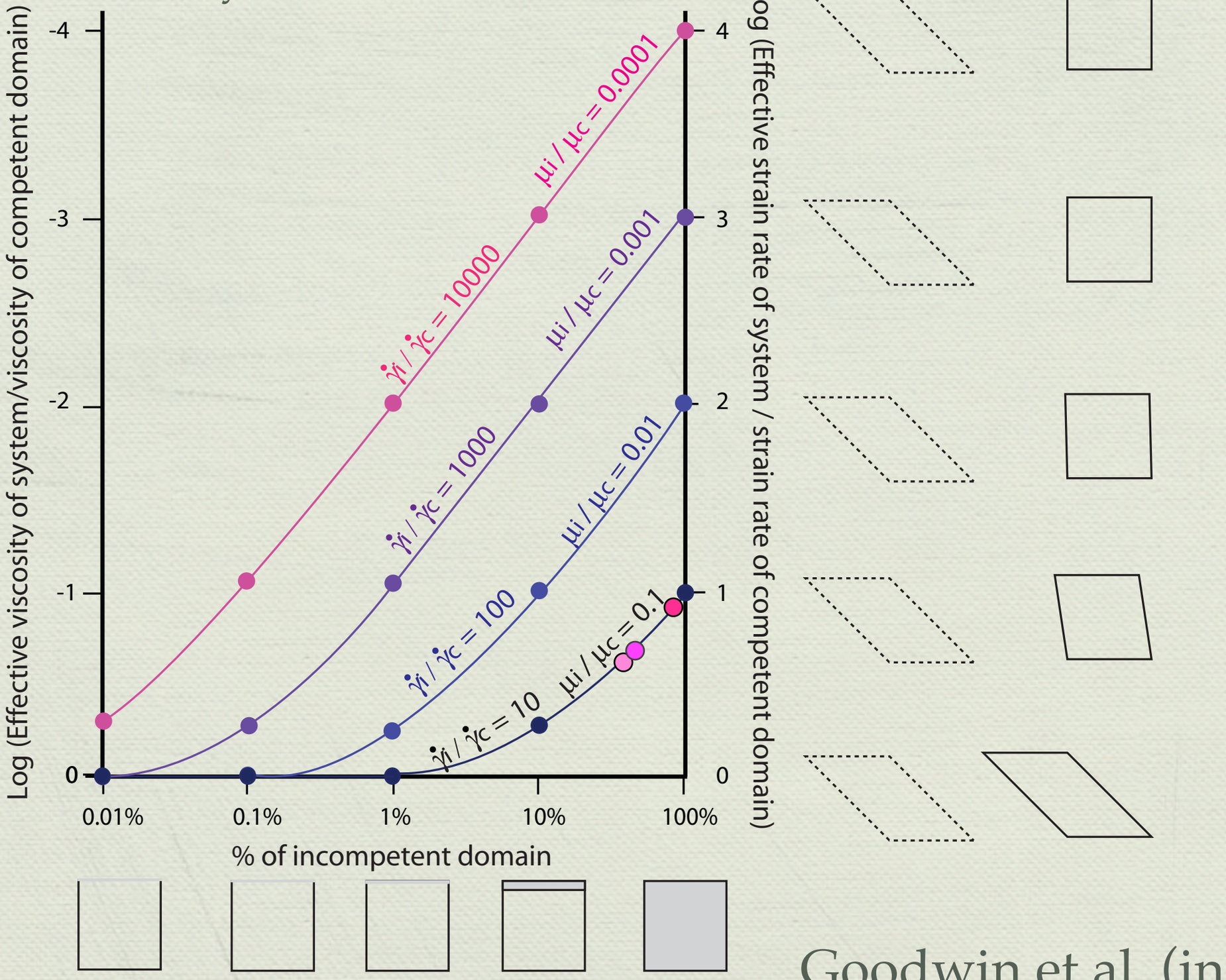

Goodwin et al. (in prep.)

Conclusions

- The effect of heterogeneity on bulk viscosity can be quantified if strain and can be determined
- High mica rocks have up to an an order of magnitude lower viscosity than low mica rocks.
- *If can back out stress and deformation mechanism(s) for experimentally calibrated phases, can quantify strain rate.*
- The 'effective bulk viscosity' approach can used more generally to extend experimental results