Impact of metasomatism on shear zone rheology: An example from the Pocologan Harbour granitoid belt, Canadian Appalachians

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Active faults and shear zones form the plumbing of fluid circulation in the upper and middle continental crust, allowing surface water to percolate to depth and metamorphic and/or hydrothermal fluids to migrate into upper crustal levels. The strain history of a thermodynamically metastable host rock is commonly linked with the fluids it may react with: Net transfer reactions or hydration reactions have the potential to either promote shear zone widening or induce strain localization. While most effects of fluid-rock interaction on deformation have been established across continuous outcrops or through laboratory experiments, much less work has been carried out to quantify them at the regional scale. To do so, we use benchtop µXRF data to quantify major element mass changes and phase distributions within representative specimens from across the strain gradient associated with regional shear zones. Furthermore, we quantify the fabric anisotropy from phase maps with quantitative image analysis. We tested this method on the Pocologan-Kennebecasis shear zone (PKSZ) in New Brunswick where we quantified the compositional changes of the shear zone host rocks and the contribution of phase transitions to the anisotropy of the thin section-scale fabric.

The PKSZ is located within the Ganderia microcontinent at the contact between the Pocologan Harbour granitoid belt and the Pocologan metamorphic suite. The latter reached amphibolite facies conditions during the Acadian Orogeny. Both units recorded dextral strike-slip ductile deformation during the Neoacadian Orogeny and were subsequently folded and faulted during an episode of orogen-oblique extension that lasted until the Carboniferous. Within the granite, monzonite, and quartz-diorite orthogneiss of the Pocologan Harbour granitoid belt, the foliation is defined by three mineral assemblages: chlorite + zoisite, muscovite, or muscovite + potassium-feldspar. Whole rock compositions of the deformed specimens show significant element mobility compared to undeformed specimens. Assuming that Ti was the least mobile major element, specimens with an assemblage of muscovite + potassium-feldspar are significantly enriched in Na, K, and Si (> 300 wt%) while being depleted of Mg (>90%). Because of the low chlorite-carbonate-pyrite alteration index, we interpret the compositional changes to relate to

metasomatism instead to variations of protolith compositions or hydrothermal alteration. The deformation gradient across the PKSZ is best approximated by the shape anisotropy of quartz, plagioclase, biotite and muscovite aggregates, with the least altered specimens displaying equivalent or greater phase aggregate anisotropy than the most altered specimens. Interestingly, the increase in mica modal proportion is not correlated with greater fabric anisotropy.

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