**Topic:** Metamorphic Petrology

**Data Sources and Publications:**

*McCoy, A. M., Karlstrom, K. E., Shaw, C. A., and Williams, M. L., 2005, The Proterozoic ancestry of the*

*Colorado Mineral Belt: 1.4 Ga shear zone system in central Colorado, in Keller, G. R., and Karlstrom, K. E., eds., The Rocky Mountain region—an evolving lithosphere: Tectonics, geochemistry, and geophysics: Washington, D.C., American Geophysical Union Geophysical Monograph 154, p. 71–90.*

**Additional resources:**

*Whitney, D., 2020, P-T-t Paths, in Integrating Research and Education -Teaching Phase*

*Equilibria,* [*https://serc.carleton.edu/19577*](https://serc.carleton.edu/19577)*, accessed 3/2/21.*

*McCoy, A.M., 2001, The Proterozoic ancestry of the Colorado Mineral Belt: 1.4 Ga shear zone system in*

*central Colorado, MSc thesis, University of New Mexico, 173 pages. [Additional figures and context]*

*Ward, D., Mahan, K., and Schulte-Pelkum, V., 2012, Roles of quartz and mica in seismic anisotropy of*

*mylonites, Geophysical Journal International, doi: 10.1111/j.1365-246X.2012.05528.x. [ID of*

*synkinematic sillimanite in Idaho Springs – Ralston shear zone quartzite mylonite]*

**Goal:** 1) To reinforce your understanding of the alumino-silicate metamorphic index minerals

- kyanite, andalusite, sillimanite

2) To understand how metamorphic minerals (and assemblages) can be used to infer Pressure-Temperature histories of rocks

3) To understand how textures in rocks in association with metamorphic minerals can be used to determine relative timing of deformation/metamorphic events.

4) To understand how these observations can affect your understanding of this particular map area.

**Figures to create:**

1. P-T-t diagram. *Note: if you consider all of the suggestions below, your diagram may not match exactly the one shown by McCoy.* Show how conditions may have changed through time in the history of the rocks in this map area. Use observations of aluminosilicate index minerals in the Coal Creek schist and quartzite to demonstrate this. Start with drawing a PT diagram with Y axis (Pressure) and X axis (Time) with stability fields for the Kyanite, Andalusite, and Sillimanite. Then, look at temporal and spatial relations between these index minerals, their growth, and deformation as described in McCoy et al., (2005), McCoy (2001) and Ward et al., (2012).
2. Based on this data, draw how the rocks may have traveled through this P-T space through time. Hint. For the metasedimentary rocks, this time (t) path should start at or near the origin 0,0, because these began as sediment near the Earth’s surface. Then the path should depict at least one cycle of prograde (increasing T) and retrograde (decreasing T) metamorphism, and then ultimately end back at the origin 0,0 since it resides back on earth’s surface today.

**Questions to Answer:**

1. What are the aluminosilicate index minerals and what is the significance of their stability fields in Pressure-Temperature space? Are there other important index minerals that occur in the Coal creek quartzite/schist sequence?
2. What is a likely order of formation for these aluminosilicate index minerals through this rock’s history, and what is the evidence? (which formed first, intermediate, and last)
3. What P-T conditions did the Coal Creek schist and quartzite experience?
4. How might the P-T history of the Boulder creek granodiorite have been different from the metasedimentary rocks?
5. Did the schist/quartzite undergo a classical regional succession of metamorphic facies: (AKA Barrovian, Buchan, Franciscan, or Sangabawa)
6. What does this tell us about the geologic history of rocks in this mapping area?
7. How do these data and interpretations relate to other field and analytical datasets that other students groups are working with?
8. How would this additional data and your interpretations of them affect your original map and cross-section interpretation?
9. Identify some of the main sources of uncertainty in these data and interpretations and discuss some ways that they are addressed.