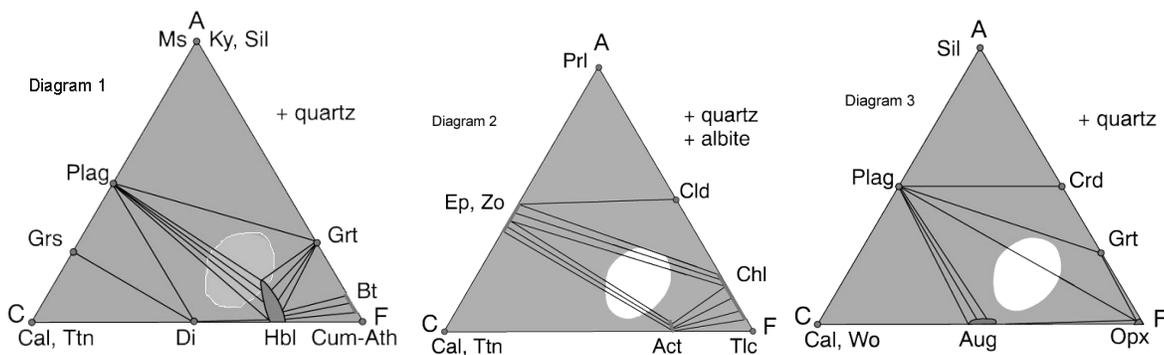


1. Short answer. Describe the following terms: [15 pts]
- a. serpentinization
 - b. hornfels
 - c. porphyroblast
 - d. blueschist
 - e. index mineral
2. One of our class members investigated mylonites from Argentina. [10 pts]
- a. What is a mylonite, and how is it formed?
 - b. How do we distinguish between protomylonite, mylonite and ultramylonite?
 - c. What properties of mylonitic rocks can be used to determine the sense of shear direction?
3. Traversing a series of metamorphosed pelitic rocks you observe increasing metamorphic grade: [10 pts]
- a. What is the protolith of a pelite?
 - b. What, if any, changes in average grain size would you expect to see?
 - c. What is the sequence of classic Barrovian metamorphic zones that you would expect to see?
 - d. What is the term for the boundary that separates two metamorphic zones?
 - e. Why are new metamorphic assemblages generated when changes in P, T, or chemistry occur?
4. You are studying prograde metamorphism of metabasalts. You observe the mineral assemblages as shown in the circled areas, on the ACF diagrams below (**note** – they are out of order!). Which minerals are stable in the circled areas in each diagram, and what metamorphic facies does each diagram represent? [10 pts]



5. One of our class members researched a sample from Bridal Veil Falls in the Black Hills. These are classified as syenite or nepheline syenite. Describe the mineralogy and chemistry of these rocks, which are unusual compared to most igneous rocks on Earth. [5 pts]

6. One of our class carried out geothermometry on a schist sample from the Black Hills. [20 pts]

- a. What instrumentation is used to carry out these measurements?
- b. What mineral assemblage did he use?
- c. Describe in words the theoretical basis for geothermometry. What elements or element ratios vary with temperature, which allow us to calculate a T value? What assumptions are made in this process? (formulas not required)
- d. In terms of P/T slope, what is a characteristic of a good geothermometer?

7. Respond to one of the topics below. CHOOSE ONE – ONLY ONE. [30 pts]

a. One of our class members carried out research on a Hawaiian basalt.

How is the tectonic setting and the mantle source of the magmas that form the Hawaiian Islands similar and different to typical MORB?

Address major and trace element geochemistry. Provide diagrams along with well-thought out and neatly written statements.

OR

b. Draw a neat schematic cross section of an island arc, and relate metamorphic facies to this tectonic setting. Label the following facies on your diagram using the letters given:

- | | |
|-------------------------|----------------|
| a. zeolite | e. greenschist |
| b. prehnite-pumpellyite | f. amphibolite |
| c. blueschist | g. granulite |
| d. eclogite | |