

name _____

Petrology Exam #2 Fall 2009

1. In what geological and/or plate tectonic settings would you expect the following kinds of rocks to commonly form? Explain your answers!

blueschist	
granulite	
eclogite	
amphibolite	
marble	
skarn	
serpentinite	
schist	

2. Ultramafic rocks rarely show evidence of prograde metamorphism. Instead, they very often show signs of retrograde metamorphism. Why is this? What sorts of things happen to an ultramafic rock during retrograde metamorphism? Describe in a general sense the sorts of changes that occur, and give some specific examples of textures and minerals that form under various conditions.

3. Figure 21.4 in your book shows a phase diagram with a metamorphic P-T-t path indicated by arrows. What is a metamorphic P-T-t path? How do metamorphic petrologists determine P-T-t paths for metamorphic rocks?

4. Look at the Table 22.1 on page 491 in the book. Note that fewer minerals are common in metamorphosed ultramafic rocks than in basic rocks or aluminous rocks. Why the differences? Explain this observation.

5. Consider the phase diagram shown on the next page. Minerals are orthopyroxene, spinel, kyanite, sapphirine, garnet, forsterite, kyanite, sillimanite, quartz, and cordierite.

a. Look at the phase diagram, use the phase rule, and tell me how many chemical components are involved?

b. Are any of the reactions on the phase diagram degenerate? If so, which?

c. Choose any reaction on the diagram, give formulas for the minerals involved, and balance it.

d. Some turkey only labeled one side of a reaction in the middle of the diagram (Opx, Sil, Qz). What goes on the other side?

Does this information help?

opx = enstatite = $\text{Mg}_2\text{Si}_2\text{O}_6$

saph = sapphirine = $\text{Mg}_6\text{Al}_4\text{Si}_4\text{O}_{20}$

sp = spinel = MgAl_2O_4

sil = sillimanite = Al_2SiO_5

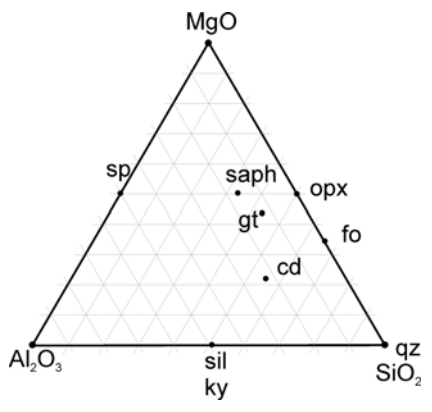
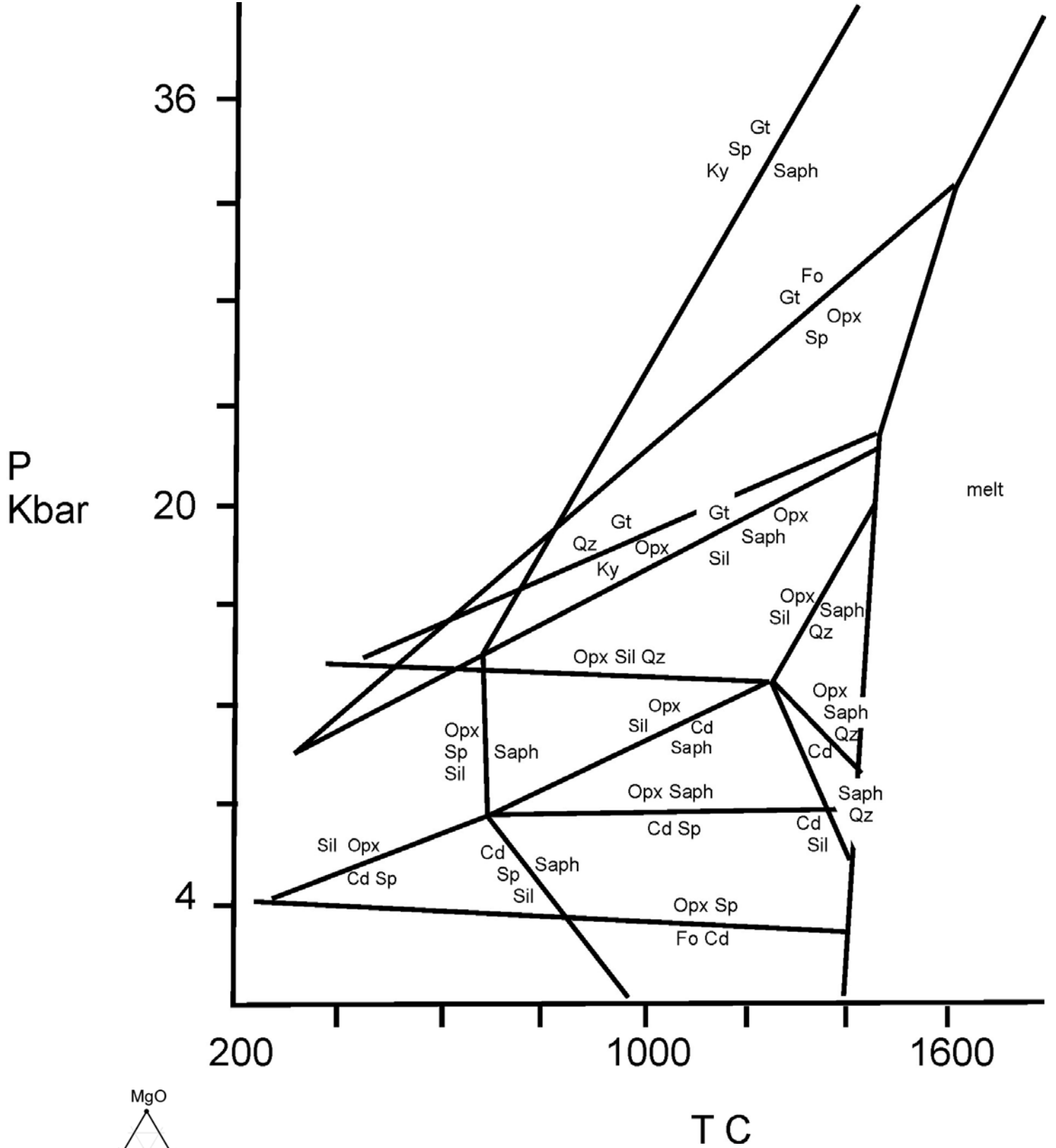
Gt = pyrope garnet = $\text{Mg}_3\text{Al}_2\text{Si}_3\text{O}_{12}$

cd = cordierite = $\text{Mg}_2\text{Al}_4\text{Si}_5\text{O}_{18}$

Ky = kyanite = Al_2SiO_5

Fo = forsterite = Mg_2SiO_4

Qz = quartz = SiO_2



e. Choose one invariant point, enlarge it and the reactions around it, and put triangular compatibility diagrams in the appropriate places with appropriate tie lines. Be EXCEPTIONALLY NEAT,

f. Look at the pressure and temperature ranges shown. If a rock experiences these sort of pressures and temperatures, is it a normal kind of metamorphism? Describe where/how such metamorphism might occur.

g. Note that none of the low pressure relations involve garnet. Why?

h. Look at the minerals involved and their compositions. What kind of rock might this diagram apply to?

i. Where on the diagram are the following minerals/assemblages stable? (Show on the diagram - use letters to label correct places.)

- A. Opx
- B. Saph
- C. Gt+Sp
- D. Opx+Sp+Sil
- E. Sil+Gr+Saph+Qz
- F. Sil+Cd+Opx+Saph+Qz

6. Consider the Dutchess County exercise.

a. How do the results of the thermometry/barometry compare with the P-T results determined using AFM diagrams?

b. Which do you think is a better way to determine metamorphic conditions - AFM diagrams or thermobarometry? Explain why/justify your answer.

c. Describe, in general terms, how metamorphic grade varies regionally in Dutchess County. Low grade is where? High grade is where?

d. How does the regional variation in metamorphic grade relate to tectonics? That is, why are high grade rocks exposed where they are, and low grade rocks where they are? btw - these rocks were metamorphosed in the Taconic Orogeny, during late Ordovician time. For bonus points, tell me how many millions years ago that was?

7. Three different types of regional metamorphism facies series are Buchan, Barrovian, and Franciscan.

a. First, explain regional metamorphism - what is it, what causes it, etc.?

b. What are the facies of Buchan metamorphism?

c. Where would you go to find examples?

d. What are the facies of Barrovian metamorphism?

e. Where would you go to find examples?

f. Why is it Barrovian metamorphism different from Buchan metamorphism?

g. What are the facies of Franciscan metamorphism?

h. Where would you go to find examples of Franciscan metamorphism?

i. How does Franciscan metamorphism differ from Buchan and Barrovian metamorphism?

8. How does the garnet-biotite geothermometer work? Why does it make a good thermometer?

9. What is a whiteschist? Why are they so rare?