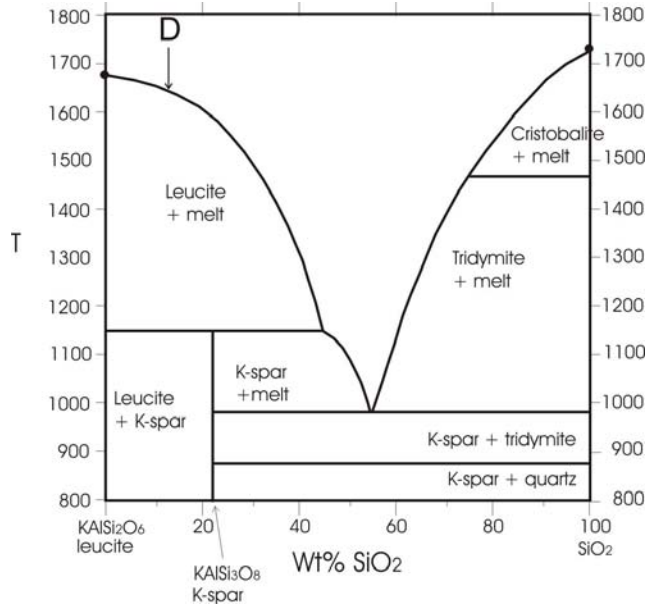


Geo 320: Petrology
Final Exam
Fall 2009

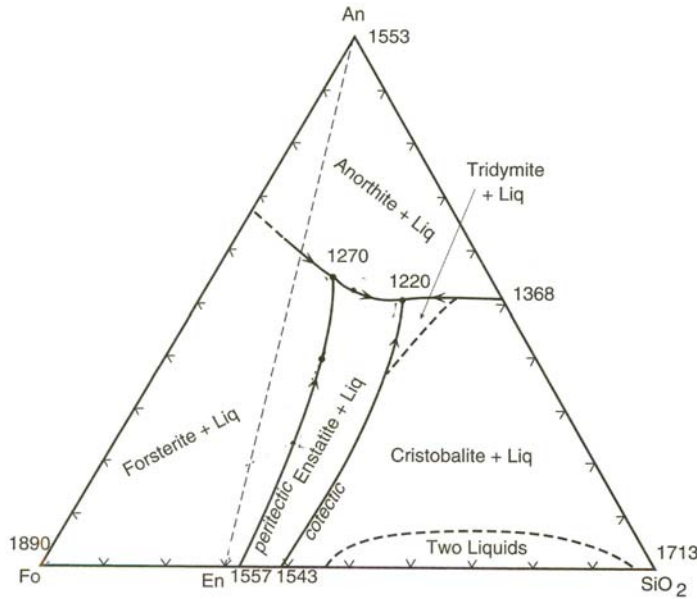
1. What are the most important things learned in this class? Choose at least four or five and explain why they are important. If you were to follow up on those topics, what questions would you ask? What topics would you pursue? Etc.
2. Look at a phase diagram for SiO₂ minerals. Why are different minerals stable in different parts of PT space? Specifically, what properties of the various minerals determines their stability? At 800°, if you go from low pressure to high pressure, you pass through fields for tridymite, high quartz, low quartz, coesite and stishovite. Why does this make sense? At 1 atm, if you go from low T to high T, you pass through fields for low quartz, high quartz, tridymite, cristobalite and then a melt. Why does this make sense? Explain the stability relationships.
3. Magmas of many different compositions reach the surface of the earth. Similarly, we find plutons of lots of different compositions so we know that intrusive magmas are also highly variable in composition. What is the source of the variability? Why are there so many different compositions? Although compositionally variable, most are dominated by oxygen and silicon. Why?
4. What are metamorphic zones, index minerals, and metamorphic isograds?
5. Suppose you have a magma of granitic composition. What kind of rock would form - what would it be called and what would it look like, and what minerals etc. would it contain - if
 - a) the magma solidified deep underground
 - b) the magma solidified at some shallow depth underground
 - c) the magma began to solidify deep underground but later erupted at the surface
 - d) the completely molten magma erupted at the surface
6. Describe the standard IUGS and TAS systems used to name igneous rocks. When would you use one, and when the other. More important, why do these systems work? They are only 2-D approaches to classification and we know that rocks vary in more than 2 ways.
7. The most common volcanic rock at Earth's surface is basalt. In oceanic regions it is everywhere. On continents there are huge tracts of flood basalts. In comparison, there are many fewer occurrences of other volcanic rocks such as andesite or rhyolite. Why is this? Why so much basalt? What are the three principle kinds of basalt and where are they normally found?
8. If you study metamorphosed pelitic rocks (metapelites), you see a whole bunch of way cool minerals. What is a metapelite? What was its protolith? If you study metabasites you also may see a bunch of cool minerals, but the mineralogy of metabasites does not vary as much as that of pelites. What is a metabasite? What was its protolith? Finally, if you study marbles or quartzofeldspathic rocks, the mineralogy is often quite boring and limited. What are marbles and quartzofeldspathic rocks and what were their protoliths? Now, explain why the mineralogies of each of the four metamorphic rock types are different. And, why are some (metapelites for example) much more variable than others?



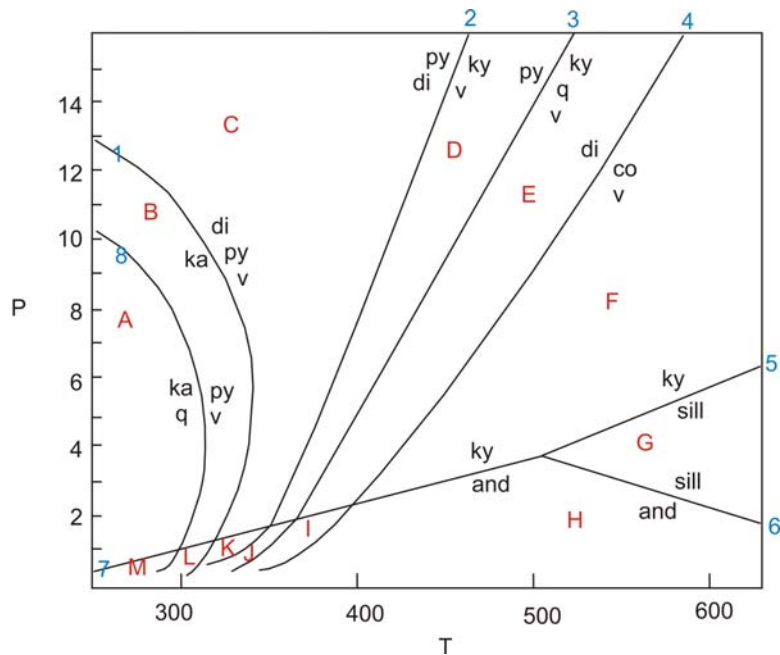
9. Consider compositions A through J, indicated on top of the diagram above. For each of them: what will be the temperature at which the last drop of liquid disappears, and what minerals will be present and what % will there be of each?

composition	last melt at what temp	minerals and percentages
A		
B		
C		
D		
E		
F		
G		
H		
I		
J		

10. For this question, assume you have a melt that contains some mix of Mg_2SiO_4 , SiO_2 , and $\text{CaAl}_2\text{Si}_2\text{O}_8$. This means we can use the diagram below to consider what happens as it crystallizes.



- If the composition of the melt plots somewhere within the triangle (neither on the outside nor at a corner), what mineral assemblage will it contain after it has completely crystallized. Is there only one possibility, or are there more than one? Explain.
- In what order will minerals crystallize for compositions X. When done, what minerals will be present in what amounts? What is good name for the rock that is formed?
- In what order will minerals crystallize for compositions Y. When done, what minerals will be present in what amounts? What is good name for the rock that is formed?
- In what order will minerals crystallize for compositions Z. When done, what minerals will be present in what amounts? What is good name for the rock that is formed?
- If the starting melt composition plotted somewhere on the side of the diagram between SiO_2 and An, what would be present after crystallization is completed?
- If the starting melt composition plotted exactly on top of Fo (at the corner) what would be present after crystallization is completed?



11. You have seen this phase diagram before. It shows a system with reactions relating about 10 minerals. The reaction lines are numbered (1 to 8) and the fields between reactions are labeled with letters (a to m).

a. How many components are involved in the system shown on this diagram?

b. According to this diagram, where are each of the following assemblages stable?

mineral/assemblage	where stable?
co	
ka	
and	
cz	
ky + q	
di + co	
ka + q	
ka + sill + ky	
ky + di + v	
py + di + co + v	
di + co + ky + and	
di + co + ky + and + v	

c. Reactions 2 and 3 have a change in slope when they cross reaction 7. But, reactions 8, 1 and 4 pass smoothly across reaction 7. Why?

d. Note those funky reactions (1 and 8) that curve around and go backwards. They have a negative slope at hi P and a positive slope at low P. Why? Be specific about why the slope changes and why it changes from negative to positive.