GLY306 Petrology

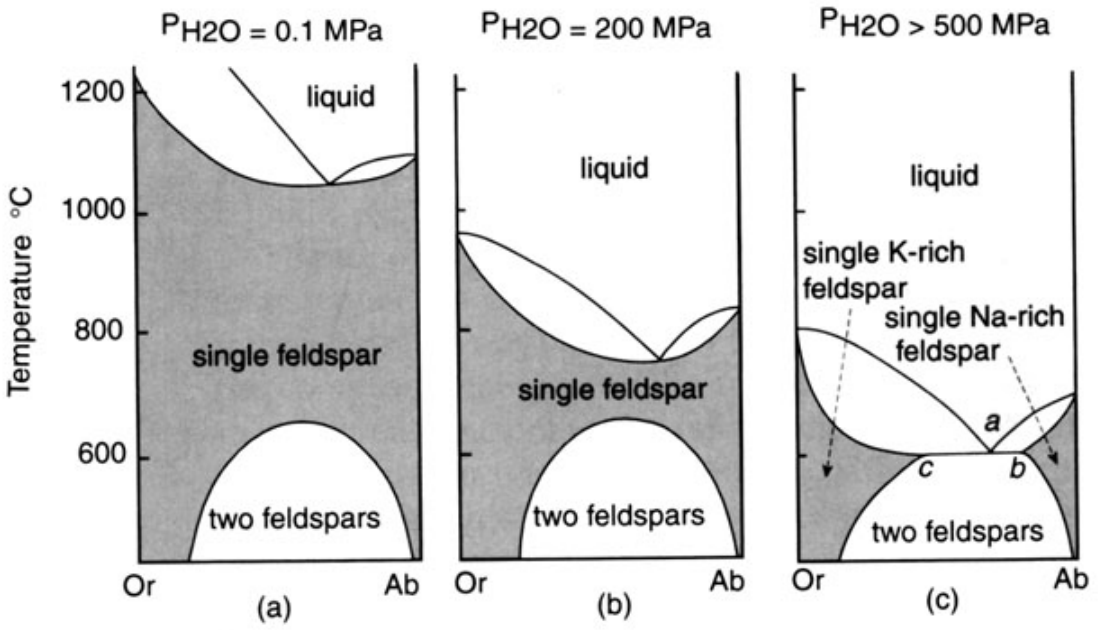
Exam I

1. (10 points) Give the following optical properties for the minerals listed below.

	Hornblende	Plagioclase	Quartz	Augite
Color/pleochroism				
Extinction angle				
Cleavage angle				
Twining				
Refractive index				

2. (20 points) A. How can the phase diagrams below explain the difference between hypersolvus granites and subsolvus granites?

   B. What is the petrogenetic significance of each type of granite and how would you distinguish them in hand sample?



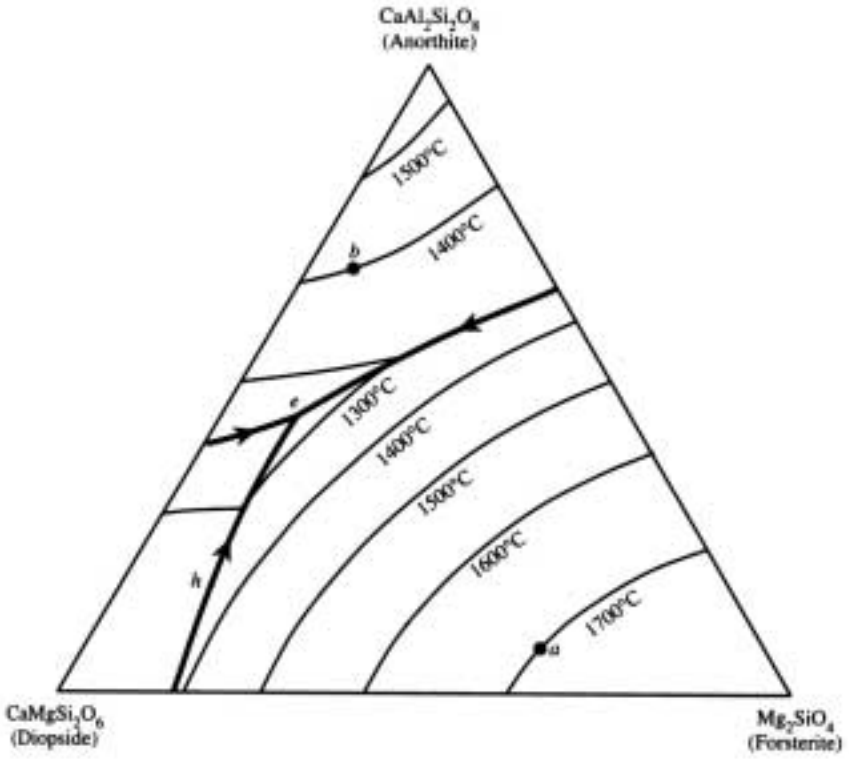
2. A. Diagram (a) shows a "dry" (low pH2O) system in which a single feldspar phase froms in the liquid. This if the composition of the initial liquid (and hence the feldspar) is in the two-feldspar range, resolution will occur when the temperature of the system reaches the solvus. This will produce either perthite or anti perthite, depending on the composition of the feldspar.

Diagram (b) produces essentially the same effects as (a). However the initial temperature of crystallization is lower and the thermal minimum has shifted a bit.

In diagram (c) the solidus has lowered to the point where it is in direct contact with the solvus. In this case, liquids with compositions in the range between c and b on the diagram will crystallize two feldspar phases, a K-spar and a plagioclase. Compositions outside this range would have a single feldspar that would exsolved the minor phase if the original liquid composition was within the range of the solvus.

3. B. Hypersolvus granites represent dry (shallow) conditions for their origin; subsolvus granites represent wet (deep) origins. Hypersolvus granites contain a single feldspar that contains exsolution lamellae of the minor phase (perthite or antiperthite depending on the initial liquid composition). Subsolvus granites contain both k-spar and plagioclase phenocrysts.

(30 points) Answer questions related to crystallization in the ternary system below.

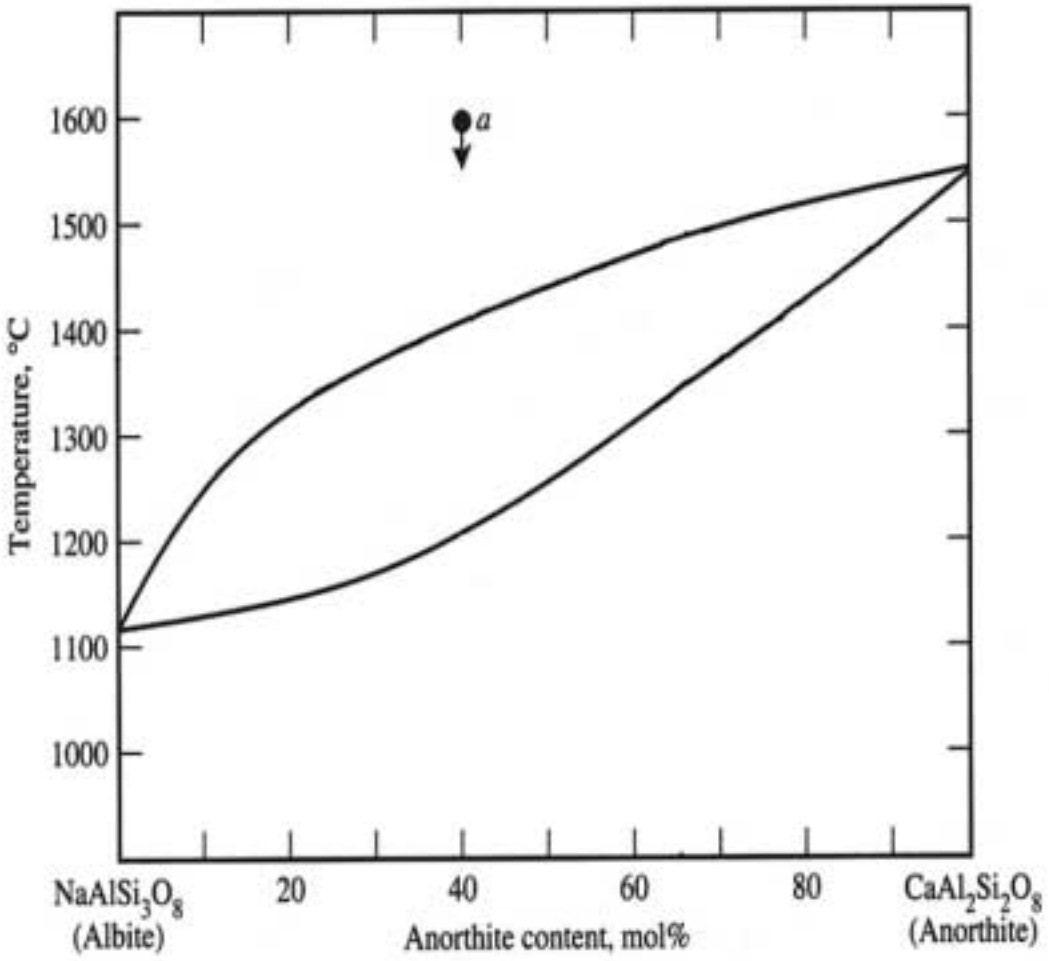


a) Label the main fields in the diagram.
b) Assuming a starting bulk composition of ***a***, at what temperature would the first crystal form?
c) Trace the liquid line of descent from ***a*** to the point where a second mineral would begin to crystallize.
d) Through what range of temperatures would the magma contain only Forsterite?
e) What is the final composition of the last drop of liquid to crystallize, assuming no fractionation?
f) As the last drop of liquid disappears, what minerals are crystallizing?
g) What is the fraction of Fo, Di, and An in the final rock formed by this system?
h) Starting with a bulk composition of ***c***, what is the first crystal to form?
i) Trace the liquid line of descent from the bulk composition of ***c*** to the point where the second mineral would begin to form.
j) What is the second mineral formed in this process?
k) Plot the bulk composition of a rock that contains an equal ratio of Fo, Di, and An on this diagram.
l) At what temperature would this rock begin to melt?
m) What would be the composition of the first liquid formed?
n) What would be the trace of liquid composition as the rock slowly melted?
o) What would be the last mineral to melt?

4. (10 points) Give the correct chemical formulas and crystallographic system for this group of minerals.

	Formula	Crystal system
Albite		
Orthoclase		
Biotite		
Hornblende		
Fayalite		
Enstatite		
Microcline		
Magnetite		
Chlorite		
Nepheline		

5. (30 points) Describe the crystallization in the binary system below.



a) Assuming an anothosite with a bulk composition of ***a***, what is the composition of the first crystal formed?
b) Assuming equilibrium, what is the composition of the last drop of liquid to crystallize?
c) Over what temperature range does crystallization occur?
d) At a temperature of 1350°, what is the ratio of liquid to solid?
e) What is the petrogenetic significance of the crystallization described above?
f) Assume a rock containing plagioclase with a composition of An_{70}. At what temperature would it begin to melt?
g) What would be the composition of the first liquid formed?
h) Would this rock have a higher, lower or equal strontium concentration compared with the liquid?
i) On gradual melting, how would the composition of the plagioclase change?
j) At what temperature would the rock be completely melted?