Petrology
Exam #1
Fall 2002

1. Make a drawing of the basalt tetrahedron and describe the principle types of basalts and what minerals they contain.

2. Kimberlites are ultramafic rocks. How do you suppose the crystallization temperatures of kimberlites compare to those of basalts? Why do some people say this explains why there are so few kimberlites found at the earth's surface?

3. Many andesites are porphyritic. They often contain phenocrysts of plagioclase, augite, orthopyroxene or (less commonly) magnetite, olivine, hornblende, biotite or sanidine. In contrast, most basalts are NOT porphyritic. How do you explain this contrast?

4. Why does the most widely used igneous rock classification scheme (IUGS) rely primarily on the ratios of Kfeldspar-plagioclase-quartz to name rocks? Why is this useful or appropriate?

5. Figure 3.3 is a Harker diagram. Why are such diagrams useful and what do they show? Why do the dots seem to line up and show trends in many cases? Suppose they did not line up and show trends? What would that mean?

6. Consider the phase diagram below. It is for a strange system, containing only two components: $NaAlSi_3O_8$and Fe_2SiO_4. There are three possible phases: fayalite, albite and melt.
a. Consider a piece of solid Earth composed of 70% fayalite and 30% albite. Describe what happens as temperature increases to some value well above the liquidus, assuming all crystals and melt stay in equilibrium. How will the composition of crystals and melt change as this goes on?
b. Consider a melt with composition equivalent to 70% fayalite and 30% albite. Describe what happens as temperature decreases to some value well below the solidus, assuming all crystals settle out as they form and so do not stay in equilibrium with the melt Be sure to describe (use a drawing if it will help) what the cumulate at the bottom of the magma chamber will look like, and how the melt changes composition with time.
c. Suppose you start with a rock composed of fayalite and albite. This would be equivalent to a basalt. Let's assume it begins to melt and the melt squirts off, leaving solid rock behind. This process continues – every time a little melt is created it gets separated from the remaining solid stuff. How does the melt composition change over time? What does this have to do with differentiation of the Earth?