Quiz #4 - Thursday, October 2.

This will be a group quiz. Your group is responsible for coming up with answers, and will all share the same grade. Here's how it works:

Most, or all, of these questions will be posed to someone from each group, but you won't know who ahead of time. So, each group should make sure that everyone in their group can answer all the questions. And, to avoid tedium and save time, each of you will answer only a few of the questions.

1. Describe the effects that each mineral has on the liquid line of descent.

2. How are the terms compatible and incompatible defined? From your results, which elements behaved compatibly during crystallization of this magma? Which behave incompatibly? Do all of the elements exhibit the same behavior throughout the duration of crystallization? Explain.

3. Describe the changes in rock composition (proportion of cumulus minerals) that result from each increment of crystallization. Use IUGS rock names (Q-Kspar-Plag) to plot your answers and name the rocks.

4. Describe the chemical changes that result in the residual magma after each increment of crystallization. Use the IUGS rock names (TAS) to name the residual magmas.

5. After each step of crystallization, the left over liquids are called "residual liquids." What does that mean? The other kind of liquid is a "primitive liquid." Is the parental basaltic magma in this experiment a "primitive liquid?" Explain.

6. At what melt fraction (F) does the magma approximate andesite composition. (The IUGS uses a number of modifying terms in front of the word andesite depending on rock composition. Note the modifying terms, but ignore them for this question.)

7. At what melt fraction (F) does the magma approximate rhyolite composition (ignoring modifying terms)?

8. What aspects of this magma chamber are realistic? Which are not? Discuss the way the model might be made more realistic.

9. This experiment modeled fractional crystallization. We looked at the effects of removing minerals from a melt in steps. If, instead, our original melt crystallized via equilibrium crystallization, what would have been the result? Describe the minerals that would form, their proportions, and name the rock.

10. At the beginning of his write up, Wirth says "Today, several additional mechanisms of crystal-melt fractionation are also recognized, including: *flow segregation*, *filter pressing*, and *convective melt fractionation*." What do those three things mean?

11. For step 4 (under Analyzing the Results), Wirth had you graph a number of diagrams that we call Harker diagrams. What are Harker diagrams and what can they tell you? In other words, why

are they useful? Suppose you studied a bunch of rocks from one area and plotted their compositions on Harker diagrams, and found the data produced smooth curves – what would you conclude. On the other hand, suppose the data did not produce smooth curves - what would you conclude then?

12. Your Harker diagrams involve major elements. Why, or why not, would they be useful for considering minor or trace elements (assuming you had the data)?

Read the following regarding Yellowstone National Park and answer the questions that follow. Some are not trivial and you may have to turn on your "speculators." Of course, if you are hard working and diligent student you may wish to read the textbook or check the web or the library too.

From: Wood and Kienle, 1990, Volcanoes of North America: United States and Canada: Cambridge University Press, 354p., p.263-267, Contribution by R. L. Christiansen

> The **Yellowstone Plateau** spans the continental divide between the Northern and Middle Rocky Mountains, at an average elevation of around 2,400 meters. The plateau lies at the center of one of the Earth's largest volcanic fields, entirely post-dating 2.5 million years ago. The major eruptions of the volcanic field were exceedingly voluminous, but their products are only surficial expressions of the emplacement of a batholithic volume of rhyolitic magma to high crustal levels in several episodes. The total volume of magma erupted from the **Yellowstone Plateau volcanic field** since 2.5 million years ago probably approaches 6,000 cubic kilometers.
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> This great magmatic volume and the enormous calderas produced by the largest pyroclastic eruptions are associated with a surprisingly subtle morphology. The **Yellowstone caldera**, the youngest of three nested and overlapping calderas, is filled by younger rhyolitic lavas, and is readily recognizable in only one or two sectors. The two older, nested calderas, however, form part of a conspicuous circular basin at the west edge of the volcanic field, called **Island Park** which is enclosed along its eastern margin by a younger constructional lava platform at the west edge of the Yellowstone Plateau.

13. Yellowstone volcanism has involved a great deal of rhyolitic magma. How much? What is the volume of volcanic material involved? Discuss, explain, as appropriate.

14. What was the source of Yellowstone's rhyolitic magma?

15. Some people have hypothesized tat the Yellowstone magmas were derived from more mafic primary magmas. If so, what was the source of those magmas? Where are the cumulates (or other materials) that were left behind? If you don't know, how would you go about looking for them? In other words, how would you test the hypothesis?

16. There are also many basalts in the Yellowstone region. How would you determine if they came from the same source as the rhyolites?