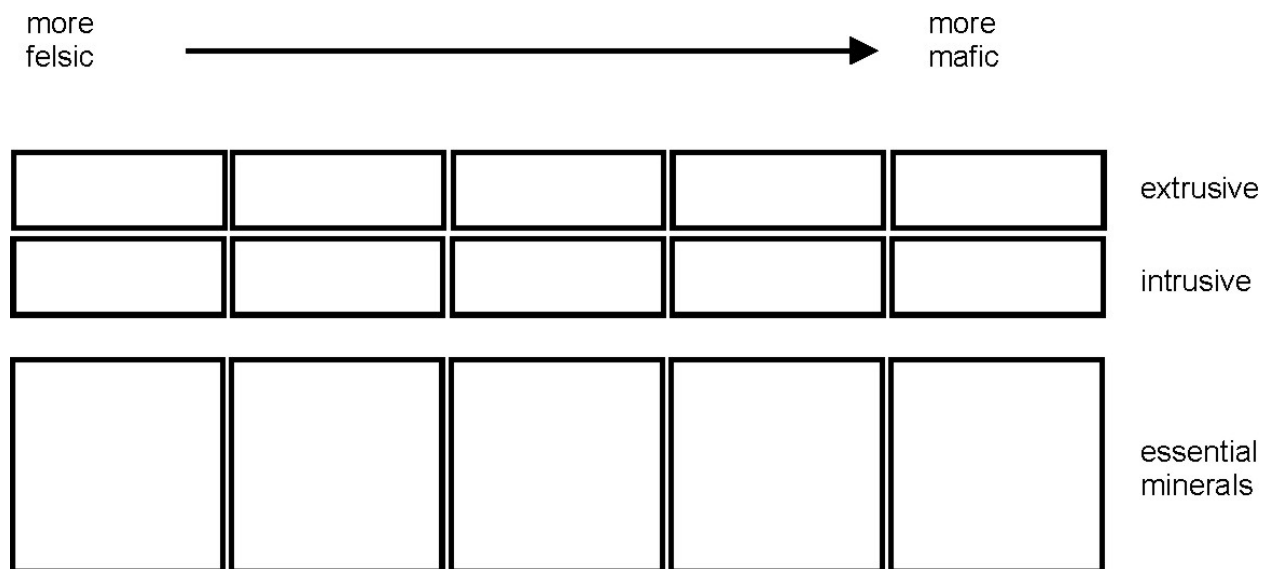


Petrology
Exam 1 - 2009
Igneous Rocks

1. a. Make a sketch that shows the relationship between Earth's crust, mantle, lithosphere and asthenosphere.
 - b. What is the thickness of each of the four - if it varies laterally or with depth, clearly describe the variation.
 - c. What is the composition of each of the four - if it is variable laterally or with depth, clearly describe the variation.
 - d. Over time, the Earth's layers has become increasingly differentiated. What does this mean? Describe the nature of the differentiation and explain the processes that caused it.
2. How do we "know" the composition of the mantle. List the different kinds of evidence we have and explain what the evidence tells us and how.
3. Describe the difference between a primitive, a primary, a parental, and a derived magma. Where do each of them come from? Where would you go to find a sample of a primitive magma?
4. Consider the following rocks: basalt, rhyolite, granite, peridotite, diorite, andesite, gabbro, komatiite. Put them on the chart below in the correct places in the top two rows. Then under each column, fill in the *essential minerals* for the rocks in that column.



Where would dacite, lherzolite and pyroxenite fit in this chart (I left no places for them)?

5. Contrast and compare these kinds of volcanoes/volcanic eruptions:

- ◆ caldera
- ◆ composite
- ◆ cinder cone
- ◆ dome
- ◆ shield
- ◆ fissure
- ◆ flood basalt

- ◆ pyroclastic flow
- ◆ maar

For each:

- How big are they?
- What are they composed of (what rock and magma type(s))?
- Where are they found?
- Are the eruptions dangerous/violent?
- What is the origin of the magma that creates each of the above kinds of eruptions?
- Why are they different?

6. Define each of the following terms being sure to tell (a) what they are made of (which could be variable for some), and (b) how large they are (which could be variable for some). A sketch will help for some/most of them:

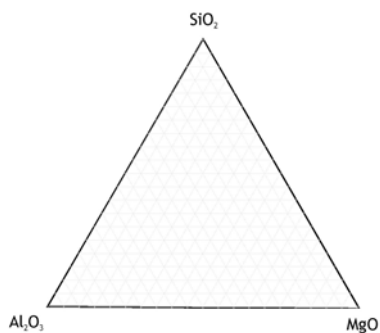
- ◆ lopolith
- ◆ laccolith
- ◆ stock
- ◆ dike
- ◆ pluton
- ◆ batholith
- ◆ sill

7. a. Some igneous rocks are coarse grained, some are fine grained, some are combinations of coarse and fine grains. Why? Explain how the different kinds form and why they have the grain size they have.

b. Some igneous rocks contain phenocrysts and groundmass. What minerals are most common as phenocrysts - name some and explain why they are common? What minerals are most common as groundmass - name some and explain why they are common.

8. a. On the diagram below, plot the composition of

- spinel $MgAl_2O_4$
- pyrope $Mg_3Al_2Si_3O_4$
- enstatite $Mg_2Si_2O_6$
- forsterite Mg_2SiO_4



b. Write and balance a reaction between these minerals.

c. Why is this reaction important when thinking about the mineralogy of the mantle?

9. a. Quartz is never found in rocks that contain feldspathoids, almost never found in rocks that contain olivine, and never found in rocks that contain spinel. Explain why. Be specific for each.

b. Use a phase diagram with a peritectic to show one reason why some minerals are never found together.

10. What are the principle kinds of basalts? What are

their differences, and where are each found? Which is/are most common?

11. a. What is an ophiolite?

b. How do ophiolites form and where are they found?

c. Draw a cross section of an idealized ophiolite complex, clearly explaining what is in each layer.

d. Explain why the order of the layers (from bottom to top) in an ophiolite complex makes sense.

e. Often when we go to look at rocks in a ophiolite sequence we find that they are ugly, slimy, rotten and altered to junk. Why? Why are they so prone to alteration. What do they commonly alter to?

12. Describe three distinctly different kinds of occurrences where we can find ultramafic rocks. Explain how each of them form, and what kinds of rocks are typically found there.