

Final Exam

(Answers should be complete and well thought out. Some could easily be a page in length.)

1. Devise and plan a research project that would answer this question: How has the composition of Earth's crust changed during the past 4.6 billion years. Where would you go, what samples would you collect, and what would you do with them? As part of your proposal, explain, using appropriate phase diagrams, how (theoretically) the outermost parts of Earth have become differentiated. How has the composition of Earth's crust evolved over time. And what about the mantle? Has the mantle been differentiated as well?
2. Some of the phase diagrams we looked at earlier in the semester had peritectics and eutectics. What do these terms mean? Why are peritectics and eutectics important? What do they cause to happen that otherwise might not happen? Make drawings of rocks, showing minerals and appropriate textures, that show features related to peritectics and eutectics.
3. Contrast and compare primitive and primary magmas. Describe how each is formed and what the differences are. Then, give some real world examples of each. Where would you go to find rocks made of each? What is a parental magma, and what are secondary magmas? Give an example of how a parental magma can lead to the formation of secondary magmas and igneous rocks? What does the name "parental magma" connote which sets it apart from primitive and primary magmas? Dum de dum de dum . . . you are traveling around and are collecting a bunch of igneous rocks. How would you determine if they formed from primitive, primary or secondary magmas?
4. Describe the different kinds of basalts, where they typically form, and clearly explain why they form in the different places they do.
5. Consider the elements O, Si, Al, Fe, Ca, Na, K, Mg, or oxides SiO_2 , Al_2O_3 , FeO, CaO, Na_2O , K_2O , MgO. Why did I list them in this order? Make a table that compares the composition of the most common igneous rocks, considering these components. Which of these components vary the most and which the least? It seems to me that most of the common igneous rocks have very similar compositions. Do you agree? If so, why? If not, explain why there is so much variation. Why are there no, or very few, basaltic rocks associated with subduction zones. What kinds of rocks are found instead? Why?
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. Contrast and compare metamorphism of ultramafic, mafic, quartzo-feldspathic, pelitic, calcareous, and siliceous rocks. Describe the general sorts of minerals that can be found in each class of rocks, and how they change or evolve with increasing metamorphic grade. Which class of rocks shows the most variation with metamorphic

grade? Why?

8. Describe the range of pressure - temperature conditions that cause rocks to be metamorphosed? What are the upper and lower temperature and pressure limits? Why? Why can't rocks be metamorphosed under other conditions of pressure and temperature? Make a PT diagram showing metamorphic facies and annotate it to show the P and T limits of metamorphism, and to explain why those limits exist. What about facies series? What are the possibilities? Limitations? Why do different metamorphic events follow different facies series, and why are there only a limited number of possibilities? Describe, using a plate tectonic model, where rocks of the different metamorphic facies, and the different metamorphic facies series, can be found. Then name some examples of each (give geographic locations or geologic terranes).

9. Describe how thermodynamics is used to interpret the history of metamorphic rocks. Thermo, however, doesn't always seem to be practical or to give reasonable results. What are the limitations, assumptions, etc.? And, why do we generally NOT use thermodynamics to interpret the history of igneous rocks?