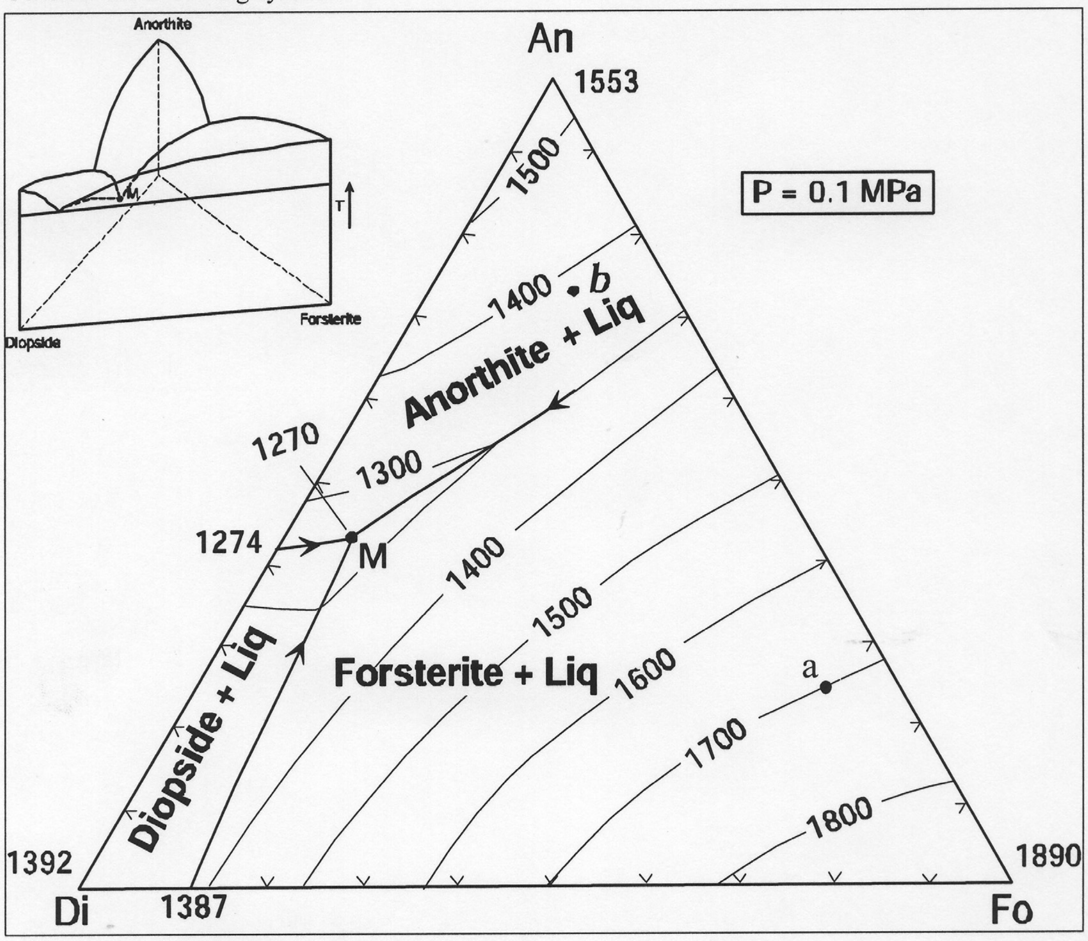
ESS103A Igneous Petrology Name______________________
May 26, 2006
Three-component systems: Di-An-Fo

Consider the following system:



Part A: Get our bearings

1. Where is the liquidus in this diagram? (We can discuss the topo map analogy) Can you say in a general sense which phase crystallizes first? What property of the melt determines the order of crystallization?

2. Find the cotectic curves and the ternary eutectic point. What is the relationship between the cotectic curves and the binary eutectic points? (Hint: think about slicing cross-sections out of the 3-D diagram).

3. For which variables do we have "adjustable knobs" in this diagram? Which variable(s) are invariant?

Part B: Equilibrium crystallization I

4. What is the composition of point **a**?

5. Derive the variance (degrees of freedom, **F**) for composition **a** at 1800°C.

6. As the system of composition **a** cools, at what temperature will the number of phases **P** (or φ, in the book) change? Physically, what happens at this temperature?

7. Derive **F** at composition **a** and the temperature from question 6. What is the implication for the melt composition as cooling continues?

8. Draw the liquid line of descent from 1700°C to 1400°C. How do you know which way the liquid composition evolves?

9. What is the ratio of liquid to solid at 1500°C?

Part C: Equilibrium crystallization II

10. At what temperature will **P** (φ) next change? Physically, what happens at this temperature? What is the variance **F** at this temperature?

11. What is the composition of the melt at 1300°C?

12. What are the relative amounts of An, Fo, and liquid at 1300°C? See p.107, Figure 7-3 and the surrounding description of how to use the lever rule in this situation.

13. What is the instantaneous bulk solid extract at 1300°C? How is this different from the total accumulated solids crystallized up to this point?

14. What is **F** at point **M**? Physically, what happens here? (Think about what happens at the binary eutectic on a binary diagram like Fig 6-11).

Part D: Melting

15. What is the composition of the first melt that is derived from a rock with composition **b**? With composition **a**?