ESS103A Igneous Petrology Name_____
April 19, 2006
Olivine solid solution diagram

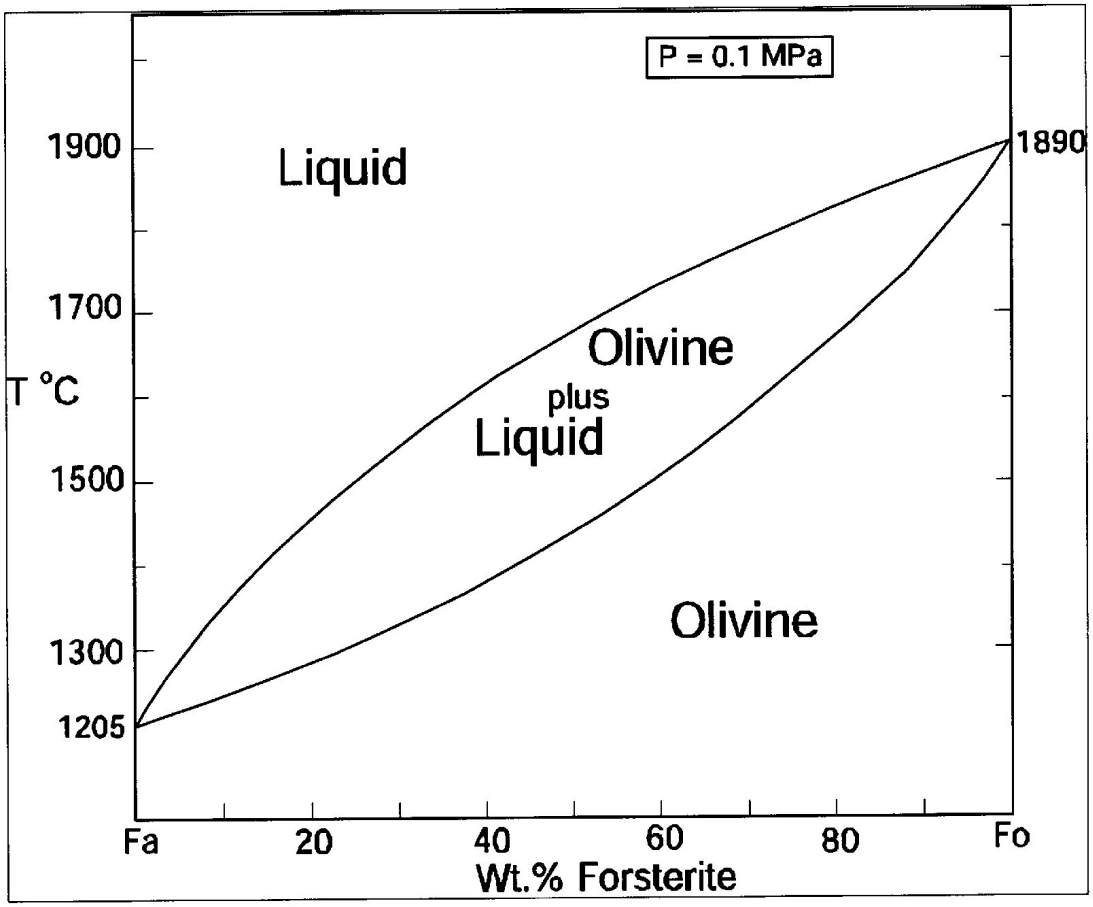
The Phase Rule for isobaric or isothermal systems: F = C – P + 1

P = the number of phases: the number of different types of mechanically separable portions of the system (don't confuse this with pressure!)

C = components: the ***minimum*** number of chemical constituents that are required to define the composition of every phase in the diagram

F = variance or degrees of freedom: the number of intensive parameters that must be specified in order to completely determine the state of a system. Alternatively, F is the number of intensive parameters that can be changed independently without changing the parameters of the phase rule (i.e. losing or gaining a phase).

Consider the following system:



1. Does this graph describe an isobaric or isothermal system?

2. Find the point on the graph that represents the system Fo_{80} at 1950°C and label it point **A**. Determine **F** at point **A**.

3. What is/are the intensive parameter(s) described by **F**?

4. As composition **A** cools, at what temperature does **P** (# of phases) change?

5. This boundary you found in 4. is called the **liquidus**, because it describes the composition of the liquid at a given temperature. The line below it is called the **solidus**, because it describes the composition of the solid at the same temperature. The appearance of this graph is typical for a system with solid solution.
Draw two horizontal lines across the graph at 1700°C and 1800°C and a vertical line from point **A** to the bottom of the graph. What is the composition of the melt at these two temperatures? What is the composition of the solid at these two temperatures?

6. Use the **lever rule** to determine the weight percent of the melt and the solid at 1700°C and 1800°C.

Here's how the **lever rule** works:
Assume our bulk system is at composition **A**, and at a particular temperature the composition of the liquid is represented by **X** and the composition of the solid is represented by **Y**.

X ——————— **A** ——————————— **Y**

Wt% liquid = 100 x AY/(XY) where AY = distance between A and Y, etc.
Wt% solid = 100 x XA/(XY)

7. What is **F** when system **A** cools to 1500°C? What is the composition of the solid? How does this compare to the initial composition of the melt?