ESS103A Igneous Petrology Name_____
April 19, 2006
SiO_2 polymorphs 2

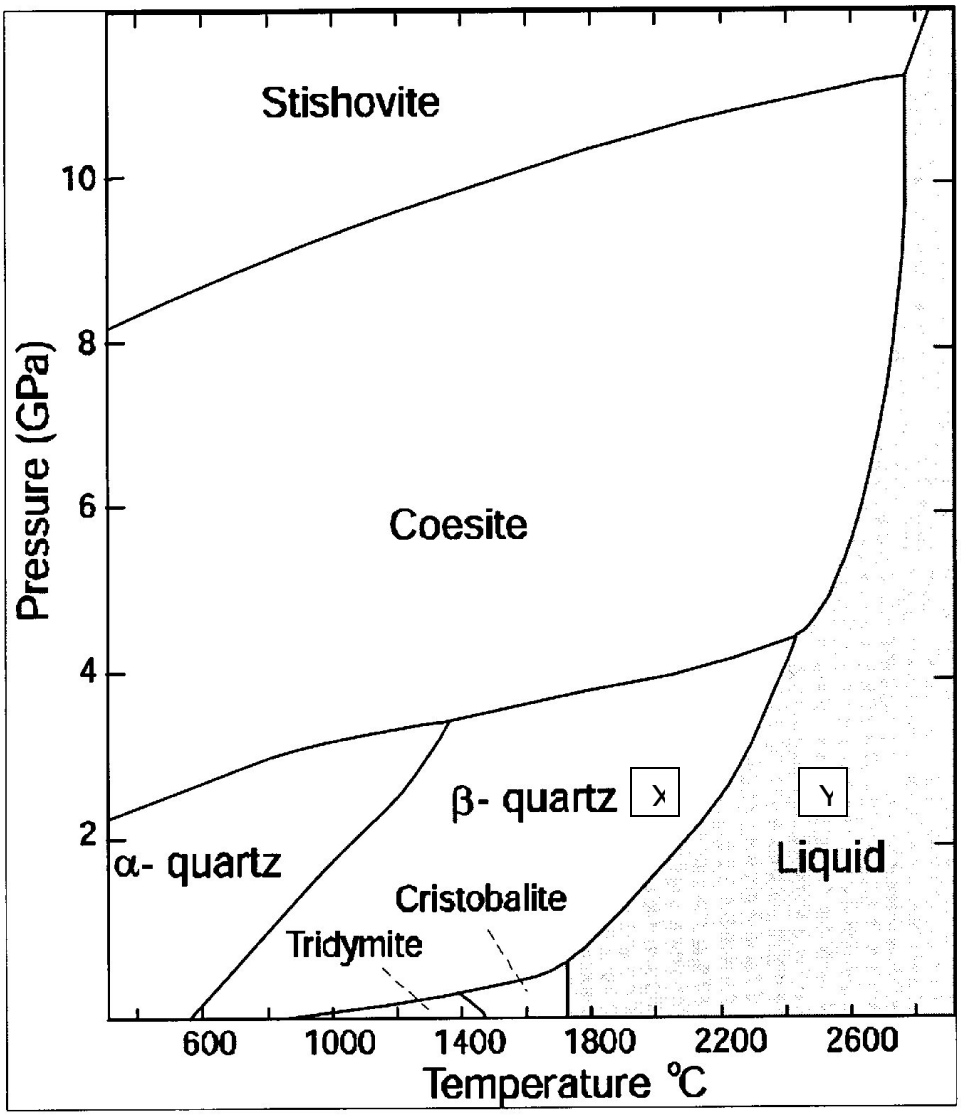
The Phase Rule: F = C – P + 2

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. Derive **F** at ~3.2 GPa and ~1300°C (the point where the stability fields of α-qtz, β-qtz, and coesite meet- call this point **C**).

2. At **C**, can you change pressure without changing **P** (# of phases)? Can you change temperature without changing **P**? Physically, what happens if you change pressure or temperature?

3. How do these observations relate to the value of **F** at this point? (Remember what we did on Friday.)

4. The **Clapeyron equation** gives the slope of the equilibrium boundary between two phases:

$$\frac{dP}{dT} = \frac{\Delta S}{\Delta V}$$

This equation states that the slope of the boundary in P-T space (right side of the equation) is equal to the ratio of the difference in entropy between the products and reactants ($\Delta S = S_P - S_R$) to the difference in volume between the products and reactants ($\Delta V = V_P - V_R$).

a) Look at the boundary between β-qtz and liquid. What is the reaction that occurs as the system moves from point **X** to point **Y**?

b) Which do you expect to have the greater molar entropy, β-qtz or melt? Is $\Delta S = S_P - S_R$ positive or negative for this reaction?

c) Which do you expect to have the greater molar volume, β-qtz or melt? Is $\Delta V = V_P - V_R$ positive or negative for this reaction?

d) Is $\frac{\Delta S}{\Delta V}$ positive or negative? Does this agree with the slope in the P-T diagram?