GLY 4310

Name ______________________________

February 20, 2020

Take Home Quiz 4 KEY

Take home quizzes are due at the beginning of the following lecture. They are worth 2 points of EXAM credit. Please attach this sheet to your answers if additional sheets are used.

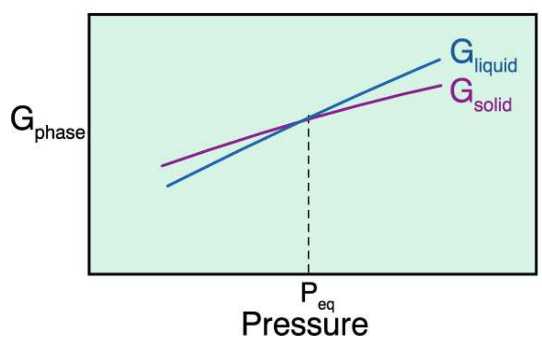
1. What is oxygen fugacity? What are typical fugacities associated with magmas inside the earth? How does a change in fugacity affect ions in magma? What does this effect have on the sequence of mineralization?

Hint: Careful reading of section 7.3 of the text will help.

Oxygen fugacity is an equivalent of the partial pressure of oxygen in a particular environment (atmosphere, rocks, etc.) corrected for the nonideal character of the gas. Typical fugacities associated with deep magmas are 10^{-10} to 10^{-40} atm. As oxygen fugacity increases, iron is oxidized from ferrous (Fe^{2+}) to ferric (Fe^{3+}), reducing the ionic size. Ferrous iron associates with Mg^{2+} in mafic silicates. As fugacity increases, more iroon is oxidized to the ferric state, where it forms Fe-Ti-oxide phases. This lowers the amount of Mg+Fe available for forming mafic phases, and increases the Mg:Fe ratio. Mafic minerals will thus be very high temperature forms (forsterite rather than a forsterite-fayalite mix), crystallizing early in the sequence.

2. Use equilibrium thermodynamic arguments under isothermal conditions to explain why the core of the earth changes from liquid to solid as depth increases.

$$\left(\frac{(\delta G)}{(\delta P)}\right)_T = V$$



$V_{liquid} > V_{solid}$, so the slope of G vs. P is greater for a liquid than a solid

At low P, $G_{liquid} < G_{solid}$. Thus the outer core is lqiuid.

At high P, $G_{solid} < G_{liquid}$. Therefore, the inner core is solid.