Planetary Geology   4460   Homework #4 Due Friday Sept. 29, 2017

Problem 1. (10 points) Impact Cratering Energies Assume an asteroid with a diameter of 5 km and a density 3.5 gm cm^{-3} impacts the earth, with a velocity of 20 km s^{-1}. Find the kinetic energy in Joules which will be released.

Problem 2. (5 points) Olivine melting A   Suppose that you have solid olivine which is a solid solution with a composition equivalent to 50% Forsterite and 50% Fayalite. You heat it till the first melt begins to appear, then let that small amount of melt escape to the surface. At what temperature does that melt first form? What is the composition of that melt? Use the olivine phase diagram from Winter on the following page. Draw on that diagram the lines and points which let you answer the above question, and label those points with respect to your answers.

Note: the olivine and the diopside-anorthite diagrams already have some lines drawn on them since I've stolen these from a similar problem. Those lines are probably somehow related to ones you should draw, but they are from a slightly different problem, so don't count on them being exactly the same as what you should draw. They may or may not be.

Problem 3. (10 points) Olivine melting B Suppose that you again have the 50% Forsterite 50% Fayalite solid but this time you heat it till approximately 20% has melted. At what temperature has 20% melted? What is the composition of that melt? Draw on that diagram the lines and points which let you answer the above question, and label those points with respect to your answers.

Problem 4. (5 points) Diopside Anorthite Crystallization. Suppose you have a melt which is 70% Anorthite and 30% Diopside, and it cools till crystals begin to form. You continue cooling it till a very small amount of melt is left, that then escapes and erupts onto the surface. What is the composition of that final melt, and what temperature does that occur at?