

**Planetary Geology 4460**  
**Homework #5**  
**Due Fri. Oct. 6, 2017**

For the problems using the Olivine phase diagram, mark on the diagram the relevant locations for the various critical steps in the melting process.

**1) Multi-step partial melting. (30 points)**

**Part A.** Suppose you start with “mantle” olivine with a composition of 70% Forsterite, 30% Fayalite. You let it melt till 10% is liquid, then that magma escapes to form surface basalt, or a near surface intrusion. What will be the composition of that basalt? (Hint: Use the lever rule.)

**Part B.** At some later time that near surface basalt is reheated (either by new magma from below, or by subduction) and begins to melt. Once again this continues until 10% is liquid, then that magma escapes to form a new intrusion or flow. What is the composition of that new material. (Again remember the lever rule.)

**Part C.** Suppose you find some way to determine the amount of residual solid left from the Part B (second stage) melting. This could be via seismic techniques or mapping of deposits after they have been uplifted and eroded. How much residual solid should you expect to see for every kg. of Part B solidified magma? (This is a very easy question – intended mostly as a hint on how to get started towards answering Part D.)

**Part D.** How much total mantle material (both residual solid and escaped stage one (Part A) melt must be processed to produce every kg. of the final second stage (Part B) magma?

Olivine Phase Diagram on next page.

Note – In a real-world situation the composition of the original material will be more complex as will the composition of the resulting melts. However this basic process is the way you can create silicic magma beginning with much more mafic mantle material.

