Ocean 540=549b
Autumn 2002
Problem Set #3

Due Monday October 28.

1. Assume that the phase diagram shown in Figure 7-5, Lecture 7 for the system An-Fo-Di is a suitable model for cooling of magma introduced into the oceanic crust. Assuming that the composition marked "A" is characteristic of a basaltic liquid, sketch out the temperature and liquid and solid compositions (each require two of the three components to be tracked) versus the fraction of liquid remaining assuming closed system, equilibrium conditions.

2. If the vertical temperature gradient in a "rigid-walled" magma body 500 m thick is 150 K, what is the heat flux that can be sustained through the upper boundary, assuming that the Nusselt number scales as $\left[Ra/Ra, crit\right]^{1/3}$. Parameters for basaltic liquid: α is 5 x 10^{-5} K^{-1}, ν is .01 m^{2}s^{-1}, κ is 5 x 10^{-7} m^2 s^{-1}, and k is 2 W m^{-1} deg^{-1}.