Fall 2007
EPS 236: Geological fluid mechanics

Homework number 10

Due Wednesday, November 14

THIS IS YOUR FINAL HOMEWORK EXERCISE. You will need to use the library or other resources (e.g., the web) for these questions. Please think *carefully* about how you estimate Ra; make sure to explain what you do and why you do it.

There are also some option questions about porous materials that I assigned in a different class (EPS 200) that you are encouraged and welcome to do.

21. Estimate the Rayleigh number and Prandtl number for the Earth's mantle assuming the entire mantle is convecting (explain your choices for the different variables in the expressions for Ra and Pr – you may need to look up some numbers). Should the mantle be convecting?

22. Estimate the Rayleigh number and Prandtl number in a magma chamber containing basaltic melt (again, explain your choices for the different variables in the expressions for Ra and Pr). Here, assume a thickness of 200 m, that the temperature on the top of the magma chmaber is 500 ^{o}C and that the temperature at the base of the magma chamber is 1200 ^{o}C. Something you should realize about magmas: the liquid magma is much less viscous that frozen magma, so knowing the freezing temperature should be important. Will convection occur in ther magma chamber?

23. In questions 22 and 23 you assumed that the convecting fluid had a constant chemical composition. How large would the density difference due to compositional stratification have to be to prevent convection?