

12.109 Problem Set #2

Using Phase Diagrams

1) For the binary phase diagrams attached below, carry out the following melting and crystallization exercises:

a) System MgO - MgCr₂O₄. For a bulk composition that is 20 wt. % Cr₂O₃ describe the equilibrium crystallization path and subsolidus behavior from above the liquidus (~2800 °C) to 1400 °C. Now describe the equilibrium melting behavior for the same composition. This mineral assemblage is not very common in nature, but the form of the MgO - MgCr₂O₄ phase diagram is similar to one for a common rock - forming silicate solid solution. What is this binary system?

b) System NiO - V₂O₅. For a composition that is 80 % NiO describe the path followed during fractional crystallization. Start from above the liquidus (>1400 °C) and give the temperature and nature of all reactions that will occur during this process. Also, identify the temperature and composition of the last liquid that will be the end product of a fractional crystallization process. Now, contrast the fractional crystallization path with an equilibrium crystallization path.

2) For the system Fo - Di - An construct isothermal sections at 1500, 1400, 1300 and 1200 °C. Show the single phase, two phase and three phase volumes at each temperature. Spinel (MgAl_2O_4) does not plot in the ternary, and the boundary curves for $\text{Sp} + \text{An} + \text{Liq}$ and $\text{Sp} + \text{Fo} + \text{Liq}$ are reaction curves. For the purposes of constructing isothermal sections assume that Sp plots at some negative value of Di, as shown on the phase diagram. What is the difference between point **D** and point **E**? Describe the solid - liquid reactions that occur at **D** and **E**. Bulk composition **A** represents a simple system analog of a common volcanic rock type found on the earth. Identify the rock type and explain why **A** is a good simple system analog.