Chapter 1

Chapter 6 - Problems

1.1 Problems

Problem 1

You measured Curie Temperature curves for two samples A and B as shown in Figure **??**. Based on your knowledge of Curie Temperatures, what is the likely magnetic mineralogy for each sample?

Problem 2

The data in *demag.dat* in the Chapter_6 data directory (see Problems for Chapter 5 for downloading instructions) are thermal demagnetization data for a specimen that had a 2 T field exposed along x, a 0.4 T field exposed along y and a 0.12 T field exposed along z. The sample was then heated to a particular temperature step (°C) and cooled in zero magnetic field, allowing all grains that become superparamagnetic at temperatures lower than the treatment temperature to become randomized. After each treatment step, the magnetic vector was measured. The column headings are: Treatment temperature (C), Intensity, Declination, Inclination.

a) Write a python program to read the data in and convert the declination, inclination and intensity to cartesian components.

b) Modify your program to normalize the intensities to that measured at 20°C.

c) Extend the program to plot the x and y components as a function of temperature.

d) Based on your understanding of coercivity and Curie temperatures, what is carrying the x and y components?

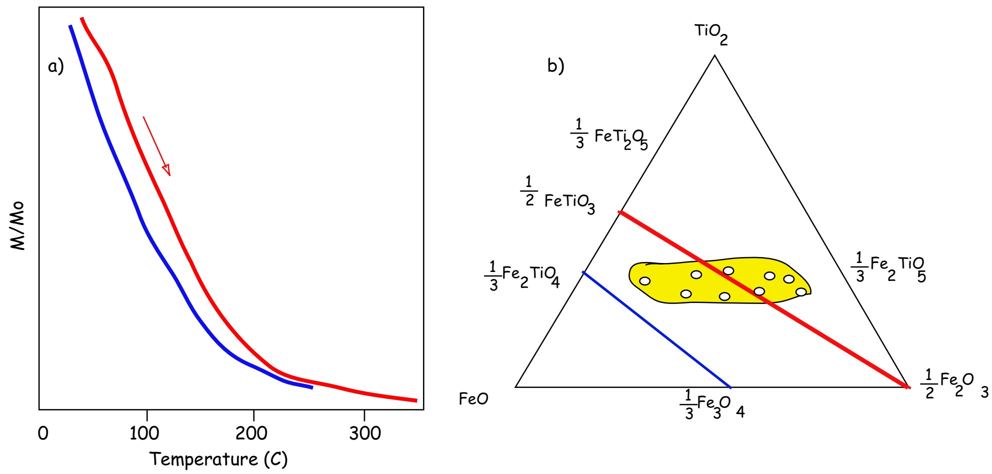

Figure 1.1: a) Thermomagnetic run of mineral whereby magnetization (normalized by the initial value) is measured as a function of temperature. The red line is the heating curve and the blue line is the cooling curve. b) Electron microprobe data from FeTi oxides (dots in yellow field) plotted on TiO_2-FeO-Fe_2O_3. ternary diagram. [Figure redrawn from Butler, 1992.]

Problem 3

Ferromagnetic minerals in two rock samples are known to be FeTi oxides and are found to have the properties described below. Using this information and looking up the properties of FeTi oxides described in the text, identify the ferromagnetic minerals. For titanomagnetite or titanohematite, approximate the compositional parameter x.

a.) Strong-field thermomagnetic analysis indicates a dominant Curie temperature $T_c = 420°$C. Subjecting the specimen to increasingly larger fields to measure successive isothermal remanences (see Chapter 5) reveals a coercivity spectrum with a coercivity of less than 300 mT. What is this ferromagnetic mineral?

b) Strong-field thermomagnetic analysis (used for measuring the Curie temperature) shows the behavior in Figure **??**a with Curie temperature T_c = 200°C. In addition, electron microprobe data indicates abundances of FeO, Fe_2O_3, and TiO shown in Figure **??**b. Unfortunately, electron microprobe data are not very effective in determining the Fe_2O_3:FeO ratio (placement from left to right in the TiO-FeO-Fe_2O_3 ternary diagram). Accordingly, there is much uncertainty in the Fe_2O_3:FeO ratio indicated by the microprobe data. But microprobe data are effective in determining the TiO:(Fe_2O_3 + FeO) ratio (placement from bottom to top in the TiO-FeO-Fe_2O_3 ternary diagram). With this information, identify the ferromagnetic mineral.