Geothermobarometry

Modified from C. Tom Foster, rev July 2011

Objective

The objective of this lab is to understand the fundamentals of geothermobarometry, how to appropriately use it, and when the results should be taken with a grain of salt. For this lab, we'll be using the program GBT.

Pre-lab

Complete this portion prior to the start of lab:

- Write short paragraph definitions for the following terms based on the range of textbooks (especially the Spear) that are in the lab:
  - Geothermometer
  - Geobarometer
  - Calibration (as in reference to geothermobarometry)
  - Solution model (include 2+ types in your definition)
  - Error envelope related to PT calculation
  - Internally consistent
- If you have access to a Mac, please bring it to lab (PC-users will get to use a lab computer)

Lab

We're going to use GBT (http://ees2.geo.rpi.edu/MetaPetaRen/Software/software.html) to explore the highs & lows of geothermobarometry. There are more recent programs (and solution models) available (*e.g.* TheriakDomino, Thermocalc), but none are as easy to use as GBT. It was considered an "advance" when they finally converted to using OSX 10.4 over Mac OS 8, so you'll need to find a Mac to do this lab.

1. download and install GBT if its not already on the computer
2. click on GBT to get the program running
   a. three windows will open when the program first starts:
      1. Command
      2. Graphics
      3. Output
   b. In the Command window, you have the following choices:
      1. Read Mineral File
      2. Make a new plot
      3. Plot Keq Lines on P-T Diagram
      4. Save Postscript File
      5. Save preferences (window positions)
      6. I/O switch (file or keyboard)
      7. Plot digitized reaction curves
   c. We're mainly going to deal with 1 – 3 in this exercise
3. Click on 1 and load the "MOOSE.tab" file

a. File contains data from Hodges & Spear (1982) from the Moosilauke region of New Hampshire
b. Mineral pairs / groups used for PT calculations should all come from the same sample (*e.g.* 77B). Students should pick a different sample than their neighbor.
c. Rocks are close to the aluminosilicate triple point

4. Make a new plot (2) and then Plot Keq Lines (3)
    a. The rocks within the Moosilauke samples contain: garnet + staurolite + biotite + muscovite + plagioclase + sillimanite + quartz
    b. What geothermometers (1st page of reactions) would be appropriate for these rocks?
        1. Pick one of the appropriate thermometers and run calculations for each of the calibrations listed (-1 will do them concurrently)
            1. Don't correct for Fe3+
        2. What's the range in temperatures produced assuming 4 kb?
        3. Take a screenshot of your graphics window (Command-Shift-4 then click & drag to choose region) and rename it to something appropriate – print this to hand in
        4. Repeat for each thermometer that is appropriate
        5. What is causing the range in temperatures?
        6. Which calibrations seem out-of-line for this sample?
    c. What geobarometers (2nd page of reactions; -1 to get from one list to the other) would be appropriate for these rocks?
        1. Pick one of the appropriate barometers and run calculations for each of the calibrations listed (-1 will do them concurrently)
        2. What's the range in barometers produced assuming the approximate temperature you calculated in part (b)?
        3. Take a screenshot of your graphics window (Command-Shift-4 then click & drag to choose region) and rename it to something appropriate – print this to hand in
        4. Repeat for each barometer that is appropriate
        5. What is causing the range in barometers?
        6. Which calibrations seem out-of-line for this sample?
5. Make a new plot (2) and then try the following:
    a. Choose pairs of internally consistent thermometers & barometers to estimate the P&T of these samples
        1. Does each P&T you calculate vary from the grouping you got in part (4)?
        2. Take a screen shot.
        3. Repeat for each pair of calibrations that are internally consistent
6. Go back to (4) and try again, but this time correct for Fe3+. Is there a large change in your answer? Take a screen shot.
7. Start over at the beginning with file "SC-160.tab"

    a. Rock contains garnet + cpx + opx + hornblende + plagioclase + quartz + k-feldspar + rutile + ilmenite
    b. Go back through and to (4b) – (5)
8. Based on what you have learned with the "Moose.tab" and "SC-160.tab" files, take the mineral analyses from the Dutchess County Barrowian sequence:
    a. What calibrations do you think would be the best choice to determine a PT? Why?
    b. Which mineral analyses taken from the Dutchess County thin sections would be the most appropriate to use? Why?
    c. Based on your answers to (a) and (b), run GBT and determine the PT.
    d. Compare the calculated PT with the PT field you determined in lab 6 – do they match? If they don't, can you give some reasons why they might not?

What you will hand in

- Typed prelab definitions
- Typed answers to lab questions
- Appropriate screenshots