Notes to accompany thermobarometry homework assignment (Selverstone)

Many of my students are extremely math challenged (many schools in New Mexico do not even require algebra for graduation from high school). Although our students are required to take a year of calculus in order to get a degree in geology, most of them have not made it this far by the time they take petrology. Carrying out a simultaneous solution of two equations in two unknowns is a real reach for some of them. However, I want students to realize that math is a useful language, and for them to gain confidence by calculating and evaluating answers for themselves. As a result, I assign 6 quantitative homework assignments over the course of the semester. The balancing act has been finding a way to write assignments so that the math-challenged students don't simply become frustrated and give up.

This assignment gives students the option of solving the thermometer and barometer equations by hand, or using a simplified version of the Excel spreadsheet program GPT.xls (by Reche and Martinez). This way, all of the students are guaranteed to be able to come up with numbers that they can then evaluate. Students get extra credit for using both methods (and for thinking about why the calculated answers are not identical).

Before dealing with any math, the students first need to make a *prediction* about the results. This involves looking at differences in calcium content in garnet in plagioclase in two different regions, and thinking about which area will record higher pressure. The answer to this question requires that the students think back to Le Chatelier's Principle and apply it to the reaction *3 Anorthite = Grossular + 2 Kyanite + Quartz*, which will have already been discussed in class.

The students then must calculate two sets of P-T conditions – an early set recorded by inclusions in garnet, and a later set recorded by mineral rim compositions – and then use these values to evaluate the hypothesis that the sample experienced continent-continent collision followed by rapid unroofing. They must also think about whether or not one of the calculated temperatures was the maximum temperature experienced by the rock, which requires them to think a little about diffusion and closure temperatures.

At the end of this assignment, students have a much better understanding of how thermobarometers work, and how to think about the P-T values that they calculate. There is no single "right" answer to the questions about whether the calculated conditions represent T_{max} or how consistent the results are with the proposed tectonic hypothesis. I really look for consistency arguments and evidence of logical thinking when I grade the assignment.