What Forms Where?
Notes

For some reason, students often have a hard time understanding reaction stoichiometry and mass balance. So, I created a quick exercise as an introduction to those topics. (Then it grew larger and more complicated. But, it need not be complicated if you stick to the basics.)

The simplest way to use this exercise is to have students to do it during class, in groups. At the simplest level, all they have to do is to subtract reactants in appropriate amounts, calculate the products that form, and determine the new assemblage when a reaction line is crossed.

They can do this in just a few minutes, but my experience is that they will not all get the same answers. So we discuss the results and the general importance of bulk composition and reaction stoichiometry.

Note: You may wish to warn students that the answers will not all be integers. They may end up with 1 1½ moles of something, for example.

To aid the discussion, I drafted some figures showing the correct answers in graphical form. Copies are available in the "answers" document, and also in a separate pdf document (*25What forms solutions graphics.pdf*). If you wish to edit them, the figures should open in Adobe or Corel drafting programs.

The graphical depictions seem to work quite well for students who had a hard time figuring out what was going on when they were only considering mineral names, reaction stoichiometry, and numbers of moles, etc.

The key, and fundamental, point to make if you use this exercise is that some compositions will not "see" some of the reactions. *Or, another way to say this is that "the reactions on a phase diagram tell you what is NOT stable. They do not tell you what is stable because that depends on bulk composition."* To help make this point, I drafted triangular diagrams for the CaO-Al_2O_3-SiO_2 system. The diagrams show the bulk composition being considered and the stable assemblage in different parts of PT space.

Interpreting the triangular (chemographic) diagrams adds another level of complication to this exercise. You may elect to omit consideration of these diagrams if you have not already discussed how compositions are plotted on triangular diagrams, and significance of tie lines, etc.

This exercise can also be used to discuss the phase rule. Why, except in one (degenerate) case, are there always three minerals stable together? Etc. There are lots of possibilities.

If you want to further consider the importance of bulk composition, you can expand this exercise to a discussion of a three component system in general. A PT diagras, available in *25What forms solutions graphics.pdf*, shows all the stable reactions in the CaO-Al_2O_3-SiO_2 system. It also hasl triangular diagrams around the outside that show the regions of composition space that are affected by each reaction.