GEOL322 HW#1: Writing chemical reactions

Use the Geochemists Workbench to solve the following problems. In this and in future homework assignments send to me as email attachments all scripts that you create. Please give all script files meaningful filenames that include your name (e.g., HW#1question#1Ayers). Also, make sure to write out answers to question – don't just turn in printouts of the program output. Due in one week.

1) Read the chapter "Using Rxn" in the *GWB Essentials Guide*..

2) I usually spend a significant amount of class time teaching students how to write balanced chemical equations describing weathering reactions. The rules are (assuming no changes in valence states):

- Al is conserved (insoluble, immobile), transferred into solid product of reaction (clay)
- Excess Si forms silicic acid, which does not dissociate unless the environment is very basic (pH > 9)
- Alkalis and alkaline earths form ions in solution
- Balance equation with respect to Al, Si, and soluble cations, then balance oxygen by adding H_2O
- Balance hydrogen by adding H^+ (usually reactant, from environment)
- Make sure equation balanced in terms of mass and charge

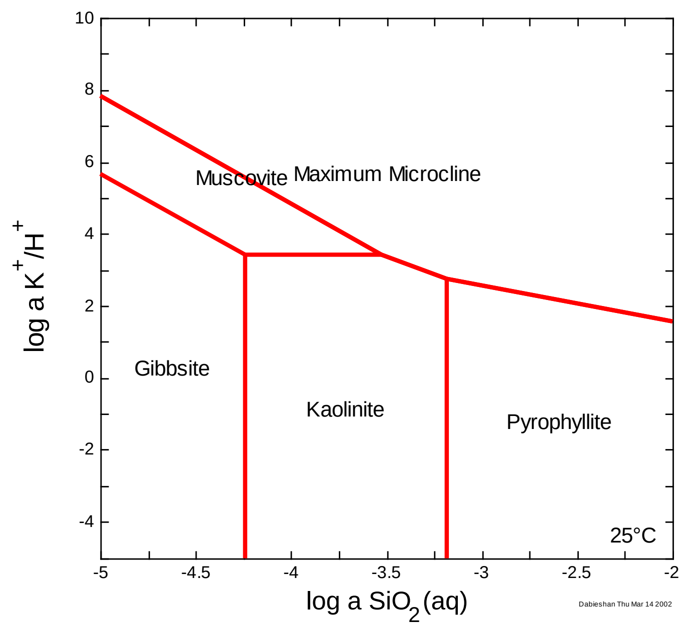

Figure 1

a) Use these rules to write a balanced chemical reaction between kaolinite $Al_2Si_2O_5(OH)_4$ and muscovite $KAl_3Si_3O_{10}(OH)_2$, then use the GWB program Rxn to see if your answer is correct.
b) Write the equilibrium constant expression for this reaction.
c) What is the value of K_{eq} at 60°C?
d) How many degrees of freedom for this reaction? Fig. 1 may help answer this and the following questions (note that maximum microcline = K-feldspar).
d) If pH = 6, what is the activity of K^+?
e) Add another mineral, K-feldspar. Give the reaction, the value of K_{eq} at 60°C, and the number of degrees of freedom. What activity of silica does this assemblage define at 60°C?

3) I also spend a lot of time teaching students how to write balanced half-reactions describing the transfer of electrons (oxidation or reduction). The rules are:

1. Write reaction with oxidized form on left and reduced form on right.

2. Balance all elements but H and O.

3. Balance O by adding H_2O.

4. Balance H by adding H^+.

5. Balance charge by adding e^-'s to left side (i.e., write reaction as a reduction).

A full redox reaction is obtained by adding together complementary oxidation and reduction reactions, which always occur together because e^-'s don't usually float around in solution.

Example half reaction: $Fe_2O_3 + 2e^- + 6H^+ \Leftrightarrow 2Fe^{2+} + 3\ H_2O$

a) Use Rxn. to write a balanced half-reaction for magnetite (swap e^- for $O_{2(aq)}$). Print out the output from Rxn.

b) Write the corresponding equation for Eh at 25°C: