Math 307: Problems for section 2.2

October 12, 2012

Problem: The following formula matrix occurs in a chemical system given by a rock sample [3]. The elements are Si, Al, Fe, Mg, K, H **and** O**. The species are**
qu = quartz (SiO_2)
si = sillimanite (Al_2SiO_5)
Kf = K feldspar ($KAlSi_3O_8$)
st = steam (H_2O)
al = almandine ($Fe_3Al_2Si_3O_{12}$)
py = pyrope ($Mg_3Al_2Si_3O_{12}$)
an = annite ($KFe_3Si_3AlO_{10}(OH)_2$)
ph = phlogopite ($KMg_3Si_3AlO_{10}(OH)_2$)
Fec = Fe-cordierite ($Fe_2Al_4Si_5O_{18}$)
Mgc = Mg-cordierite ($Mg_2Al_4Si_5O_{18}$)**.**

Thus, the formula matrix is

$$A = \begin{array}{c} \\ \text{Si} \\ \text{Al} \\ \text{Fe} \\ \text{Mg} \\ \text{K} \\ \text{H} \\ \text{O} \end{array} \begin{array}{c} \begin{array}{cccccccccc} \text{qu} & \text{si} & \text{Kf} & \text{st} & \text{al} & \text{py} & \text{an} & \text{ph} & \text{Fec} & \text{Mgc} \end{array} \\ \begin{pmatrix} 1 & 1 & 3 & 0 & 3 & 3 & 3 & 3 & 5 & 5 \\ 0 & 2 & 1 & 0 & 2 & 2 & 1 & 1 & 4 & 4 \\ 0 & 0 & 0 & 0 & 3 & 0 & 3 & 0 & 2 & 0 \\ 0 & 0 & 0 & 0 & 0 & 3 & 0 & 3 & 0 & 2 \\ 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 2 & 0 & 0 & 2 & 2 & 0 & 0 \\ 2 & 5 & 8 & 1 & 12 & 12 & 12 & 12 & 18 & 18 \end{pmatrix} \end{array}$$

(i) Determine possible reactions for this system.

(ii) Is there a fixed ratio of molar amounts of the elements in every possible sample composed of species from this system?