

**PRINCIPLES OF GEOCHEMISTRY**  
**GEOL 423**  
**PROBLEM SET 5**  
**FALL 2009**

Data needed to solve these problems are available in Faure.

Problem 1: Calculate the concentrations of  $\text{Mg}^{2+}$  and  $\text{F}^-$  and the solubility of sellaite ( $\text{MgF}_2$ ) in pure water at  $25^\circ\text{C}$  neglecting possible hydrolysis. Express the solubility of sellaite in terms of mol/L and g/100 mL.

Problem 2: A quantity of 0.1 g of solid  $\text{Na}_2\text{SO}_4$  (which is completely soluble and dissociates to  $\text{Na}^+$  and  $\text{SO}_4^{2-}$ ) is added to one liter of a solution containing  $3 \times 10^{-2}$  moles of dissolved  $\text{Pb}^{2+}$ . Demonstrate that  $\text{PbSO}_4$  precipitates from the solution and calculate the weight of  $\text{PbSO}_4$  in grams that forms per liter.

Problem 3: What is the ratio of the activities of  $\text{Zn}^{2+}$  and  $\text{Pb}^{2+}$  in a solution that is in equilibrium with respect to sphalerite ( $\text{ZnS}$ ) and galena ( $\text{PbS}$ )? Note that there is an error in Table 10.1 of Faure. For  $\text{PbS}$ ,  $\text{pK}_{\text{sp}}$  should be 27.5 not 17.5!

Problem 4: Predict the outcome of reactions that occur when a solution having  $[\text{Cd}^{2+}/\text{Pb}^{2+}] = 25$  comes in contact with a rock containing galena ( $\text{PbS}$ ). Will additional galena precipitate, or will it dissolve? Will greenockite ( $\text{CdS}$ ) precipitate? What will be the ratio of  $[\text{Cd}^{2+}/\text{Pb}^{2+}]$  in the solution after equilibrium is established? Note that there is an error in Table 10.1 of Faure. For  $\text{PbS}$ ,  $\text{pK}_{\text{sp}}$  should be 27.5 not 17.5!

Problem 5: Calculate the concentrations of  $\text{Pb}^{2+}$ ,  $\text{MoO}_4^{2-}$  and  $\text{Ca}^{2+}$  in pure water in equilibrium with both powellite ( $\text{CaMoO}_4$ ) and wulfenite ( $\text{PbMoO}_4$ ).

Problem 6: A mine water has been analyzed and found to have the following properties:  $\text{pH} = 2.4$ , 353 ppm Al, 586 ppm K, and 68280 ppm  $\text{SO}_4^{2-}$ . Ignoring activity coefficients, hydrolysis and complexation, determine whether this mine water is saturated with respect to alunite, i.e.,  $\text{KAl}_3(\text{SO}_4)_2(\text{OH})_6$ . Don't forget to convert ppm to  $\text{mol L}^{-1}$ !