CEE 543 Aut 2012 HW#9

1. During turnover of a lake, reduced bottom water is mixed with oxidized surface water. Assume that bottom and surface waters with the following compositions mix in a 1:1 ratio.

   Bottom water: $TOT[\text{Fe(II)}] = 1.5\text{x}10^{-3}$; $TOT[\text{S(–II)}] = 3\text{x}10^{-4}$; $(SO_4^{2-}) = 1.0\text{x}10^{-3}$
   Surface water: $(O_2(\text{aq})) = 3\text{x}10^{-4}$; $(SO_4^{2-}) = 1.3\text{x}10^{-3}$; $(NO_3^-) = 1.2\text{x}10^{-4}$

(a) Prepare a $\log c$ - pe diagram for the mixture for the range $-20 < \text{pe} < 20$, assuming that solution pH is 7.5 and the ionic strength is fixed at 0.005 *M*. Assume that the elements listed above can exist in the following oxidation states:

   Fe: +II or +III; S: –II or +VI; N: –III, 0, or +V; and O: –II or 0

   You should use Visual Minteq to generate the data for the concentrations of Fe, S, and N species as a function of pe. However, the current Visual Minteq database does not include $O_2(aq)$ as a species, nor does it contain information about any O(0)/O(–II) redox reaction, so you should develop the data for the $O_2(aq)$ curve separately and add that information to the spreadsheet and graph manually. Consider Fe(II)-OH and Fe(III)-OH complexes, but ignore all other complexes that might form. Also ignore any possible precipitation reactions. Plot data only in the concentration range $-2 > \log c > -14$. (Hint: If Visual Minteq returns an error message when you scan across the pe range of interest, try running it twice – once from pe 0 to pe 20, and then from pe 0 to pe –20.)

(b) Write the *TOTe* equation for the mixed solution, and find the solution composition at equilibrium.