Geobiology Spring 2013
Isotope Problem Set: Due Monday March 18th

Name: _____

1. Identify and calculate the exact molecular weights of all the isotopologues of CO_2 and H_2O. Calculate their relative abundances in a sample of seawater assuming all atoms are at their natural abundances and there are no isotope effects.

2. A ratio of $^{32}S/^{34}S$ of 20.031 was measured for a sample of sulfate. The same ratio in the Canyon Diablo Triolite is 22.22. What is the $\delta34S$ value for the sulfate sample?

3. A sample of diamond has a $\delta^{13}C$ value relative to the lab standard. The lab standard has a $\delta^{13}C$ value of -6.50 relative to VPDB. What is the diamond relative to VPDB?

4. A bacterium fixes carbon autotrophically and produces biomass with a $\delta^{13}C$ value of -31.6 per mil VPDB starting with atmospheric CO2 having a delta value of -7.8 per mil VPDB. Speculate about the type of isotope effects that might operate and propose possible carbon assimilation pathways. What are the alpha and epsilon values for the sum of the processes.

5. Inorganic carbon delivered to the ocean/atmosphere system by volcanism and weathering has the $\delta^{13}C$ value of -5 per mil.

   a) Calculate the isotopic composition of carbonate minerals precipitated from the seawater, stating your assumptions about different burial fractions and the fractionation by primary producers.
   b) Carbonate rocks that have a $\delta^{13}C$ value of + 9 per mil are common in the Neoproterozoic. What would you expect f_{org} to have been during the deposition of these carbonates?
   c) Carbonate rocks that have a $\delta^{13}C$ value of -8 per mil can also be found in a number of Neoproterozoic successions. Which ε and f_{org} can explain the deposition of these carbonates? Propose a mechanism that delivered inorganic carbon with very low $\delta^{13}C$ value to these rocks.
   d) If carbonate rocks are deposited in areas with a strong delivery of inorganic carbon from carbonate weathering ($\delta^{13}C$ value of + 3 per mil), what would you expect their $\delta^{13}C$ value to be? State your assumptions.

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