Environmental Geochemistry, Geology 431, Exam One

Type all answers and use a spread sheet for any multiple calculations—Show all your steps. Please do all your work on your own with no consultation with your colleagues.

1. The following data were collected from a site on the Clark Fork River. Bed sediment data are from a complete digestion (like the residual method we talked about in class) of the sediment collected from the bed. The other data is standard USGS techniques for dissolved and total recoverable. The water had a median TSS concentration of 50 mg/l.

SAMPLE TYPE	Cu	Fe	Mn	Pb	Zn	
Dissolved (ug/l)	10	12	55	2	25	
Total Rec. (ug/l)	75	9.7×10^2	2.6×10^2	14	95	
Bed Sed. (<63 um)	1.8×10^3	4.5×10^4	1.7×10^3	2.4×10^2	1.8×10^3	(all in ppm)

A. Calculate the metal concentrations you would expect in the suspended sediment based on the total recoverable data and compare this to values in the bed sediment. Explain any differences or similarities.
B. Use this data to calculate the distribution coefficient (D) for each element using both the total recoverable calculated values and the values for the bed sediment. Explain any differences or similarities.
C. Calculate the molar ratios of Cu, Pb and Zn to both Fe and Mn. What inferences can you make from these calculations?
D. How do the bed sediment values relate to crustal concentrations? What inference can you make from these comparisons?

2. Metal concentrations in sediment commonly have strong relationships with grain size. The following data were collected on river sediment, showing the concentration of Zn and Pb in different size fractions:

Mean Size (μm)	Zn (ppm)	Pb (ppm)
300	60	35
180	90	60
50	100	50
28	155	45
10	300	82
2	425	110

A. Plot this data and compare it to what you would expect for these sizes if the metal concentrations were controlled only by surface area/volume changes.
B. Explain the distribution, especially any deviations from the expected distribution.

3. The following minerals and other components were found in samples of sediments collected from cores in a reservoir. Classify their geochemical environment based on Berner's (1981) classification.

Sample	Minerals	Other Components	Classification
1	siderite, vivianite, rhodochrosite	methane	
2	pyrite, makinawite, other metal sulfides	hydrogen sulfide, bicarbonate	
3	hematite, ferrihydrite, birnessite	nitrate, bicarbonate	

4. Water from contaminated wells (well 1 and well 2) at different depths were analyzed for various cations and anions. Well 1 was found to contain only measurable sulfate (SO_4^{2-}), whereas well 2 was found to contain only measurable sulfide (either HS^- or H_2S). The pH in well 1 was 8.3 and 5 in well 2. Assume that the concentrations of species in the well water is the same as on your Eh-pH diagrams and that everything is in equilibrium. Then answer the following questions as best you can. If you cannot answer them state why.

A. What should be the pe and Eh (put down both) of the water in each of the wells based on sulfur species? Well 1: Well 2:

B. What carbonate species would you expect to find in each well?
Well 1: Well 2:

C. Further analyses of the water from the wells found that the dominant nitrogen species in well 1 was NO_3^{-1} and in well 2 it was NH_4^{+1}. How would that change your pe & Eh determinations?
Well 1: Well 2:

D. With this information what iron species should you find in each well if there was very little carbonate present and the sulfur concentrations were fairly high?
Well 1: Well 2:

E. What would be the Berner classification of each well?
Well 1: Well 2:

F. Assuming that As, Cu, and Mn were present in the wells what species would you expect to find in each well?

	Well 1:	Well 2:
As		
Cu		
Mn		

G. No dissolved zinc was found in well 1. How can you explain this?