Geochemical Processes at Earth Surface **Exam 7-1-2009**

1. a. explain in your own words the term 'conservative mixing' and 'non-conservative mixing' for an estuarine system; use any of the relevant figures below to illustrate your point(s)
   b. explain in your own words the meaning of anti-estuarine circulation; give an example and explain the functioning (circulation, driving forces) of this system make a sketch to illustrate your point(s)
   c. For one sample of the Scheldt estuary the salinity is accurately known: 0.56 ‰ (see table 1A); Pure Scheldt river water contains no chloride (Cl= 0 ppm); calculate for this sample the Scheldt river Calcium (Ca) concentration
   d. use the Cl content in your group's sample to determine the % riverwater in your sample (see Table 1A below)
   18 pt

2. a. What is the difference between an ICP-OES and ICP.MS in detection limit and detection/measuring principle ?
   b. What is the meaning of the abbreviations EDS and WDS
   c. What is the difference between EDS and WDS for X-ray analyses
   8 pt

3. This question is (partly) about the ICP-OES data set given below. The sediment samples for this file had been totally dissolved in an acid mixture containing HF,HNO3, HClO4, evaporated to dryness, then redissolved in 1N HCl solution. The data reported are those as measured in this 1n HCl solution (see more info in the data file).

a. Al and Si usually are major elements in sediments but only Al is reported here, not Si. Indicate in what general kind of minerals Al and Si occur, and why only Al and not Si is reported here.

b. the concentration measured by ICP in solution is given in ppm: what does this mean ?

It is common to calculate a ' dilution factor' i.e. the factor with which you have to multiply the ICP data on the dissolved elements so as to get the concentration of these elements in the initial solid-phase. Below we will first work towards obtaining this dilution factor; subsequently, we will calculate the final data.

c. what was the total amount of ~~Aluminium~~ Fe in your sample (in mg)
d. what was the aluminium content of your sample (in mg/kg and in %)
e. what was the dilution factor for your sample that can be calculated from the measured Al in solution and the calculated Al in your sample?
f. how would you determine this dilution factor directly from your data: give parameters and units
   (see table 1B below)
   20 pt

4. a. Ocean sediments are usually considered to have three main components. Biogenic material is one of them; give the names and a brief general description of the other two components
   b. Carbonate is one of the three major biogenic components that may be found in marine sediments; what are the other two components ?
   c. what physical/chemical parameters determine the presence/distribution of biogenic carbonate in the ocean sediments; motivate briefly and give their relative importance
   d. what are the major controls for the distribution in the ocean sediments for the other two biogenic components ; motivate briefly
   18 pt

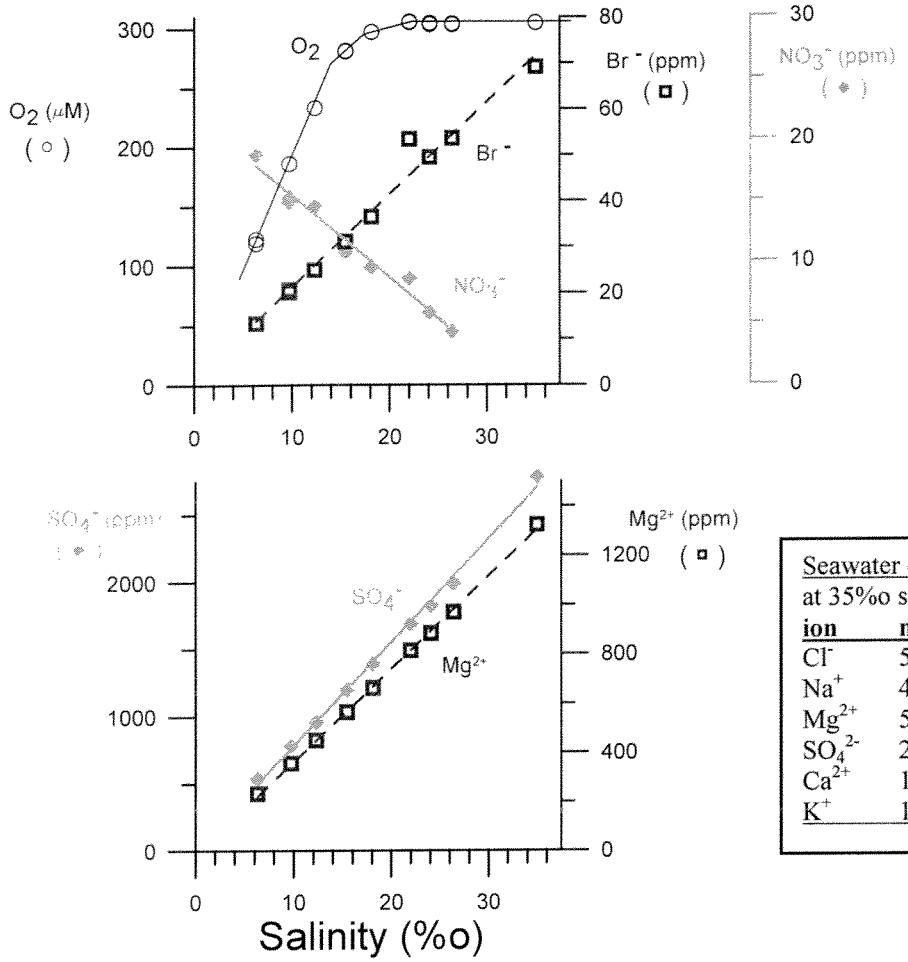
5. a. explain in your own words the meaning of 'closed sum effect'; illustrate your explanation with adequate numbers
   3 pt

6. a. what is the origin of the Redfield ratio (give ratio, origin, what it represents)
   3 pt

7. a. There is a general sequence in oxidants for the degradation of organic matter; give the sequence of oxidants
   b. what determines this general sequence
   c. during this reaction, each oxidant is transferred into a different compound; give these compounds
   10 pt

8. a. indicate in the Figure from Li et al. potential pathways or processes which lead to the formation of a solid-phase manganese (Mn) peak in the sediment
   b. do you think that any of these peaks was being formed at the moment of taking this core ? Indicate why you think so and where it is forming; if not, explain why not.
   10 pt

9. During the last Ice age (Glacial) large amounts of ice occurred at the high latitudes; do you think this may have had any difference on thed2H and d18O isopic composition of deep ocean water (i.e. below 4 km water depth) at the Pacific equator. Motivate your answer, i.e. if there is no change: why not; if there is a change: why, and into what direction.
   10 pt.



Seawater composition:
at 35‰ salinity:

ion	mM	ppm
Cl^-	560	19350
Na^+	480	10770
Mg^{2+}	54	1290
SO_4^{2-}	29	2712
Ca^{2+}	10.5	412
K^+	10.5	399

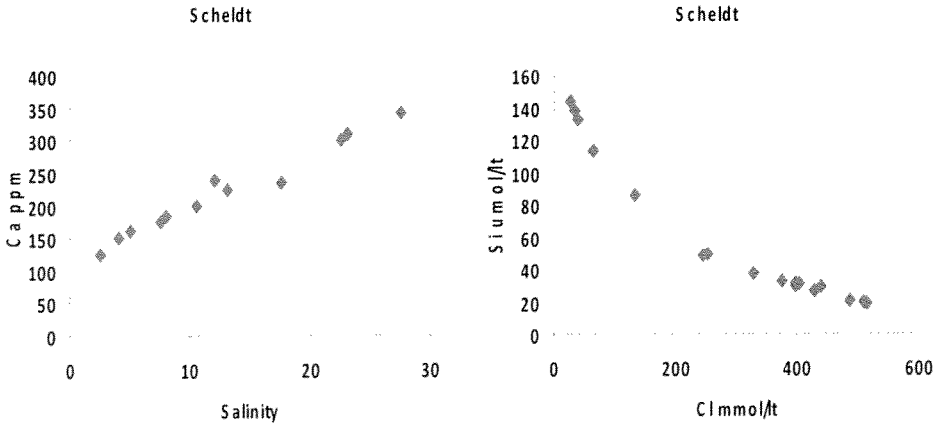


Fig. C2. Water column dissolved concentrations versus salinity or Chloride content in the Scheldt Estuary for: a. O_2, NO_3^-, Br-; b. SO_4^{2-}, Mg^{2+}; c. Ca^{2+}; and d. Si (or H_4SiO_4).

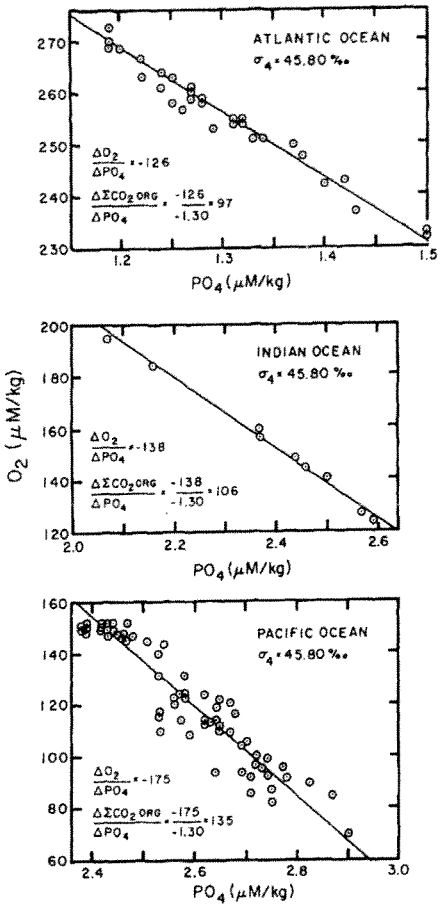


Fig. C-1. Plots of dissolved oxygen against dissolved phosphate along the 45.80°/oo isopycnal horizon (depth 2300 to 2600 meters) in the three major oceans.

(Isopycnal horizon refers to water of the same density)

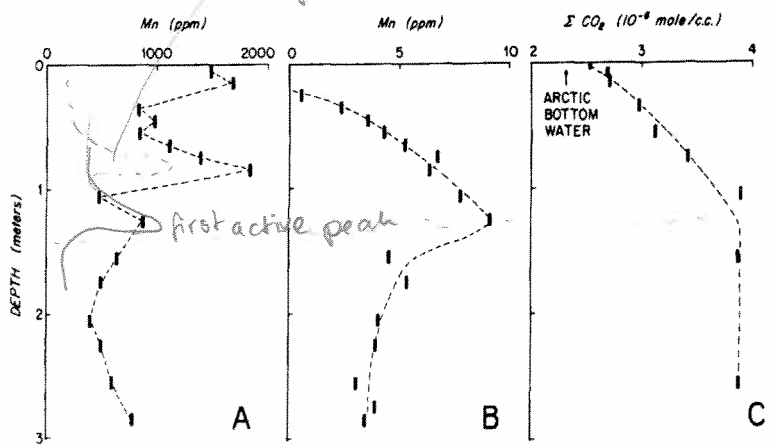


Fig. 1. (A) Content of manganese in the sediment, (B) concentration of manganese in the pore water and (C) total inorganic carbon concentrate in the pore water.