Chemical Oceanography Problem Set 2 (10pts)
Feb. 23, 2017
Due 3 PM March 7, 2015

All answers are to be submitted by email to both maltabet@umassd.edu and david_ryan@uml.edu in MS Word or Excel format. We will confirm receipt of your assignment by return email. Late submission will result in the loss of one point per day from the point total**.** You are strongly encouraged to review the problems early to clarify any questions you might have. This problem set is designed to be open book and open notes, but you are expected to work individually to obtain your answers. Essays and short answers must be in your own words. You should show all your work and clearly delineate how you derived your results where pertinent. This problem set constitutes 10 % of your overall grade. **You are expected to work independently to solve these problems.**

(1.5) 1. Because you thought it would be fun, you bring a bucket of seawater (S=35) to the shores of the Dead Sea, ~380 m below sea level. You notice that barometric pressure is 1.056 atm. What are the concentrations in the bucket of N_2, O_2, and Ar when the bucket is equilibrated with atmosphere at a temperature of 20°C? If the bucket warms quickly to 25°C without gas exchange, what is the measured % O_2 saturation and AOU? Why does the change in AOU have nothing to do with biological activity? HINT: start with E&H Table 3A1.1

(1.5) 2. Typically, the ratio of dissolved gases are measured more precisely than their concentrations. For assessing biological productivity in the ocean, the ratio of photosynthetically produced O_2 to inert Ar has been used in this respect. First, plot the concentrations of O_2 and Ar in seawater (salinity 35) in equilibrium with air for a 5 to 25°C range in temperature, every 1.0 °. Use vertical scales sufficient to see any change in concentration and briefly explain why they occur. Calculate the ratio of O_2 to Ar for the same temperature range and plot separately. Compare and contrast variations with temperature of the O_2/Ar ratio with their concentrations. Last, explain why the O_2/Ar ratio is a better indicator of biological production than O_2 concentration.

(2.0) 3. How and why does ozone in the stratosphere benefit Earth's biosphere. What are the natural chemical processes leading to its formation and destruction? Why was it important that an international agreement (Montreal Protocols) was reached to limit the production and release of chlorofluorocarbons? What does Antarctica have to do with this? How does ozone form in the troposphere and why is that a problem?

Include chemical formulas and reactions to illustrate your answers

(5.0) 4. Please read the paper by Ellwood et al. (2015) Proc. Natl. Acad. Sci. 112, E15-E20 (posted as a separate pdf with this problem set) and comment on the following concepts discussed in class with respect to the information and data described in the paper. I am not looking for a detailed description of the fine points in the manuscript, but rather an indication that you understand the terms below and very briefly how they relate generally to the research being presented. Terms - Biolimiting, Redox Species, Fe Cycling, Dissolved vs. Particulate Metals, Depth Profile, Nutrient Behavior.